



Hagneia kallea gen. and sp. nov. (Hemiptera: Fulgoromorpha: Ricaniidae) from North Vietnam

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Abstract

A new monotypic genus of ricaniid planthoppers (Hemiptera: Fulgoromorpha: Ricaniidae), *Hagneia* gen. nov., is described for *Hagneia kallea* sp. nov. (type species). Habitus, male and female external and internal genital structures of the new species are illustrated.

Key words: planthoppers, Fulgoroidea, Vietnam, taxonomy, morphology

Introduction

Ricaniidae Amyot et Audinet-Serville, 1843 is a family of sup-sucking planthoppers (Hemiptera: Fulgoromorpha) distributed in all warm temperate and tropical regions of the world. These phytophagous insects are associated with herbaceous and woody plants and have adapted themselves to habitats ranging from rain-forests to semideserts. Various species are known to feed on crop plants and could be pests or plant disease vectors. With high known diversity, the family is weakly elaborated in terms of its taxonomic, morphological and biological features. It is separated into 66 genera (2.7% of the Fulgoromorpha) and covers 434 species (3.2% of the Fulgoromorpha) (Bourgoin 2020).

The biodiversity of Vietnam remains relatively underinvestigated despite strong evidence for high regional species richness. Especially the insect fauna is largely unknown, including Ricaniidae planthoppers. Referring to the latter, there are only 5 genera and 19 species known to date (Pham & Cao 2009, Stroiński & Pham 2019). However, on the basis of the available material, it can be assumed that biodiversity of Ricaniidae in Vietnam is much higher than previously estimated and much higher than expected (work in progress).

Material and methods

Dry pinned and preserved in 96% ethanol specimens were used for this study.

Label information of all specimens examined is provided verbatim with each line separated by a slash (/) and each label given in square brackets.

Terminology. The nomenclature of forewing (tegmen) veins follows the interpretation proposed by Bourgoin *et al.* (2015).

For the nomenclature of clavus (veins and areas) see description below (Figs 8–11):

posterocubital cell (pc)—area between vein CuP and Pcu and Pcu+A₁; this area could be split to following 2 subareas:

anterior part of posterocubital cell (pca)—from the base to the level of connection veins Pcu and A₁,

posterior part of posterocubital cell (pcp)—from connection Pcu and A₁ to the end of clavus;

postcubital cell (pcu)—area between veins Pcu and A₁;

anal cell (ac)—area between veins A₁-Pcu+A₁ and A₂;

postanal cell (pcl)—area between vein A₂ and margin of tegmen.

Vein A_2 is often located very close to postclaval margin, which is frequently bent down.

Antennal structures are named in accordance with Stroiński *et al.* (2011). The terminology of the genitalia follows Bourgoïn (1988) and Bourgoïn & Huang (1990) for the male, and Bourgoïn (1993) for the female.

Preparations and illustration. The abdomen of the specimen examined was cut off and cleared for 30 min in a warm (50°C) 10% KOH solution with a few drops of black chlorazol (CAS No. 1937-37-7) for dyeing the ectodermic genital structures, based on the method introduced by Carayon (1969). Dissections and cleaning of the genital structures were carried out in distilled water. Final observations were made in glycerol using a Olympus stereoscopic microscope (SZH10). The photographs of the male and female external and internal structures were taken using a stereoscopic microscope Leica MZ 16 with IC3D camera and biological microscope Leica DM 5500B with DFC490 camera; final images were created using the Helicon 5.0 software and Adobe Photoshop. The photographs of the habitat (*locus typicus*) and live individuals were taken by Gernot Kunz.

The SEM photographs of uncoated specimens were taken in the Laboratory of Scanning Microscopy, MIZ PAS (Warsaw), using a scanning electron microscope HITACHI S-3400N under low vacuum conditions.

Measurements and abbreviations.

Measurements were made with an ocular micrometer and given in millimeters (mm). The following measurements, ratios and their abbreviations were used in this study:

Total length—measured (in dorsal view) from head apex to tegmina apex;

A/B—width of vertex measured at anterior margin / length of vertex measured at midline;

C/E—width of frons at upper margin / length of frons at midline;

D/E—maximum width of frons / length of frons at midline;

F/B—length of pronotum at midline / length of vertex at midline;

G/F—length of mesonotum / length of pronotum at midline;

G/B+F—length of mesonotum / cumulative length of vertex and pronotum at midline;

G/H—length of mesonotum at midline / width of mesonotum between lateral angles;

I/J—length of tegmen measured from the base to the apical margin in median portion / width of tegmen measured at the widest part.

MIZ—Museum and Institute of Zoology PAS, Warsaw, Poland;

MNHN—Muséum national d'Histoire naturelle, Paris, France.

Systematics

Class Insecta Linnaeus, 1758

Order Hemiptera Linnaeus, 1758

Suborder Fulgoromorpha Evans, 1946

Superfamily Fulgoroidea Latreille, 1810

Family Ricaniidae Amyot et Audinet-Serville, 1843

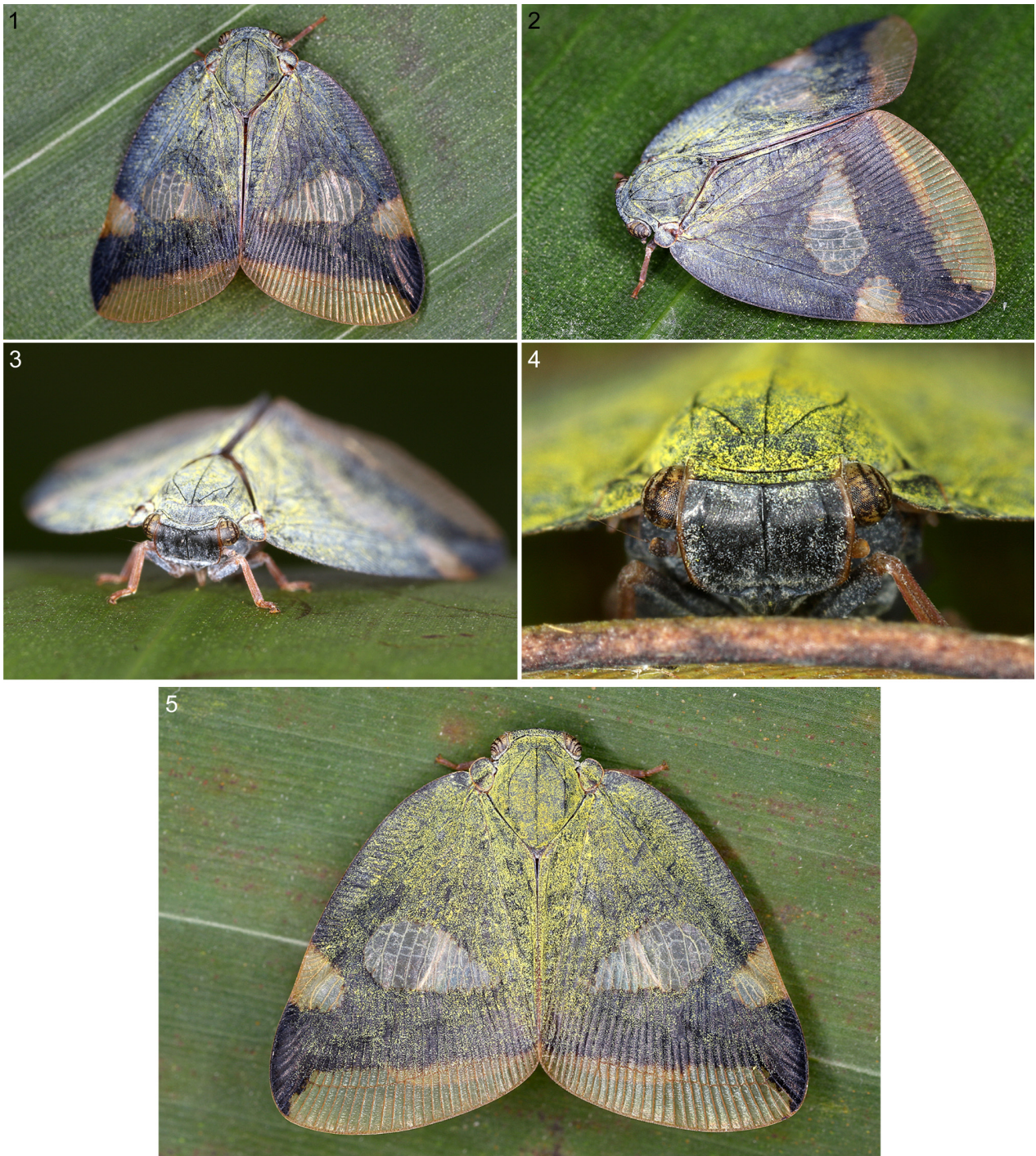
Hagneia gen. nov.

