

## A review of "Group 1" of the genus *Paulianellus* (Coleoptera: Scarabaeidae: Aphodiinae) with descriptions of three new species

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**Taxonomy, new species, new combinations, Coleoptera, Scarabaeoidea, Aphodiinae, Aphodiini, *Paulianellus*, Palearctic Region, Oriental Region**

**Abstract.** Species of the genus *Paulianellus* Balthasar, 1938, which belong to "Group 1", as considered by Stebnicka (1986), are reviewed and keyed. The following three new species are described: *Paulianellus laoticus* sp. nov. from Laos and Thailand, *Paulianellus neomaderi* sp. nov. from China (Shaanxi, Sichuan and Yunnan) and *Paulianellus taiwanensis* sp. nov. from China (Taiwan). The species *Paulianellus asahinai* (Nakane, 1951) comb. nov. is revalidated and a further new combination, *Paulianellus murensis* (Stebnicka, 1981) comb. nov., is proposed.

### INTRODUCTION

*Paulianellus* was established by Balthasar (1938) as a subgenus of the genus *Aphodius* Hellwig, 1798, and the taxon was elevated to the rank of genus by Dellacasa et al. (2001). Its species are known from Asia only. The genus (formerly subgenus) is rather heterogeneous, which was noted by Stebnicka (1986), who studied its Nepalese Himalayan species with providing a key to these species and dividing them into three groups. The characterization of the three groups chosen by her is quite appropriate. It was intended for the Himalayan species, but our study of all the species of the genus suggested that it is applicable to the genus *Paulianellus* in general.

In the course of our work on the identification of many specimens from private as well as institutional collections, we encountered three new species, which can be included into "Group 1" (as considered in the part Taxonomy). This part presents their descriptions and also further taxonomical actions (new combinations due to the above mentioned raising of the subgenus to the genus and revalidation of a Japanese species).

Species of "Groups 2 and 3" are beyond the scope of our detailed studies, but their possible position is briefly mentioned in the part Discussion.

### MATERIAL AND METHODS

Specimens were examined with Olympus SZ61, MBS-10 and SZP 1120-T stereomicroscopes. Measurements were taken with an ocular grid. The photographs published here were taken by using a Meopta laboratory microscope and CMOS 5 digital camera with the Helicon Focus 3.20.2 Pro software.

Male genitalia (aedeagi) were treated by boiling with a 10% sodium hydroxide solution.

Specimens of the newly described species are provided with printed red labels: "name of the taxon sp. nov., HOLOTYPUS ♂ [or] ALLOTYPUS ♀ [or] PARATYPUS, ♂ [or] ♀, David Král, Miloslav

Rakovič & Ladislav MencL det. 2014" and with pale green labels specifying numbers related to a photo-documentation system by the first author (LM). Exact label data are cited for the type material examined. Individual lines within each label are separated by slashes "/", separate labels are indicated by double slashes "//". Information in quotation marks indicates the original spelling. Our remarks and additional comments are found in brackets. Morphological terminology concerning the epipharyngeal structures was adopted from Dellacasa et al. (2001).

The following acronyms identify the collections housing the material examined (curators names are in parentheses):

- ABCB Axel Bellmann private collection, Bremen, Germany;  
DKCP David Král collection (deposited in NMPC);  
HNHM Hungarian Natural History Museum, Budapest, Hungary (Ottó Merkl);  
IECA Institute of Entomology, Biology Centre CAS, České Budějovice, Czech Republic (Aleš Bezděk);  
LMCT Ladislav MencL private collection, Týnec nad Labem, Czech Republic;  
MHNG Muséum d'histoire naturelle, Genève, Switzerland (Giulio Cuccodoro, Ivan Löbl);  
MRCD Miloslav Rakovič private collection, Dobřichovice, Czech Republic;  
NHMB Naturhistorisches Museum, Basel, Switzerland (Michel Brancucci †, Eva Sprecher-Uebersachs);  
NMPC National Museum, Praha, Czech Republic (Jiří Hájek, Vítězslav Kubáň);  
VKCB Vítězslav Kubáň private collection, Brno, Czech Republic;  
ZFMK Zoologisches Forschungsmuseum Alexander König, Bonn, Germany (Dirk Ahrens).

## TAXONOMY

### *Paulianellus* Balthasar, 1938

*Aphodius* (*Paulianellus*) Balthasar, 1938: 6. Type species. *Aphodius maderi* Balthasar, 1938 (by monotypy);

*Aphodius* (*Paulianellus*): Balthasar 1964: 162; Dellacasa 1988: 390; Dellacasa & Dellacasa 2006: 133.

*Paulianellus*: Dellacasa et al. 2001: 327, figs 759, 767-769.

For the diagnosis of the genus see Dellacasa et al. (2001). The species of "Group 1" as proposed by Stebnicka (1986), and considered here are characterized below, under the heading of the present Key to species.

### *Paulianellus asahinai* (Nakane, 1951) sp. restit., comb. nov.

(Figs. 1, 7, 13, 16, 25, 28, 37, 40, 49, 55-56)

*Aphodius* (*Acrossus*) *asahinai* Nakane, 1951: 70; Nakane & Masumoto 1967: 35.

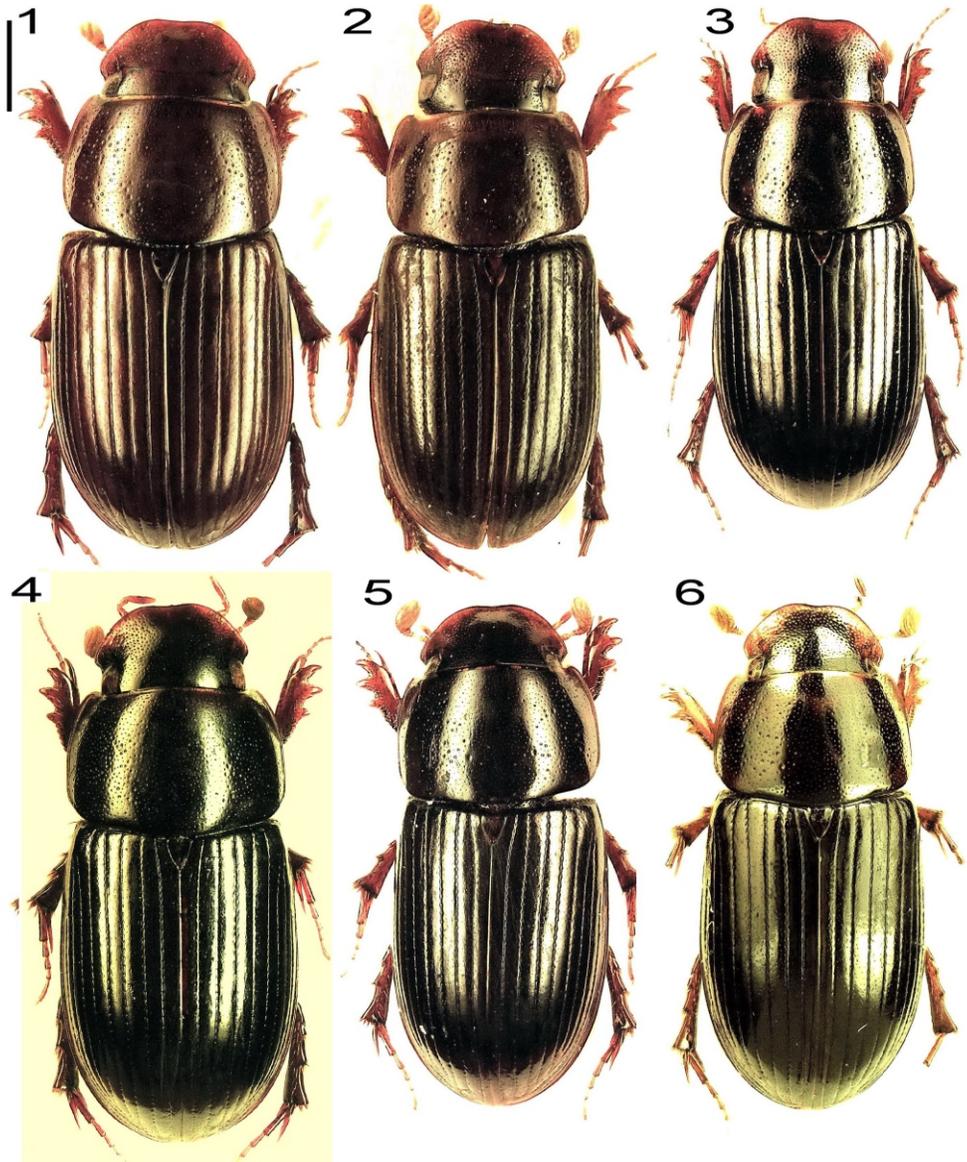
*Aphodius* (*Paulianellus*) *asahinai*: Balthasar 1964: 162, as synonym with *Aphodius* (*Paulianellus*) *maderi*.

*Aphodius* (*Paulianellus*) *maderi*: Kawai et al. 2005: 113, table 88: figs 1-11.

