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A contribution to knowledge of the aedeagal morphology and Chinese species of the genus *Agathidium* Panzer, 1797 (Coleoptera: Leiodidae: Leiodinae). Part IV - subgenus *Cyphoceble* Thomson, 1859

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Abstract. *Agathidium* (*Cyphoceble*) *undulatum* sp. nov. (China, Sichuan), *A.* (*C.*) *lineatum* sp. nov. and *A.* (*C.*) *vesiculum* sp. nov., from China (Yunnan) are described and compared with similar species. Types of basal part of aedeagus in *Agathidium* of the Old World are classified. The Chinese species of the subgenus *Cyphoceble* Thomson, 1859 are keyed. The catalogue of all the known species of the subgenus *Cyphoceble* is provided in the appendix.

INTRODUCTION

The present paper continues the previous articles dealing with Chinese *Agathidium* (Švec 2016, 2017a, 2017b). It follows the concept of the genus *Agathidium* presented by Angelini (1993, 1995, 2004, 2010) and Perreau (2016) for the advantage of the practical attitude to sorting out and distinguishing the individual species within subgenera.

The genus *Agathidium* Panzer 1797 is the most numerous genus within Leiodinae and Leiodidae at all. It comprises 849 species described up to now. The majority of the species are known from Asia. Within the Asian region the richest country is China regarding the amount of *Agathidium*. Altogether 154 *Agathidium* species have still been known from the country not counting species described here. Therefore, the present number of the *Agathidium* species is 852 while the Chinese *Agathidium* species are 157 in number.

The smallest *Agathidium* subgenera are *Chaetoceble* Sainte Claire Deville, 1899 with 1 species, *Euryceble* Hlisnikovský, 1964 with 7 species and *Cyphoceble* having only 31 species including three species newly described below. Among them, 14 species are known from continental China - four from Yunnan, three from Sichuan, two from Hubei (one is known from Sichuan, Yunnan and also Hubei) and four from Taiwan. The actual known number of the *Cyphoceble* species is difficult to state as all the known American species that were treated in monographs elaborated by Wheeler & Miller (2005) and Miller & Wheeler, (2005), have not been sorted under subgenera. The cited authors who worked out the American fauna of the genus *Agathidium* did not follow the valid taxonomy of the genus divided into subgenera, but they assigned the American species to species groups. Without revisions of the types it is practically

impossible to reliably attribute American species to the subgenera that were established in the last 160 years and recognized by all the other authors because of the incomparable characters made for establishing of the species groups. It is obvious that both systems - on one hand using subgenera and on the other hand assigning species to the species groups are not compatible. The American species groups cannot be completely applied to the fauna of the Old world and conversely without further deep studies in the genus.

Park, Leschen & Ahn (2013) tried to help to solve the phylogenetic relationships of the genus *Agathidium* and the allied genera and also help to solve the phylogeny within the genus *Agathidium* recently. Despite the achieved results, the issue is still open and remains almost a virgin field for further study. This statement is developed and substantiated by the evidence in the part Discussion.

MATERIAL AND METHODS

This paper is based on the material collected in China by Vasily Grebennikov (Ottawa, Canada) and by Jiří Hájek (NMPC) and Jan Růžička (Praha, Czech Republic).

Abbreviations of the collections:

CNCO Canadian National Collection of Insects, Arachnids and Nematodes, Ottawa, Canada;
IZAS Institute of Zoology, Chinese Academy of Science, Beijing, China,
NMPC National Museum, Praha, Czech Republic
ZSPC Zdeněk Švec, private collection, Praha, Czech Republic.

The abbreviations used in the enclosed catalogue of the subgenus *Cyphoceble* are provided in the relevant appendix.

The examined material was compared with the type and other *Agathidium* material deposited in ZSPC and in NMPC.

Collecting data cited in quotation marks are taken from the locality labels accompanying the examined examples. The individual lines from the original locality labels are separated by a slash; the individual labels are separated by double slash in this work. Each holotype or paratype is indicated by a red label bearing the status of the specimen (holotypus or paratypus respectively) name of the species, the name of the authors, the year 2019 and attached to the same pin as the relevant specimen.

The specimens were relaxed in 4% acetic acid first, then rinsed in water and dissected in a drop of water. The male genitalia were mounted in Arabic gum on the same label as the relevant specimen; the female genitalia (spermatheca) in polyvinylpyrrolidine (Lompe 1986) or in Euparal on a transparent label added to the same pin as the dissected specimen or directly on the label near the relevant specimen.

The descriptions are based on the holotypes. Variability is mentioned in the paragraph "Variation" if necessary and includes features exhibited by the paratypes. Also the important characters of the sexual dimorphism are included in the mentioned paragraph. Those characters that seem to be usual in the genus - e.g. presence of short recumbent setae in dorsal punctures, microsculpture of venter, setosity on antennae, legs and venter are not mentioned in the descriptions.