(Figs 1–68)

Type species. *Hagneia kallea* sp. nov., here designated.

Locus typicus (Figs 6–7). Vietnam, Province Cao Bằng, Nguyên Bình District, Núi Pịa Oac Sud (22.594395, 105.885330).

Etymology. Generic name is dedicated to my dearest best friend Agnieszka Gruszczyńska. Her given name derives from the Classic Greek ἀγνεΐη—(h)agnein, meaning pure, holy. Gender feminine.



FIGURES 1–5. *Hagneia kallea* gen. et sp. nov., photos of live individuals by Gernot Kunz.

Diagnosis. *Hagneia* gen. nov. can be distinguished by the combination of following characters: frontal disc with 3 carinae separated basally; clypeus with median carina; mesonotum with 5 carinae; costal area wider than postcostal cell; longitudinal veins ScP+RA, MP and CuA leaving basal cell separated; posterior part of tegmen with 2 lines of transverse veinlets; basitarsomere of metatarsus shorter than cumulative length of second and apical tarsomeres, with not fully developed row of apical teeth; ventral apical part of basitarsomere with pad of strong setae; aedeagus with 3 symmetrical pairs of well sclerotized apical spinose processes; female posterior margin of the gonoplac smooth (without any teeth).

Description. HEAD. Head with compound eyes (in dorsal view) narrower than mesonotum.

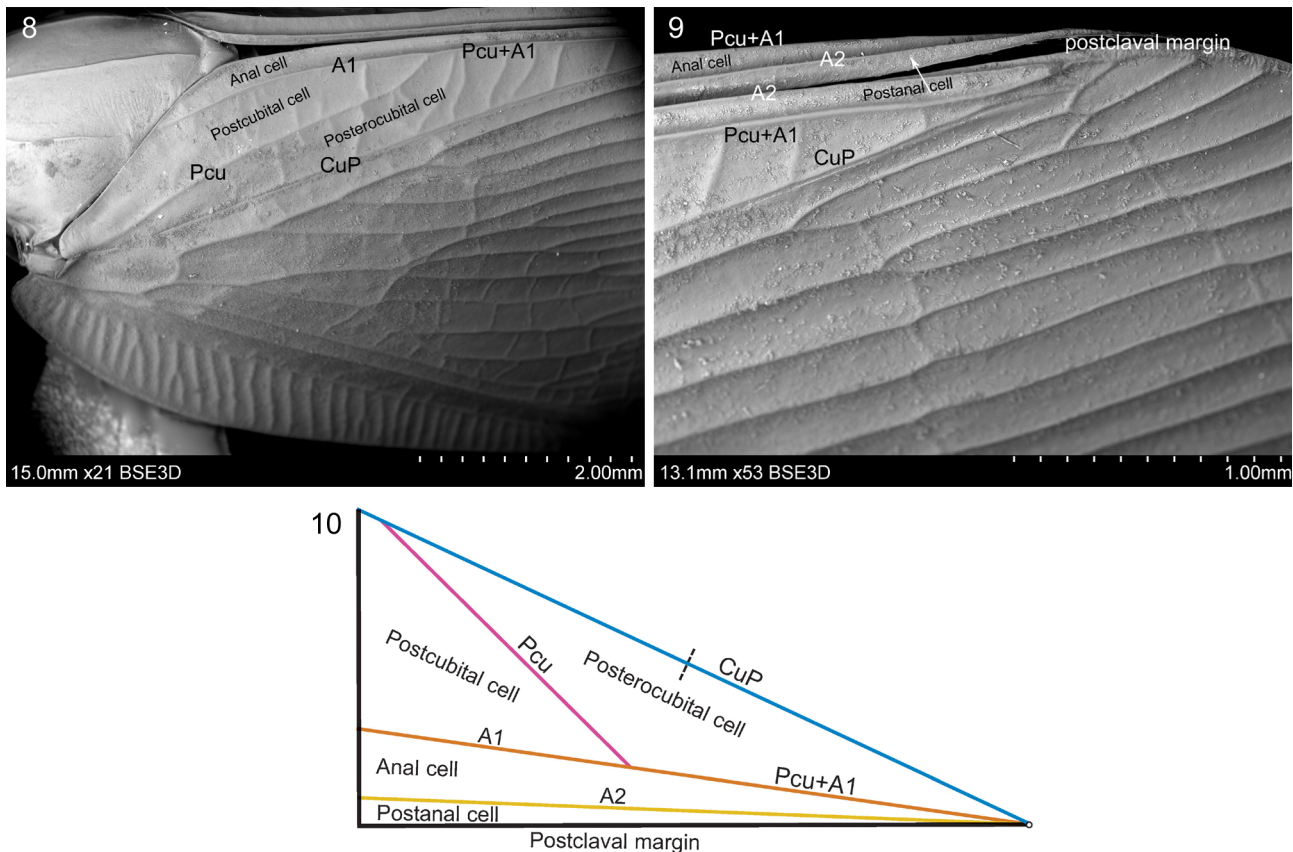
Vertex (Figs 1–5, 11–12, 14–15) transverse, with or without median carina, distinctly wider than long at midline, all margins well carinated. Frons (Figs 4, 15–16) with all margins well carinated; at upper margin longer than high

at midline, widest at the level mid of compound eyes; lateral margins covering base of pedicel, incised near the level of antenna. Frontal disc with 3 carinae, distinctly separated basally; median carina distinctly surpassing half of disc, lateral carinae distinctly shorter, ending about the lower part of compound eyes (in some specimens weakly visible).

Compound eyes with very small callus at postero-ventral margin and posterior margin. Ocelli present. Antenna (Figs 17–20): pedicel cylindrical, with functional area (trichoid sensilla type 1 and antennal plate organs) at the top and on the tip of frontal side surface. Clypeus (Figs 15–16) distinctly narrower than frons, with median carina. Rostrum with apical segment a little shorter than subapical one.



FIGURES 6–7. Habitat in *locus typicus* of *Hagneia kallea* gen. et sp. nov., 22°35'39.88"N; 105°53'8.52"E. (6) general view; (7) light trapping. Photos by Gernot Kunz.



