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**EREBUSA CALOBATES, NEW GENUS, NEW SPECIES, A TROGLOBITIC CRAB
(BRACHYURA: POTAMIDAE) FROM LAOS**

Darren C. J. Yeo and Peter K. L. Ng

A B S T R A C T

A new genus and species of troglobitic potamid crab is described from central Laos. The new taxon possesses a unique combination of morphological characters not found in any other known fresh-water crabs. Key diagnostic characters include the compressed frontal regions, reduced eyes, auriculiform merus of the third maxilliped, long ambulatory legs, and unusual male first pleopod structure. The reduced eyes and extremely long slender legs make this species the most highly modified cave-dwelling crab reported thus far from Indochina.

In early 1998, the authors were sent specimens of an interesting fresh-water crab belonging to the family Potamidae collected from caves in central Laos by Louis Deharveng, during a French speleological expedition. The specimens differed from described potamids in several important structures: carapace, eye, third maxilliped, ambulatory leg, and male first pleopod. Since these differences were judged to be of generic significance the present specimens are described as a new genus and new species, here named *Erebusa calobates*.

Four species of fresh-water crabs have so far been collected from caves in Indochina. Three of these are potamids, *Phaibulamon stilipes* Ng, 1992, *Potamon namlang* Ng and Naiyanetr, 1993 [both from Thailand], and *Nemoron nomas* Ng, 1996 [Vietnam]. The fourth is the gecarcinucid *Phricotelphusa deharvengi* Ng, 1988 [Thailand]. *Potamon namlang* was originally identified as *P. andersonianum* (Wood-Mason, 1871) by Ng (1988a) who suggested that it was an epigeal species that probably accidentally wandered into the caves. This also appears to be the case for *N. nomas*, as Ng (1996: 35) had commented that "... although the holotype male was collected about 300 m inside a cave, it seems unlikely it is a cavernicolous species, considering that it has almost no troglomorphic features, and that a female of the species was obtained in the open forest." *Phaibulamon stilipes* and *Phricotelphusa deharvengi* are regarded as true troglobitic species (Ng, 1988a, 1992; Guinot, 1994). However, these species lack the reduced eyes and nonpigmented

corneas seen in more highly modified troglobitic forms (e.g., see Holthuis, 1979, 1980; Ng, 1991a). *Erebusa calobates* has pigmented corneas but strongly reduced eyestalks, in addition to having very long ambulatory legs, making it the most highly modified cave-dwelling crab to be reported from Indochina so far.

MATERIALS AND METHODS

The following abbreviations are used: G1 for male first pleopod, G2 for male second pleopod. Measurements (in millimeters) are of carapace width and length, respectively. The carapace height is measured from the suture between anterior thoracic sternites 2 and 3 to the highest point of the gastric region on the dorsal carapace surface. Terminology used essentially follows that of Ng (1988b). Specimens examined are deposited in the Zoological Reference Collection (ZRC) of the Raffles Museum, National University of Singapore, and the Muséum national d'Histoire Naturelle (MNHN), Paris, France.

TAXONOMY

Family Potamidae Ortmann, 1896

Erebusa, new genus

Type Species.—*Erebusa calobates*, new species, by present designation.

Diagnosis.—Carapace slightly broader than long, relatively high, about 0.5 times carapace length, longitudinally convex anteriorly. Epigastric and postorbital cristae distinct, rounded. Frontal and orbital regions very narrow, anterior part of carapace compressed. External orbital angle highly reduced, hardly visible dorsally; epibranchial tooth triangular; anterolateral margins gently convex. Ischium of third maxilliped broadly rectangular, with

distinct longitudinal median sulcus; antero-external angle of merus auriculiform; exopod extending beyond upper edge of ischium to midpoint of merus, with well-developed flagellum subequal to merus width. Cheliped with distinctly elongated merus. Ambulatory legs very long, slender. Male anterior thoracic sternites 2 and 3 with distinct suture between them; thoracic sternites 3 and 4 separated by very faint suture. Male abdomen narrowly triangular. G1 slender, sinuous; terminal segment lacking dorsal fold; subterminal segment with narrow, necklike distal part. G2 distal segment longer than half length of basal segment.

