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STYGOTHELPHUSA CRANBROOKI, A NEW SPECIES OF CAVE CRAB FROM GUA SIREH, SARAWAK, MALAYSIA (CRUSTACEA: DECAPODA: BRACHYURA: GECARCINUCIDAE)

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ABSTRACT. — A new species of freshwater cave crab of the genus *Stygothelphusa* Ng, 1989 (Gecarcinucidae) is described from Gua Sireh in Sarawak, Malaysia. The species is allied to *S. bidiensis* (Lanchester, 1900) and *S. nobilii* (Colosi, 1920) from other parts of Sarawak, but differs by its carapace physiognomy, pronounced epibranchial tooth, proportionately much longer ambulatory legs and distinctive male first gonopod structure.

KEY WORDS. — Crustacea, Brachyura, Gecarcinucidae, *Stygothelphusa*, new species, cave, Sarawak, Malaysia

INTRODUCTION

Ng (1989) established a new genus, *Stygothelphusa*, for *Potamon* (*Thelphusa*) *bidiense* Lanchester, 1900, a species orginally described from the Bidi cave system in Bau, Sarawak. A second poorly known species, *Parathelphusa* (*Liothelphusa*) *nobilii* Colosi, 1920, from Sarawak, originally placed in the Bornean genus *Arachnothelphusa* Ng, 1991, was later referred to *Stygothelphusa* by Ng & Álvarez (2000) (see also Ng, 2004; Ng & Yeo, 2007; Ng et al., 2008).

In the 1990s, the author collected numerous specimens from a cave system about 60 km east of the from the Bau system in Kuching that superficially resembled *S. bidiensis* and *S. nobilii* but differed markedly in having a pronounced epibranchial tooth, relatively longer ambulatory legs and a differently shaped male first gonopod. It is here described as a new species, *S. cranbrooki*.

The abbreviations G1 and G2 are used for the male first and second gonopods, respectively. The terminology used follows Ng (1988). Measurements provided (in millimetres) are of the carapace width and length, respectively. Specimens examined are deposited in the Sarawak Museum, Kuching (SM); Museum of Zoology, University of Turin (MZUT); and the Zoological Reference Collection of the Raffles Museum of Biodiversity Research, National University of Singapore (ZRC).

TAXONOMY

Family Gecarcinucidae Rathbun, 1904

Stygothelphusa Ng, 1989

Type species. — *Potamon* (*Thelphusa*) *bidiense* Lanchester, 1900, by original designation; gender feminine.

Remarks. — *Stygothelphusa* was established for the type species by Ng (1989) because of its squarish carapace, very long ambulatory legs, distinctive G1 structure which has the terminal segment less than a quarter of the total length, and a G2 which has an elongated distal segment which is as long as or equal to the basal segment (Ng, 1989, 2004).

The taxonomy of the type species, *Stygothelphusa bidiensis* (Lanchester, 1900) has been treated at length by Ng (1989) and there is no need to elaborate. The type specimen is no longer extant, and a neotype male from the Bidi caves was selected by Ng (1989: 70).

Parathelphusa (*Liothelphusa*) *nobilii* Colosi, 1920, is a poorly known species. It was originally reported as "*Potamon* (*Geothelphusa*) *kenepai* De Man, 1899" by Nobili (1903: 15–16) from two male and one female specimens collected from 2500 feet on Gunung Saribau (= Sari-Baw) by Robert Shelford in 1902. This location is uncertain but is unlikely to be what is today called Saribas near Sri Aman (ca. 1°10'N, 111°38'E) to the east of Serian. Interestingly, Shelford (1905: 210) described a new frog from this location which he reported as "Mount Saribaw, Samarahan River,

Sarawak". The Samarahan area is closer to the Serian and Bau areas, and also has large sections of limestone, and is likely Shelford's crab specimens came from this area. Colosi (1920: 25) commented that Nobili had originally believed his specimens belonged to a new species and he gave a provisional name, "*Potamon saribanensis*", which was never published. Colosi (1920) recognised the Saribau specimens as new, and named them *Parathelphusa* (*Liothelphusa*) *nobilii*. Although both Nobili (1903) and Colosi (1920) described the species, no figures have ever been provided of the taxon and its gonopods are not known, so its precise generic affinities could not be ascertained with any certainty. Bott (1970: 59) synonymised Colosi's species with *Potamon* (*Geothelphusa*) *hendersonianum* De Man, 1899 (from central Kalimantan), without comment and referred it to *Thelphsula* Bott, 1969. Ng (1995: 196) discussed the problems with Bott's (1970) classification of *Potamon kenepai* (originally described from Mount Kenepa in central Kalimantan) (which he referred to *Adeleana* Bott, 1969) and *P. hendersonianum* (which he placed in *Thelphusula* Bott, 1969). Ng (1995) argued that both species were closely related, and transferred them to a new genus, *Bakousa* Ng, 1995 (type species *Bakousa sarawakensis* Ng, 1995).