**Type locality.** "Nara, Yamato, Honshu, Japan".

**Material studied. Japan: Honshu Island:** 2 ♀♀ (MRCD), Nara, 8.v.1949, N. Yato lgt.; 1 ♀ (NMPC), P. Nara, 24.v.1950; 1 ♂, 2 ♀♀ (DKCP), Nara, 3.v.1959, K. Tsukamoto lgt.; 1 ♀ (MRCD), Nara park, 7.x.1969, Kobayashi lgt.; 1 ♀ (LMCT), 5 spec. (MRCD), Nara Pref., 4.v.1975, Yashiro lgt. 2 ♀♀ (ABCB), Nara P., Mt. Kasuga, 26.x.1999, M. Kawahara lgt.; 1 ♂ (ABCB), Nara Pref., Nara park, Nara-shi, 2.vi.2000, S. Kawai lgt.

**Diagnosis.** Oblong oval, moderately convex, glabrous, shining, from reddish brown or castaneous to dark brown, areas at clypeus margins rather translucent and thus lighter;



Figs. 1-6. *Paulianellus* spp., ♂♂ in dorsal view. 1- *P. asahinai*, 2- *P. taiwanensis* sp. nov., 3- *P. neomaderi* sp. nov. (holotype), 4- *P. laoticus* sp. nov. (holotype), 5- *P. maderi*, 6- *P. murensis*. Scale lines: 1.0 mm.

body length: 4.7-6.4 mm. Further description is focused on differences from characters of *P. maderi* as presented below.

Head with frontoclypeal suture narrow, but quite distinct throughout; surface punctuation sparser (compared to *P. maderi*); smaller punctures prevailing not only laterally, but also posteriorly.

Epipharynx (Fig. 49). No significant differences from *P. maderi*.

Pronotum widest behind middle, lateral margins rather arcuate than straight even posteriorly, lateral border relatively wide anteriorly and only moderately narrowed posteriorly.

Scutellum exerting no important differences from *P. maderi*.

Elytra: punctures in discal intervals very fine, comparable to those in *P. maderi* in females, almost imperceptible in males.

Legs in dorsal view exerting no considerable differences from *P. maderi*.

Ventral side (Fig. 7) exerting important differences from *P. maderi* in macrosetation of abdominal ventrites: macrosetae considerably shorter than ventrites laterally; ventrites only sparingly macrosetaceous or glabrous medially.

Aedeagus as in Figs. 55-56.

**Sexual dimorphism.** The head punctation is sparser and rather unequal in size and density of punctures in males, denser and rather equal in females. The smaller punctures on pronotum are finer in males compared to females. The metaventral plate longitudinal furrow is more distinct and surrounded by a flat area in males, less distinct and surrounded by a moderate impression in females.

**Variability.** Based on the material examined, the body size ranges from 4.7 to 6.4 mm. Lighter (reddish brown or castaneous rather than blackish brown) individuals are more abundant compared to other members of the "Group 1" studied here. There is also a variability of paler spots at clypeus lateral and/or anterior margins. The distribution of the larger punctures on the pronotal disc is moderately variable.

**Differential diagnosis.** The following characters are of importance for the differentiation of *P. asahinai* from other species of the group: the head with distinct frontoclypeal suture, the pronotum widest behind middle and macrosetae on ventrites shorter than the ventrites in lateral areas and nearly absent in middle area. For the complete differentiation of all the six species of "Group 1" one from another see the Key to Species below.

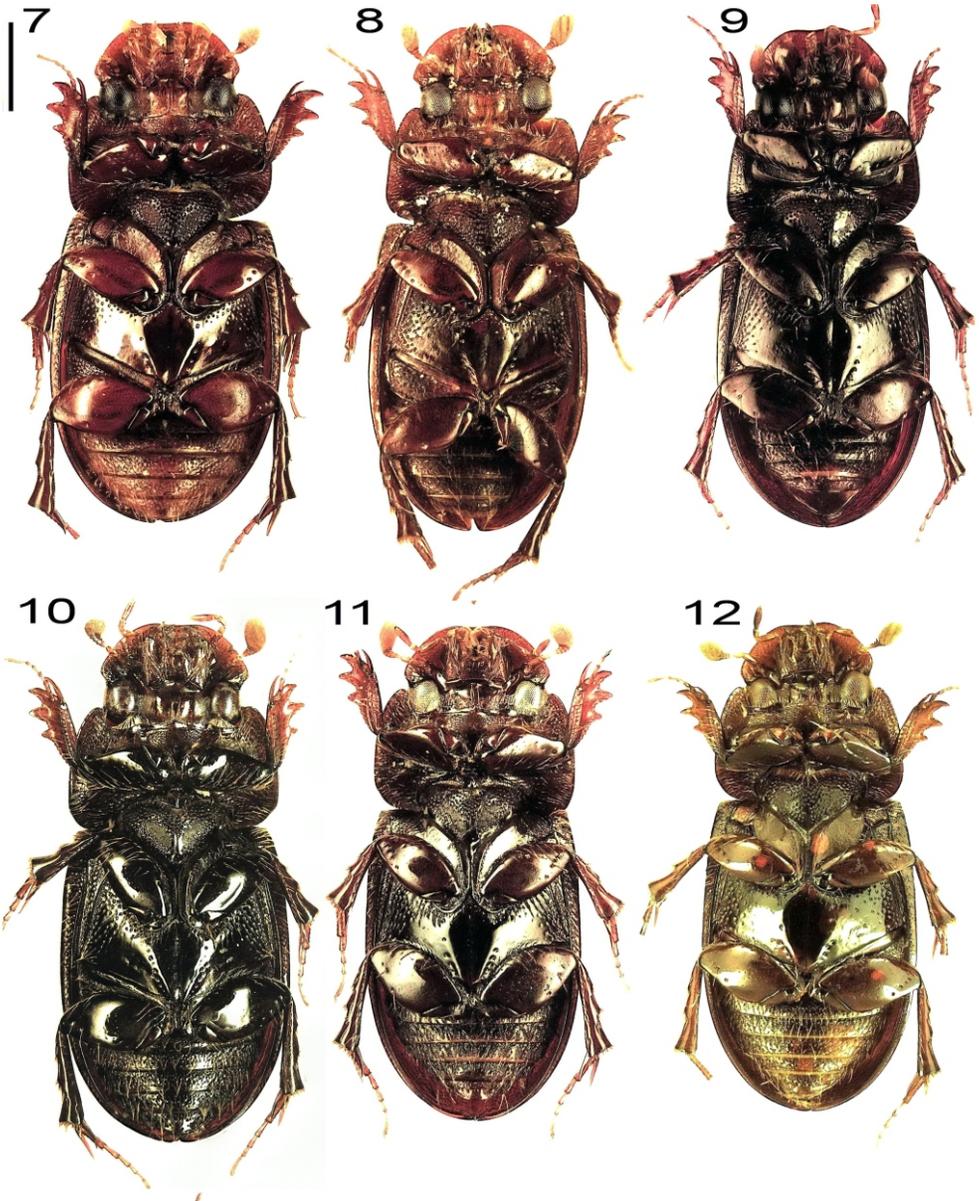
**Distribution.** Japan (Honshu, Kagoshima, Kyushu) (Nakane & Masumoto 1967, Kawai et al. 2005); North Korea (?) and South Korea (?) (see Discussion section below for details).

### ***Paulianellus laoticus* sp. nov.**

(Figs. 4, 10, 19, 22, 31, 34, 43, 46, 52, 61-62)

**Type locality.** LAO-N, Phongsaly prov., Phongsaly env., 21°41-2'N 102°06-8'E, 28.v.-20.vi.2003, ~ 1500 m.

**Type material. Laos: Phongsaly Prov.:** Holotype, ♂ (NMCP), "LAO-N Phongsaly prov. / 21°41-2'N 102°06-8'E / 28.v.-20.vi.2003, / PHONGSALY env., / ~ 1500 m, Vít Kubáň leg. [printed]" [No.: 1443]. Paratypes: Allotype, ♀ (NMPC), 3 ♂, 1 ♀, (DKCP), 4 ♂, 1 ♀, 2 spec. (LMCT), 4 ♂, 1 ♀, 2 spec. (MRCD), 1 ♂, 1 ♀, 3 spec. (VKCB), same data as holotype; 1 ♂, 4 spec. (DKCP), "LAO-N Phongsaly prov. / 21°41-2'N 102°06-8'E, / PHONGSALY env., / 6.-17.v.2004 ~ 1500 m, / Vít Kubáň leg. [printed]". - **Houa Phan Prov.:** 1 ♂, 1 ♀ (ABCB), 1 ♂, 1 spec. (IECA) "LAOS, - NE, HUA PHAN prov. / BAN SALUEI, Phu Phan Mt. / 20°15'N 104°02'E, 1500-2000m / J. Bezděk leg.; 26.iv.-11.v.2001 [printed]"; 5 spec. (NMPC), 1 spec. (LMCT), 1 spec. (MRCD), 2 spec. (VKCB), "LAOS-NE, Houa Phan prov., / 20°13'09-19" N 103°19'54"- / 104°00'03" E, 1480-1510m, / PHOU PANE Mt., 22.iv.-14.v. / 2008, Vít. Kubáň leg. [printed]"; 1 ♀ (DKCP), 1 ♀ (LMCT), 1 ♀ (MRCD), 3 ♂♂, 5 ♀♀ (NMPC), "LAOS-NE, Houa Phan prov., / 20°13'09-19"N 103°59'54"- / 104°00'03"E, 1480-1510 m, / PHOU PANE Mt., 2.-22.vi / 2011, Vít. Kubáň leg. // Primary mountain forest, / at light / Laos 2011 Expedition National Prague, / Czech Republic [printed]". - **Louang Phrabang Prov.:** 1 spec. (DKCP), "LAOS-N, 24.iv.-16.v.1999, / Louang Phrabang prov., / 20°33-4'N 102°14' E, / Ban Song Cha (5 km W), / ±1200 m, Vít Kubáň