Etymology.—The generic name is derived from *Erebus*, Latin for a place of darkness in the nether world, alluding to the cavernicolous habits of the sole member of the genus. Gender feminine.

Remarks.—The serrated anterolateral margins of the carapace and the very long ambulatory legs of *Erebusa* ally it more closely to *Tiwaripotamon* Bott, 1970 (sensu Ng, 1992; Dai and Naiyanetr, 1994) [northern Vietnam to southern China] than to any other Indochinese potamid genus. We examined the lectotype of *T. annamense* (Balss, 1914) [a male 42.0 × 30.1 mm, Zoologische Staatssammlung, München, catalogue number: 1169/1], the type species of *Tiwaripotamon*, and its characters support Ng's (1992) and Dai and Naiyanetr's (1994) definition of the genus. Comparing *Erebusa calobates* with species of *Tiwaripotamon* (also cf. Balss, 1914; Bott, 1970; Ng, 1992; Dai and Naiyanetr, 1994), *Erebusa* differs in the following key diagnostic features: (1) ischium of third maxilliped broadly rectangular, with distinct longitudinal median sulcus (versus ischium squarish, with longitudinal sulcus faintly developed or absent); (2) antero-external angle of third maxilliped merus auriculiform (versus antero-external angle rounded); (3) exopod of third maxilliped relatively long, reaching midpoint of merus (versus exopod relatively short, not reaching midpoint of merus); (4) male abdomen narrowly triangular (versus broadly triangular); and (5) G1 terminal segment proportionately long (~0.5 times subterminal segment) and bent outward, not upcurved [versus G1 terminal segment proportionately short (~0.3 times

subterminal segment) not bent outward, usually upcurved]. In addition, other characters which probably have less generic significance but can nevertheless be confidently used to separate *Erebusa* from species of *Tiwaripotamon* are: (1) its relatively high carapace, slightly broader than long, with gently convex anterolateral margins (versus relatively flat carapace, distinctly broader than long, with distinctly convex anterolateral margins); (2) granular to rugose carapace surfaces (versus smooth carapace surfaces); (3) highly reduced and dorsally hardly visible external orbital angle (versus small but dorsally distinctly visible external orbital angle); (4) strongly reduced eyes occupying less than half the orbit (versus normal eyes, occupying the entire orbit); and (5) proportionately much longer and more slender ambulatory legs, with dactylus, carpus, and merus ~11.3 times, 3.6 times, and 8.0 times longer than widest point, respectively (versus proportionately shorter and more stout, with dactylus, carpus and merus ~9.7 times, 2.3 times, and 4.3 times longer than widest point, respectively). Dai and Naiyanetr (1994) reviewed *Tiwaripotamon* and split it into three genera, namely, *Tiwaripotamon* sensu stricto, and two new genera, *Neotiwaripotamon* and *Chinapotamon*. The ambulatory legs in the members of the latter two genera are comparatively shorter and stouter than those of species of *Tiwaripotamon*, and they do not resemble *Erebusa* even superficially.

Phaibulamom Ng, 1992, established for *P. stilipes* Ng, 1992, another similarly long-legged species described from Kanchanaburi Province in western Thailand, is the only other troglobitic potamid crab genus known from Indochina. *Erebusa calobates* can, however, be easily separated from *P. stilipes* by the following differences: (1) highly reduced external orbital angle (versus distinct external orbital angle); (2) long third maxilliped exopod, reaching median level of merus, with well-developed flagellum (versus relatively short third maxilliped exopod, not exceeding upper edge of ischium, lacking a flagellum); (3) ambulatory legs lacking dense setae along margins (versus ventral margin of merus and both margins of propodus lined with dense short stiff setae); and (4) G1 relatively slender, with long slender terminal segment, about 0.5 times length of subterminal segment (G1 relatively broad, with stout, short termi-

nal segment, about 0.3 times length of sub-terminal segment) (cf. Ng, 1992).