Ng (1995: 197) noted that *Bakousa* was related to *Stygothelphusa*, but noted that the former had much shorter chelipeds and ambulatory legs, a proportionately longer ischium of the third maxillipeds, a relatively stouter G1 and a shorter G2 basal segment. All *Bakousa* species are free-living, not associated with caves and have pigmentated carapaces and legs (De Man, 1899; Ng, 1995), while *Stygothelphusa* is always associated with caves and has pale body colouration. The G1 and G2 differences are not substantial, and while the G1 terminal segment of *Stygothelphusa* species is slightly stouter (for *S. bidiensis* at least), and the G2 basal segment is relatively shorter compared to the long distal segment, what stands out are the much longer pereopods of *Stygothelphusa*. Another key character to separate *Stygothelphusa* from *Bakousa* is the form of the anterior male thoracic sternum (sternites 1–4). In *Stygothelphusa*, the anterior thoracic sternum is proportionately narrower transversely with the sternoabdominal cavity reaching to the level of the junction between sternites 2 and 3, on an imaginary line connecting the anterior margins of the coxae of the chelipeds (Figs. 3C, 4A). In *Bakousa*, the anterior male thoracic sternum is proportionately wider transversely, and the sternoabdominal cavity only reaches to the junction between sternites 3 and 4, on an imaginary line connecting the median points of the coxae of the chelipeds (Ng, 1995: Fig. 12C).

At the author's request, Oliver Chia examined and photographed the three type specimens of *Parathelphusa* (*Liothelphusa*) *nobilii* in MZUT and it is clearly a species of *Stygothelphusa* (Fig. 2). The form of the male anterior thoracic

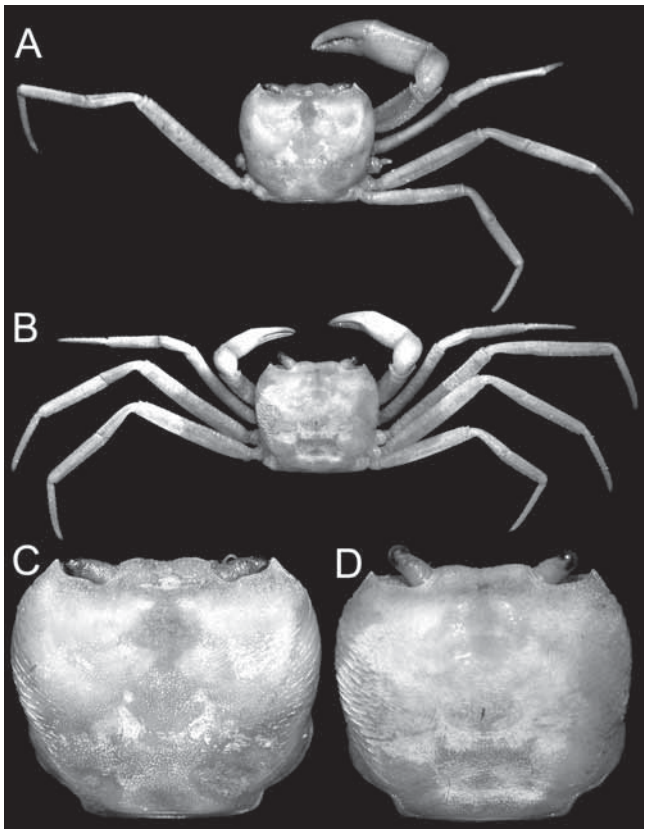

Fig. 1. *Stygothelphusa bidiensis* (Lanchester, 1900). A, C, male (15.4 × 13.7 mm) (ZRC 1998.539); B, D, male (12.9 × 11.9 mm) (ZRC 2013.1624). A, B, overall habitus; C, D, dorsal views of carapaces. Specimens from Fairy Cave, Bau, Sarawak.