Figs. 7-12. *Paulinellus* spp., ♂♂ in ventral view. 7- *P. asahinai*, 8- *P. taiwanensis* sp. nov., 9- *P. neomaderi* sp. nov. (holotype), 10- *P. laoticus* sp. nov. (holotype), 11- *P. maderi*, 12- *P. murensis*. Scale lines: 1.0 mm.

leg. [printed]". - **Xieng Khouang Prov.:** 1 ♂ (ABCB), "LAOS-NE, Xieng Khouang prov., / 19°38.20' N 103°20.20' E / Phonsavan (30 km NE): PHOU SANE Mt., / 1420 m, 10.-30.v.2009, / D. Hauck leg. // Primary mountain forest, / flight intercept trap / Laos 2009 Expedition: / NHMB Basel, NMPC Prague / Laos 2009 Expedition: / M. Brancucci, M. Geiser, Z. Kraus, D. Hauck, V. Kubáň [printed]". **Thailand: Mae Hong Son Prov.:** 1 spec. (MRCD), "N. THAI: / Mae Aw // 2/5/2002 / M. Rakovič / lgt. [printed]"; 1 ♂ (DKCP), "THAI 10-13.5.1993 / 19.27N 98.20E / SOPPONG 1550 m / Vít Kubáň leg. [printed]". - **Chiang Mai Prov.:** 1 spec. (ABCB), "N-THailand 1.- / 17.VII.1990 Doi / Inthanon lg Malicky

// Zoologische Staatssammlung / München [printed]"; 1 ♂, 2 spec. (MRCD), "NW THAILAND, 25.iv.- / Chiang Mai prov., - 7.5. / BAN SAN PAKIA 1996 / Sv. Bílý leg, 1700 m [printed]"; 3 spec. (DKCP), 3 spec. (LMCT), 3 spec. (MRCD), 23 spec. (ZFMK), "THAILAND, CHIANGMAI Prov. / Pha Hom Pok Mt., 1900-2200 m / 20°02'35"N 99°08'45"E / L. Dembický leg., 23.-30.iv.2009 [printed]".

**Diagnosis.** Oblong oval, moderately convex, glabrous, shining, blackish brown, sometimes nearly black, but forebody sometimes darker than elytra, clypeus margins usually brown and pronotum anterior margin sometimes brown, legs and antennae brown; body length: 5.5-7.2 mm. Further description is focused on differences from characters of *P. maderi* as presented below.

Head with clypeofrontal suture more distinct than in *P. maderi* (see below) but less distinct than in *P. asahinai* (see above); surface with denser, more evenly distributed punctures not exerting considerable differences in size (compared to small and large punctures in *P. maderi*). Anterior margins of genae not quite aligned with more arcuate clypeus lateral margins.

Epipharynx (Fig. 52). No significant differences from *P. maderi*.

Pronotum shape similar to that of *P. maderi*. Lateral border very wide anteriorly, moderately narrowed before posterior corner. Posterior corner not only truncate, but also moderately emarginate.

Scutellum exerting no important differences from *P. maderi*.

Elytra: punctures in discal intervals slightly finer compared to those in *P. maderi*, but yet distinct in both sexes.

Legs in dorsal view exerting no considerable differences from *P. maderi*.

Ventral side (Fig. 10) exerting no important differences from *P. maderi*.

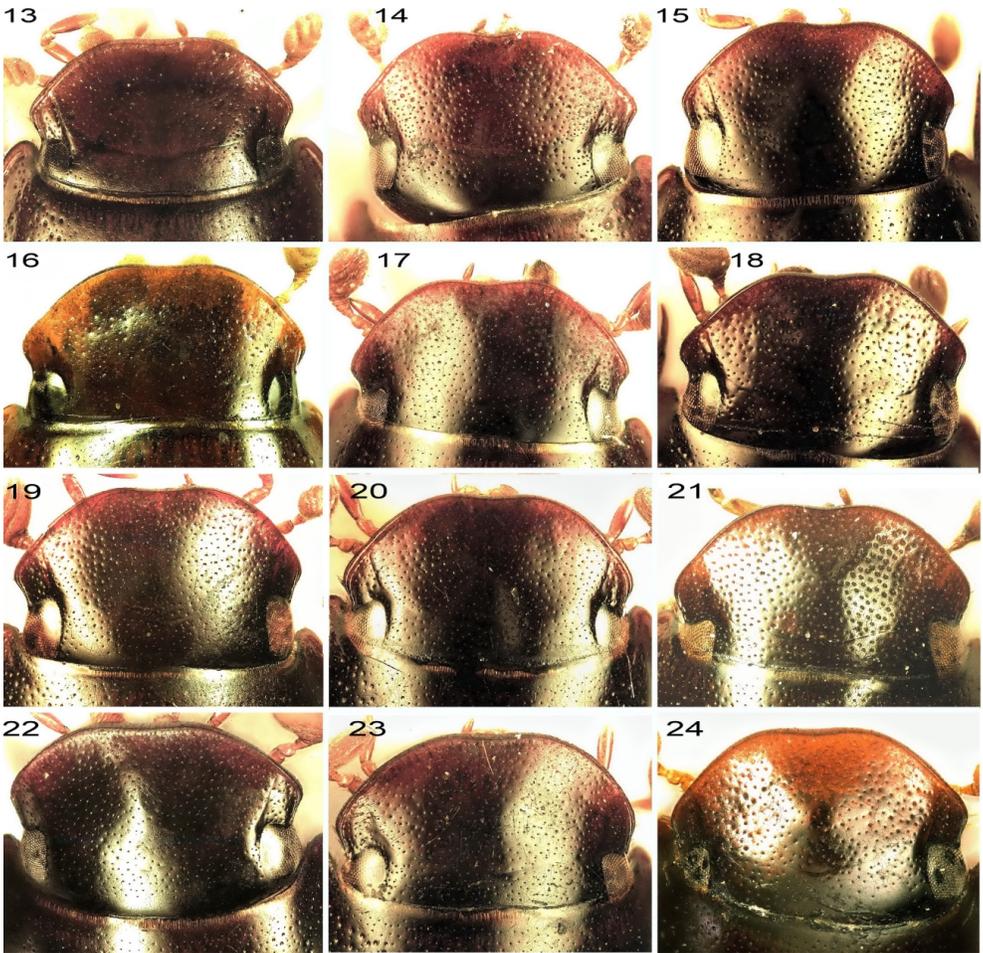
Aedeagus as in Figs. 61-62.

**Sexual dimorphism.** The head punctuation is only slightly differentiated in males, finer posteriorly and coarser anteriorly in females. The larger punctures on the pronotum are more distinct in females compared to males. The metaventral plate longitudinal furrow is more distinct and surrounded by a flat area in males, less distinct and surrounded by a moderate impression in females.

**Variability.** Based on the type material of the new species, the body size ranges from 5.5 to 7.2 mm. Blackish brown, nearly black individuals occur most frequently; the proportion of brown individuals is much smaller. There is also a variability of paler (brown) spots at clypeus lateral and/or anterior margins. The punctuation of dorsal surfaces is only slightly variable.

**Differential diagnosis.** Among the members of the genus *Paulianellus*, "Group 1", only *P. laoticus* sp. nov. has not only truncate, but also emarginate posterior corners of the pronotum. For the complete differentiation of all the six species of "Group" 1 one from another see the Key to Species below.

**Collecting circumstances.** Type material collected by V. Kubáň in Laos: Ban Song Cha (1999), Phongsaly (2003, 2004) and Phou Pane (2008, 2011) was taken almost all from human faeces or rarely at light, both exposed in primary mountain forests; that of Phou Sane (2009) in same way, but in a dry deciduous forest (all V. Kubáň, pers. comm. 2015). Paratypes originating from Pha Hom Pok (Thailand) were collected from relatively fresh cow dung on a small pasture surrounded by a primary forest near headquarters of the Pha Hom Pok National Park (L. Dembický, pers. comm. 2015).



Figs. 13-24. *Paulianellus* spp., head in dorsal view. 13, 16 - *P. asahinai* (13-♂, 16-♀); 14, 17 - *P. taiwanensis* sp. nov. (14-♂, 17-♀); 15, 18 - *P. neomaderi* sp. nov. (15-♂, 18-♀); 19, 22 - *P. laoticus* sp. nov. (19-♂, 22-♀); 20, 23 - *P. maderi* (20-♂, 23-♀); 21, 24 - *P. mureensis* (21-♂, 24-♀).

**Name derivation.** Toponymic (adjective derived from the name of the country where the holotype was collected).

**Distribution.** Southeast Asia (Laos, Thailand).

***Paulianellus maderi* (Balthasar, 1938)**

(Figs. 5, 11, 20, 23, 32, 35, 44, 47, 53, 63, 64, 66-72)

*Aphodius* (*Paulianellus*) *maderi* Balthasar, 1938: 7; Balthasar, 1964: 162; Dellacasa 1988: 390; Dellacasa & Dellacasa 2006: 133.

*Paulianellus maderi*: Dellacasa 2001: 327, figs 759, 767-769.