The measurements of the total body length were taken from all specimens examined. Specific measurements of the individual body parts were taken from the holotypes only except of the data about the variation and the spermatheca. The measurements of morphologic body parts were measured to the first decimal place of millimetre, the measurements of the genitalia were measured to the second decimal place of millimetre.

The examined material was determined by the first author. The types have been deposited in NMPC, ZSPC and CNCO. Indication of the place of the deposition CNCO added to the locality data at the type material should be considered as temporary; it means that the holotypes and a part of the paratypes temporary deposited in CNCO will be eventually deposited in IZAS

Abbreviations of body parts and measurements:

AII-AXI	antennomeres II-XI.
TI-TIII	tarsomeres I-III.
AIII/AII	The ratio of the length or width of the antennomeres III:II, analogously ratios of others antennomeres.
L	Length.
W	Width.
L/W or W/L	Ratio between measurements

Terminology:

Supraocular carina = Antero-lateral raised marginal bead of head (e.g. Angelini 2004), i.e. carina at antero-lateral margin of head dorsum running from clypeus just above eyes (if present) caudally,

subocular line = line or even carina bordering eyes on ventral side, if present,

basal part of median lobe = median foramen (Park, Leschen & Ahn 2013),

median lobe = median lobe of aedeagus = tegmen,

lateral lines = lines connecting medially to mesoventral longitudinal carina running obliquely antero-laterally, if present.

KEY AND DESCRIPTIONS

Trying to enlarge the number of the characters used in the determination and/or morphological analyses we took into account also the presence or absence of the subocular line or even carina that can be detected in some *Agathidium* (we did not asses the other genera in this point of view).

We also propose to classify the aedeagi in *Agathidium* based on the shape of the basal part of the median lobe. Our experience ensures us that the shape of the basal part of the median lobe is very stable in the individual species. Obviously some very rare small exceptions exist. This part of the male genitalia can be straight, bent in various degrees and directions, twisted or knotted. Surprisingly some of the authors who presented the important basic works on the genus *Agathidium* (e.g. Hlisnikovský 1964, Wheeler & Miller 2005 and Miller & Wheeler 2005) completely omitted this character, neither mentioning the shapes nor presenting relevant part in figures. We want to draw more attention to the basal aedeagal shapes. We propose for the

purpose of the present part of our series concerning the Chinese *Agathidium* and the forthcoming works to sort the *Agathidium* aedeagus into seven basic types A-G (Tab. 1, Figs. 1-15).

It is necessary to take into account that without sufficient knowledge of the morphology of the American species, where the shapes of the aedeagus bases are not figured by Wheeler & Miller (2005) and Miller & Wheeler (2005), the aedeagal shapes presented below concern only the Old World *Agathidium.* It should be noted that similarly as almost any others morphological or taxonomical sorting also the presented classification of the aedeagal shapes is quite artificial with the weakness caused by huge variability of the shapes. Therefore some shapes can stand at the border of the two similar types. The purpose of the presented sorting is to enable determination of the species using keys and to make easier the searching of the correlations of the individual morphologic characters within the numerous and still confusing genus.

The types of the basal parts of the Old World *Agathidium* aedeagi known to us are as follows.

The basal part of the median lobe can be:

A - straight, long or short, truncate or rounded at the basal orifice;
B - feebly bent, the basal orifice opened obliquely away from median lobe;
C - bent in the shape of the letter J, the basal orifice opened in the direction toward ventral side of the median lobe;
D - narrowly or openly ring-shaped;
E - spiral-shaped twisted in the longitudinal axis of median lobe and/or laterally of the axis or also with proximal part twisted in reverse direction;
F - irregularly knotted in two or three dimensions;
G - spiral or irregular tightly or loosely shaped approximately in the horizontal direction in the comparison in view of the longitudinal axis of median lobe,

Examples of all the types mentioned above are presented on the Table 1.
The aedeagal type A is typical for the species of the subgenus *Neoceble* Gozis, 1886 and for *Cyphoceble* with only few exceptions - e.g. *A*. (*N*.) *kireitshuki* Perkovsky, 1990 (type C) from the Russian Far East, *A*. (*C*.) *geniculatum* Angelini & De Marzo, 1995 from Taiwan (type B), Chinese *A*. (*C*.) *vesiculum* sp. nov (type E) and *A*. (*C*.) *undulatum* sp. nov. (type G). Generally the type A with short basal part is much frequent than the same type with protracted basal part. The type A with short basal part can be detected rarely also in the subgenus *Agathidium* s.str. (roughly 10% of the species) The type A occurs rarely also in the subgenera *Microceble* Angelini & De Marzo, 1986 (e.g. *A*. (*Micr*.) *semiarcuatum* Angelini, 2000 and others belonging to the group species *grouvellei* - see Angelini 2004) and in the subgenus *Macroceble* Angelini, 1993. Some bizarre shapes of the aedeagi in some species of the subgenus *Macroceble* Angelini, 1993, which can be sorted under the type A standing a little aside *A*. (*Macr*.) *abominable* Angelini & De Marzo, 1981 from India, *A*. (*Macr*.) *fraternum* Angelini, 1992; *A*. (*Macr*.) *fungivorum* Angelini & De Marzo, 1989 from Thailand and *A*. (*Macr*.) *crinitum* Angelini & De Marzo, 1994 from Nepal (see Tab. 2).
Aedeagi of the types B-E were detected mainly in the subgenera *Agathidium* s.str., *Microceble* and *Macroceble*. The types F and G are less frequent but more variable within various subgenera (e.g. species in the Tab. 1)