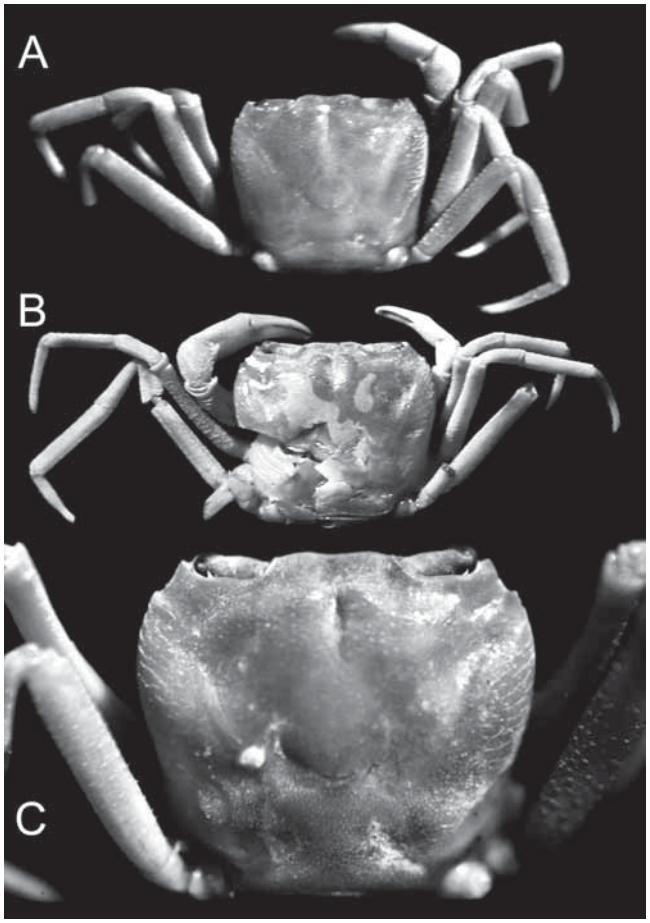

Fig. 2. *Stygothelphusa nobilii* (Colosi, 1920). Overall habitus. A, lectotype male (15.0 × 13.0) (MZUT Cr 1308), Saribau, Sarawak; B, paralectotype female (21.0 × 18.0 mm) (MZUT Cr 1308); C, paralectotype male (17.0 × 14.7 mm) (MZUT Cr 1308). All specimens from Saribau, Sarawak.

sternum and third maxillipeds agree with *Stygothelphusa* as discussed above. All three specimens carry the catalogue number MZUT Cr 1308. Bott (1970: 59) listed a "lectotype" male specimen in the museum with the number 1570 but he did not give measurements so we do not know which one it was. Bott (1970: 59) also listed a specimen measuring 21.0 by 18.0 mm but its sex and type status was not stated. Colosi (1920: 26) had noted that the type specimens of *Parathelphusa* (*Liothelphusa*) *nobilii* had been labelled "n. 1570 *Potamon saribanensis* Nob. *Tipi* : Sarawak, Monte Sariban, R. Shelford 1902", and Bott probably cited Nobili's number. Whether Bott actually examined Colosi's types (or photographs) is not known.

Nobili (1903: 15, 16) noted that he only had one complete male measuring 15.0 by 12.3 mm, and another larger incomplete male 17.0 mm in carapace width. The female was not measured. The most complete male photographed is 15.0 × 13.0 mm (differing slightly from Nobili's measurements for the length) (Fig. 2A). The larger male has lost its chelipeds and several of its legs is 17.0 × 14.7 mm (Fig. 2C). The female specimen is 20.8 × 18.1 mm (Fig. 2B), which agrees well with the measurement of 21.0 × 18.0 mm given in Bott (1970: 59), suggesting he measured the largest specimen in the series. The most complete male specimen (15.0 × 13.0 mm) (Fig. 2A) is here designated the lectotype of *Parathelphusa* (*Liothelphusa*) *nobilii* Colosi, 1920.

The carapace of *Stygothelphusa nobilii* is superficially very similar to *S. bidiensis*, but can easily be separated by its proportionately shorter ambulatory legs (see discussion for *S. cranbrooki* later). Its G1 structure is not known. As discussed earlier, the precise type locality of *Stygothelphusa nobilii* is uncertain.

The nomenclatural problems associated with a junior homonym, *Stygothelphusa* Álvarez & Villalobos, 1991, established for a cave species from Mexico, has been discussed at length by Ng & Álvarez (2000) and Ng & Low (2010).

Stygothelphusa cranbrooki sp. nov.
(Figs. 3, 4, 5C, D, F, 6E–H)

Material examined. — Holotype: male (15.0 × 13.6 mm) (ZRC 2013.1621), Gua Sireh, near Kampung Bantang, Sarawak, 1°10.71'N, 110°28.09'E, coll. P. K. L. Ng & H. H. Tan, 30 Oct.1997. Paratypes: 1 female (brooding young crabs) (15.9 × 13.7 mm) (ZRC 2013.1620), coll. P. K. L. Ng & H. H. Tan, 30 Oct.1997; 5 males (largest 19.4 × 16.4 mm), 6 females (largest 16.6 × 14.5 mm) (ZRC 2013.1622), coll. students 30 Oct.1997; 1 male (13.8 × 12.4 mm) (ZRC 2013.1619), coll. P. K. L. Ng, 23 Jun.1998; 6 males (largest 15.4 × 13.9 mm), 6 females (largest 17.2 × 15.0 mm) (ZRC 1998.540), coll. students, 23 Jun.1998; 1 male (10.8 × 9.4 mm), 3 females (largest 16.1 × 14.5 mm) (ZRC 1998.541), coll. P. K. L. Ng, 25 Jun.1998; 5 males (largest 16.8 × 14.9 mm), 5 females (16.6 × 14.9 mm) (ZRC 1999.690), coll. P. K. L. Ng, 10 Jun.1999. All specimens from Gua Sireh, near Kampung Bantang, Sarawak, 1°10.71'N, 110°28.09'E.