Long slender ambulatory legs are present in one more Indochinese genus, *Nemoron* Ng, 1996, represented by a single terrestrial potamid species from Vietnam, *N. nomas* Ng, 1996. *Nemoron nomas*, however, cannot be confused with *E. calobates* because in addition to having a distinct triangular external orbital angle, the former species also has large well-developed eyes that entirely fill the orbits (versus highly reduced eyes, occupying less than half of the orbit in *E. calobates*).

Erebusa calobates, new species

Figs. 1–5

Material Examined.—Holotype, ♂ (20.8 × 17.8 mm) (ZRC 1998.1073), Tham Tê, near Ban Na, Khammouan Province, Laos, collected by L. Deharveng and A. Bedos, 11 February 1998. Paratypes: 2 ♂♂ (20.0 × 17.4 mm and 19.9 × 17.5 mm), 1 juvenile (ZRC 1998.1074–1075), same data as holotype; 1 gravid ♀ (23.0 × 19.3 mm) (ZRC 1998.1076), Tham Houai Say, near Ban Khen, Khammouan Province, Laos, collected by F. Brehier, 26 February 1998; 1 ♂, 1 ♀ (♂ 22.7 × 19.7 mm, ♀ 17.7 × 15.5 mm) (MNHN), Tham Thon, near Ban Thongkha, Khammouan Province, Laos, collected by L. Deharveng and A. Bedos, 15 February 1998.

Description of Male Holotype.—Carapace relatively high from frontal view, slightly broader than long; dorsal surface longitudinally convex anteriorly, glabrous, covered with tiny granules; regions distinct, cervical groove faint, H-shaped groove distinct (Fig. 1A, E). Epigastric cristae rounded, not sharp, separated by distinct narrow groove, almost confluent with postorbital cristae; postorbital cristae distinct, not sharp, rounded, not confluent with epibranchial teeth; regions behind epigastric and postorbital cristae covered with small granules (Fig. 1A, E). Frontal margin gently emarginate medially, finely serrated; frontal region strongly deflexed downward, relatively narrow; supraorbital margin gently sinuous, infraorbital margin almost straight, both weakly cristate, finely serrated; orbital region relatively narrow; suborbital region strongly depressed (Fig. 1A, E). Eyes strongly reduced, occupying less than half of orbit; eyestalk very short; cornea slightly reduced, with distinct pigmentation (Fig. 1A, E). External orbital angle highly reduced, barely visible from dorsal view, confluent with supraorbital margin; epibranchial tooth distinct, triangular, cristate, serrated, demarcated by narrow cleft on inner margin; an-

terolateral margin finely serrated, minutely cristate, gently convex, slightly curving inward posteriorly; posterolateral margin entire, straight, very gently converging posteriorly; branchial region covered with sparse rugae and granules; metabranchial region striated (Fig. 1A, E). Epistome anterior margin with low median triangle; posterior margin with median triangular tooth (Fig. 1E).

Ischium of third maxilliped broadly rectangular, ~1.5 times longer than broad, with well-developed longitudinal median sulcus; merus antero-external angle auriculiform, with concave outer surface, subequal to half of ischium length; palp normal; exopod long, exceeding upper edge of ischium, reaching midpoint of merus, inner margin of distal part lacking tooth, with well-developed flagellum subequal to width of merus (Fig. 1F).

Left cheliped missing. Right cheliped with outer surfaces of merus and carpus rugose; fingers gently curving inward, with narrow gape when closed, subequal to length of palm, with two slightly enlarged cutting edge teeth, tips gently hooked and overlapping, with distinct longitudinal rows of pits; carpus with low, robust, obliquely directed subdistal spine on inner margin; merus elongate, with serrated margins (Fig. 2A, B).

Ambulatory legs very long, slender, sparsely granular, margins finely serrated, second pair longest; second ambulatory leg dactylus ~11.3 times longer than proximal width, shorter than propodus, ~0.7 times as long as propodus, with numerous forward-directed short spines along longitudinal margins; carpus ~3.6 times longer than distal width, subequal to length of dactylus; merus ~1.9 times length of propodus, ~8.0 times longer than broad; fourth ambulatory leg similar in proportions to second leg (Fig. 2C, E).