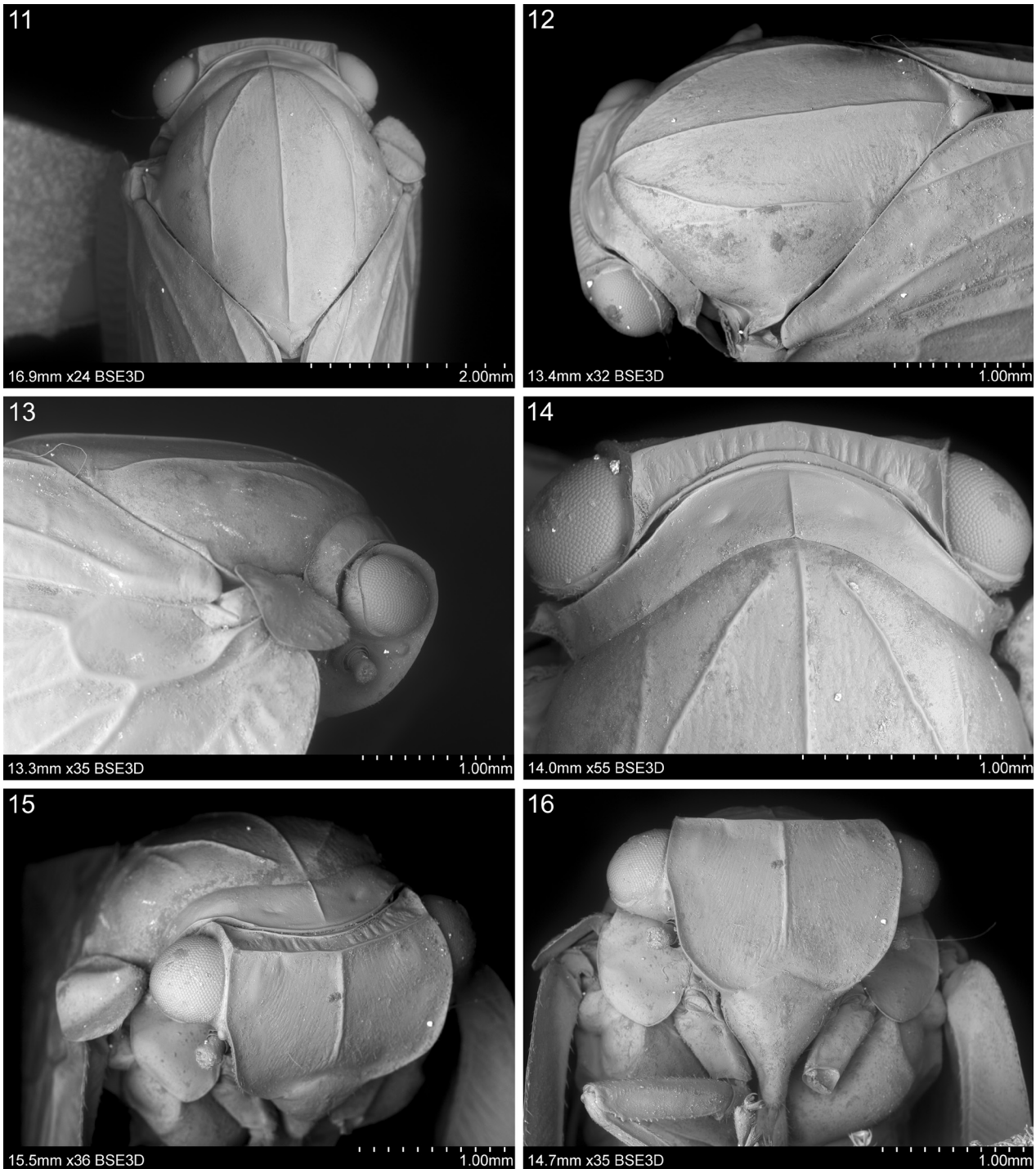
FIGURES 8–10. *Hagneia kallea* gen. et sp. nov., clavus. (8) basal part, (9) posterior part, SEM photographs; (10) schematic representation of veins and areas of claval vein.

THORAX. Pronotum (Figs 1–5, 11–14) distinctly longer than vertex at midline; disc of pronotum with median carina and two lateral impressions. Mesonotum (Figs 1–5, 11–14) elongated, diamond shape, distinctly longer at midline than combined length of vertex and pronotum; median carina, lateral and antero-lateral carinae present; median carina and lateral carinae connected basally; median carina reaching scutellum, lateral carinae not reaching posterior margin; anterolateral carinae connected with lateral at the level of lateral angles, lateral angles placed before midlength.

Tegmina (Figs 1–5, 21–26) membranous, elongately-triangular, flattened, with distinct venation and transverse veinlets. Costal margin weakly arcuate, apical angle broadly rounded, placed distad to claval angle, posterior margin arcuate; tornus absent. Costal area with dense transverse veinlets ending before tip of clavus; wider than postcostal cell, wider in basal half, tapering apicad and with wave shape apex. Costal cell narrower than costal area, with transverse veinlets, in some specimens weakly incomplete and weakly visible. Basal cell elongately oval, distinctly longer than wide (about 2 times). Longitudinal veins ScP+RA, MP and CuA leaving basal cell separated; all first forks of longitudinal veins placed distinctly before half of tegmen; veins ScRA and RP arising as short common stem from basal cell (vein forked just after leaving basal cell); first fork RP before first fork ScRA and after first fork of MP₁₊₂; common stem of MP₁₊₂ and MP₃₊₄ longer than ScRA but shorter than CuA; first fork of MP₃₊₄ closer than MP₁₊₂; in few specimens forks at about the same levels. CuA with protruded model of forking.

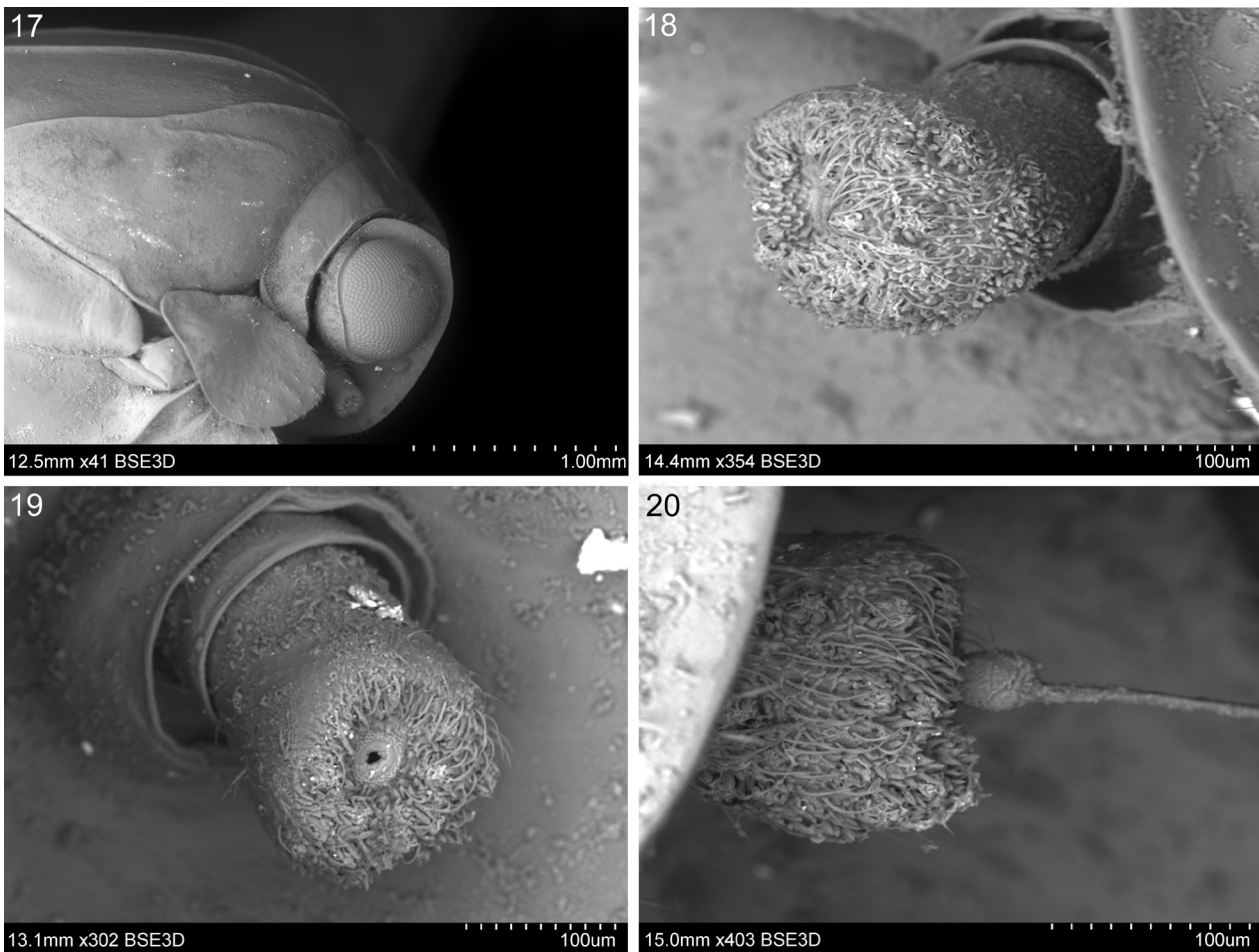
Tegmen with 2 lines of transverse veinlets, apical and subapical cells distinctly longer than wide, apical one shorter than subapical; nodal line absent; median portion of tegmen with numerous irregular transverse veinlets. Cubital cell with transverse veinlets at basal part. Clavus closed; CuP ending at margin, in some specimens fused with the last branch of CuA, which is very variable (single or bifurcate, straight or curved); claval veins fused after midlength of CuP vein; postero-cubital cell (basal and posterior part) and postcubital cell with well visible transverse veinlets.