Comparative material. — *Stygothelphusa bidiensis* (Lanchester, 1900): 1 neotype male (16.4 × 14.5 mm) (SM Cru 1986.17), Bidi Caves, bau, Sarawak, coll. C. J. Brooks, Jun.1903; 2 males, 3 females (largest 16.9 × 14.8 mm), 2 juveniles (SM Cru 1986.18–25), Bidi Caves, Bau, Sarawak, coll. C. J. Brooks, Jun.1903; 2 males (larger 12.9 × 11.9 mm), 2 females (larger 17.2 × 15.7 mm) (ZRC 2013.1624), Gua Kapo (= Fairy Cave), Bau Caves, Sarawak, 1°22.91'N, 110°7.08'E, coll. P. K. L. Ng & H. H. Tan, 28 Oct.1997; 3 males (largest 11.9 × 9.8 mm), 6 females (largest 16.3 × 13.7 mm) (ZRC 2013.1623), Gua Kapo (= Fairy Cave), Bau Caves, Sarawak, 1°22.91'N, 110°7.08'E, coll. H. H. Tan & P. K. L. Ng, 28 Oct.1997; 4 males (largest 15.4 × 13.7 mm) (ZRC 1998.539), Gua Kapo (= Fairy Cave), Bau Caves, Sarawak, 1°22.91'N, 110°7.08'E, coll. students, 23 Jun.1998; 1 female (15.9 × 13.6 mm) (ZRC 1989.3038), Gua Pitas, Bau Caves, Sarawak, coll. S. Yussof, 1987; 2 males (larger 15.0 × 13.0 mm), 2 females (larger 17.0 × 14.9 mm) (ZRC 1984.7543–7546), Borneo, no other data. *Stygothelphusa nobilii* (Colosi, 1920): lectotype male (15.0 × 13.0 mm) (here designated), 1 paralectotype male (17.0 × 14.7 mm), 1 female (20.8 × 18.1 mm) (MZUT Cr 1308), 2500 feet asl, Gunung Saribau, Sarawak, coll. R. Shelford, 1902.

Diagnosis. — Carapace quadrate, broader than long; dorsal surfaces gently rugose (especially along margins) to smooth (Fig. 3A, B); striae on anterolateral regions strong (Fig. 3B); branchial regions gently inflated dorsally and laterally, lateral margins appearing gently convex from dorsal view (Fig. 3B, D), gently convex from frontal view (Fig. 3D); epibranchial tooth spiniform, distinct, separated from external orbital angle by clear cleft (Fig. 3A, B); ambulatory legs very long

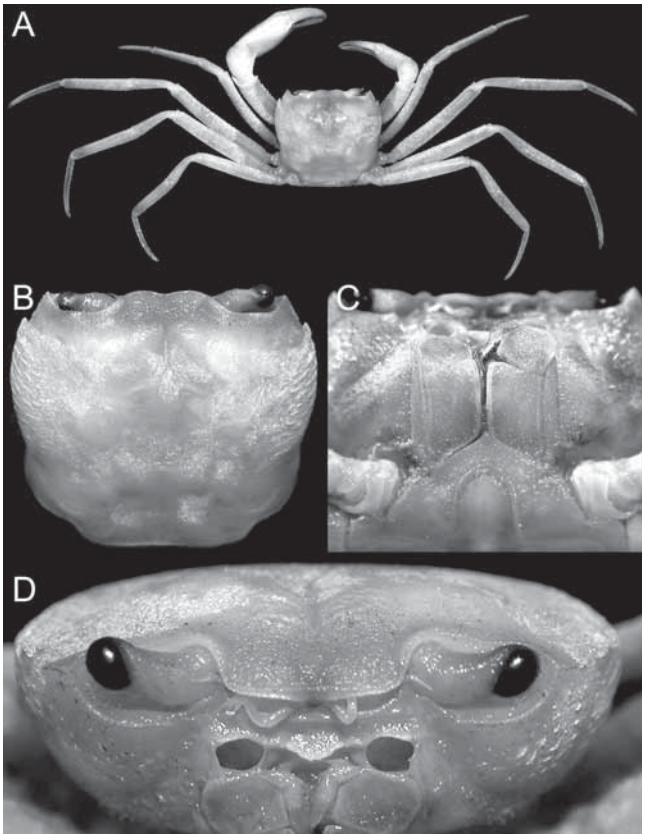

Fig. 3. *Stygothelphusa cranbrooki* sp. nov. Holotype male (15.0 × 13.6 mm) (ZRC 2013.1621), Gua Sireh, Sarawak. A, overall habitus; B, dorsal view of carapace; C, anterior thoracic sternum and third maxillipeds; D, frontal view of carapace.

