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Calvariomorphus—a new genus of marsh beetles (Coleoptera: Scirtidae) with remarkable elytral excitators

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Abstract

A new genus of marsh beetles (Coleoptera: Scirtidae: Scirtinae) from Southeast Asia is described to accommodate *Contacyphon peterseni* (Klausnitzer, 1973) from Bismarck Archipelago and three newly described species: *Calvariomorphus malayanus* **sp. nov.** (type species of the genus), *C. sakaii* **sp. nov.**, and *C. palauensis* **sp. nov.** Morphology and relationships between *Calvarium*-like taxa, defined on the basis of several common morphological features (compact body, very narrow clypeus, deep subantennal fossae) are discussed.

Key words: Scirtiformia, *Calvarium*, *Calvariopsis*, biogeography, water beetles

Introduction

In the present paper, we are describing a small genus of marsh beetles which is very rare in collections. The new genus is inconspicuous, but exhibits a set of unusual morphological characters that are described and illustrated in detail. It includes four species, three of them are newly described, and the fourth was described by Klausnitzer (1973) as *Cyphon peterseni*.

Material and methods

Specimens were studied and measured with the use of a Nikon SMZ1500 stereomicroscope and Nikon Eclipse *Ni* compound microscope. Photographs were taken with a Nikon D5100 digital camera combined with both microscopes. In selected cases, a HITACHI S-3400N scanning electron microscope was used to observe and photograph morphological characters. Wings were observed in glycerine slides. Mouthparts and abdomens were cleared in NaOH or KOH solution for 4–12 hours, washed with distilled water, and transferred into gum-chloral medium (male genitalia) or stained with chlorazol black and transferred into glycerine (female genitalia). After taking the photographs, the slides were remounted, the genitalia were washed with distilled water and glued on cardboards with a solution of polyvinyl alcohol. The images were generated using Helicon Focus (7.6.1 and earlier versions) software and enhanced using Adobe® Photoshop CC for selected specimens.

Total length (TL) was measured from above and extends from the anterior edge of pronotum to the apex of elytra. Elytra width (EW) was measured for both elytra together. The shape of the pronotum is described when observed in perpendicular view. Label data are cited verbatim in double quotes (“ ”), backslashes (\) separate lines. Terminology of wing venation after Friedrich & Beutel (2006) and head morphology after Zwick (2013).

The following abbreviations are used in the text: AP—posterior anal vein, $CuA+AA_{1+2}$—fusion of anterior cubital and anterior anal veins, EW—elytral width, MP—posterior medial vein, r3—third radial cross-vein, rp-mp2—second radio-medial cross-vein, sar—supraantennal ridge, sgr—subgenal ridge, soc—subocular carina, TL—total length.

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Depositories:

BPBM	Bishop Museum, Honolulu, USA
EUM	Ehime University Museum, Matsuyama, Japan
MHNG	Muséum d'Histoire Naturelle, Geneve, Switzerland
MNHN	Museum national d'Histoire naturelle, Paris, France
ZMHB	Museum für Naturkunde der Humboldt-Universität, Berlin, Germany
ZMUC	Zoological Museum, University of Copenhagen, Denmark

Results

Genus *Calvariomorphus* gen. nov.

(Figs 1–14)

Type species: *Calvariomorphus malayanus* **sp. nov.**, by present designation.

Diagnosis. Body small (TL<2 mm), oval; head transverse, with deep subantennal fossae, subgenal ridge without buttonhole configuration; prosternal process small, elongate, tear-shaped; mesoventral notch for reception of prosternal process subtriangular to transversely pentagonal, mesoventrite with a deep groove in anterior portion, mesoventral process short, subtriangular, distinctly notched, apex bilobed. Penis symmetrical, tegmen reduced, U-shaped, sternite IX modified. Females often with excitators in apical portion of elytra.

Description. Male. Body (Figs 1, 5A) oval, TL 1.6–2.2 mm, strongly convex, light brown to brownish black, covered with whitish, suberect setae, punctation of dorsum not granulate.

Head (Figs 2, 5D) small, wider than long; eyes of moderate size, not protuberant, finely facetted; tempora relatively short, distance from posterior margin of eye to occipital ridge ca. 1/5 diameter of the eye, strongly converging basally; distance from ventral margin of eye to subgenal ridge very small, eye almost touching subgenal ridge; supraantennal ridges not elevated, joined mesally to clypeal margin; frons slightly convex; subantennal fossae big and deep, ventrally reaching subgenal ridge. Frontoclypeal suture absent; clypeus transverse, ca. 4× wider than long, with straight anterior margin, lateral margins subtly converging posteriorly. Anteclypeus present, very short, shorter than clypeus. Ventral portion of head between subgenal ridges slightly concave, gular area convex, gular ridges well developed. Subgenal ridge well marked, without buttonhole configuration. Antennae filiform, covered with relatively long setae, reaching basal portion of elytra; antennomere 1 widest, subcylindrical, with sharp ridge on anterior margin; antennomere 2 subcylindrical, narrower and distinctly shorter than antennomere 1; antennomere 3 very narrow, subconical, shorter than antennomere 2; antennomere 4 long, with subparallel sides, ca. 2× longer than antennomere 3; antennomeres 5–10 slightly shorter than antennomere 3, subcylindrical; antennomere 11 slightly longer than antennomeres 5–10, subtriangular. Labrum 1.5× narrower than clypeus, transverse, ca. 1.6× wider than long, anterior margin and anterolateral angles rounded. Mandibles (Fig. 2B, C) slightly asymmetrical, denticle on right mandible better developed, ca. 2× longer than wide at bases, abruptly curved in apical 1/3, apices unidentate, outer margin covered with sparse setae; inner margin of mandibles with sharp ridge and subtriangular denticle; mola without spines or setae. Maxillary palpi (Fig. 2D): palpomere 1 subconical, 2 shorter, subcylindrical, 3 longest and widest, subconical, 4 as long as 3 but slightly narrower, subconical, pointed at apex. Galea with subparallel sides, slightly shorter than lacinia, with two fan-shaped rows of setae at apex; lacinia subtriangular, elongate, inner margin of lacinia with straight setae, setae on apical portion hooked. Mentum (Fig. 2B, E) only slightly wider than long, transverse (W/L = 1.2), subquadrate. Ligula narrow at base, widened apically, transversely oval, apical margin rounded, covered with setae, without membranous portion. Labial palpomeres: palpomere 1 long, narrow, sinuate, palpomere 2 wider, subconical, curved; apical wide, subconical, arising from apex of preapical one.

Pronotum small, transverse, slightly narrower than base of elytra, ca. 2.2× wider than long; lateral carinae straight, converging anteriorly; disc convex; anterior margin rounded; anterolateral angles subrectangular, not projecting; posterior angles subrectangular, well marked; base rounded. Prosternum reduced anteriorly; prosternal process narrow, elongate, tear-shaped, ca. 2.5× longer than wide, covered with delicate setae.

Scutellar shield small, equilaterally triangular, flat, with pointed apex; anterior margin straight. Elytra elongated, wider at base than base of pronotum; widest in anterior 1/3; humeri well marked, apices regularly rounded. Epipleura narrow at base, half as wide as metanepisternum, gradually narrowing, present till apices. Punctation of elytra irregular, not granulate, uniform, sparse.

FIGURE 1. *Calvariomorphus* **gen. nov.**, dorsal view (with the exception of H). A) *C. malayanus* **sp. nov.**, male, B) same, female, C) *C. palauensis* **sp. nov.**, male, D) same, female, E) *C. sakaii* **sp. nov.**, male, F) same, female, G) *C.* sp. (Nicobar Islands), H) same, semilateral view. Scale bars = 0.5 mm.