Hind wing with precostal cell present; ScRA and MP forking distinctly after midlength of wing, CuA forking distinctly before half of wing; *rp-m*, *m-cua* and *icu* transverse veinlets present in distal part of wing.



FIGURES 11–16. *Hagneia kallea* gen. et sp. nov., SEM photographs. (11–14) Anterior part of body: (11) dorsal view, (12) dorso-lateral view, (13) lateral view; (14) vertex, pronotum and base of mesonotum, dorsal view; (15) head and thorax, fronto-dorsal view; (16) frons and clypeus, frontal view.

Hing legs (Figs 27–32): metatibia distinctly longer than metafemur, partly flattened and widened at distal part; metatibia with 2 lateral spines placed distally to each other in distal part; apical row of teeth of metatibia with 7 well developed spines different in size; external lateral spines bigger than internal lateral spines; 5 internal spines different in size with asymmetrical diastema in formula 1+4 (with external spines formula 2 +5); basitarsomere of metatarsus shorter than cumulative length of second and apical tarsomeres, with not fully developed row of apical teeth: 2 lateral teeth equal in size and big and 3 internal small placed externally/asymmetry 1(2)1; ventral apical part of basitarsomere with pad of strong setae; mesotarsomere with pad of strong setae on ventral side.



FIGURES 17–20. *Hagnea kallea* gen. et sp. nov., SEM photographs. (17–20) Antenna: (17) position on head, lateral view, (18) fronto-dorsal view, (19) dorso-posterior view, (20) frontal view.

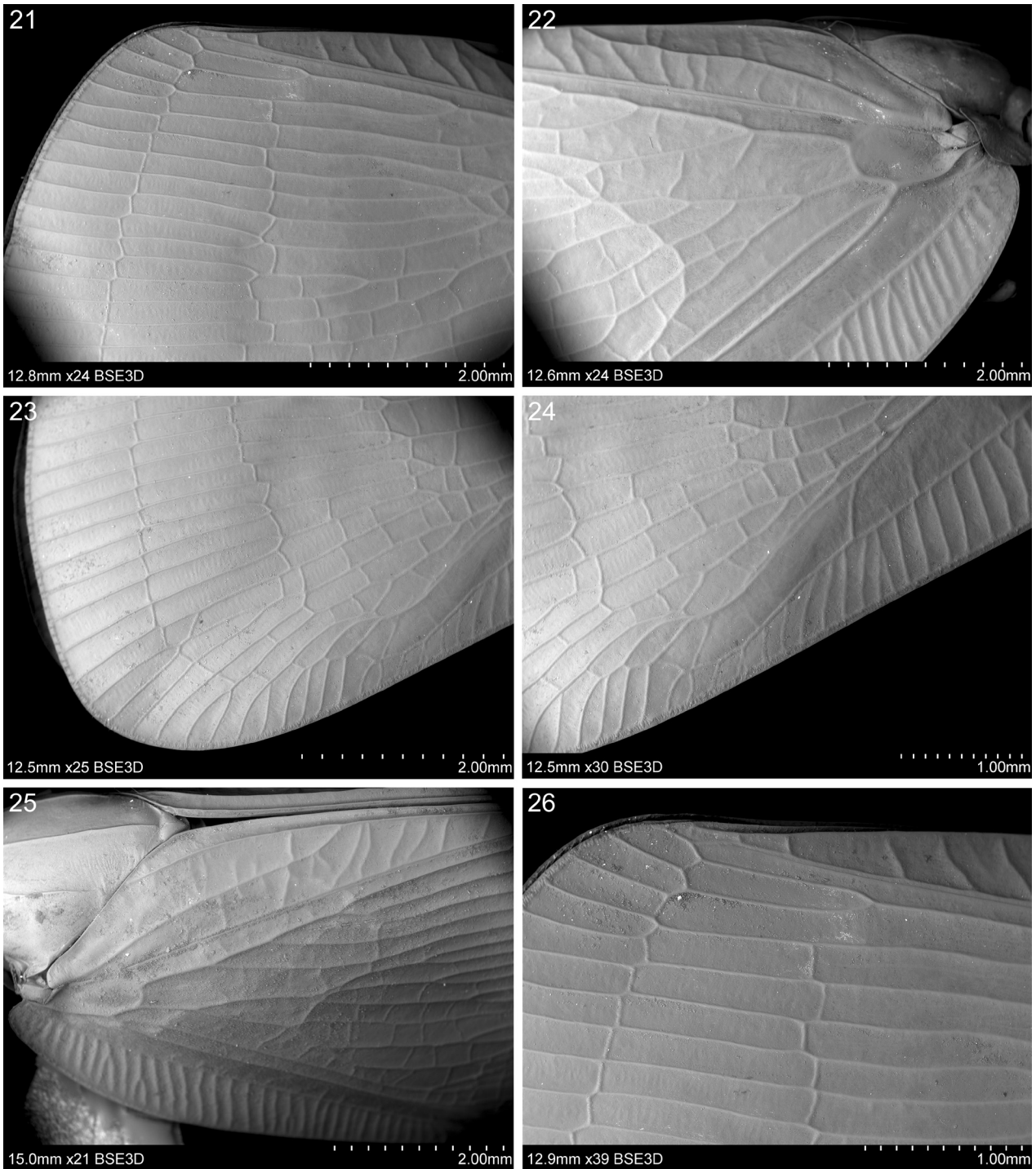
MALE TERMINALIA (Figs 33–48). Anal tube (in lateral view, Figs 33–34, 42) elongate, massive, distinctly surpassing posterior margin of pygofer; posterior part narrower than basal one; anus placed before midlength, ventral margin straight. Anal tube (in dorsal view, Figs 35–36, 39) elongate, subrectangular, widest about midlength; anus placed before midlength, postero-ventral angle widely rounded; posterior margin in dorsal view with median concavity, lateral margins slightly arcuate.

Pygofer (in lateral view, Figs 35–36, 39) higher than wide; dorsal part narrower than ventral one, dorso-posterior angle with well-developed process. Genital styles (Figs 35–38, 40–41), in lateral view, longer than wide with sharp spine-like process at the end of dorsal margin; apical part wider than basal; ventral margin almost straight (in lateral view), weakly sinuate in ventro-lateral view; dorsal margin weakly convex, with small concavity before spine-like process; caudo-dorsal angle widely rounded and surpassing the base of process, posterior margin weakly convex.

Phallic complex (Figs 43–48): periandrium (Figs 43–45) without any processes, elongate, with long lateral split surpassing the half of its length; dorsal part of periandrium a bit shorter than ventral one, median part partly membranous, apically with median split; ventral part with widened apex and additional small lateral lobes.

Aedeagus (Figs 46–48) long and narrow, apically with 3 pairs of symmetrical, well sclerotized, spinose processes and short median split. Median split asymmetrical: ventral split present only in 1/4 ending with elongate triangular lobe; dorsal split very deep, reaching almost basal part. All processes single armed and oriented basad: dorsal processes biggest than other, distinctly curved in 1/3 of its length, posterior part with membranous ventral margin; median processes shorter, massive and fully sclerotized; ventral processes with small membranous part at basal part on dorsal margin, with little curved tip.