(Fig. 3A); male sternoabdominal cavity reaching to level of junction between thoracic sternites 2 and 3, on imaginary line connecting anterior margins of coxae of chelipeds (Figs. 3C, 4A); male abdomen T-shaped (Fig. 4); G1 curved outwards; terminal segment gently curved upwards, ca. 0.2 times subterminal segment (Fig. 6E-G); G2 distal segment flagelliform, subequal in length to basal segment (Fig. 6H).

Description of holotype male. — Carapace quadrate, broader than long; regions distinct; dorsal surfaces gently rugose to smooth; antero- and posterolateral regions lined with distinct oblique striae; cervical grooves broad but shallow; pterygostomial, suborbital and sub-branchial regions rugose to granulose (Fig. 3). Branchial regions gently inflated dorsally and laterally (Fig. 3A, B, D). Frontal margin distinct, level with tip of external orbital tooth, gently sinuous, median part gently deflexed downwards, margin forming poorly defined median pseudo-frontal triangle (Fig. 3B, D). Anterolateral margin gently convex, not clearly demarcated from posterolateral margin; epibranchial tooth distinct, sharp, separated from external orbital angle by distinct cleft; external orbital angle acutely triangular, outer margin ca. 2 times length of inner margin, lined with small granules; striae on anterolateral regions distinct, strong; epigastric cristae strong, distinctly raised, rugose but not sharp, separated by deep median Y-shaped groove, anterior of postorbital cristae; postorbital cristae relatively low, indistinct but sharp, separated from epigastric cristae y shallow cervical groove (Fig. 3A, B, D). Posterior margin of carapace gently sinuous (Fig. 3A, B). Epistome wide; posterior margin with distinct median triangular lobe with rounded tip, lateral margins gently sinuous (Fig. 3D). Eye distinct, filling most of orbit; cornea large, fully pigmented (Fig. 3B, D). Antennular fossa transversely narrow, rectangular in shape; flagellum folding transversely (Fig. 3D). Third maxilliped quadrate; ischium quadrate, with shallow oblique median sulcus; merus squarish with slightly auriculiform anteroexternal margin; exopod reaches beyond distal edge of ischium, flagellum distinct, longer than width of merus (Fig. 3C). Thoracic sternum smooth, relatively narrow transversely, sternites 1–4 fused, without distinct median sutures visible; sternoabdominal cavity reaching to the level of the junction between sternites 2 and 3, on an imaginary line connecting the anterior margins of the coxae of the chelipeds (Figs. 3C, 4A).

Chelipeds elongated; left larger; outer surfaces and margins distinctly rugose, without sharp spines or spinules; distal edge of dorsal margin of elongate merus with spine; carpus with low inner distal spine, posterior margins lined with small granules; outer surface of palm gently (Figs. 3A, 5C, D); major chela with fingers shorter than palm, cutting edge of pollex with 2 teeth and numerous denticles, cutting edge of dactylus with submedian tooth and denticles (Fig. 5C); minor chela with fingers longer than palm, cutting edges of fingers with numerous denticles (Figs. 5D).

Ambulatory legs very long, slender; second pair longest; merus unarmed, dorsal margin gently serrated but not spiniform, with low subdistal spine; outer surfaces in first to third pairs rugose; propodus with row of small ventral spines; dactylus gently curved, with 2 rows of spines on dorsal and ventral margins (Figs. 3A, 5F).

Male abdomen T-shaped; telson elongate, lateral margins almost straight, tip rounded, as long as somite 6 (Fig. 4A); somites 3–6 progressivley narrower, trapezoidal (Fig. 4B); somite 3 widest, covering most of thoracic sternite 8 (Fig. 4C); somites 1 and 2 longitudinally narrow, reaching to coxae of last pair of ambulatory legs (Fig. 4C).

G1 with proximal part stout, straight, distal half curved outwards; terminal segment tapering towards subtruncate tip, gently curved upwards (towards buccal cavity in situ), ca. 0.2 times subterminal segment, distal part covered with numerous very small scale-like spinules, rest of margin with long and short setae (Fig. 6E–G). G2 much longer than G1; basal segment long, distal segment flagelliform, subequal in length to basal segment (Fig. 6H).