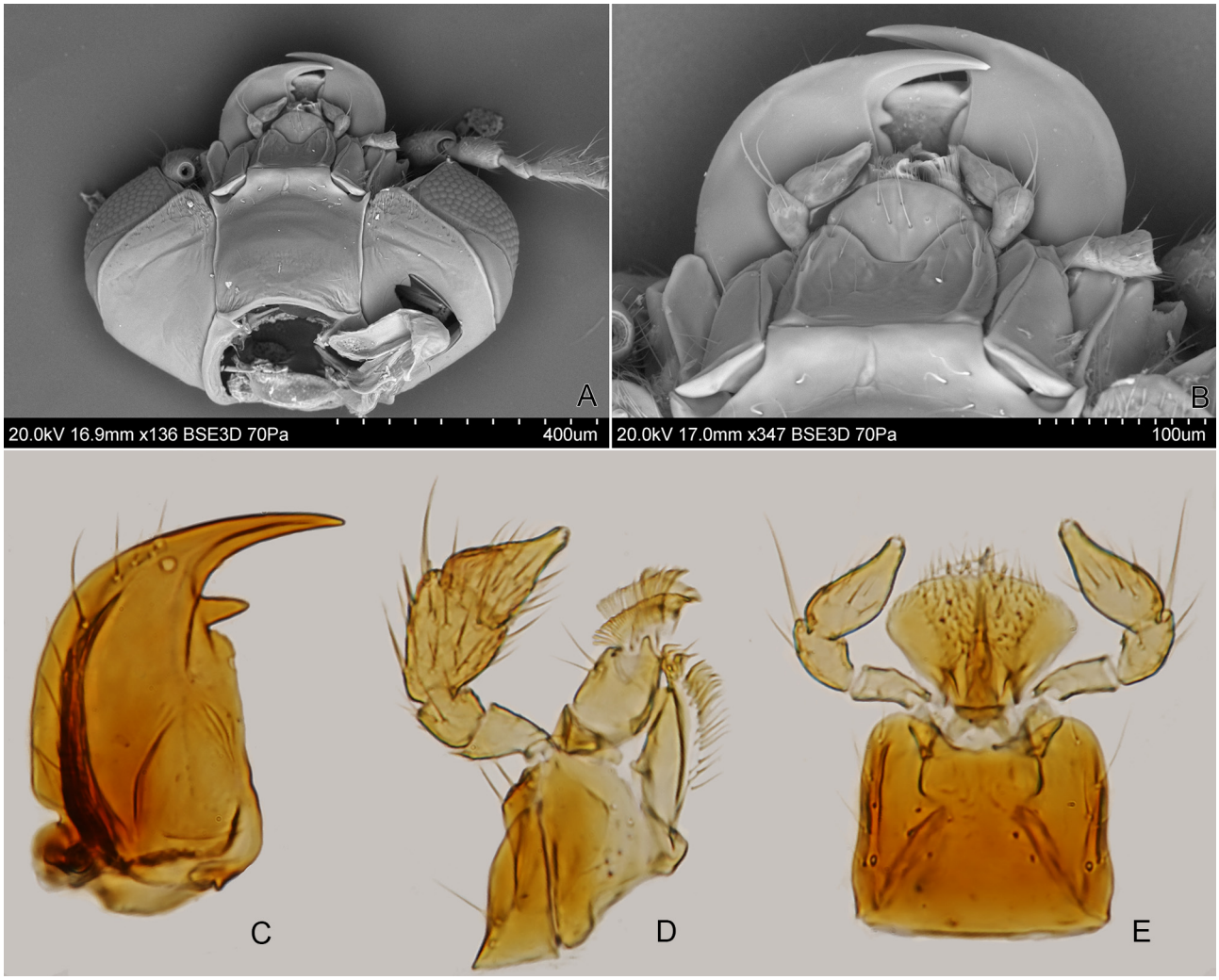

FIGURE 2. *Calvariomorphus* **gen. nov.**, morphology of head. A) *C. palauensis* **sp. nov.**, head, ventral view, B), same, close-up of mouthparts, C) *C. malayanus* **sp. nov.**, mandible, D) same, maxilla, E) same, labrum.

Hind wings (Fig. 3) ca. 2× longer than its width; radial cell subtriangular; apical portion of r3 poorly visible, straight; rp-mp2 arcuate, forming oblique angle with MP_{1+2}; MP_4 short, joining MP_3 and $CuA+AA_{1+2}$; anal field with well marked AP. Medial field with three free veins; pigmented areas in radial cell, radial, central and apical fields.

Mesoventrite (Fig. 5D–E) small; anterior portion with deep grooves along anterior margin, central portion forming oval or hexagonal fossa for reception of prosternal process; mesoventral process completely separating mesocoxae, as long as wide, sides slightly converging posteriorly, apex bilobed, touching metaventrite; mesanepisternum rhomboidal, impunctate, with concave central portion, forming coxal rest for procoxa; mesepimeron small, impunctate, subtriangular, slightly narrowed mesally.

Metaventrite (Fig. 5B–C, G) moderately long, transverse, convex; anterior portion with spherical cuticular structures; discrimen present in posterior 1/2; metanepisternum subtrapezoidal, slightly narrowing posteriorly. Metacoxae moderately large, strongly oblique, ca. 3.7× wider than its length, extending laterally to epipleura; metacoxal plate obliquely narrowing.

Legs moderately long, tibiae with paired carinae, without modifications.

Abdomen ca. 1.1× wider than its length, convex; ventrites 1–4 of similar length; ventrite 5 slightly longer, subtriangular at apex. Ventrites 2–5 covered with regularly distributed setae, ventrite 1 with setae only in central portion, lateral portions without setation (Fig. 7A).

Sternite VIII absent; sternite IX U-shaped or V-shaped, apical portions of lateral arms widened in some species; tergite VIII with apodemes as long as apical plate, apical plate transverse, subrectangular to subtrapezoidal, apical margin covered with dense setae; tergite IX slightly shorter than tergite VIII, apical portion membranous, apodemes slightly longer than apical portion, diverging. Tegmen reduced, U-shaped, parameres pointed or armed with spines. Penis symmetrical, dorsoventrally flattened; trigonium elongated, subrectangular, pointed at apex, shorter to slightly longer than parameroids, parameroids long and narrow, often subrectangular, sometimes with spines on apical margin, apices rounded.

Female. TL 1.7–2.2 mm. Apical portion of elytra often with excitators (*sensu* Ruta 2008), presumably secretory structures connected with exocrine glands (Fig. 4). Hind wings functional, fully developed. Setation of abdominal ventrite 1 present along posterior margin of ventrite (Fig. 7B). Sternite VIII (Fig. 9) elongate oval, apex with sparse setae. Tergite VIII very long; apical portion subtrapezoidal, with sparse setation on apical margin; apodemes long, several times longer than apical portion. Ovipositor long; branchlets present; gonocoxites narrow, membranous, gonostyli arising apically, each with two tufts of setae at apex. Bursa membranous, with variable sclerites present; bursella small, spherical, accessory gland sometimes with sclerites near to its opening.

Biology. Unknown.

Etymology. Combination of the name *Calvarium* Pic and the New Latin ending *–morphus* meaning having the shape of *Calvarium*. Reference to the similarity to the genus *Calvarium* Pic. Gender: masculine.

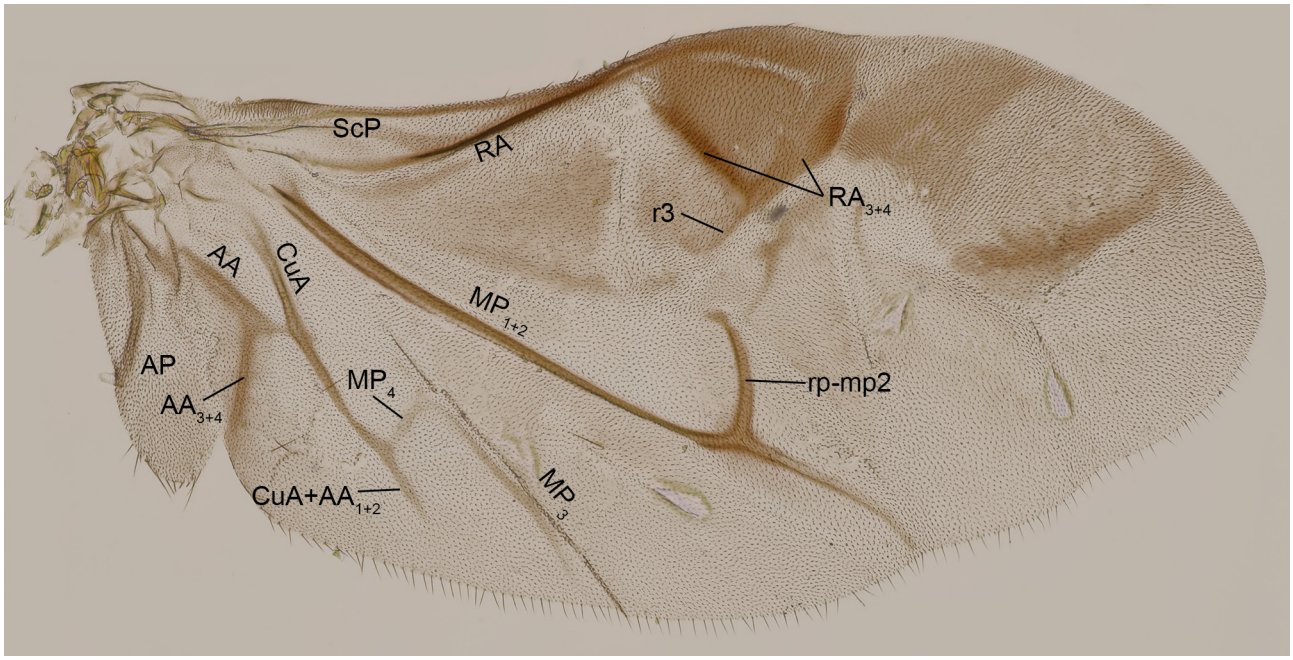

FIGURE 3. *Calvariomorphus malayanus* **sp. nov.**, hind wing. Abbreviations: AA—anterior anal vein, AP—posterior anal vein, CuA—anterior cubital vein, CuA+AA_{1+2}—fusion of anterior cubital and anterior anal veins, MP—posterior medial vein, r3—third radial cross-vein, RA—anterior radial vein, rp-mp2—second radio-medial cross-vein, ScP—posterior subcostal vein.