FEMALE TERMINALIA (Figs 49–68). Pregenital sternite with well-developed and distinctly separated lateral lobes; posterior margin medially with processes (Figs 49–51, 61).

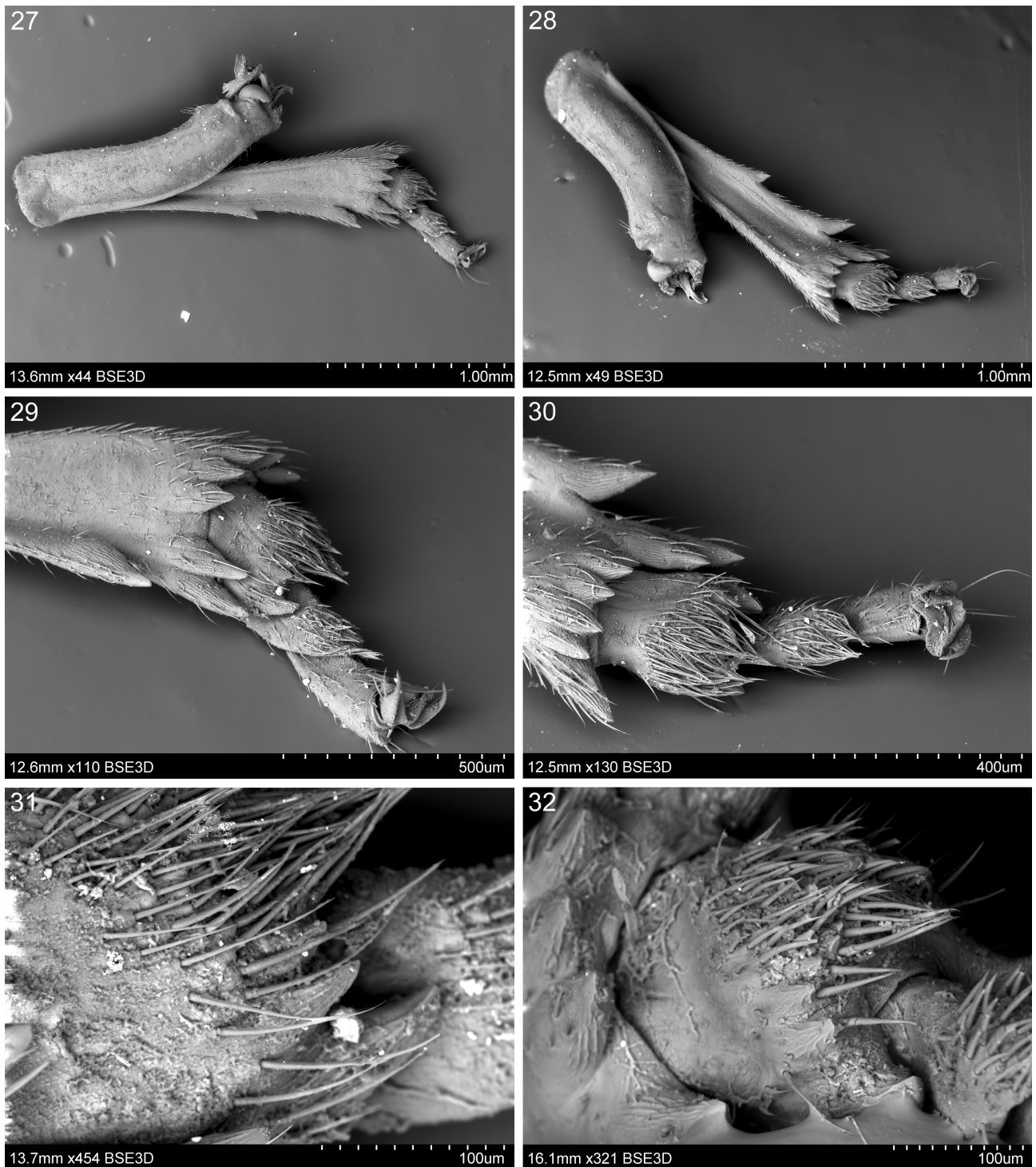


FIGURES 21–26. *Hagneia kallea* gen. et sp. nov., SEM photographs, tegmen. (21) Postero-ventral part; (22) basal half; (23) postero-apical part; (24) end of costal area and costal cell; (25) clavus; (26) end of clavus.

Anal tube (in lateral view, Figs 55–57, 63) not reaching the posterior margin of gonoplac; anal tube (in dorsal view, Figs 53–54, 62) ovoid, wider before anus; anus placed a bit after midlength; anal style (paraproct) and anal segment (epiproct) short.

Gonoplac (Figs 49–50, 55–60, 64) well developed, unilobate, laterally flattened; posterior margin of the gonoplac smooth (without any teeth); membranous part of gonoplac placed basally on ventral margin.

Gonapophysis VIII (Fig. 65) sabre-like, “v” shape in cross section, with teeth at dorsal margin; endogonocoxal process tapering apicad, shorter than gonapophysis VIII, with median sclerotized core surrounded by membranous part.