Variation. — Adult female specimens are similar to the males in all non-sexual characters, except that their chelipeds are more symmetrical. Female abdomens are wide, rounded, and completely cover the thoracic sternum. The epibranchial tooth

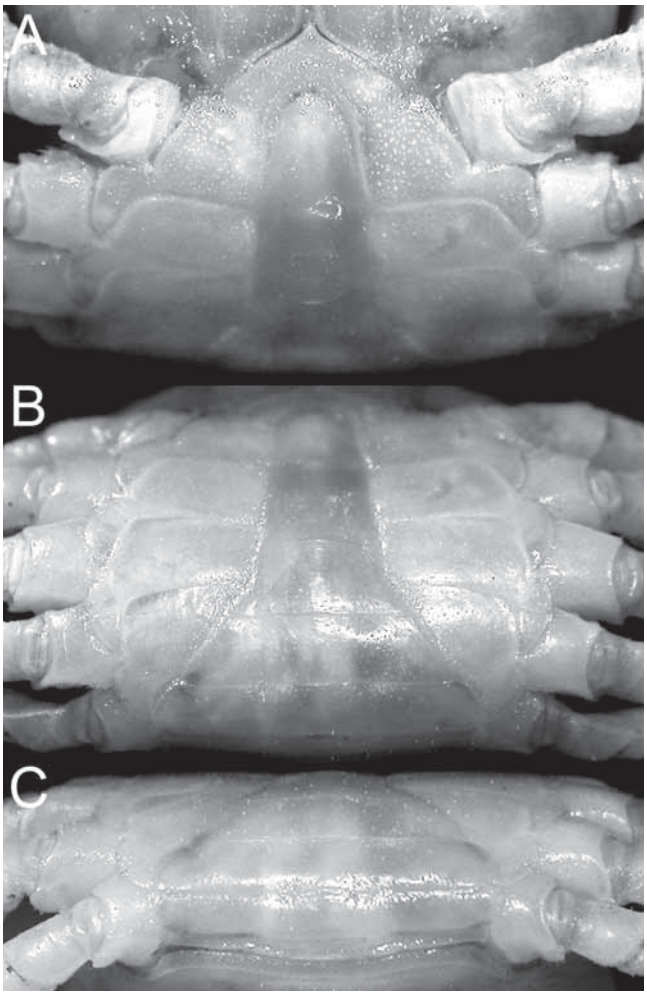

Fig. 4. *Stygothelphusa cranbrooki* sp. nov. Holotype male (15.0 × 13.6 mm) (ZRC 2013.1621), Gua Sireh, Sarawak. A, anterior thoracic sternum, abdominal somite 6 and telson; B, thoracic sternum and abdominal somites 3–5; C, posterior thoracic sternum and abdominal somites 1–3.

is usually distinct although in some specimens, it appears to be partially worn down; although in all the specimens, the striae on the anterolateral regions are always stronger and more prominent compared to *S. bidiensis*.

Colour. — In life, *S. cranbrooki* is white to light yellow overall; although the cornea of the eyes are pigmented black.

Habitat. — *Stygothephusa cranbrooki* was only found in the dark zone of the cave and was not observed near the entrance. The main opening to the cave is some 50 m above the ground and opens into a complex cave system that leads downwards into subterranean rivers. The crabs were collected in moist areas under rocks in the dark zone, and were very common in places where there was water and piles of rubble.

The behaviour and habits of *S. cranbrooki* are the same as those described for *S. bidiensis* (see Ng, 1989; Ng & Yussof, 1990). While it has some cave-adapted characters like very long pereopods and a general loss of body pigmentation, the eyes are not degenerated and the cornea retains all of its pigmentation. While it cannot be regarded as a troglobite (cf. Holthuis, 1986; Guinot, 1988), it has, however, also never been found outside caves. In Gua Sireh, *S. cranbrooki* has been found in good numbers over 100 m deep inside the cave, in complete darkness.