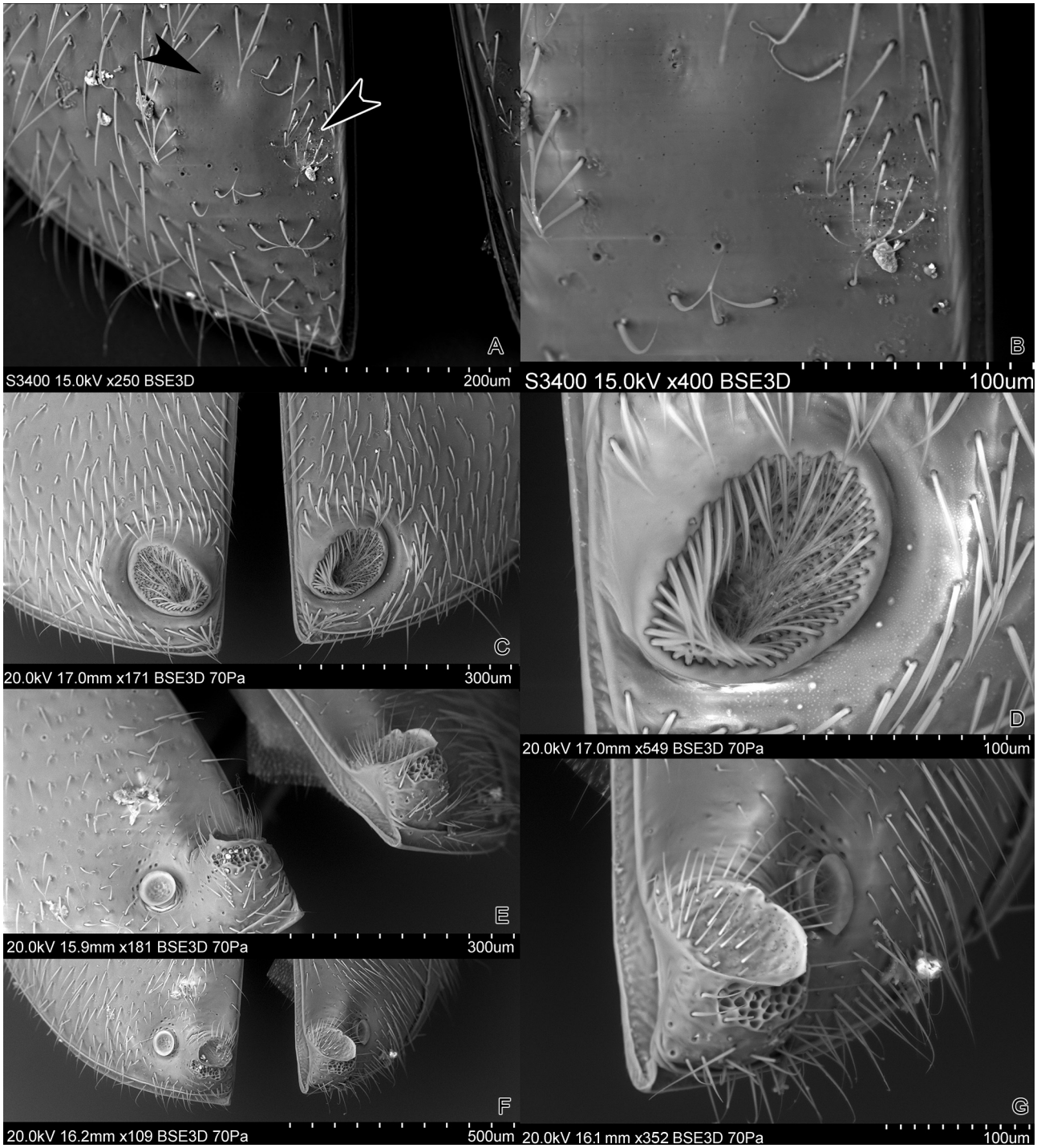

FIGURE 4. *Calvariomorphus* **gen. nov.**, excitators. A) *C. malayanus* **sp. nov.**, apex of elytron, areas with micropores marked with arrows, B) same, close-up, C) *C. palauensis* **sp. nov.**, apices of elytra, caudal view, D) same, close-up, E) *C.* sp. (Nicobar Islands), apices of elytra, semilateral view, F) same, caudal view, G) same, close-up.

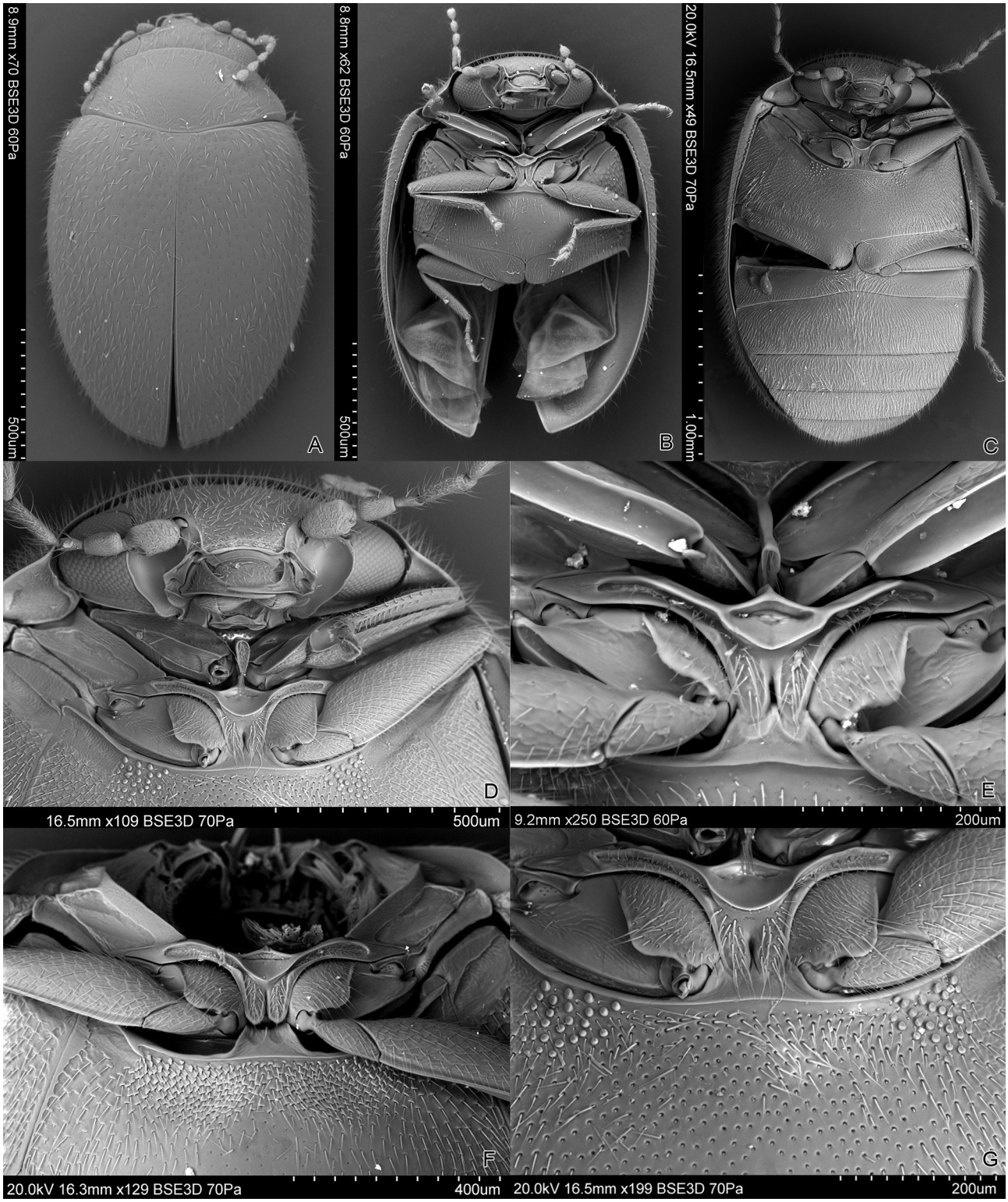

FIGURE 5. *Calvariomorphus* **gen. nov.**, dorsal (A) and ventral (B–G) view. A) *C. malayanus* **sp. nov.**, dorsal view, B) same, ventral view, C) *C. sakaii* **sp. nov.**, D) same, close-up of head and mesoventrite, E) *C. malayanus* **sp. nov.**, close-up of mesoventrite, F) *C. palauensis* **sp. nov.**, meso- and metaventrite, G) *C. sakaii* **sp. nov.**, meso- and metaventrite.

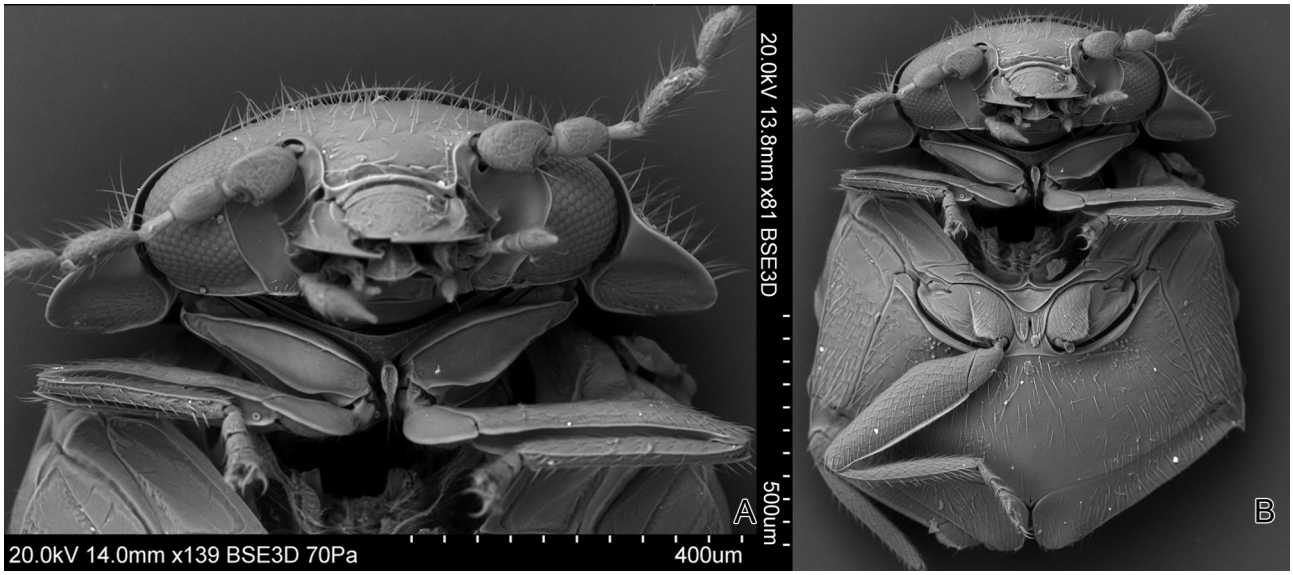

FIGURE 6. *Calvariomorphus peterseni* (Klausnitzer), comb. nov., holotype, ventral view. A) head, ventral view, B) same, head and ventral portion of thorax, ventral view.