Key to the identification of the Chinese species of the genus *Agathidium* Panzer, 1797, subgenus *Cyphoceble* Thomson, 1859 (the single Nepalese species of the subgenus *Cyphoceble* is included in the key as its occurrence in China is not quite impossible)

1 Length 4.5-5.1 mm, dorsum reddish or dark brown, apex of tegmen triangular, parameres shortened. 2
- Length 2.5-3.8 mm. Reddish or dark to black, apex of tegmen differently shaped. 4

2(1) Head at most with traces of microsculpture near eyes. AIII/AII = 2.4-3.0. 3
- Head and pronotum microreticulate. AIII/AII = 2.0. Head densely and strongly punctured. Aedeagus of type A, very similar to that in next species. Spermatheca slim, parallel-sided with bent distal part and twisted base. Length 4.5-5.1 mm. Taiwan..... *yushanicum* Angelini & De Marzo

3(2) Head with traces of microsculpture near eyes, pronotum with microreticulation. AIII/AII=3.0. Sides of tegmen concave before tip. Aedeagus of type A. Top of tegmen roof-shaped. Female not known. 4.8-5.1 mm. Taiwan. ..... *paracuminatum* Park & Ahn
- Head and entire pronotum without any microsculpture, elytra with slight transversally oriented microsculpture. Sides of tegmen convex laterally before *Tilia* leaf-shaped tip. Aedeagus of type B. Spermatheca a little broadened with bent distal part and swollen twisted basal part. 4.7-5.1 mm. China (Sichuan). ....*pseudoyushanicum* Cooter & Švec

4(1) Head and/or pronotum or even whole dorsum with double puncturation, punctures at least of two distinctly differentiable sizes. 5
- At least head with simple puncturation or with punctures of almost same sizes hardly distinguishable. 9

5(4) Antennae uniformly testaceous or with antennal club very slightly darker than rest of antenna. 6
- Antennae with club distinctly dark or with antennal segments 7°-11° dark 8

6(5) Elytra sparsely but distinctly double punctured. AIII:AII=1.7-2.0. 7
- Elytra very finely and very sparsely simply, hardly detectable, punctured. AIII:AII=1.6. Basal part of aedeagus variable, of type E (Fig. 6), tegmen without any nipple apically in dorsal view. Spermatheca a little broadened with bent distal part and swollen twisted basal part. 3.1-3.4 mm. China (Hubei, Sichuan). .....*wangianum* Angelini

7(6) Aedeagus of type B (Fig. 29), tegmen apically *Tilia*-leaf shaped with distinct nipple apically in dorsal view. Dark brown, spot on front, clypeus, pronotal margins and narrow strips along suture, lighter. Length 3.0 mm. China (Yunnan). ..... *lineatum* sp.nov.
- Aedeagus of type E (Fig. 34), tegmen evenly narrowed to tip with very small unobtrusive nipple. Elytra chest-nut coloured, usually darker than head and pronotum. Spermatheca with bladded-shaped basal part (Fig. 33). 2.3-2.6 mm. China (Yunnan). ..... *vesiculum* sp. nov.

8(5) Antennal segments 7°-11° dark, AIII/AII = 2, sutural striae clearly impressed, extending beyond middle of elytra, temple $^{3}/_{5}$ length of the eye, width ratio of pronotum/head = 1.44, membranous wings absent. Length 3.45 mm. Spermatheca cylindrical with short bent distal part and twisted basal part. Male unknown. Taiwan. ..... *inquisitor* Angelini & De Marzo
- Antennae with club dark, AIII/AII = 1.5, sutural striae clearly impressed, confined within the apical half of elytra, temple ½ length of the eye, width ratio of pronotum/head = 1.75, membranous wings present. Aedeagus of type A, tegmen conically tapered to shortly rounded apex in dorsal view. Female not known. Length 3.8 mm. China (Yunnan). .....*aeneonigrum* Angelini