*Aphodius* (*Acrossus*) *yunlingensis* Petrovitz, 1961: 443, fig. 1. Type locality. "China, Prov. Szechwan, Mts. Yunling";

Balthasar 1964: 136; Dellacasa 1988: 364. Synonymized by Petrovitz (1975: 114).

**Type locality.** "China, Szetschwan [= Sichuan]".

**Type material studied. China: Sichuan:** Holotype [allegedly a male, but possibly a female; with lost aedeagus]: (NMPC), "China, Prov. / Sze-tschwan [white printed label] // *Aphodius* / (*Paulianellus*) / *maderi* n. sp. Balth. / Holotypus [pink handwritten/printed label] // Mus. Nat. Pragae / Inv. 65905 [red printed/handwritten label] // A. (*Paulianellus*) / *maderi* / Balthasar, 1938 / Current status / = PAULIANELLUS / *maderi* / (Balthasar, 1938) / v. Dellacasa, 2001, 2001 [yellowish white printed label] // 1481 // Dok.L.Menc 2012 [pale green printed label]".

*Aphodius* (*Acrossus*) *yunlingensis*: - **Sichuan:** Paratype: ♂ (MHNG), "China / Pr. Szechwan / Mts. Yunling [white printed label] // Aph. *Acrossus* / *yunlingensis* m. / det.Petrovitz [white printed label] // Coll. / R. Petrovitz [white printed label] // PARATYPUS [red printed label] // 1514 / Dok.L.Menc, 2012 [pale green printed label].

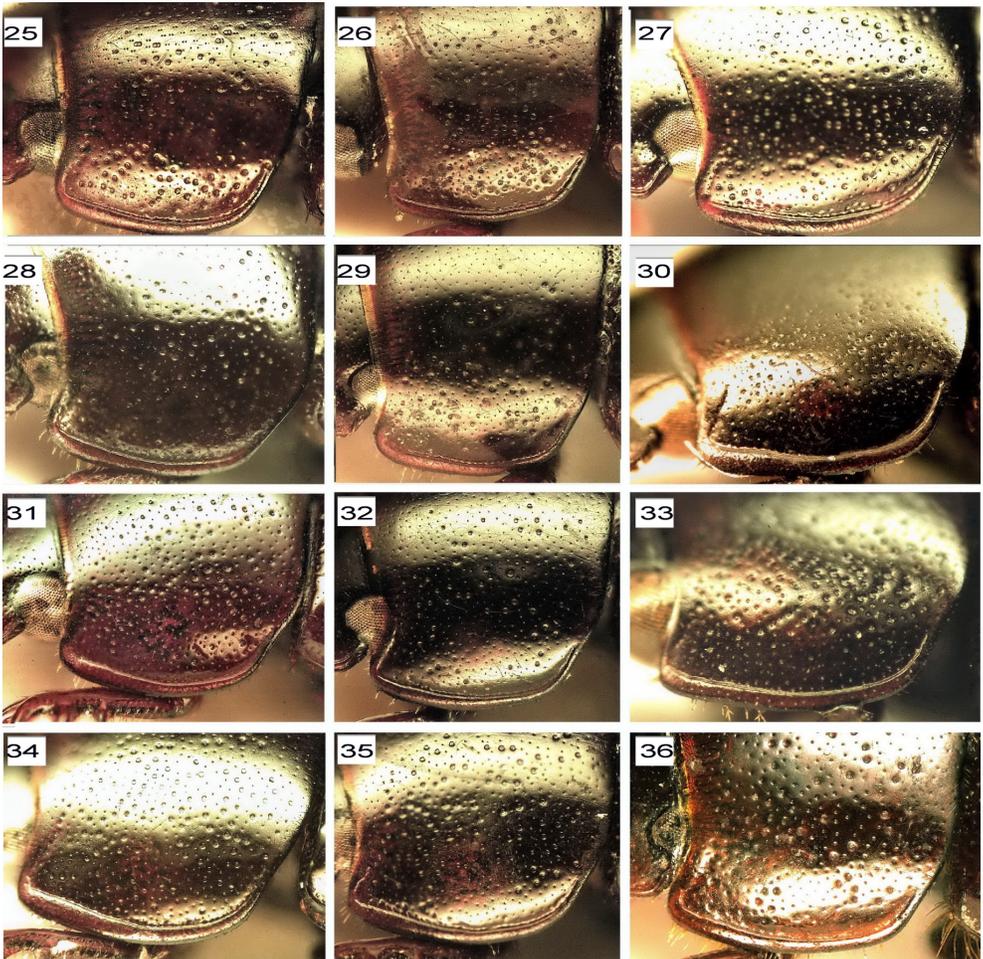
**Additional material studied. China: Anhui:** 1 ♀ (DKCP), Dabieshan, 65 km SW Huoshan, 1400 m, 21.-24.vi.1998, Bolm lgt. - **Shaanxi:** 1 spec. (LMCT), Qinling mts., 115 km WSW of Xi'an, river bank above Houzhenzi, 33°50'N 107°47'E, 1450 m, 4.vii.2001, D.W. Wrase lgt. - **Sichuan:** 1 ♀ (DKCP), Wolong, 9.-10.viii.1992, J. Schneider lgt. - **Yunnan:** 2 ♀♀ (DKCP), Jinsha r. vall., Daju, Hutiao gorge, 27°18'N 100°13', 1900 m, 15.-17.vii.1990, D. Král lgt.; 4 ♂♂, 2 ♀♀ (DKCP), 2 ♂♂, 2 ♀♀ (MRCD), Weishan mt., 25°10'N 100°21'E, 1800-2500 m, 22.-25.vi.1992, D. Král lgt.; 4 ♀♀ (DKCP), Habashan mts., E slope, 27°20'N 100°09'E, 3000-3800 m, D. Král lgt.; 3 ♀♀ (DKCP), Gaoligongshan mts., 90 km W of Baoshan, 26.-28.v.1995, S. Bečvář lgt.; 1 ♀ (DKCP), Qiaojia - SE environs, 26°52'-54'E 103°00'-17'E, 1700-2300 m, 2.viii.1998, L.+R. Businský lgt.; 1 ♂ (LMCT), Jizushan mts., 25°58'N 100°21'E, 2500-3100 m, 30.v.-3.vi.1991, V. Kubán lgt. - **Xizang:** 1 ♀ (DKCP), E-Tibet, N of Brahmaputra great bend, 30°00'-07'N 94°52'-95°09'E, 2050-2400 m, 16., 20.vii.1992, L.+R. Businský lgt.

**Redescription.** Oblong oval, moderately convex, glabrous, shining, blackish brown, sometimes nearly black, but forebody usually darker than elytra, clypeus margins usually brown and pronotum anterior margin sometimes brown, legs and antennae brown; body size: 4.8-7.0 mm.

Head only moderately convex, clypeus broadly rounded each side of shallow anteromedian emargination, its margin narrowly lifted upward, thus forming distinct border line, which is at least as strong up to middle of gena as anteriorly along anteromedian emargination and then continuously reduced in width toward eye. Epistomal gibbosity weak, frontoclypeal suture hardly perceptible laterally, imperceptible medially. Surface with smaller and larger punctures (but not with relatively large punctures intermixed with very fine ones, as usual in many Aphodiini); punctures not quite evenly distributed; larger and smaller punctures more abundant medially and laterally, respectively. Genae distinctly more protruding than eyes, their anterior margins aligned with only slightly arcuate clypeus lateral margins.

Epipharynx (Figs. 52, 69). Anterior margin distinctly deeply sinuate at middle, regularly rounded anterolaterally; epitorma drop-shaped, not reaching anterior margin; corypha with several slender apical spinules, among them with two distinctly stouter and more elongate ones; acropariae with dense, long macrosetation; prophobae considerably densely macrosetaceous; chaetopariae with two rows of stout spinules; pedis densely microsetaceous, with some macrosetae near anterior margin; tormae relatively long.

Pronotum transverse, widest at about middle, its lateral margin arcuate from anterior corner to nearly its midlength and then nearly straight to moderately truncate posterior angle (truncation visible in lateral view only). Anterior margin not bordered. Lateral margin bordered; border still present along posterior corner truncation, but widest at anterior corner and continuously reduced in width backward. Basal margin not bordered, slightly sinuate on each side (against elytral intervals 3 and 4). Surface doubly punctate: with very fine, fairly evenly distributed punctures and much larger, quite unevenly distributed ones; larger punctures missing in area along anterior margin and also each side of midline, and increasing in density from midline toward lateral margins.



Figs. 25-36. *Paulianellus* spp., pronotum in left lateral view. 25, 28-*P. asahinai* (25-♂, 28-♀); 26, 29-*P. taiwanensis* sp. nov. (26-♂, 29-♀); 27, 30-*P. neomaderi* sp. nov. (27-♂, 30-♀); 31, 34-*P. laoticus* sp. nov. (31-♂, 34-♀); 32, 35-*P. maderi* (32-♂, 35-♀); 33, 36-*P. murensis* (33-♂, 36-♀).

Scutellum is osceles triangular, with slightly arcuate sides; with few fine punctures in basal half.

Elytra with ten striae and ten intervals, without humeral denticles. Striae much narrower than intervals, punctate, punctures small, moderately incising intervals on both sides of each stria (Figs. 5, 66); distances between neighbouring punctures comparable to puncture diameter. Intervals finely, not densely, but distinctly punctate, weakly convex on disc, lateral intervals moderately more convex, particularly at elytral apex. Stria 8 shortened anteriorly and thus, intervals 8 and 9 fused together there.