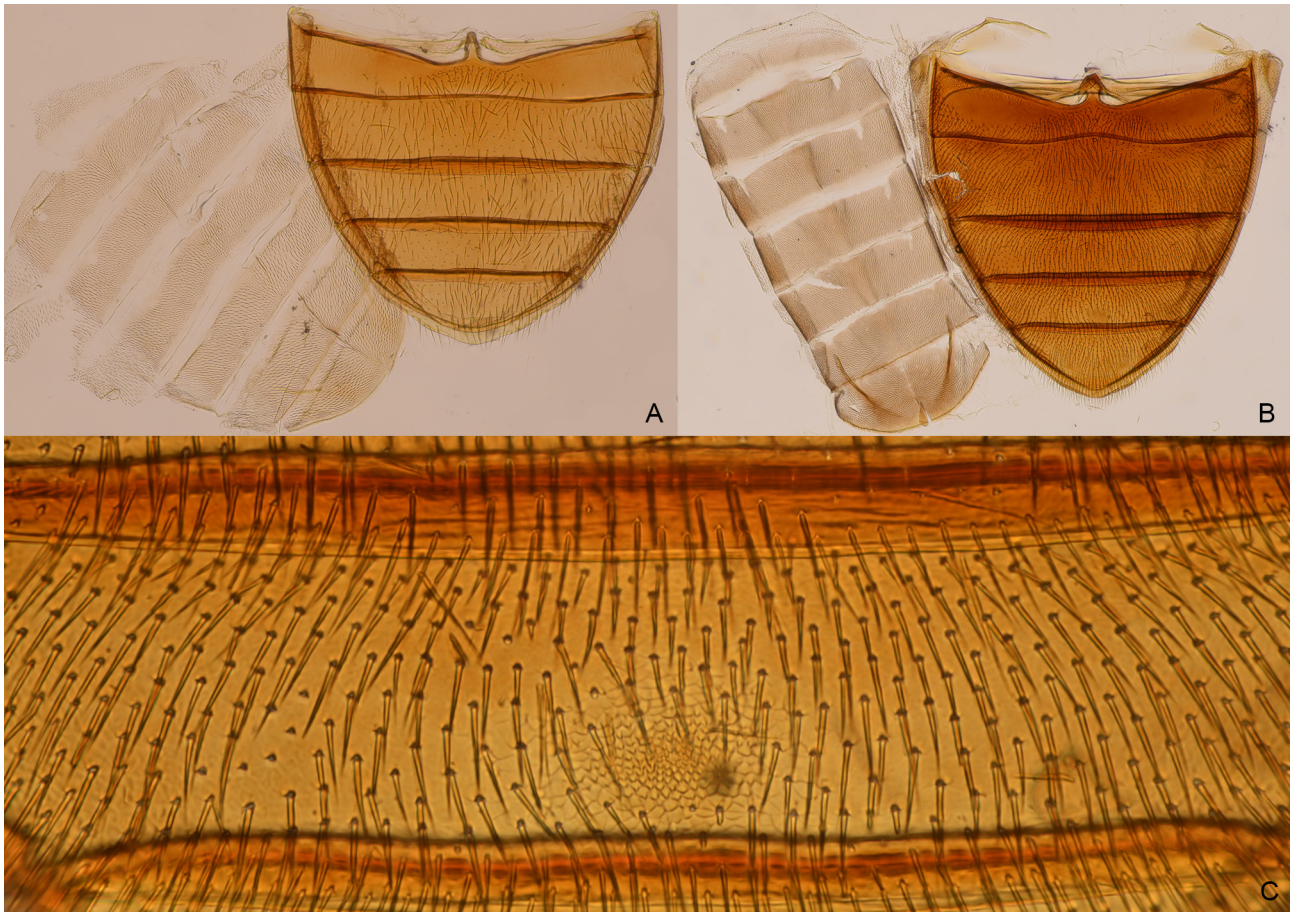

FIGURE 7. *Calvariomorphus* **gen. nov.**, abdomen. A) *C. malayanus* **sp. nov.**, male, B) *C. sakaii* **sp. nov.**, female, C) same, close-up of ventrite 4.

***Calvariomorphus malayanus* sp. nov.**
(Figs 1A–B, 2C–E, 3, 4 A–B, 5A–B, E, 7A, 8, 9)

Type material. Holotype, male (ZMUC): "SINGAPORE: \ Ubin Island \ 1°24'N 103°58'E \ 3-5.xi.1991. O. Martin leg. \ Zoologisk Museum, København". **Paratypes, 2 males, 1 female (ZMUC):** same data as holotype. **Paratype, male (MNHN):** "COLL. Comtesse de BÉARN \ CROISIÈRE DU "NIRVANA" \ SINGAPORE \ E. CORDIER 7.IV.1908"; "MUSEUM PARIS \ Comtesse de BÉARN 1909"; "Dascillide"; "?Cyphon \ sp" [handwritten by Pic]. **Paratype, male (BPBM):** "MALAYA: Kuala \ Lumpur, 19km S of \ Subang, 23.XII.58"; "T. C. Maa \ Collection \ BISHOP". **Paratype, 5 males (ZMHB):** "Hist.-Coll. (Coleoptera) \ Nr. 49600 \ Cyphon spec. \ Bintang, Roettger \ Zool. Mus. Berlin". **Paratype, male (MHNG):** "BORNEO—Sabah \ Sepilok \ IV-V.82, M. Horak".

Diagnosis. Small species (TL ~ 1.6–1.9 mm), body widest in the middle of elytra, trigonium of penis slightly longer than parameroids, females with two excitators shaped as subtle depressions in apical region of each elytron.

Description. Body very small, TL 1.60–1.87 (1.73, n = 4) mm, TL/EW ~ 1.5–1.6 (1.5), oval, brown, legs and antennae paler, yellowish, covered with yellowish semierect setae. Head strongly transverse, punctation sparse, punctures separated by ca. 2 diameters. Pronotum transverse, anterolateral and posterolateral angles right angled, lateral carinae almost straight, punctation sparse, similar to that on head. Angle between pronotum and elytra not marked in dorsal view. Scutellar shield subtriangular, impunctate. Elytra elongate, punctation stronger than on pronotum, punctures separated by ca. 1.5 diameter.

Penis (L 0.35 mm, W 0.10 mm) elongate, symmetrical, pala as long as parameroids, parameroids narrowly triangular, trigonium slightly longer than parameroids, narrow; tegmen (L 0.23 mm, W 0.15 mm) u-shaped, apices of parameres pointed; sternite IX (L 0.20 mm, W 0.12 mm) u-shaped, with subtrapezoidal basal portion; tergite VIII (L 0.29 mm, W 0.25 mm) with parameres as long as apical portion, apical portion covered with microtrichia, apical margin with short setae; tergite IX (L 0.23 mm, W 0.21 mm) with lightly sclerotized, membranous apical portion, apical margin covered with indistinct setae.

Female. Size similar to that in males, TL 1.73–1.83 (1.78, n = 2) mm, TL/EW ~ 1.5. Each elytron with two subtle excitators shaped as depressions in apical portion, each depression with micropores (Fig. 4A, B). Ovipositor long (L 1.37 mm), bursal sclerite elongate (L 0.17 mm).

Distribution. A widely distributed species, known from the Malayan Peninsula, Singapore, Riau Archipelago and Borneo.

Etymology. After Malayan Peninsula, the area where the species occurs.

Remarks. Bintang is sometimes called Bintam or Bintan; the area in the Riau Archipelago, close to Singapore (Kuijten 1992).