Suture between thoracic sternites 2 and 3 distinct, gently convex; suture between sternites 3 and 4 barely discernible; male abdominal cavity exceeding level of median points of cheliped bases (Fig. 1G). Thoracic sternites 5 and 6 medially interrupted; sternites 7 and 8 separated by distinct longitudinal median suture (Fig. 4A). Abdomen narrowly triangular; telson longer than sixth segment, lateral margins slightly convex to straight, tip rounded, proximal margin straight; segment 6 with median length about half of proximal margin length, proximal margin straight, lateral margins almost straight;

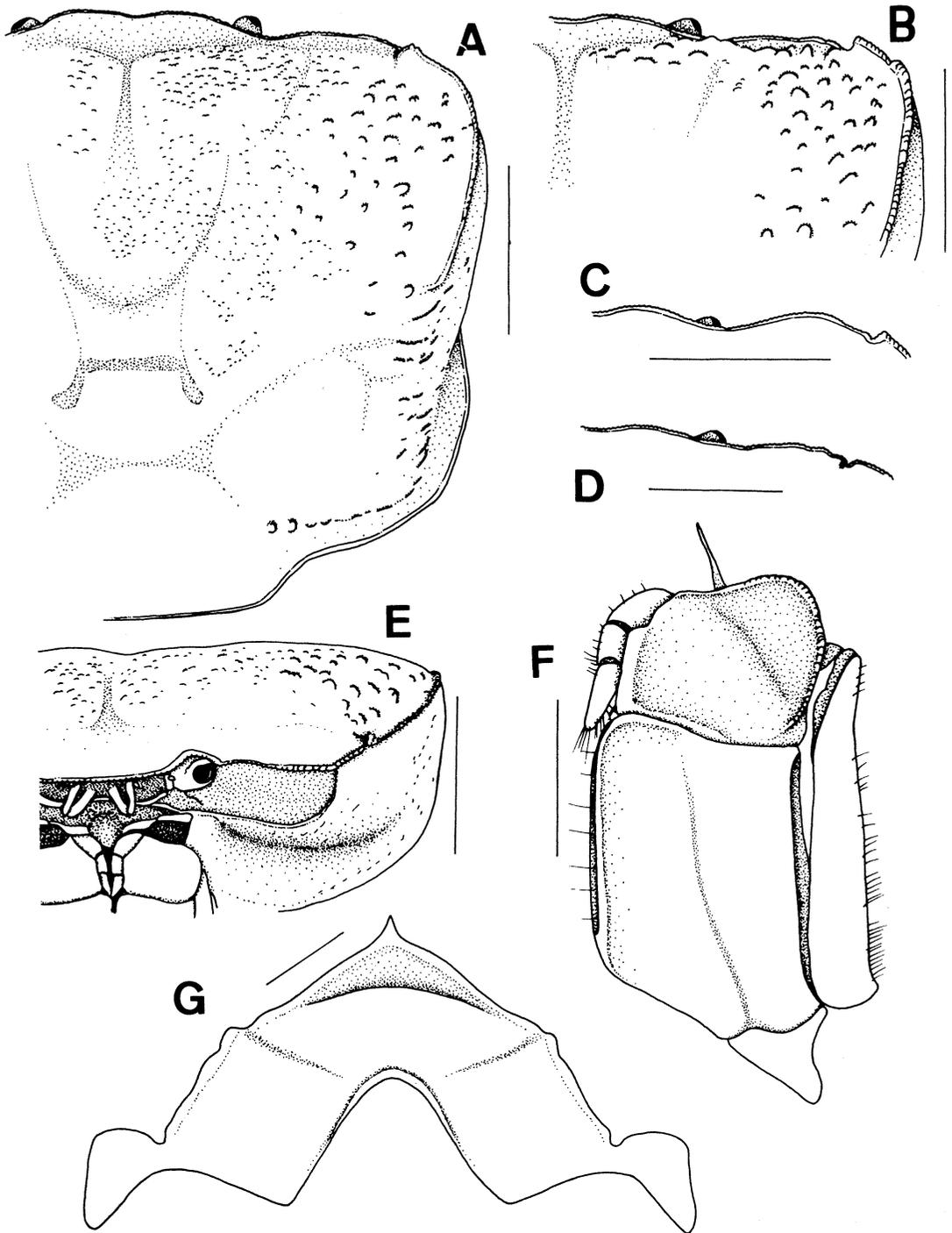


Fig. 1. *Erebusa calobates*, new genus, new species. A, E–G, holotype male (ZRC 1998.1073) (20.8 × 17.8 mm); B, paratype male (ZRC 1998.1074) (19.9 × 17.5 mm); C, paratype male (ZRC 1998.1075) (20.8 × 17.8 mm); D, paratype female (ZRC 1998.1076) (23.0 × 19.3 mm). A, right side of dorsal carapace; B, right branchial region; C, D, supraorbital margin; E, left frontal view; F, left third maxilliped; G, anterior thoracic sternum. Scales: 5.0 mm in A–E; 2.0 mm in F, G.