Legs in dorsal view. Protibia with three large outer teeth and five or six small denticles between third (posterior) tooth and protibia base; upper face with few minute, hardly perceptible punctures and with row of medium-sized punctures parallel with outer edge, bearing long macrosetae; protibial spur flat, moderately continuously narrowed and bent outward from base to apex,

slightly longer than basal protarsite. Meso- and metatibia with two pairs of distinct oblique ridges, their apices fringed with rather irregularly unequal sharp spinules; superior mesotibial spur about as long as mesotarsomeres 1 and 2 combined, inferior mesotibial spur about as long as basal mesotarsomere; superior metatibial spur reaching about middle of metatarsomere 2, inferior mesotibial spur about as long as (or slightly longer than) basal mesotarsomere.

Ventral side (Figs 11, 68) considerably punctate and macrosetaceous. Profemur with few fine punctures and with long macrosetae present on anterior as well as posterior edges and also on about posterior 2/3 femur surface. Mesofemur finely sparsely punctate throughout, with considerable setigerous punctures bearing long macrosetae along anterior as well as posterior edges and also in rows parallel with these edges. Metafemur punctation and macrosetation similar to those of mesofemur. Proventrum densely, longly macrosetaceous. Mesoventrum with small impunctate posteromedian area, otherwise with considerable dense and deep punctures. Metaventrum with numerous rugose punctures bearing long setae anterolaterally, sparingly punctate and macrosetaceous posteromedially, with rather glabrous, only imperceptibly finely and sparsely punctate metaventral plate having not very distinct longitudinal line; few medium-sized punctures present each side of metasternal plate. Abdominal ventrites rugosely punctate and setose, macrosetae long (longer than ventrites) and dense, particularly laterally.

Aedeagus (Figs. 63-64). Slender, parameres almost as long as phallobasis, regularly curved in lateral view.

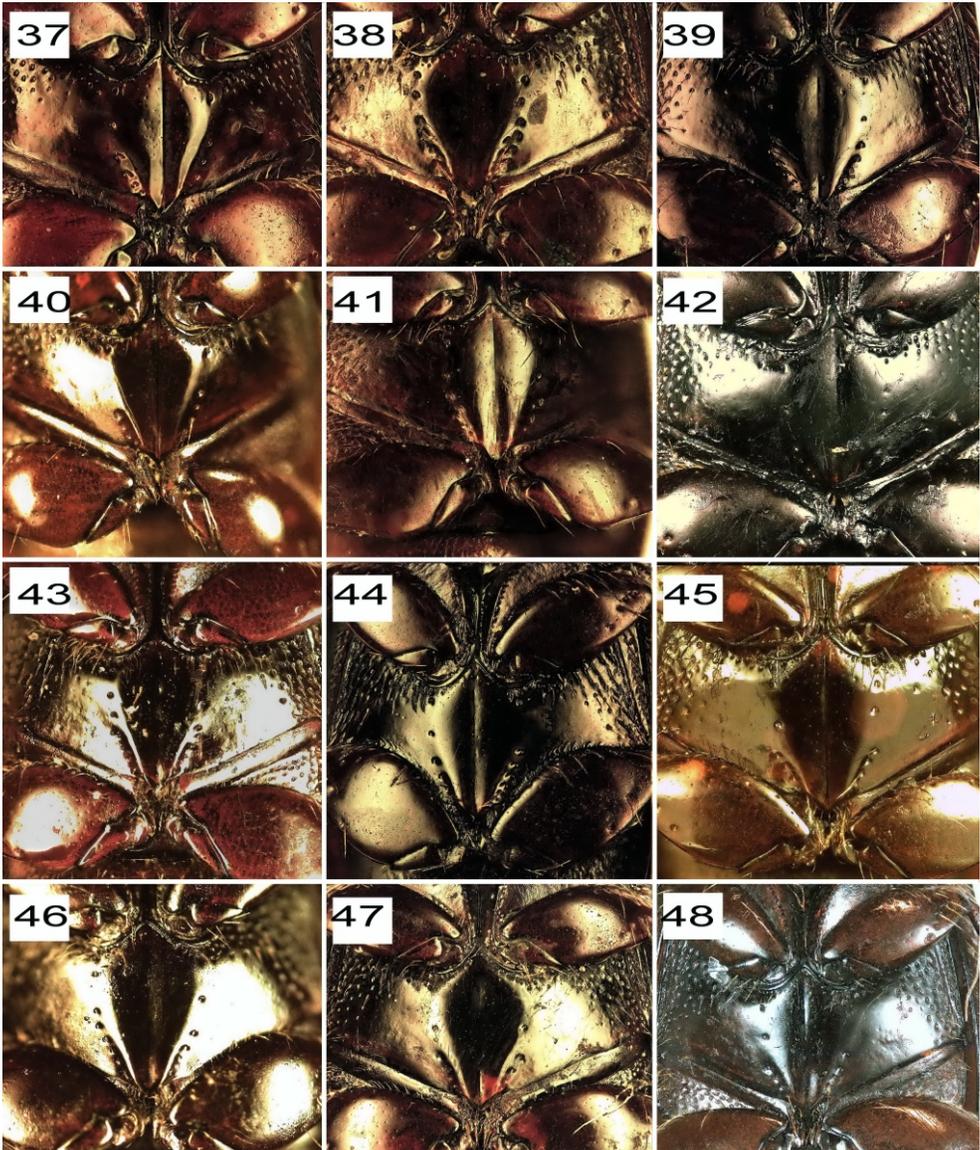
**Sexual dimorphism.** The head punctation is more differentiated in males, the larger punctures are coarser and continuously reduced in their diameter in females. Differences between larger and smaller punctures on the pronotum are more distinct in males, less distinct in females. The metaventral plate longitudinal furrow is more distinct and surrounded by a flat area in males, less distinct and surrounded by a moderate impression in females.

**Variability.** Based on the material studied here and on data from the literature, the body size ranges from 4.8 to 7.0 mm. Blackish brown, nearly black individuals occur most frequently; the proportion of brown individuals is much smaller. There is also a variability of paler (brown) spots at clypeus lateral and/or anterior margins. The punctation of dorsal surfaces is only slightly variable.

**Differential diagnosis.** The following combination of characters is of importance for the differentiation of the species from other species of "Group 1": the frontoclypeal suture hardly perceptible, the pronotum widest at middle, pronotum posterior corners only truncate (not emarginate, and macrosetae on abdominal ventrites long (longer than ventrites) and dense, particularly laterally. For the complete differentiation of all the six species of "Group" 1 one from another see the Key to Species below.

**Collecting circumstances.** Material originating from Hutiao Gorge (Yunnan) was collected from horse dung on a pathway in open, xerothermic landscape; that from Weishan (Yunnan) from human faeces and horse dung in a primary deciduous forest and that from Habashan (Yunnan) from sheep droppings and horse dung in a primary predominantly coniferous forest intermixed with oaks and *Rhododendron* trees and shrubs. (All observations by DK and Vítězslav Kubáň).