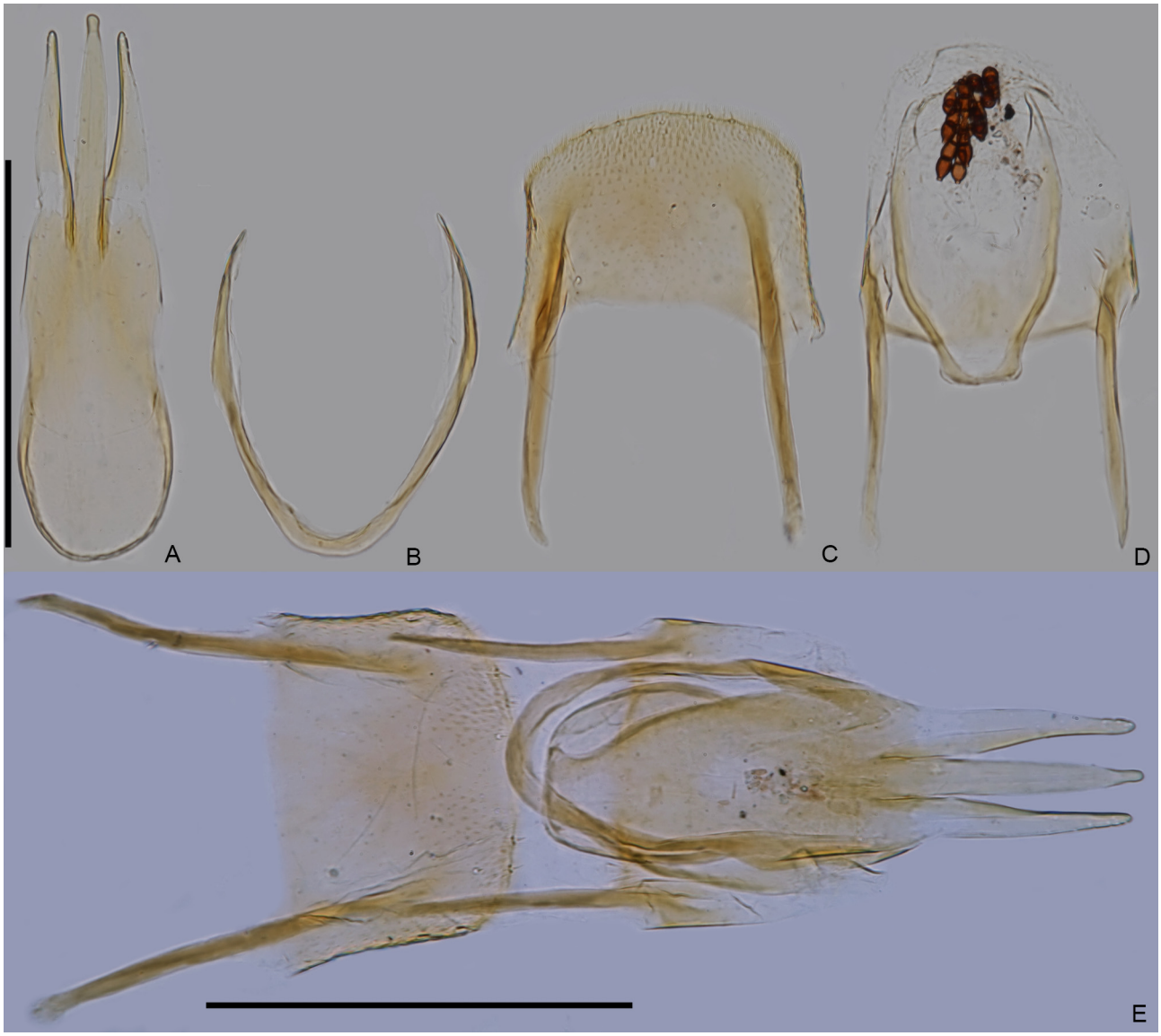

FIGURE 8. *Calvariomorphus malayanus* **sp. nov.**, male genitalia, specimen from Kuala Lumpur (A–D) and Singapore (E). A) penis, B) tegmen, C) tergite VIII, D) tergite IX and sternite IX, E) terminal sclerites and aedeagus. Scale bars = 0.25 mm.

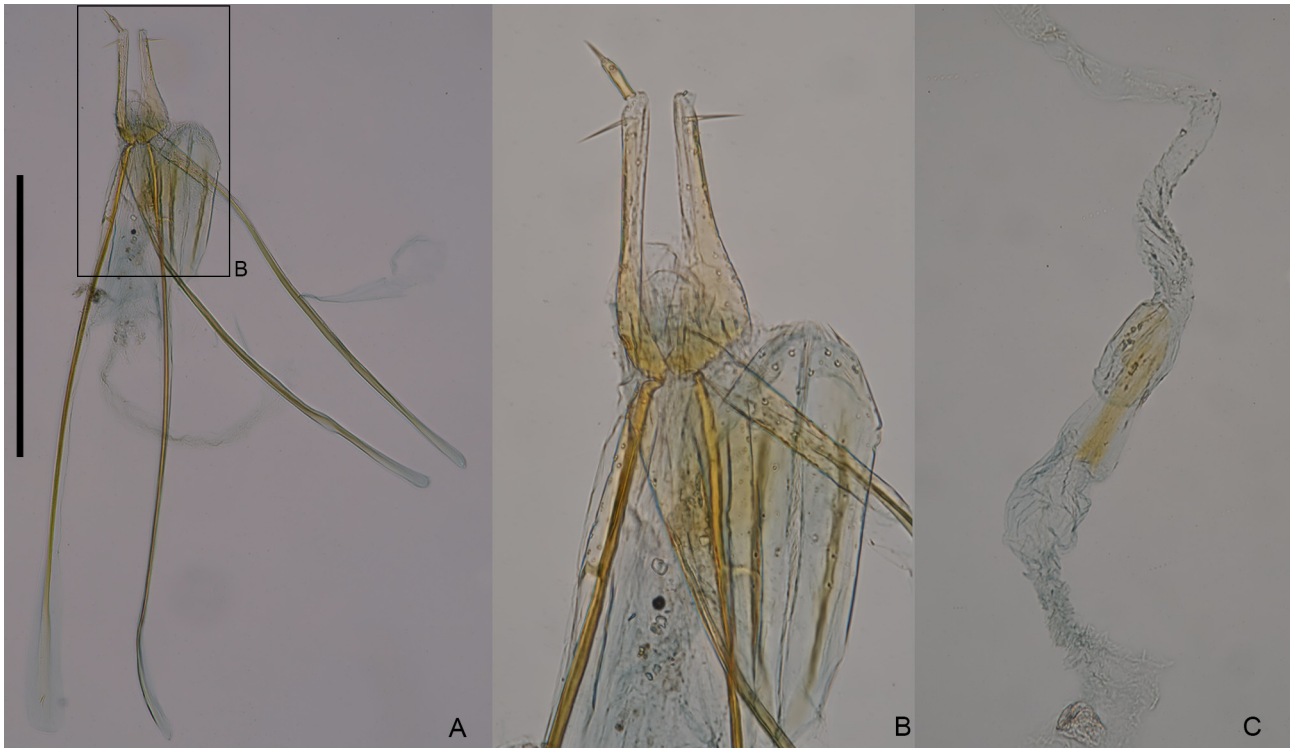

FIGURE 9. *Calvariomorphus malayanus* **sp. nov.**, female genitalia. A) genital tract, B) coxites, C) bursal sclerite. Scale bar (A) = 0.5 mm.

Calvariomorphus palauensis sp. nov.

(Figs 1C–D, 2A–B, 4C–D, 10, 11)

Type material. Holotype, male (EUM): "Palau \ Babeldaob Is. \ 15-18.IX.2002 \ M. Sato leg.". **Paratype, male (EUM):** "Palau \ Babeldaob Is. \ 14-VII-2002 \ K. Takahashi". **Paratype, female (EUM):** "Palau \ Babeldaob Is. \ 25-VIII-2002 \ K. Takahashi". **Paratype, female (EUM):** "Palau \ Babeldaob Is. \ 31-VII-2002 \ K. Takahashi".

Diagnosis. Small species (TL ~ 1.9–2.2 mm), body widest in the middle of elytra, trigonium of penis distinctly shorter than parameroids, parameroids without denticles on outer margin, females with large oval excitator in apical region of each elytron.

Description. Body small, TL 1.9 mm, TL/EW ~ 1.6, oval, light to dark brown, legs and antennae paler, yellowish, covered with yellowish semierect setae. Head strongly transverse, punctation sparse, punctures separated by ca. 2 diameters. Pronotum transverse, anterolateral and posterolateral angles right angled, lateral carinae almost straight, punctation sparse, similar to that on head. Angle between pronotum and elytra not marked in dorsal view. Scutellar shield subtriangular, impunctate. Elytra elongate, punctation stronger than on pronotum, punctures separated by ca. 1.0 diameter.

Penis (L 0.42 mm, W 0.15 mm) elongate, symmetrical, widest at base, pala longer than parameroids, trigonium with subtriangular apex, distinctly shorter than parameroids, apices of parameroids rounded; tegmen (L 0.31 mm, W 0.20 mm) u-shaped, apices of parameres widened and armed with ca. 10 denticles; sternite IX (L 0.38 mm, W 0.24 mm) consisting of two elongate and relatively wide hemisternites, each rounded at apex, with sharp denticle; tergite VIII (L 0.50 mm, W 0.42 mm) with parameres as long as apical portion, apical margin covered with setae, apical plate with sparse microtrichia situated near apical margin; tergite IX (L 0.45 mm, W 0.52 mm) with short, apical plate, apical margin with wide u-shaped emargination, apodemes long, diverging basally, much longer than apical plate.

Female. Size similar to that in males, TL 1.90–2.20 (2.09, n = 3) mm, TL/EW ~ 1.6–1.8 (1.7). Punctation of elytra stronger, each elytron with oval excitator near apex (Fig. 4C–D). Excitators concave, with numerous pores and setae directed to the middle of the structures. Ovipositor long (L 1.6 mm), bursal sclerite (L 0.83 mm) elongate, wider in posterior portion, with well visible (Fig. 11B) helicoidal structure, anterior portion narrower, rod-like; bursella oval, with folded structure inside (spermatophore?, Fig. 11B), accessory gland oval, narrowing posteriorly, narrower portion with circular sclerotizations (Fig. 11C).

Distribution. Known from the Babeldaob Is. only.

Etymology. After Republic of Palau, a country where the species was recorded.

FIGURE 10. *Calvariomorphus palauensis* **sp. nov.**, male genitalia. A) penis, B) tegmen, C) sternite IX, D) tergite VIII, E) tergite IX. Scale bar = 0.25 mm.