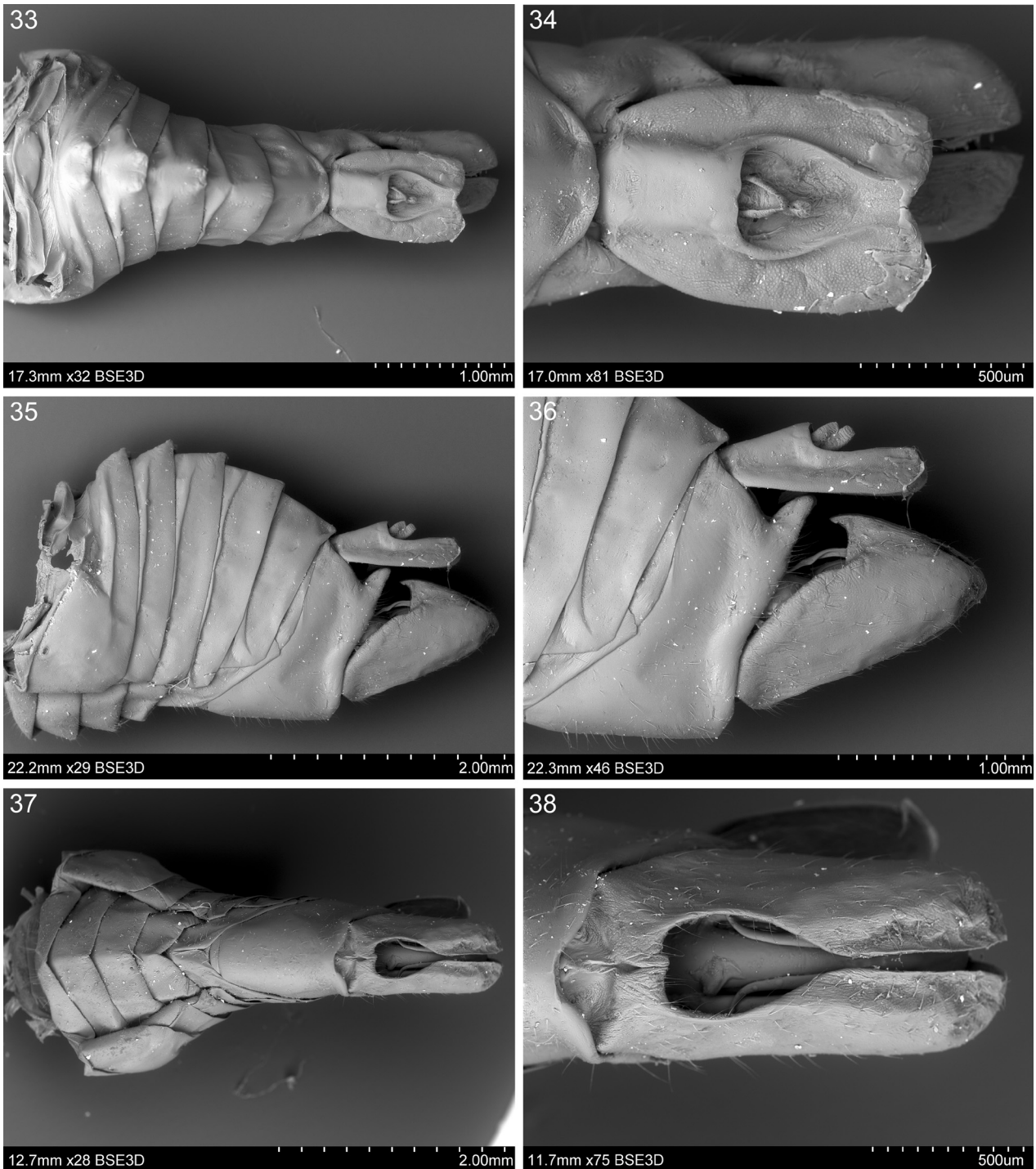


FIGURES 27–32. *Hagneia kallea* gen. et sp. nov., SEM photographs, hind leg, ventral view. (27–28) Hind leg; (29–30) end of tibia and tarsus; (31–32) first segment of tarsus.

Gonaphophyses IX and gonospiculum bridge well developed, as in Figs 66–67.

Bursa copulatrix (Fig. 68) of two pouches connected by narrow part; first pouch elongate, with cells and sclerotised ornamentation (except dorsal side); second pouch smaller, more oval than the first one, without cells but with sclerotized plates. Spermatheca (Fig. 68) well developed; *ductus receptaculi* elongate and narrow, ribbed; *diverticulum ductus* about as long as *ductus receptaculi*, with long narrow smooth ductus, apically with ovoid and smooth bulla.

Distribution. Vietnam, Province Cao Bằng, Nguyên Bình District.



FIGURES 33–38. *Hagneia kallea* gen. et sp. nov., SEM photographs, male. (33) Abdomen and terminalia, dorsal view; (34) anal tube, dorsal view; (35) abdomen and terminalia, lateral view; (36) terminalia, lateral view; (37) abdomen and terminalia, ventral view; (38) terminalia, ventral view.

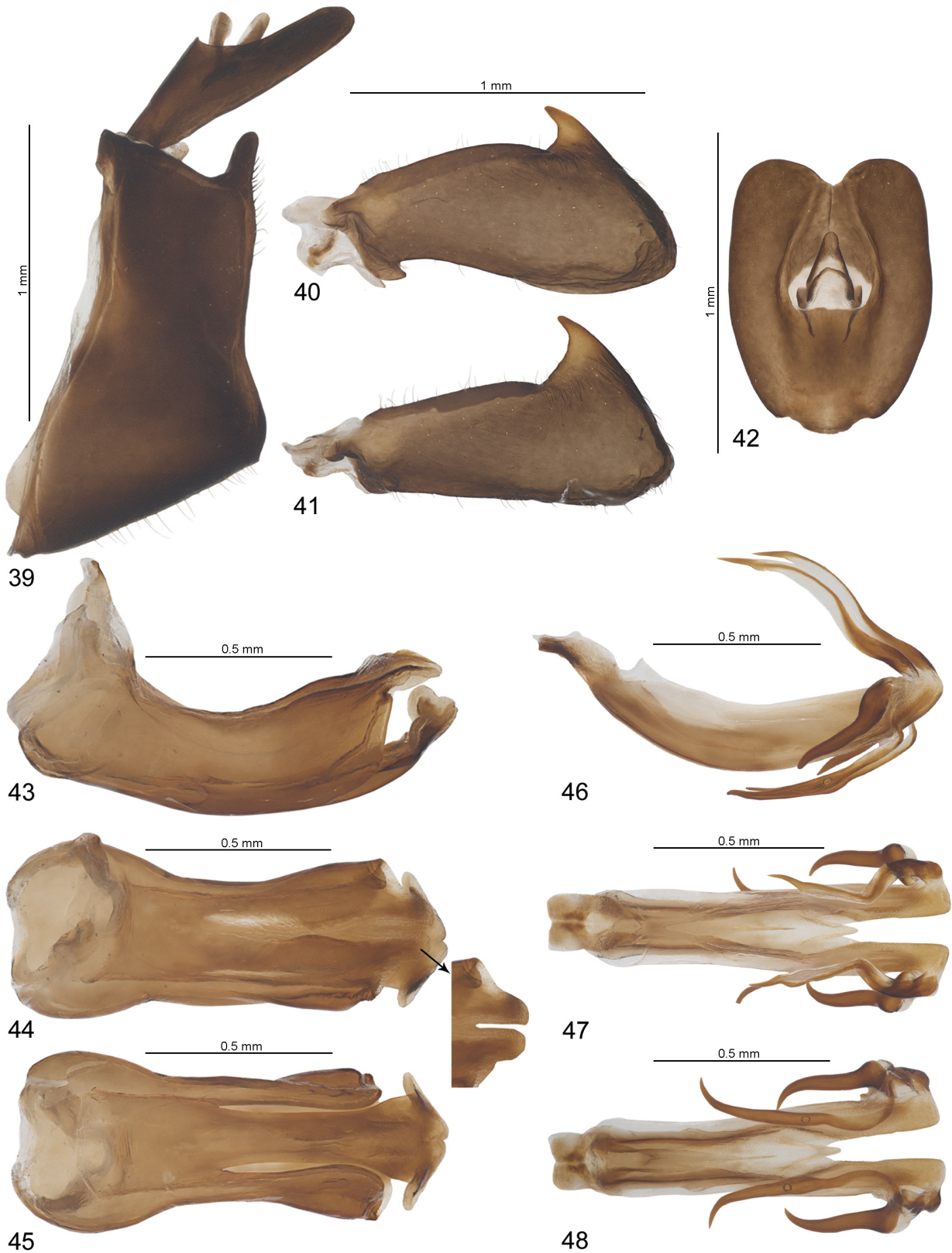
***Hagneia kallea* sp. nov.**
(Figs 1–68)

Etymology. Specific epithet derives from Classical Greek κάλλος, ~εος kallos, ~eos meaning good, beauty, noble.