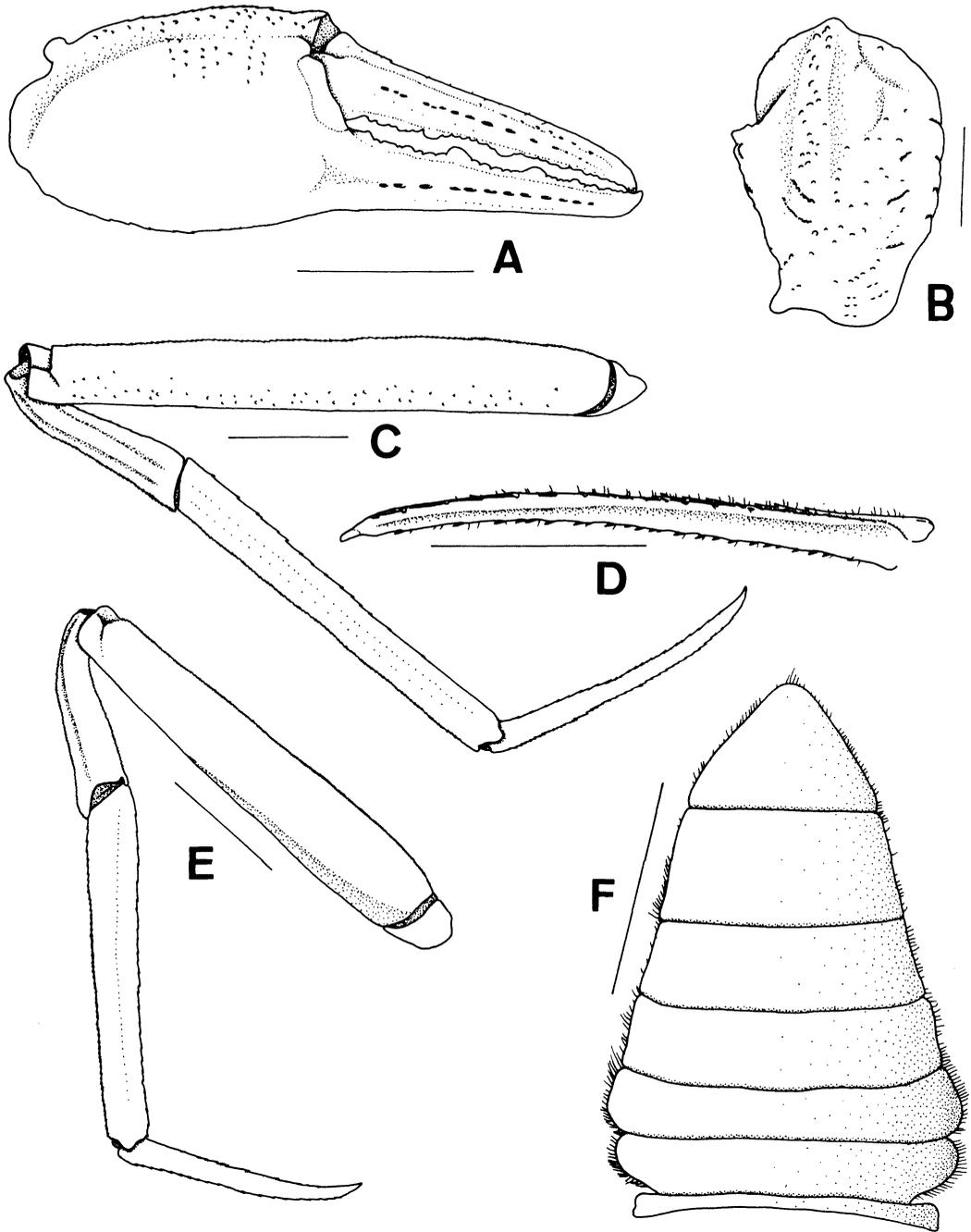


Fig. 2. *Erebusa calobates*, new genus, new species, holotype male (ZRC 1998.1073) (20.8 × 17.8 mm). A, right chela; B, superior view of carpus of right cheliped; C, left second ambulatory leg; D, dactylus of left second ambulatory leg; E, left fourth ambulatory leg; F, abdomen. Scales: 5.0 mm in A, C–E; 2.0 mm in B.

lateral margins of segments 4 and 5 almost straight; lateral margins of segment 3 slightly convex (Fig. 2F).

G1 sinuous; terminal segment clearly separated from subterminal segment, relatively

long, about 0.5 times length of subterminal segment, bent obliquely outward near median part, with distinct small, narrow hump at bend on inner margin, basal half proportionately broader than distal half, tip narrow, with