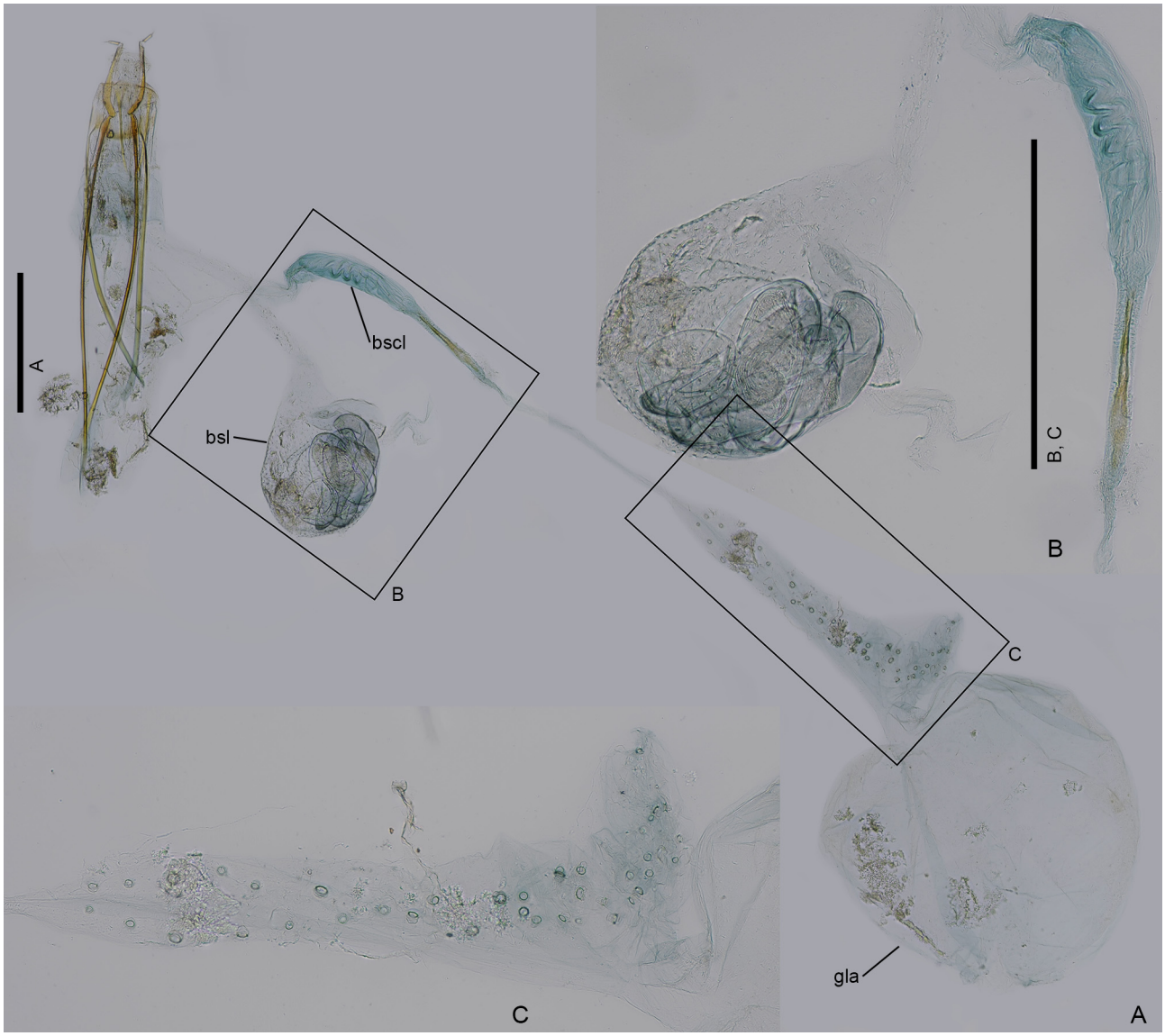

FIGURE 11. *Calvariomorphus palauensis* **sp. nov.**, female genitalia. A) genital tract, B) bursella and bursal sclerite, C) sclerites of accessory gland. Abbreviations: bscl—bursal sclerite, bsl—bursella, gla—accessory gland. Scale bar = 0.5 mm.

***Calvariomorphus peterseni* (Klausnitzer, 1973), comb. nov.**
(Figs 6, 12)

= *Cyphon peterseni* Klausnitzer, 1973: 109
= *Contacyphon peterseni* (Klausnitzer, 1973): Zwick *et al.* 2013: 345

Type material. Holotype, male (ZMUC): "Bismarck Isl. Dyaul \ Sumuna \ 7. March 1962 \ Noona Dan. Exp. 61-62"; "Holotypus \ Cyphon \ peterseni \ Klausnitzer, 1973".

Diagnosis. Small species (TL 1.8 mm), body widest in the middle of elytra, trigonium of penis slightly shorter than parameroids, parameroids with denticles on outer margins.

Redescription. Body very small, TL 1.8 mm, TL/EW ~ 1.6, oval, light brown, legs and antennae yellowish, covered with yellowish semierect setae. Head strongly transverse, punctation sparse, punctures separated by ca. 2 diameters. Pronotum transverse, anterolateral and posterolateral angles right angled, lateral carinae almost straight, punctation sparse, similar to that on head. Angle between pronotum and elytra not marked in dorsal view. Scutellar shield subtriangular, impunctate. Elytra elongate, punctation stronger than on pronotum, punctures separated by ca. 0.7–1.0 diameter.

Penis (L 0.49 mm, W 0.12 mm) symmetrical, widest in the middle of its length, pala and parameroids of similar length, trigonium shorter than parameroids, pointed at apex, parameroids with row of denticles on outer margins; tegmen (L 0.45 mm, W 0.28 mm) u-shaped, with very narrow parameres; sternite IX (L 0.45 mm, W 0.26 mm) consisting of two elongate and relatively wide hemisternites, apices subtriangular; tergite VIII missing; tergite IX (L 0.48 mm, W 0.32 mm) with short apical plate and much longer apodemes, anterior margin of apical plate with wide emargination and subtriangular outgrowths in lateral portions.

Female. Unknown.

Distribution. Known only from the type locality in Dyaul Island (Bismarck Archipelago).

Remarks. Figure 33 in the original description shows the tegmen, not sternite IX, and figure 34 is sternite IX, not the tegmen. The type specimen is in poor condition, it is disarticulated, with right elytron missing.

FIGURE 12. *Calvariomorphus peterseni* (Klausnitzer), comb. nov., holotype, male genitalia. A) penis, B) tegmen, C) sternite IX, D) tergite IX. Scale bar = 0.25 mm.

***Calvariomorphus sakaii* sp. nov.**
(Figs 1E–F, 7B, 13, 14)

Type material. Holotype, male (EUM): "[MINDANAO] \ Eagle Centre, 1100m \ Baracatan north \ slope of Mt. Apo \ 4. VIII. 1985 M. Sakai". **Paratypes, 6 males, 2 females (EUM):** same data as holotype. **Paratype, male (EUM):** same data as holotype, but collected 5.VIII.1985. **Paratype, male (EUM):** "P. I., MINDANAO \ Bukindon, 1250m. \ Mt. Katanglad \ 26-x-1959"; "L. W. Quate \ Collector".

Diagnosis. Small species, on average larger than other members of the genus (TL ~ 2.0–2.2 mm), body widest in the basal half of elytra, trigonium of penis as long as parameroids, elytra of females without excitators.

Description. Body small, TL 2.03–2.20 (mean 2.11, n=8) mm, TL/EW ~ 1.4–1.5 (1.4), oval, brownish black, legs and antennae lighter, yellowish, covered with dense, yellowish, erect setae. Head strongly transverse, punctation sparse, punctures separated by ca. 2 diameters. Pronotum transverse, anterolateral and posterolateral angles right angled, lateral carinae almost straight, punctation sparse, similar to that on head. Angle between pronotum and elytra not marked in dorsal view. Scutellar shield subtriangular, impunctate. Elytra elongate, widest in anterior half, punctation stronger than on pronotum, punctures separated by ca. 1.0 diameter.

Penis (L 0.58 mm, W 0.12 mm) elongate, with short, oval pala and long parameroids, parameroids and trigonium of similar lengths, apex of trigonium subtriangular; tegmen (L 0.24 mm, W 0.19 mm) u-shaped, with very narrow parameres and pointed apices; sternite IX (L 0.25 mm, W 0.11 mm) u-shaped, with very narrow lateral portions; tergite VIII (L 0.40 mm, W 0.38 mm) with apodemes as long as apical plate, margin of apical plate with sparse, long setae and dense, much shorter ones; tergite IX (L 0.33 mm, W 0.32 mm) with membranous, subtriangular apical plate.

Female. Size similar to that in males, TL 2.11–2.23 (2.17) mm, TL/EW ~ 1.4–1.6 (1.5). Elytra without excitators. Ventrite 4 with small, oval microreticulate area in central portion (Fig. 7C). Ovipositor long (L 1.7 mm), bursal sclerite relatively big (L 0.40 mm), subrectangular, plate-like, covered with subtle microsculpture.

Distribution. Known from two localities on Mindanao Is.

Etymology. Named after Dr Masahiro Sakai, who is a coleopterist and was the collector of the holotype of this species.