**Distribution.** China (Anhui, Shaanxi, Sichuan, Xizang and Yunnan).

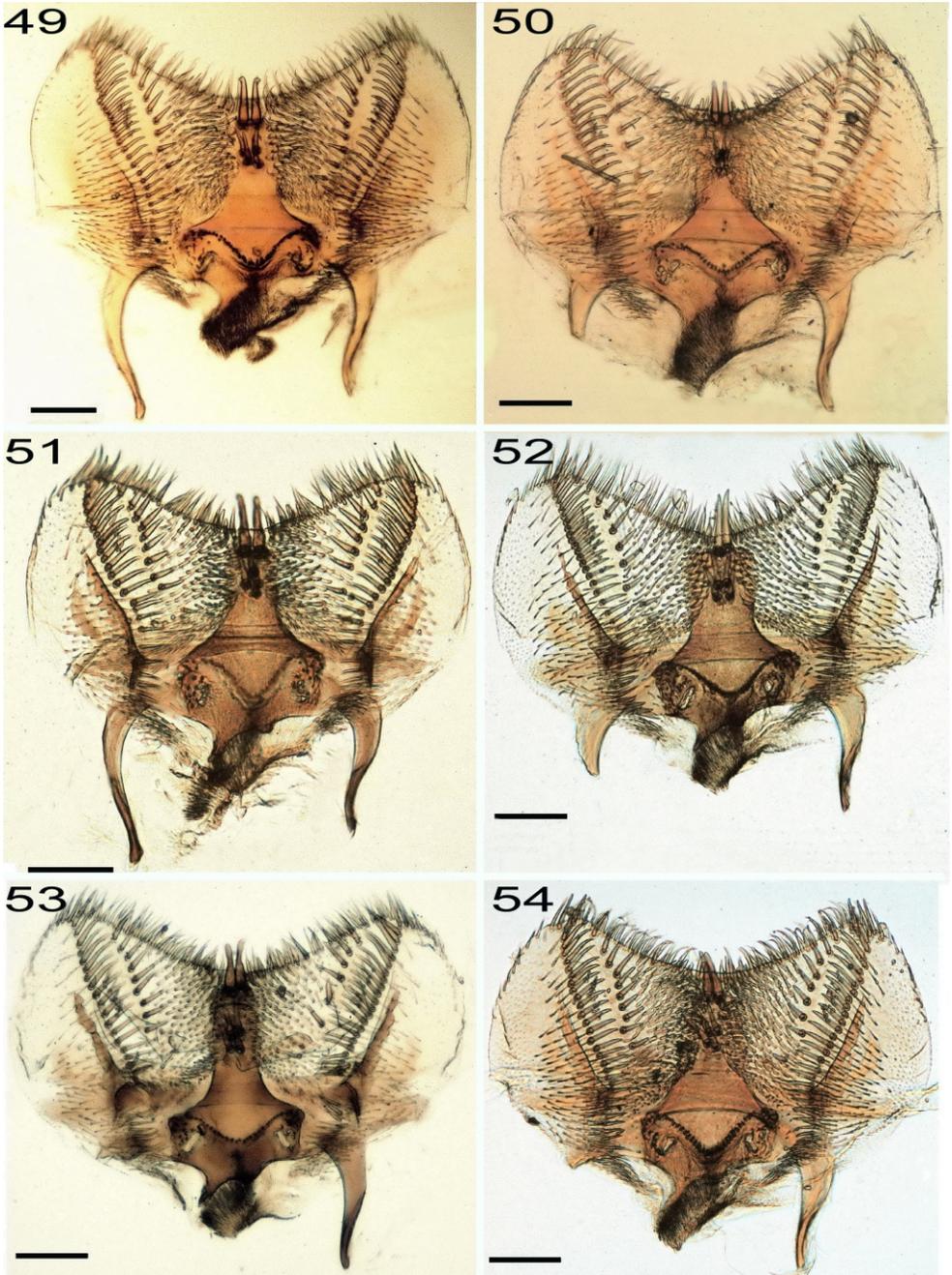


Figs. 37-48. *Paulianellus* spp., metaventral plate. 37, 40- *P. asahinai* (37- ♂, 40- ♀); 38, 41- *P. taiwanensis* sp. nov. (38- ♂, 41- ♀); 39, 42- *P. neomaderi* sp. nov. (39- ♂, 42- ♀); 43, 46- *P. laoticus* sp. nov. (43- ♂, 46- ♀); 44, 47- *P. maderi* (44- ♂, 47- ♀); 45, 48- *P. mureensis* (45- ♂, 48- ♀).

***Paulianellus mureensis* (Stebnicka, 1981) comb. nov.**

(Figs. 6, 12, 21, 24, 33, 36, 45, 48, 54, 65)

*Aphodius* (*Paulianellus*) *mureensis* Stebnicka, 1981: 531, figs 1-5; Stebnicka 1986: 25; 1989: 5; 1990: 5; Ahrens & Stebnicka 1997: 11; Dellacasa 1988: 390; Dellacasa & Dellacasa 2006: 133.



Figs. 49-54. *Paulianellus* spp., epipharynx. 49- *P. asahinai* (♀), 50- *P. taiwanensis* sp. nov. (♂), 51- *P. neomaderi* sp. nov. (♂), 52- *P. laoticus* sp. nov. (♂), 53- *P. maderi* (♂), 54- *P. murensis* (♂). Scale lines 0.1 mm.

**Type locality.** "Nepal, Mure".

**Material studied. India: Darjeeling:** 1 ♂ (DKCP), Sakyong, 1000 m, 10.-11.iv. 1983, B. Bhakta lgt. **Nepal:** 1 ♀ (DKCP), O. Nepal, Alagara, 1700 m, 5.ix.1980, B. Bhakta lgt.; 1 spec. (MRCD), Kathmandu valley, Godavari, 2.vi.1967, Dierl, Forster, Schacht lgt.; 2 spec. (MRCD), W Nepal, Dhawalagiri, Mustang Distr., Kali Gandaki - Kholu, Ghasa Kalopani, 2000-2500 m, 20.vi.1986, J. Probst lgt.

**Diagnosis.** Oblong oval, moderately convex, glabrous, shining, blackish brown, clypeus margins usually brown, legs and antennae brown; body size: 6.1-7.0 mm. Further description is focused on differences from characters of *P. maderi* as presented above.

Head with very thin, rather indistinct frontoclypeal suture; surface with distinctly coarser and deeper punctures (compared to *P. maderi*).

Epipharynx (Fig. 54). No significant differences from *P. maderi*.

Pronotum widest at about middle, lateral margins arcuate anteriorly and rather straight posteriorly; posterior corners truncate, not emarginate; lateral border very wide not only anteriorly, reaching middle of posterior truncation and only slightly narrowed there. Double punctation along lateral margin rather variable, large punctures deep.

Scutellum exerting no important differences from *P. maderi*.

Elytra: punctures in discal intervals more distinct (moderately deeper) compared to those in *P. maderi*.

Legs in dorsal view: superior metatibial spur only moderately longer than basal metatarsomere, not reaching half-length of metatarsomere 2.

Ventral side (Fig. 12) exerting important difference from *P. maderi*: macrosetae of abdominal ventrites considerably longer than ventrites not only laterally, but also in ventrite middle areas.

Aedeagus as in Fig. 65.

**Sexual dimorphism.** The larger punctures on the head are denser in males, sparser in females. Differences in distributions of larger punctures on the pronotum disk and on lateral areas are less distinct in males, more distinct in females. The metasternal plate longitudinal furrow is more distinct and surrounded by a flat area in males, less distinct and surrounded by a moderate impression in females.

**Variability.** Based on the material studied here, the body size ranges from 6.1 to 7.0 mm. Dark brown individuals occur most frequently. There is also a variability of paler (brown) spots at clypeus lateral and/or anterior margins. The punctation of dorsal surfaces is only slightly variable.

**Differential diagnosis.** The following combination of characters is of importance for the differentiation of the species from other species of "Group 1": the head with relatively coarse and deep punctures, the pronotum widest at middle, pronotum posterior corners only truncate (not emarginate, the pronotum lateral border very wide not only anteriorly and macrosetae on abdominal ventrites long (longer than ventrites) and dense, particularly laterally. For the complete differentiation of all the six species of "Group 1" one from another see the Key to Species below.

**Distribution.** India (Darjeeling) and Nepal (Stebnicka 1986, 1989, 1990; Ahrens & Stebnicka 1997).

***Paulianellus neomaderi* sp. nov.**

(Figs. 3, 9, 15, 18, 27, 30, 39, 42, 51, 59-60)

**Type locality.** [China], Yunnan, Habashan Mts., SE slope, 27°20'N 100°09'E, 2000-3000 m.

**Type material. China: Yunnan:** Holotype, ♂ (NMPC) "YUNNAN 2000-3000 m / 27.20N 100.09E / HABASHAN Mts. / SE slope 10-13.7 / Vít Kubáň leg 1992 [printed]" [No.: 1484]. Paratypes: Allotype (♀) (NMPC), 3 ♂♂, 3 ♀♀ (DKCP), same data as holotype; 1 ♀ (DKCP), "YUNNAN 1800-2500 m / 25.10N 100.21E / WEISHAN mt. / 22-25.6.[19]92, David Král leg. [printed]"; 1 ♂, 1 ♀ (DKCP), 4 ♂♂, 2 ♀♀ (MRCD), 2 ♂♂, 2 ♀♀ (LMCT), "YUNNAN 1950-2050 m / 27.18N 100.13 / DAJU Jinsha r / 7-10.7.[19]92 / Vít Kubáň leg. [printed]"; 1 ♂, 2 ♀♀ (DKCP), "YUNNAN ca 2000m / 27.18N 100.13E / HUTIAO gorge / Jinsha r. 18-22.7. / David Král leg. [19]92 [printed]"; 1 ♀ (DKCP), "China, N Yunnan, 10.-12.vii. / Lugu Hu (lake), LIGE vill. / ca2700 m 27°44'N 100°45'E / David Král lgt. 2010 [printed]". - **Gansu:** 1 ♂ (HNHM), "Sinning (Kan-su) / 1878 / exp. Szechényi [handwritten, black ink] // China [printed]". - **Shaanxi:** 2 ♂♂, 1 ♀ (DKCP), 3 ♂♂ (LMCT), 1 ♂ (MRCD), 3 ♂♂, 9 spec. (VKCB), "CHINA, 1000-1300m, / Shaanxi, Qinling mts, / XUNYANGBA (6 km / E, 23.v.-13.vi.2000, / Vít Kubáň leg. [printed]". - **Sichuan:** 1 ♀ (NHMB), "Wassuland / Bzk. Sankiangkou / W Szechuan, China / Coll. H. Becker [printed]".

**Diagnosis.** Oblong oval, moderately convex, glabrous, shining, dark brown to blackish brown, clypeus lateral margins usually reddish brown, legs and antennae brown; body size: 4.8-7.4 mm. Further description is focused on differences from characters of *P. maderi* as presented above.

Head with frontoclypeal suture even less distinct compared to *P. maderi*; punctures on head coarser than those in *P. maderi* (but not as deep and coarse as in *P. murensis*).

Epipharynx (Fig. 51). No significant differences from *P. maderi*.

Pronotum widest behind middle, lateral margins arcuate anteriorly as well as posteriorly; posterior corners truncate, not emarginate; lateral border very wide not only anteriorly, reaching at least middle of posterior truncation and only slightly narrowed there. Double punctuation along lateral margin with larger punctures less numerous (compared to *P. maderi*), and shallower (compared to *P. murensis*).