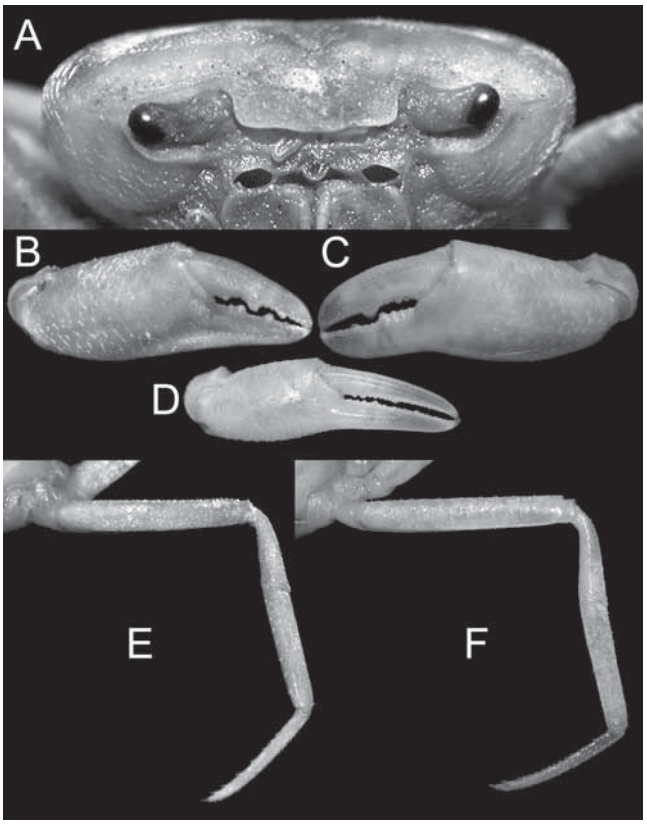

Fig. 5. A, B, E, *Stygothelphusa bidiensis* (Lanchester, 1900), male (15.4 × 13.7 mm) (ZRC 1998.539), Fairy Cave, Bau, Sarawak; C, D, F, *Stygothelphusa cranbrooki* sp. nov., holotype male (15.0 × 13.6 mm) (ZRC 2013.1621), Gua Sireh, Sarawak. A, frontal view of carapace; B, outer view of right major chela; C, outer view of left major chela; D, outer view of right minor chela; E, F, right fourth ambulatory legs.

Etymology. — Gua Sireh is a significant archaeological site, and may have been occupied for some 20,000 years. It is an important site for pottery and other artefacts, and has ancient charcoal drawings on some of the walls (see Datan & Bellwood, 1991; Doherty et al., 2000). In recent years, Gua Serih (and the adjacent areas) has become commercially important for the harvest of bird's nests from swiftlets. The naming of this species after Gathorne Gathorne-Hardy, the Earl of Cranbrook (better to known to scholars as Lord Medway), a renowned archaeologist and expert on cave swiftlets, is therefore all the more appropriate. I therefore take great pleasure in naming this species after an old friend who has contributed so much to Southeast Asian biodiversity and archaeology!

Remarks. — *Stygothelphusa cranbrooki* can easily be separated from *S. bidiensis* in having a well developed sharp epibranchial tooth clearly separated from the anterolateral margin by a deep cleft (Fig. 3A, B) (versus poorly developed, sometines not discernible, not separated from anterolateral margin by cleft, Fig. 1), the striae on the anterolateral regions are always relatively stonger and more pronounced (Fig. 3B versus Fig. 1C, D); the branchial regions are distinctly more swollen, with the surfaces appearing gently convex from frontal view, and the lateral margins of the carapace appearing squarish (Fig. 3A, B) (versus less swollen, with the surfaces appearing distinctly convex from frontal view, resulting in the lateral margins of the carapace appearing more rounded in shape, Figs. 1, 5A), and the G1 terminal segment is proportionately more elongate and gently curved upwards (Fig. 6E–G) (versus relatively shorter, straighter and conical, Fig. 6A–C). In addition, most of the adult specimens of *S. cranbrooki* have proportionately longer ambulatory legs (especially the merus) compared to *S. bidiensis* (Fig. 5F versus Fig. 5E), although this character is not always reliable, with some large female specimens of *S. bidiensis* also having relatively longer legs.

The carapace physignomy of *S. cranbrooki* is similar to *S. nobilii* in that their branchial regions are relatively less swollen (Figs. 2, 3A, B, D) than those of *S. bidiensis* (Figs. 1, 5A). However, the condition of the epibranchial spine of *S. nobilii* more closely resembles that of *S. bidiensis*, being low and not as clearly separated from the rest of the anterolateral margin (Figs. 1, 2) compared to *S. cranbrooki* (Fig. 3A, B). The ambulatory legs of *S. nobilii* are also distinctly shorter than those of *S. bidiensis* and *S. cranbrooki*. When folded against the sides of the carapace, the last ambulatory merus of *S. nobilii* does not reach the frontal margin (Fig. 2). In *S. bidiensis* and *S. cranbrooki*, the last ambulatory merus reaches or extends beyond the frontal margin of the carapace (Figs. 1A, B, 3A).

The conservation status of *S. cranbrooki* has been discussed under *S. bidiensis* sensu lato (see Ng & Yeo, 2007; Cumberlidge et al., 2009). The species is listed as vulnerable but the status of both species will need to be reassessed in view of the revised taxonomy here. *Stygothelphusa bidiensis* is now restricted the limestone formations in Bau, while *S. cranbrooki* is known only from the Gua Sireh area.