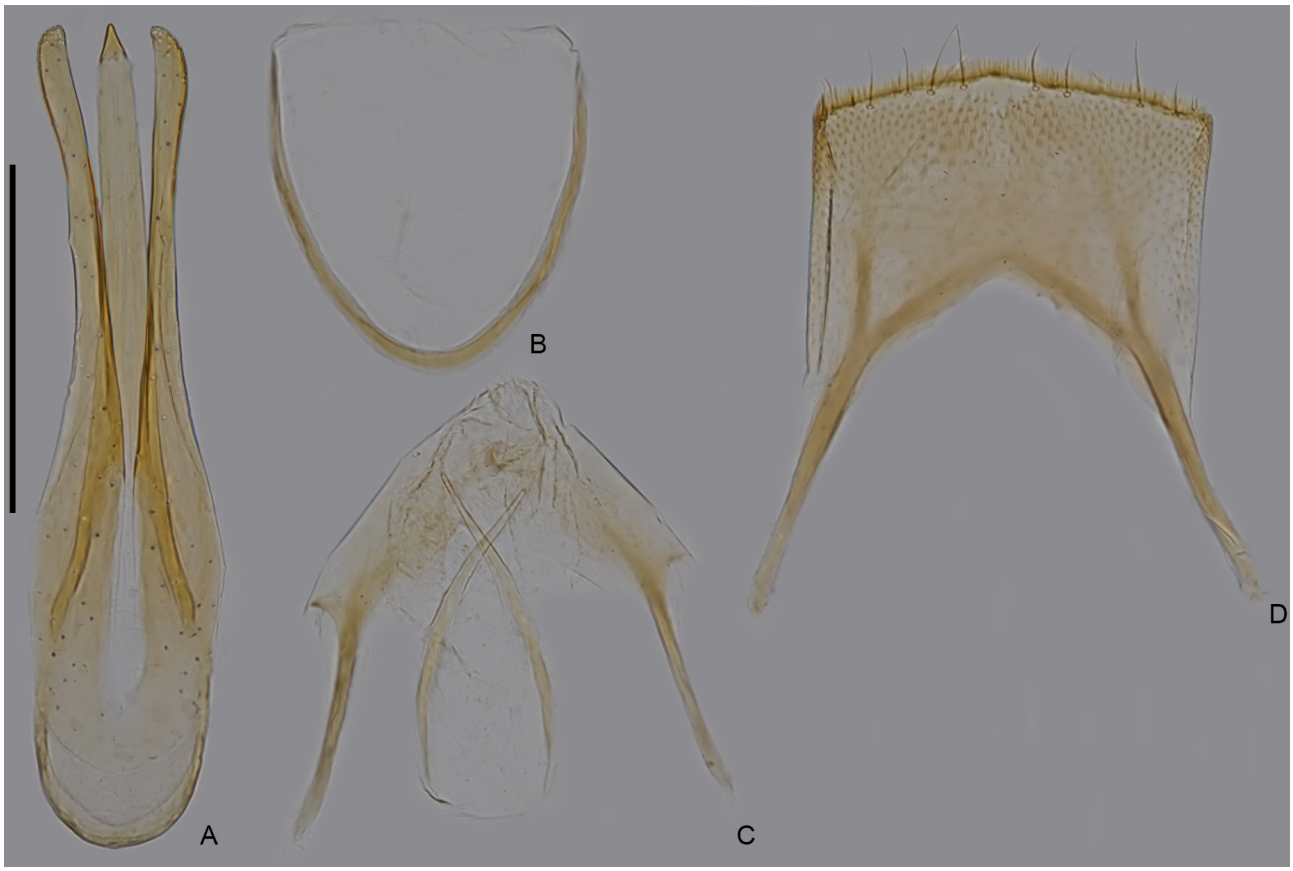

FIGURE 13. *Calvariomorphus sakaii* **sp. nov.**, male genitalia. A) penis, B) tegmen, C) sternite IX and tergite IX, D) tergite VIII. Scale bar = 0.25 mm.

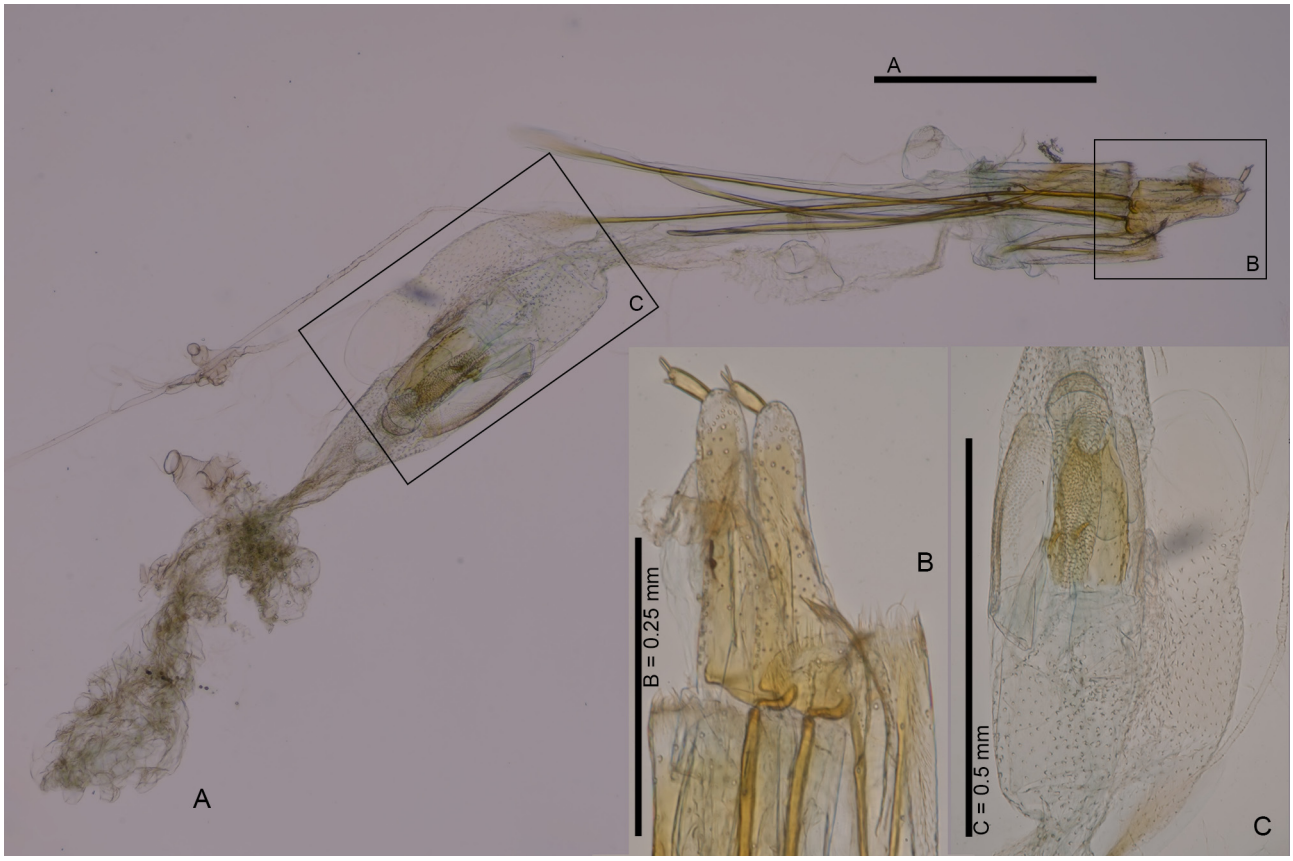

FIGURE 14. *Calvariomorphus sakaii* **sp. nov.**, female genitalia. A) genital tract, B) coxites, C) bursal sclerite. Scale bar = 0.5 mm (A, C), 0.25 mm (B).

Calvariomorphus sp.

(Figs 1G–H, 4E–G)

Examined material. Female (ZMUC): "Pulo, \ Milu \ Galatea".

Description. Body small, TL 2.1 mm, TL/EW ~ 1.7, oval, light brown, legs and antennae lighter, yellowish, covered with, yellowish, semierect setae. Head strongly transverse, punctation sparse, punctures separated by ca. 1.5–2 diameters. Pronotum transverse, anterolateral and posterolateral angles right angled, lateral carinae almost straight, punctation sparse, similar to that on head. Angle between pronotum and elytra not marked in dorsal view. Scutellar shield subtriangular, impunctate. Elytra elongate, punctation stronger than on pronotum, dense, punctures separated by ca. 0.7 diameter. Apical portions of elytra with complex excitators: each excitator consisting of small depression with oval sucker-like structure surrounded by several pores, and adsutural tubercle with large pores in posterior portion and sucker-like structure in anterior portion, adsutural tubercle covered with long setae.

Remarks. The specimen was collected in 1840s during the first Danish Galathea expedition in Nicobar Islands. Due to the fact that only a single female specimen of this interesting species is known, we have decided not to formally describe the new species.

A key to species of *Calvariomorphus* gen. nov.

1. Trigonium of penis distinctly shorter than parameroids, sternite IX with relatively wide hemisternites . . . . . .2.
-. Trigonium of penis as long as or slightly longer than parameroids, sternite IX u-shaped, with narrow lateral portions . . . . . .4.
2. Outer margins of parameroids with denticles, parameres of tegmen without spines. . . . . *C. peterseni* (Klausnitzer) [female unknown]
-. Outer margin of parameroids without denticles, parameres of tegmen with spines. . . . . *C. palauensis* **sp. nov.**

3. Body widest in anterior half of elytra, pala as long as parameroids, females with excitators: small depressions present in apical portion of elytra . . . . . *C. malayanus* **sp. nov.**
-. Body widest in the middle of elytra, pala distinctly shorter than parameroids, females without excitators . . . .*C. sakaii* **sp. nov.**

Check-list of *Calvariomorphus* gen. nov.

Calvariomorphus malayanus **sp. nov.**	Indonesia: Riau Archipelago; Malaysia: Borneo, Malay Peninsula; Singapore
Calvariomorphus palauensis **sp. nov.**	Palau: Babeldaob Is.
Calvariomorphus peterseni (Klausnitzer, 1973), comb. nov.	Papua New Guinea: Dyaul Is.
Calvariomorphus sakaii **sp. nov.**	Philippines: Mindanao Is.

Discussion

Calvariomorphus **gen. nov.** occurs in SE Asia and Australasia (Fig. 15). On the basis of morphology of male genitalia, two species groups may be distinguished. The first one has the trigonium of the penis shorter than the parameroids, hemisternites of sternite IX wide, and includes two species: *C. peterseni* and *C. palauensis* **sp. nov.** The remaining species belong to the second group, where the trigonium is as long as or longer than the parameroids, and sternite IX has very narrow lateral processes.