Scutellum exerting no important differences from *P. maderi*.

Elytra: punctures in discal intervals slightly finer compared to those in *P. maderi*, but yet distinct in both sexes.

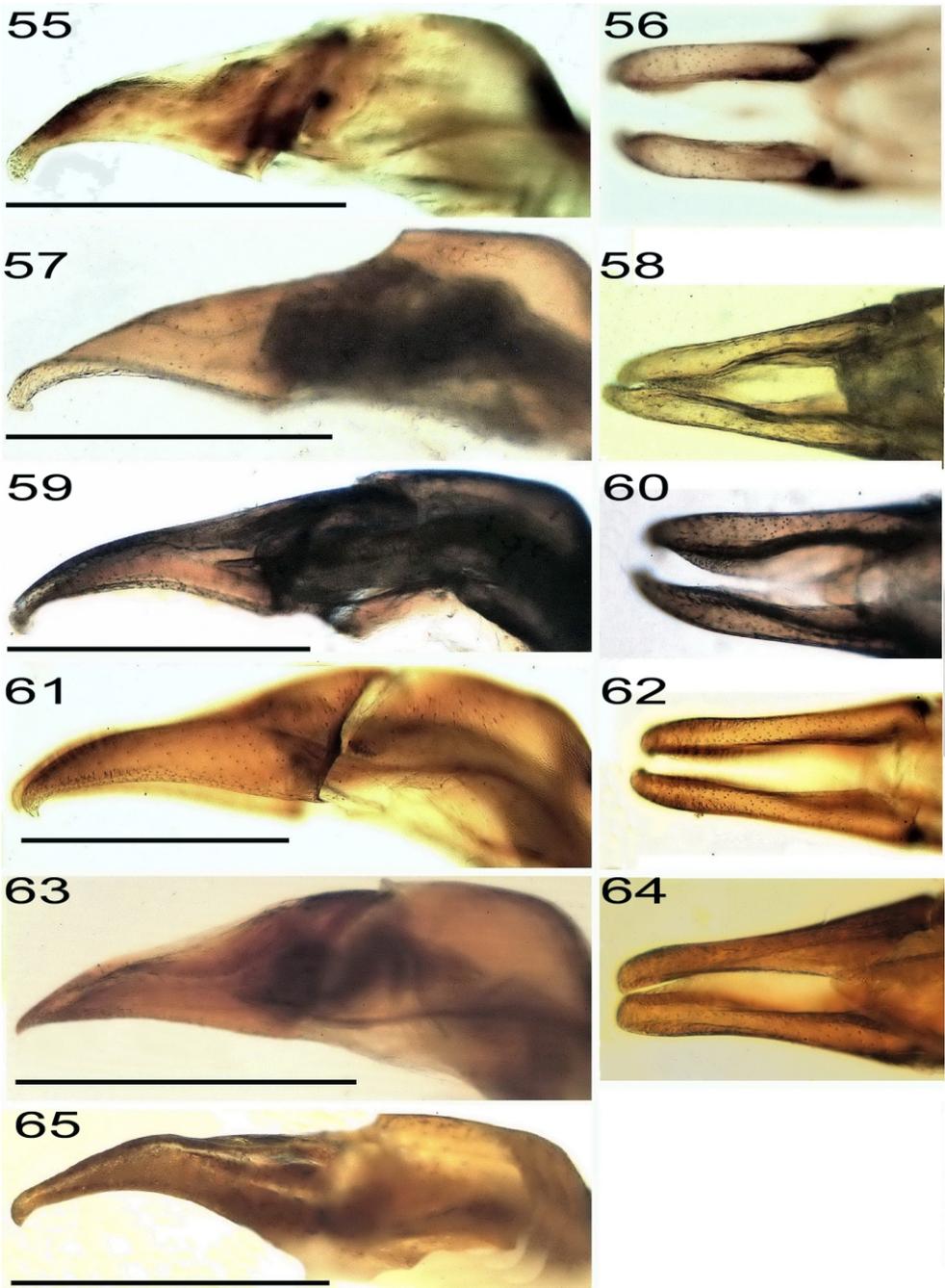
Legs in dorsal view: superior mesotibial spur shorter than mesotarsomeres 1 and 2 combined, inferior mesotibial spur shorter than basal mesotarsomere; superior metatibial spur only moderately longer than basal metatarsomere, not reaching half-length of metatarsomere 2.

Ventral side (Fig. 9) exerts important difference from *P. maderi*: macrosetation of abdominal ventrites without considerable difference between lengths of macrosetae situated laterally and those occurring in middle areas.

Aedeagus as in Figs. 59-60.

**Sexual dimorphism.** The smaller punctures on the head are more distinct in males, less distinct and more differentiated in size in females. The larger punctures on the pronotum are evenly distributed in males, unevenly distributed in females. The metaventral plate longitudinal furrow is more distinct and surrounded by a flat area in males, less distinct and surrounded by a moderate impression in females.

**Variability.** Based on the type material of the new species, the body size ranges from 4.8 to 7.4 mm. Blackish brown, nearly black individuals occur most frequently. There is also a variability of paler (brown) spots at clypeus lateral and/or anterior margins. The punctuation of dorsal surfaces is only slightly variable.



Figs. 55-65. *Paulianellus* spp., aedeagus in lateral view and parameres in ventral view: 55-56- *P. asahinai*, 57-58- *P. taiwanensis* sp. nov., 59-60- *P. neomaderi* sp. nov., 61-62- *P. laoticus* sp. nov., 63-64- *P. maderi*, 65- *P. murensis*. Scale lines: 0.5 mm.

**Differential diagnosis.** The following combination of characters is of importance for the identification of the species from other species of "Group 1": the head with frontoclypeal suture even less distinct compared to *P. maderi*; punctures on head coarser than those in *P. maderi* (but not as deep and coarse as in *P. murensis*), the pronotum widest at middle, pronotum posterior corners only truncate (not emarginate), and macrosetae on abdominal ventrites without considerable difference between lengths of macrosetae situated laterally and those occurring in middle areas. For the complete differentiation of all the six species of "Group" 1 one from another see the Key to Species below.

**Name derivation.** Based on the name of another Chinese species: *P. maderi*.

**Collecting circumstances.** Paratypes originating from Hutiao Gorge (Yunnan) were collected from horse dung on a pathway in an open, xerothermic landscape, that from Weishan (Yunnan) from human faeces and horse dung in a primary deciduous forest, that from Habashan (Yunnan) from sheep droppings and horse dung in a primary predominantly coniferous forest intermixed with oaks and *Rhododendron* trees and shrubs (all observations by DK and V. Kubáň). The paratype series from Xunyangba was collected from human faeces in woods (V. Kubáň, pers. comm, 2015). A single paratype from Lige (Yunnan) was taken from horse dung on a small pasture surrounded by *Rhododendron* shrubs (DK).

**Distribution.** China (Gansu, Shaanxi, Sichuan and Yunnan).

***Paulianellus taiwanensis* sp. nov.**

(Figs. 2, 8, 14, 17, 26, 29, 38, 41, 50, 57-58)

*Aphodius* (*Paulianellus*) *maderi*: Masumoto 1977b: 4, fig. 9; Masumoto et al. 2014a: 188, fig. 12; 2014b: 339.

**Type locality.** Taiwan, Fenchihu, 1400 m.

**Type material. China: Taiwan:** Holotype, ♂ (NMPC), "TAIWAN, IV-VI.[19]77 / Fenchihu, 1400m / J. & S. Klapperich [printed]". Paratypes: Allotype, ♀ and 1 ♀ (NMPC) and 2 ♂♂, 1 ♀ (MHNG), same data as holotype.

**Diagnosis.** Oblong oval, moderately convex, glabrous, shining, brown to dark brown, clypeus margins lighter, legs and antennae brown; body length: 5.9-6.2 mm. Further description is focused on differences from characters of *P. maderi* as presented above.

Head with frontoclypeal suture even less distinct compared to *P. maderi*; punctuation rather variable, larger punctures coarser and/or sparser compared to *P. maderi*.

Epipharynx (Fig. 50). No significant differences from *P. maderi*.

Pronotum widest behind middle, lateral margins considerably arcuate anteriorly and moderately arcuate posteriorly; posterior corners truncate, not emarginate; lateral border very wide not only anteriorly, reaching at least middle of posterior truncation and moderately narrowed there. Double punctuation along lateral margin consisting of irregularly arranged, more or less deep large punctures and regularly distributed fine punctures.