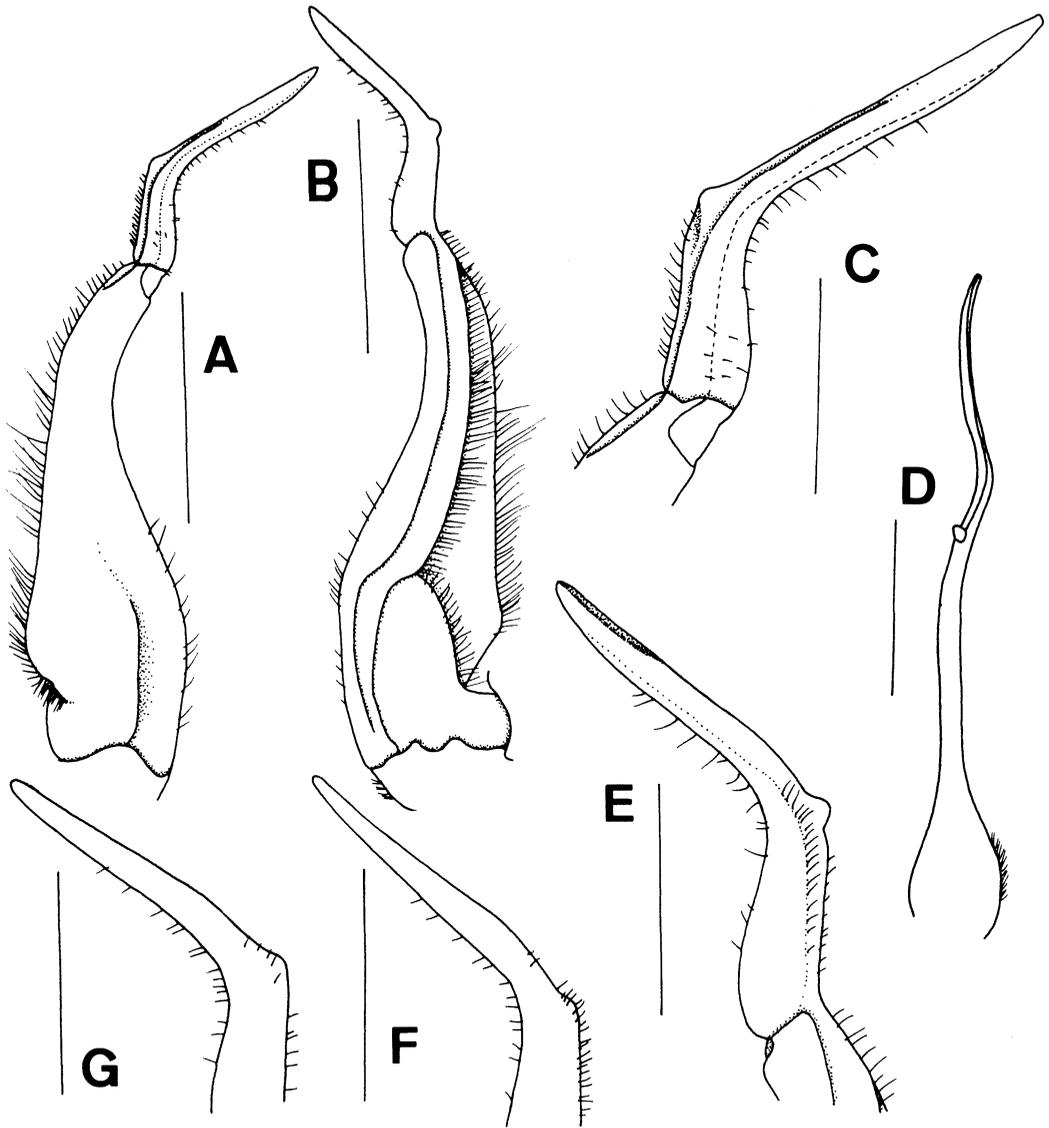


Fig. 3. *Erebusa calobates*, new genus, new species. A–E, holotype male (ZRC 1998.1073) (20.8 × 17.8 mm); F, paratype male (MNHN) (22.7 × 19.7 mm); G, paratype male (ZRC 1998.1074) (19.9 × 17.5 mm). A–C, E–G, right G1: A, dorsal view; B, ventral view; C, dorsal view of terminal segment; D, right G2; E–G, ventral view of terminal segment. Scales: 5.0 mm in A, C–E; 2.0 mm in B.

groove for G2 opening on inner margin of tip; subterminal segment sinuous, with distinct, gently concave upper part of outer margin (Fig. 3A–C, E). G2 with distal segment about 0.7 times length of basal segment (Fig. 3D).

Etymology.—The specific epithet *calobates* is derived from the Greek word *kalobates*, for walker on stilts, alluding to the long slender ambulatory legs of this species. Used as a noun in apposition.