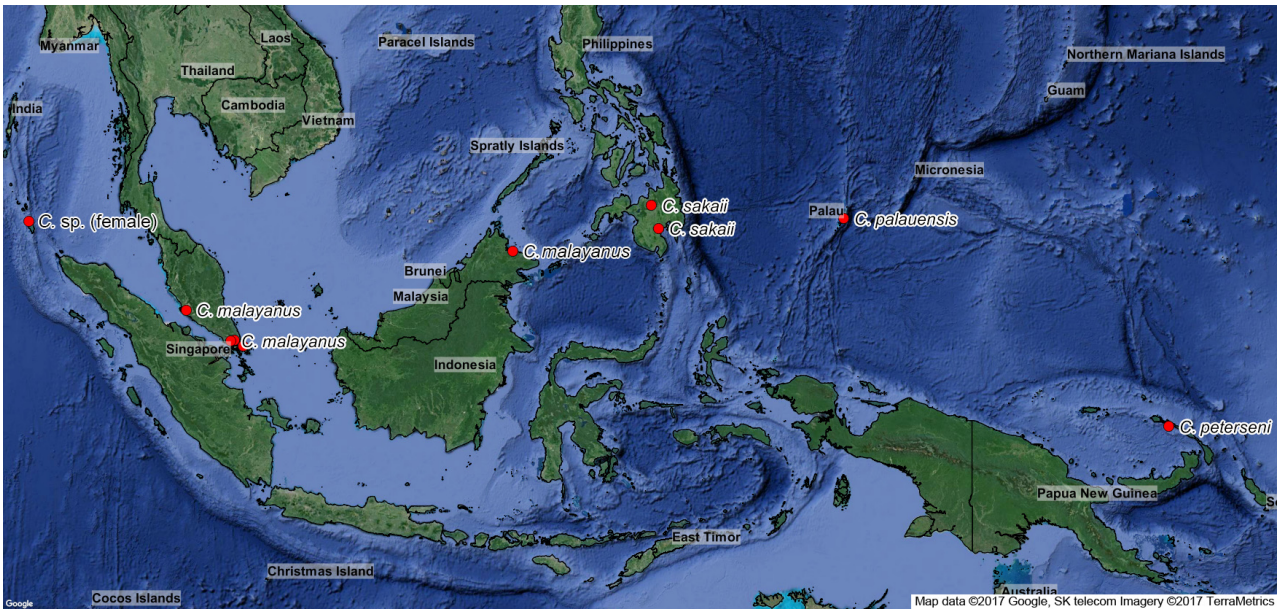

FIGURE 15. *Calvariomorphus* **gen. nov.**, geographical distribution.

Calvariomorphus **gen. nov.** shares several morphological characters with genera *Calvarium* Pic and *Calvariopsis* Ruta. All these genera have deep subantennal grooves, narrow labrum, wide mesoventral process, and the presence of globose cuticular structures on meso- and metaventrites (Ruta 2010, Fig. 16). Head morphology, especially the arrangement of ridges, grooves and carinae, provides an important character system in Scirtidae (Zwick 2013, Watts & Zwick 2019). In some genera the supraantennal ridge (sar) turns ventrally to become the subocular carina sensu Lawrence & Yoshitomi 2007 (soc) and then the soc turns to connect to the subgenal ridge (sgr). In some genera the soc is missing and as a result the sgr exhibits a buttonhole configuration. The buttonhole configuration is sometimes evident (Zwick *et al.* 2013) and the buttonhole is clearly visible from the side, but in some genera it is only visible at high magnification (Fig. 16D, F). The presence of a subocular ridge (sor, Fig. 16E) is a rare condition in Scirtidae. Reexamination of the head structure of *Calvariopsis* revealed that the buttonhole configuration is present in this genus, and the interpretation in the original description (Ruta 2019) was incorrect. *Calvariellum* is a subgenus of *Calvarium* described by Zwick (2014) to accommodate four Australian species. Both morphology of head (i.e. absence of sor) and genitalia (see Zwick 2014) suggest that it is quite distinct from *Calvarium* (s. str.) and may deserve a generic status. More detailed studies are needed to verify the status of *Calvariellum*.

Excitators (*sensu* Ruta 2008) are poorly studied, probably secretory structures present in females of several genera of marsh beetles. In *Calvariomorphus* **gen. nov.** excitators can be either well developed, as in a species from the Nicobar Islands or *C. palauensis* **sp. nov.**, present in a form of subtle structures, like in *C. malayanus* **sp. nov.** or lacking, like in *C. sakaii* **sp. nov.** There is a need to provide a comprehensive study of excitators in marsh beetles.

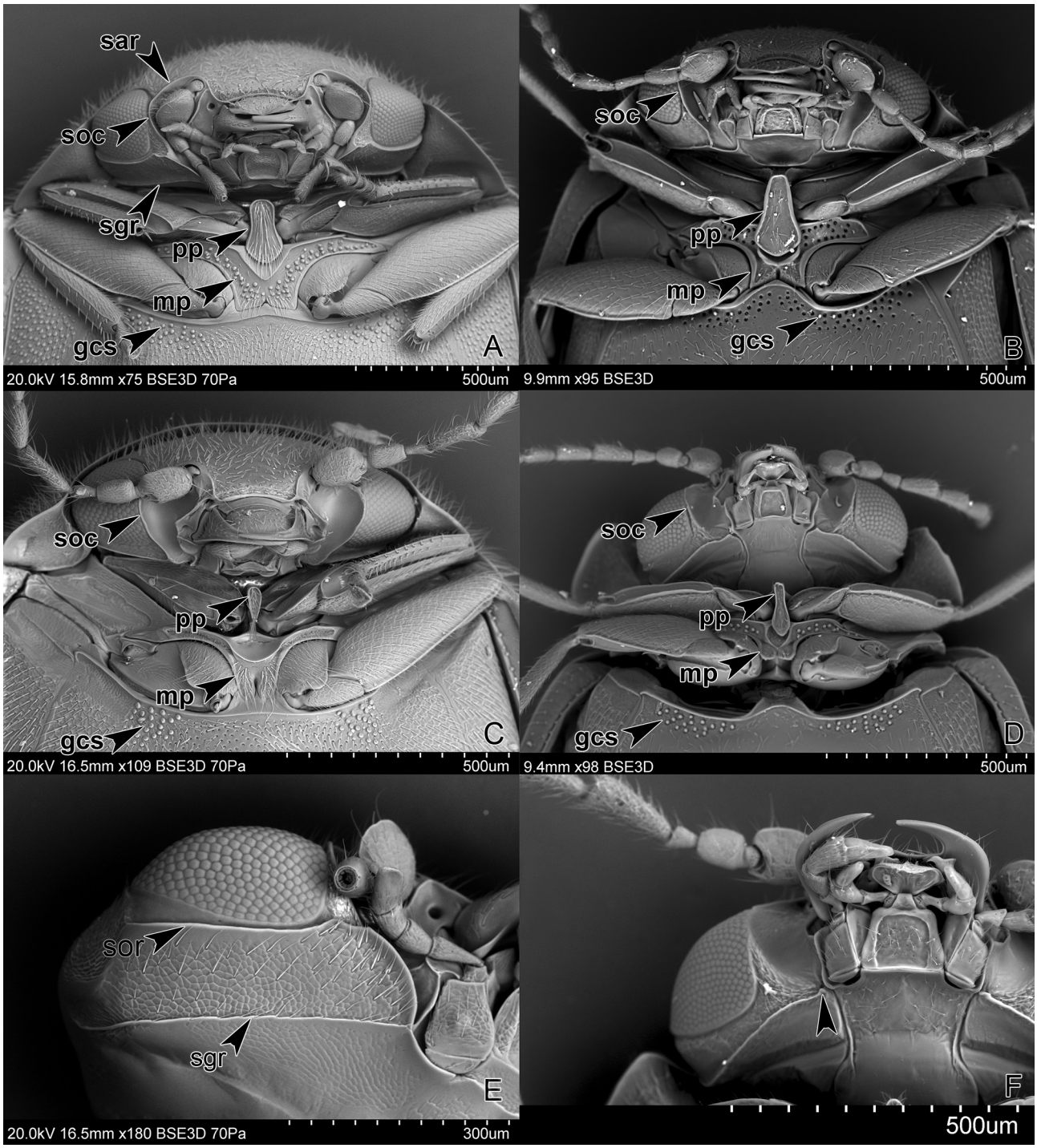

FIGURE 16. *Calvariomorphus* **gen. nov.** and similar genera, details of head and ventral structures. A) *Calvarium hashimotorum* (Yoshitomi), ventral view, B) *Calvarium* (*Calvariellum*) *hamifer* Zwick, ventral view, C) *Calvariomorphus sakaii* **sp. nov.**, ventral view, D) *Calvariopsis bituberculata* Ruta, ventral view E) *Calvarium hashimotorum*, ventral portion of head, close-up, F) *Calvariopsis yanayacuense* Ruta, ventral portion of head, close-up, buttonhole marked with arrow. Abbreviations: gcs—globose cuticular structures, mp—mesoventral process, pp—prosternal process, sar—supraantennal ridge, sgr—subgenal ridge, soc—subocular carina, sor—subocular ridge.

A key to *Calvarium*-like genera

1. Subocular carina absent, subgenal ridge with subtly marked buttonhole configuration . . . . . .*Calvariopsis* Ruta
-. Subocular carina present. 2
2. Prosternal process small, tear-shaped. . . . . .*Calvariomorphus* **gen. nov.**
-. Prosternal process larger, pentagonal . . . . . .3.
3. Subocular ridge present . . . . . .*Calvarium* (s. str.) Pic
-. Subocular ridge absent . . . . . .*Calvarium* (*Calvariellum*) Zwick

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