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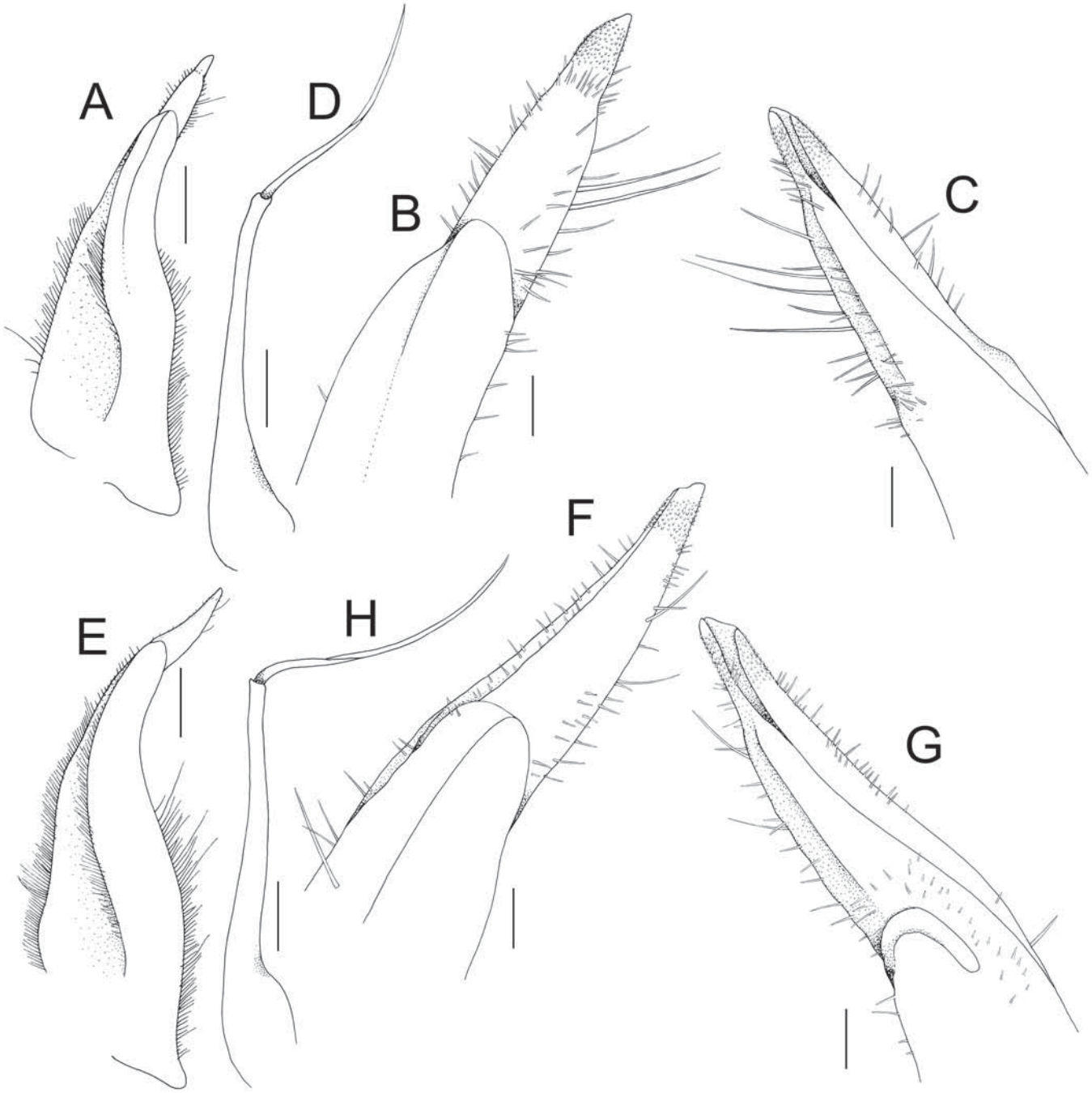

Fig. 6. A–D, *Stygothelphusa bidiensis* (Lanchester, 1900), male (12.9 × 11.9 mm) (ZRC 2013.1624), Fairy Cave, Bau, Sarawak; E–H, *Stygothelphusa cranbrooki* sp. nov., holotype male (15.0 × 13.6 mm) (ZRC 2013.1621), Gua Sireh, Sarawak. A, E, left G1, ventral views; B, F, terminal segments of left G1s, ventral views; C, G, terminal segments of left G1s, dorsal views; D, H, left G2s. Scales bars = 0.5 mm (A, D, E, H), 0.1 mm (B, C, F, G).

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