Paratypes.—Minor differences are noted among the paratypes. These differences, however, are slight and do not have interspecific significance. The carapace width to length ratio varies from 1.1 (more squarish) to 1.2 (less squarish). The slightly smaller specimens [two adult paratype males (ZRC 1998.1074–1075); paratype adult female (MNHN)] (sizes ranging from 17.7–20.0-mm carapace width) have relatively more squarish carapaces than the larger specimens [holotype male (ZRC

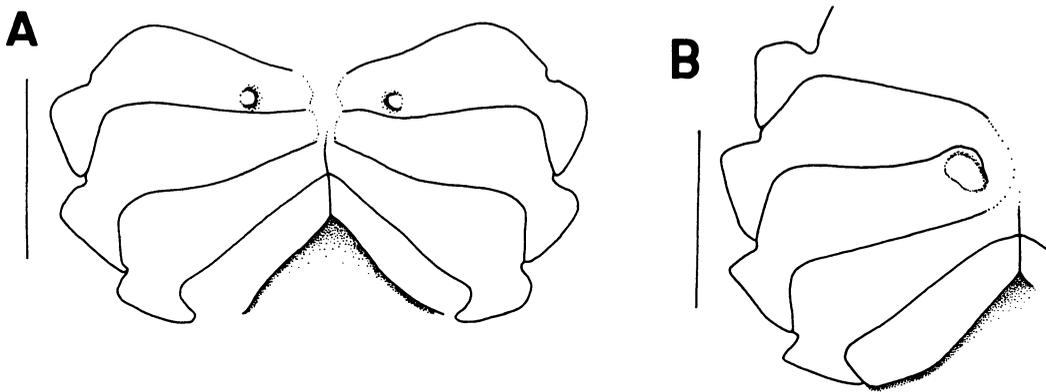


Fig. 4. *Erebusa calobates*, new genus, new species. Thoracic sternites 5–8. A, holotype male (ZRC 1998.1073) (20.8 × 17.8 mm); B, right side, paratype female (ZRC 1998.1076) (23.0 × 19.3 mm). Scales: 5.0 mm.