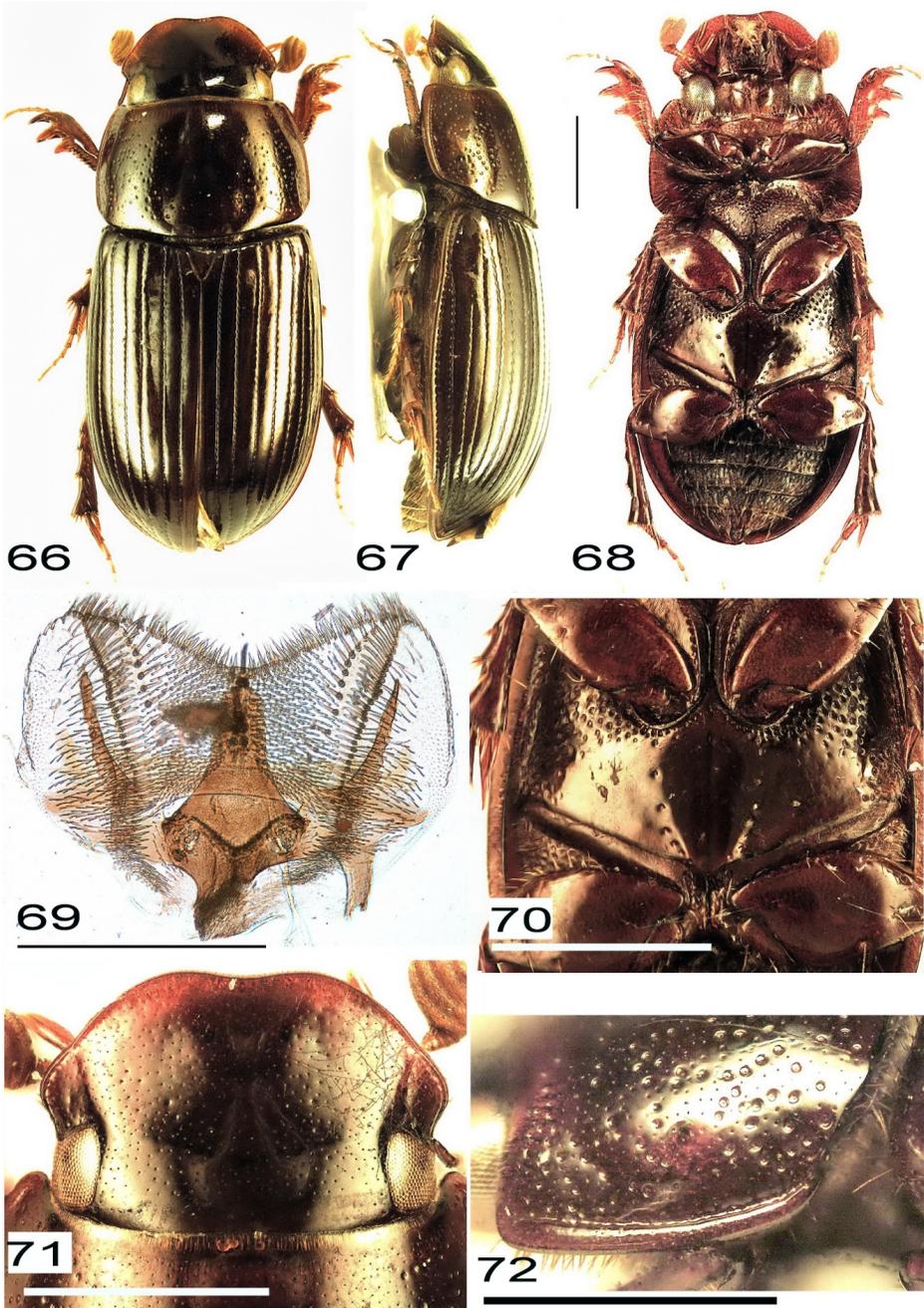
Scutellum exerting no important differences from *P. maderi*.

Elytra: punctures in discal intervals comparable to those in *P. maderi*.

Legs in dorsal view exerting no considerable differences from *P. maderi*.

Ventral side (Fig. 8) exerting no important differences from *P. maderi*.

Aedeagus as in Figs. 57-58.



Figs. 66-72. *Paulianellus maderi*, holotype, ♂. 66- dorsal view, 67- lateral view, 68- ventral view, 69-epipharynx, 70- metaventral plate, 71- pronotum in right lateral view, 72- head in dorsal view. Figs. 66-68, 70-72: scale lines: 1 mm; 69: scale line: 0.5 mm.

**Sexual dimorphism.** The head punctation is very unequal in males, sparser and finer in females. In males, punctures on the pronotum are very unequal in size, the larger punctures being present throughout the pronotum surface; the larger punctures are sparser and the smaller punctures are finer and sparser in females. The metasternal plate longitudinal furrow is more distinct and surrounded by a flat area in males, less distinct and surrounded by a moderate impression in females.

**Variability.** Based on the type material of the new species, the body size ranges from 5.9 to 6.2 mm. Dark brown individuals occur most frequently. There is also a variability of paler (brown) spots at clypeus lateral and/or anterior margins. The punctation of dorsal surfaces is only slightly variable.

**Differential diagnosis.** The following combination of characters is of importance for the identification of the species from other species of "Group 1": the pronotum is widest behind middle, the lateral border of the pronotum is very wide not only anteriorly and reaches at least middle of the posterior truncation. For the complete differentiation of all the six species of "Group 1" one from another see the Key to Species below.

**Name derivation.** Toponymic (adjective derived from the name of the country where the holotype was collected).

**Distribution.** China (Taiwan). Masumoto (1977) and Masumoto et al. (2014a, b) recorded the species under the name *Aphodius maderi* from several localities including Fenchihu (the type locality of *A. taiwanensis* sp. nov.).

#### KEY TO SPECIES OF *PAULIANELLUS* "GROUP 1"

The group includes species characterized as follows: anterior clypeus margin emarginate, elytra glabrous, without humeral denticles, tarsi nearly as long as (not longer than) tibiae.

- 1 (6) Pronotum widest behind middle. Its sides arcuate not only anteriorly, but also posteriorly.
- 2 (3) Most individuals reddish brown to castaneous, macrosetae on abdominal ventrites shorter than ventrites laterally and even missing medially. 4.7-6.4 mm. Japan, N. Korea (?), S. Korea (?). ..... *P. asahinai* (Nakane) sp. restit., comb. nov.
- 3 (2) Most individuals dark brown to nearly black, macrosetae on abdominal ventrites longer than ventrites, particularly laterally.
- 4 (5) Larger punctures on head coarser and deeper, particularly in males (Fig. 14), larger punctures at pronotum lateral margin more numerous, particularly in males (Fig. 26), superior metatibial spur reaching about 1/2 length of metatarsomere 2. 5.9-6.2 mm. China (Taiwan). ..... *P. taiwanensis* sp. nov.
- 5 (4) Larger punctures on head finer and shallower (Fig. 15), larger punctures at pronotum lateral margin less abundant, particularly in males (Fig. 27), superior metatibial spur only slightly longer than basal metatarsomere. 4.8-5.4 mm. China (Gansu, Shaanxi, Sichuan and Yunnan). ..... *P. neomaderi* sp. nov.
- 6 (1) Pronotum widest at middle, its sides arcuate anteriorly, but essentially straight posteriorly.
- 7 (8) Posterior corners of pronotum not only truncate, but also emarginate. 5.5-7.2 mm. Southeast Asia (Laos, Thailand). ..... *P. laoticus* sp. nov.
- 8 (7) Posterior corners of pronotum only truncate.
- 9 (10) Punctures on head less distinct (Fig. 20), Pronotum lateral border narrow, particularly posteriorly (Fig. 32), large punctures on pronotum shallow (Fig. 5), macrosetae on abdominal ventrites longer than ventrites only laterally. 4.8-7.0 mm. China (Anhui, Shaanxi, Sichuan, Xizang, Yunnan). ..... *P. maderi* (Balthasar)
- 10 (9) Punctures on head more distinct (Fig. 21), pronotum lateral border narrow, even posteriorly (Fig. 33), large punctures on pronotum considerably deeper (Fig. 6), macrosetae on abdominal ventrites longer than ventrites not laterally, but also in middle area. 6.1-7.0 mm. India (Darjeeling), Nepal. .... *P. murensis* (Stebnicka) comb. nov.

## DISCUSSION

The present work deals with members of the genus *Paulianellus*, with a special regard to species similar to *P. maderi*. Members of the genus occur in Asia only and can be found at relatively high altitudes above the sea level. Stebnicka (1986) successfully divided the genus into three groups, where *P. maderi* belongs to "Group 1". Her consideration was focused on (five) Nepalese species of the genus, but can be employed to the genus in general. This is quite not surprising when taking into account the fact that seven species have been recently known from the Palearctic Region (Dellacasa & Dellacasa 1986) including just five species known from Nepal. Dellacasa et al. (2014) established a new genus, *Odontacrossus* Dellacasa, Král, Dellacasa & Bordat, 2014, with its type species *O. obenbergeri* (Balthasar, 1932), into which they also included a member of the genus *Paulianellus*, "Group 3" sensu Stebnicka (1986) - *Paulianellus trisuliensis* (Stebnicka, 1986). The question of the generic classification of other three representatives of the genus *Paulianellus*, "Group 2" and "Group 3" sensu Stebnicka (1986), remains to be solved.

We took the advantage of the facts mentioned in the previous paragraph and studied only members of "Group 1" with disregarding "Group 2" and "Group 3". For practical reasons, the characterization of "Group 1" is outlined under the heading of the Key to Species presented above.

Our study resulted in descriptions of three new species and revalidation of the Japanese species *P. asahinai*. We presented data on the distribution of particular species, which we considered as reliable based on our own experience. It is, however, to note that our distributional data concerning this species include North Korea (?) and South Korea (?). We did not have a chance to study any Korean specimens, but we believe that information about the occurrence of *P. maderi* in Korea (Stebnicka 1980; Kim 1987, 2012; Dellacasa & Dellacasa 1986) are more likely to concern *P. asahinai*, which has been erroneously considered to be synonymous with *P. maderi* since 1964 till the time being.

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