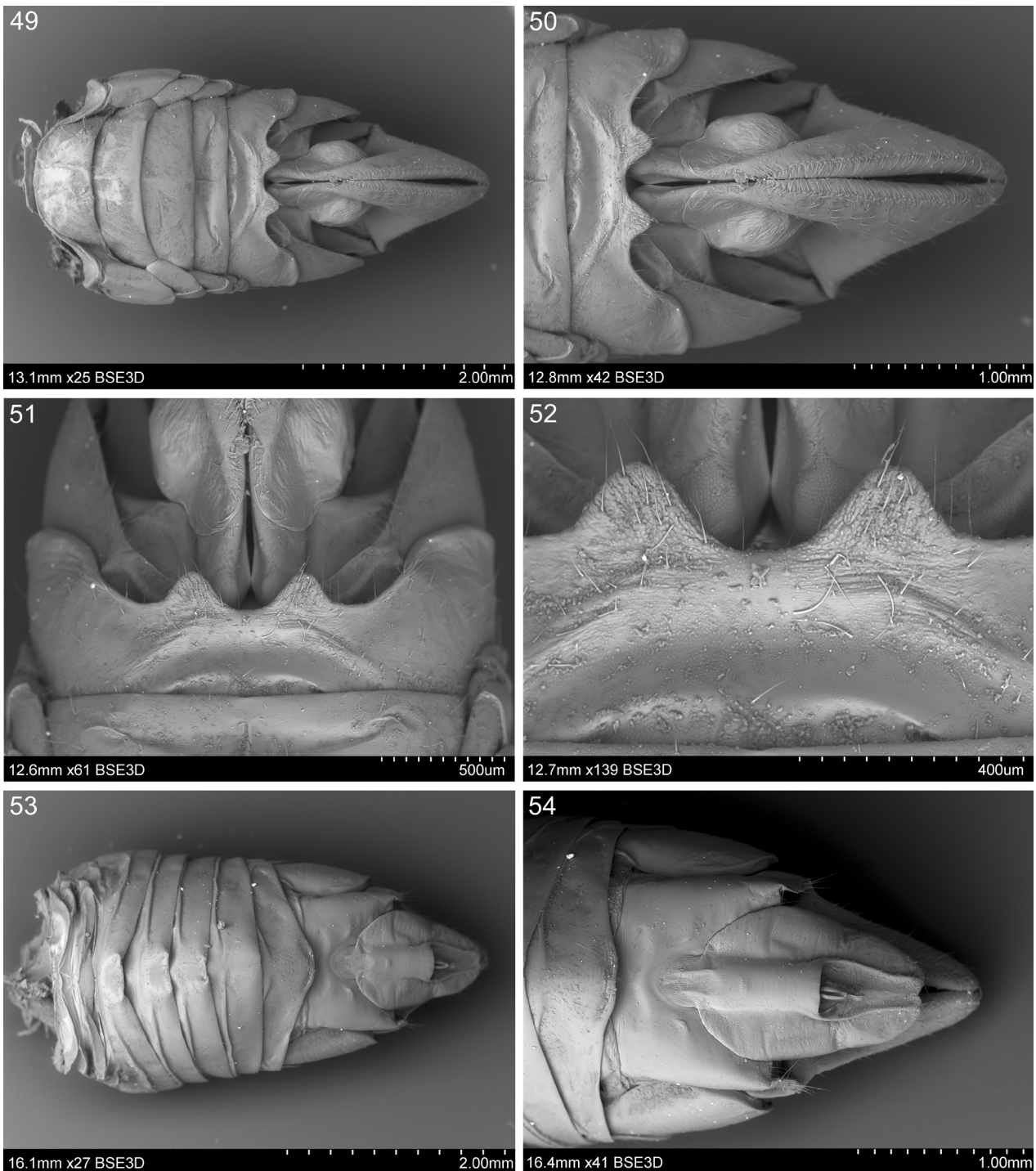
Diagnosis. Only one species in the genus. Male: dorso-posterior angle of pygofer with process oriented dorsad; female: pregenital sternite medially with 2 separated processes at posterior margin.

Description. Total length 0.8–1.3 cm.

HEAD. Vertex: proportion A/B = 9.6–11.25; all margins slightly elevated; in dorsal view, lateral margins almost straight and parallel; anterior margin widely arcuate, posterior margin with major curvature than anterior one.



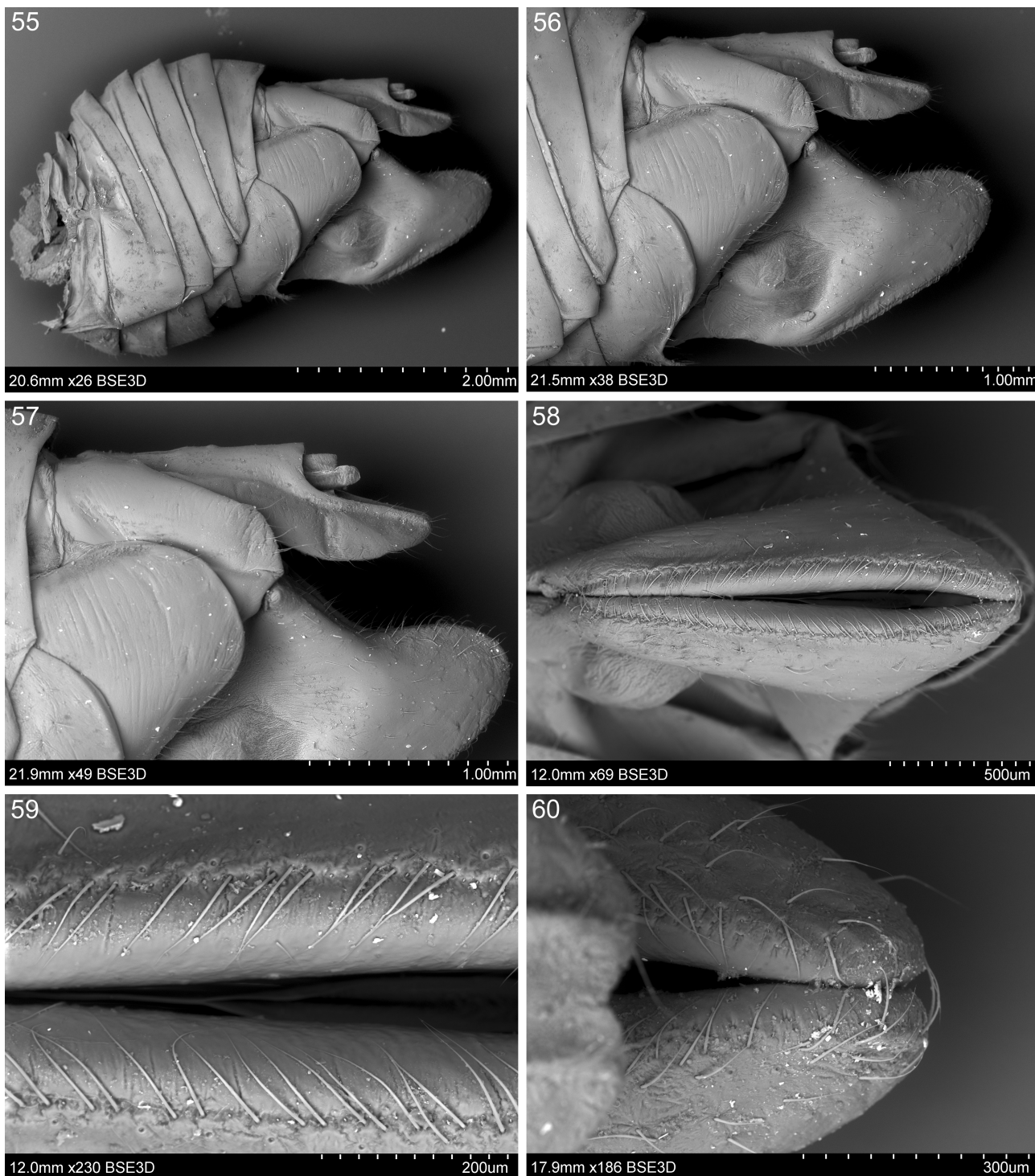
FIGURES 39–48. *Hagneia kallea* gen. et sp. nov., photographs, male. (39) Pygofer and anal tube, lateral view; (40–41) stylus: (40) ventro-lateral view, (41) lateral view; (42) anal tube, dorsal view; (43–45) periandrium: (43) lateral view, (44) dorsal view, (45) ventral view; (46–48) aedeagus: (46) lateral view, (47) dorsal view, (48) ventral view.



FIGURES 49–54. *Hagneia kallea* gen. et sp. nov., SEM photographs, female. (49) Abdomen and terminalia, ventral view; (50) terminalia, ventral view; (51) pregenital sternite, ventral view; (52) median portion of pregenital sternite, ventral view; (53) abdomen and terminalia, dorsal view; (54) terminalia, dorsal view.

Frons: proportion C/E = 1.25–1.32; proportion D/E = 1.43–1.5; upper margin straight, lateral margins weakly arcuate, distinctly curved to frontoclypeal suture in lower part. Frontal disc delicately rugose vertically, near the frontoclypeal suture concave; lateral carinae of disc parallel to lateral margins (in some specimens weakly visible). Frontoclypeal suture widely arcuate. Clypeus with short median carina present in median part, surface of clypeus in median part weakly convex. Rostrum reaching mid coxae.

THORAX. Pronotum: proportion F/B = 2.3–2.75; disc of pronotum delicately rugose; anterior margin widely arcuate; posterior margin weakly concave.