1998.1073); paratype gravid female (ZRC 1998.1076); adult paratype male (MNHN)] (sizes ranging from 20.8–23.0-mm carapace width). All paratypes show a slightly heterochelous condition. However, the size difference between the major and minor chela is more pronounced in the larger specimens [e.g., gravid paratype female (ZRC 1998.1076)]. The dorsal carapace granulation and rugosity varies, with one paratype (ZRC 1998.1074) having larger, more prominent granules than the holotype (Fig. 1B). There is also variation in the orbital margins, with some specimens having more convex supraorbital margins (ZRC 1998.1075) (Fig. 1C) or supraorbital margins which are irregular where the external orbital angle should be (ZRC 1998.1076)

(Fig. 1D). Apart from the first two characters, the above variations do not appear to be size-related, and none of them are sex-related. In addition, the G1s of the paratype males differ slightly from that of the holotype in that the hump on the inner margin of the terminal segment near the median bend is weaker and less prominent (Fig. 3F, G). The single gravid female specimen (ZRC 1998.1076) bears large eggs that have a mean diameter of about 19.0 mm and that had not yet reached the advanced “eye-spot” stage. The part of the thoracic sternum with the right vulva is depicted in Fig. 4B.

Color.—From color photographs provided by Louis Deharveng, these crabs are mostly pur-



Fig. 5. *Erebusa calobates*, new genus, new species. Holotype male (ZRC 1998.1073) (20.8 × 17.8 mm). Overall dorsal view.

ple except for the ventral and lower frontal part of the carapace and the inner face and tips of the fingers of the chelae, which are grayish to white.

Remarks.—The characters that separate *Erebusa calobates* from the superficially similar species of *Tiwaripotamon*, *Phaibulamon stilipes*, and *Nemoron nomas* have already been discussed under *Remarks* of the genus (see earlier).

Erebusa calobates is fairly abundant in the caves where it is found, occurring in small streams and isolated ponds. One specimen (a gravid female) was collected on the cave wall, out of water. None were found in the large exogenous underground rivers (L. Deharveng, in correspondence).

Erebusa calobates can be regarded as an obligate cave-dweller, i.e., a troglobite. Ng and Goh (1987) and Guinot (1994) commented that troglobitic crabs possess at least one of the following troglomorphic features: reduced eyes with the cornea often reduced or absent, loss of pigmentation to varying degrees, and elongated ambulatory legs and chelipeds. In *E. calobates*, the eyestalks are substantially reduced, occupying only a small part of the orbit. The purplish live coloration is not typical of more specialized troglobites like *Cerberusa caeca* Holthuis, 1979, and *C. tipula* Holthuis, 1979 [both from Borneo] (Potamidae), *Holthuisana alba* Holthuis, 1980 [from New Guinea], and *Sundathelphusa cavernicola* (Takeda, 1983) [Philippines] (Parathelphusidae), *Cancrocaeca xenomorpha* Ng, 1991 [Sulawesi] (Hymenosomatidae), and *Trogloplax joliveti* Guinot, 1986 [New Britain] (Goneplacidae) (Guinot, 1994; Ng and Sket, 1996) which are white to yellowish-gray. In some of these species their eyes are highly reduced, with the cornea sometimes absent (*C. caeca*). One species, *Cancrocaeca xenomorpha*, has completely lost its eyes and the orbits are almost indiscernible (Ng, 1991a). There are some troglobites from Thailand and Borneo, however, that have well-developed eyes (Ng, 1992; Guinot, 1994). *Erebusa calobates* has very elongated pereopods, but it is important to note that the possession of such structures is not a sure indication of a troglobitic life-style. Many species of epigeal, free-living terrestrial crabs also have such appendages (Ng, 1991b, 1996; Ng and Naiyanetr, 1993; Dai and Naiyanetr, 1994).

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