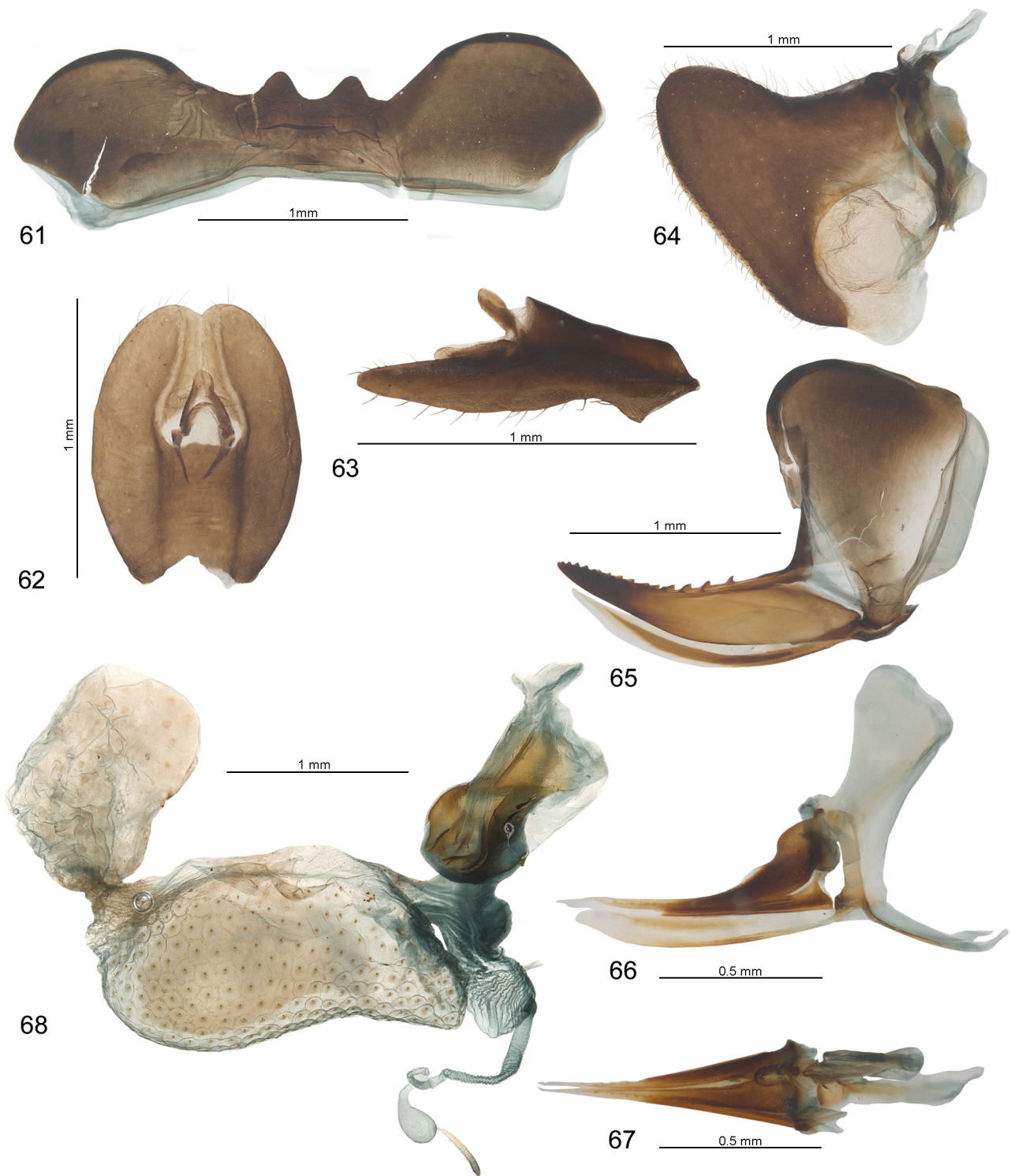
FIGURES 55–60. *Hagneia kallea* gen. et sp. nov., SEM photographs, female. (55) Abdomen and terminalia, lateral view; (56) terminalia, lateral view; (57) anal tube and dorsal part of gonoplac, lateral view; (58–59) posterior margin of the gonoplac, ventral view; (60) tip of gonoplac, dorsal view.

Mesonotum: proportion G/F+B = 6.5–6.85, proportion G/F = 9.04–9.5, proportion G/H = 1.12–1.19.

Tegmina: proportion I/J = 1.41–1.47. Hind wing ScRA with 3 terminals, MP with 2–3 terminals, CuA with 7–11 terminals.

MALE TERMINALIA. Dorso-posterior angle of pygofer with process oriented dorsad; posterior margin in 3/4 straight, in 1/4 convex (lower part).

FEMALE TERMINALIA. Pregenital sternite with posterior margin medially with 2 separated processes.



FIGURES 61–68. *Hagneia kallea* gen. et sp. nov., photographs, female. (61) Pregenital sternite, ventral view; (62–63) anal tube: (62) dorsal view, (63) lateral view; (64) gonoploc, lateral view; (65) gonapophysis VIII and endogonocoxal process, lateral view, external side; (66–67) gonapophyses IX and gonospiculum bridge: (66) lateral view, (67) dorsal view; (68) bursa copulatrix and spermatheca, lateral view.

COLORATION (Figs 1–5). Frons black with dark yellow lateral margins and narrow band alongside lateral margins. Clypeus and postclypeus medially dirty brown, lateral areas black; lateral part of head black with yellow narrow band alongside anterior margin and dark yellow patch around base of antenna. Compound eyes with irregular black and brown patches. Vertex black with lateral margins and narrow band alongside, lateral margins brown,

pronotum (lateral lobes black with brown margin), mesonotum and tegulae black. Tegmina black with white tear-shaped patch in middle and white-yellowish triangular patch near of end of costal area and huge transverse band alongside posterior margin. Hind wing with brown transverse band subapically posterior margin. Pro- and mesofemur on external and internal lateral side black, dorsally brown, pro-, mesotibia and tarsomeres brown. Metafemur, metatibia and metatarsus brown. Abdomen (male and females) black with brown narrow (dorsally) anterior margin (in females band bigger) of the tergites, ventral side of pygofer brown; terminalia black.

Type material. Holotype, male: [Vietnam, Cao Bằng Province, / Nguyên Bình District, / Phia Oac National Parc, / 22°35'39.8"N 105°53'07.2"E], [1282–1290 m a.s.l., 8–12.07.2019, / day and light trapping / leg. T. Bourgoïn, J. Gunczy, G. / Kunz, A. Soulier and A. Stroiński]—deposited in MIZ.

Paratypes, 6 ♂♂, 7 ♀♀: [Vietnam, Cao Bằng Province, / Nguyên Bình District, / Phia Oac National Parc, / 22°35'39.8"N 105°53'07.2"E], [1282–1290 m a.s.l., 8–12.07.2019, / day and light trapping / leg. T. Bourgoïn, J. Gunczy, G. / Kunz, A. Soulier and A. Stroiński]—5 ♂♂, 6 ♀♀ deposited in MIZ, 1 ♂, 1 ♀ deposited in MNHN. 4 ♀♀ preserved in MIZ were used for endosymbiotic studies and they lack abdomens.

Distribution. Vietnam: Cao Bằng Province, Nguyên Bình District, Phia Oac National Parc—22°35'39.8"N 105°53'07.2"E (22.594395, 105.885330).

Discussion

The species described above was collected at the high altitude (1282–1290 m a.s.l.) in the habitat dominated by bamboo forest by 2 methods—sweep-netting and light-trapping.

Discovery of a such large taxon (as per Ricaniidae standards) proves the need for more intensive field research. Interestingly, the described species has no teeth on the posterior margin of the gonoplac. This character is known in the African genus *Mulvia* Stål, 1866. Unfortunately, in the present state of knowledge it is difficult to say if it is a common characters for both genera or not. Further studies in this case are needed.

Acknowledgements

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