9(4) AIII:AII = 1.4. Sutural striae long, confined within the apical ⅔ of elytra. Aedeagus of type A, tegmen with pointed short process apically in dorsal view. Female unknown. Length 2.9 mm. China (Hubei). .... *wutangshanense* Angelini
- AIII:AII=1.8-3.1. Sutural striae short, confined within the apical $^{1}/_{5}$ or ½ of elytra. Aedeagus of type A, B or E, tegmen lacks any terminal process. 10

10(9) Aedeagus of type A or B. AIII:AII=1.8. 11
- Aedeagus of type G (Fig. 24). AIII:AII=2.5-3.1. Dorsum without any microreticulation. Puncturation sparse, punctures very fine of almost same size hardly differentiable. Antennae uniformly yellow-reddish. Spermatheca slim, C-shaped with twisted base (Fig. 21). Length 3.2-3.4 mm. China (Sichuan). .... *undulatum* sp. nov.

11(10) Antennae uniformly testaceous, sutural striae superficial, confined within the apical $^1/_5$ of elytra, temple ½ length of the eye; microreticulation present on head but hardly evident, superficial and uniform on pronotum, width ratio of pronotum/head = 1.45, membranous wings absent, dorsum reddish-brown, tarsal formula ♀ 4-4-4, size smaller (2.5-2.8 mm). Aedeagus of type B, spermatheca with subcylindrical basal part and twisted distal part. Taiwan. .....*geniculatum* Angelini & De Marzo.
- Antennal segments VI-VIII dark, sutural striae impressed, confined within the apical half of elytra, temple less than ½ length of the eye, head and pronotum without microreticulation, width ratio of pronotum/head = 1.3, membranous wings present, dorsum black, tarsal formula ♀ 5-4-4, size larger (3.2-3.3 mm). Aedeagus of type A. Spermatheca with subcylindrical basal part and simply bent distal part. Nepal. .... *glabrum* Angelini & De Marzo

Agathidium (*Cyphoceble*) *undulatum* sp. nov.

(Figs. 19-24)

Type material. Holotype (♂): "P.R. CHINA, Sichuan,/ Emei Shan, N29°33'56"/ E103°21'24", 26.v.2011,/ 1829m,/ sift06, V.Grebennikov", (CNCO). Paratypes: (5 ♂♂, 4 ♀♀): the same data (CNCO, ZSPC); (2 ♂♂, 6 ♀♀): "P.R. CHINA, Sichuan,/ Emei Shan, N29°34'46"/ E103°22'04", 27.v.2011, 1463m,/ sift07, V. Grebennikov", (CNCO, ZSPC);

Description. Length 3.2-3.4 mm. Length of body in holotype 3.2 mm, maximum length of head 0.6 mm, of pronotum 0.9 mm, of elytra 1.7 mm; width of head 1.3 mm, pronotum 1.9 mm, elytra 1.9 mm, antenna 1.2 mm, aedeagus 1.00 mm. Length of spermatheca 0.25 mm. Shape of body as in figs 19, 22. Yellow-reddish, narrow strips along suture pronotal and elytral margins darker. Legs yellow-reddish. Antenna almost unicolorous yellow-red; AI and antennal club very slightly darker. Ventral surface yellow-red, margins of coxal holes, trochanters and femora darker.

Head. Broadest at the temples which are long, ratio of eye length to temple length = 1.5. Temples behind eye smooth supraocular carina present, subocular carina absent. Supraocular carina very low. Clypeal line very fine, superficially impressed. Clypeus straight not emarginate. Shape of head as on Fig. 20. Antennal club 5-segmented. Ratio of length of antennomeres II-XI (AII=1.0) = 1.0-2.5-1.0-0.8-0.8-0.9-0.7-1.5-1.6-2.3. Ratio of width of AII-AXI (AII=1.0): 1.0-0.9-0.8-0.8-0.8-1.3-1.2-2.0-2.0-2.0. Ratio of width:length of AII-AXI= 0.8-0.3-0.6-0.8-0.8-1.2-1.4-1.1-1.0-0.9. Puncturation very fine and superficial, punctures very small almost of the same size, size differences between punctures hardly detectable. Punctures separated by 4-6 or more times their diameters. No microsculpture evident.

Pronotum. With simple puncturation. Punctures very fine small weak, puncturation much sparser than those on head, separated by about 8-10 or more times their diameter. Posterior and anterior pronotal angles broadly rounded margin between them almost straight laterally seen. No microsculpture evident. Shape of pronotum as in figs 19, 22.

Elytra. With simple puncturation. Punctures very fine small weak rare, much sparser than those on pronotum, separated by about 8-10 or more times their diameter. Several rare larger

punctures distributed close to suture. Sutural striae are clearly impressed from apex to middle.

Mesoventrite. Longitudinal carina lacking, lateral lines developed, complete. Caudal part deepened.

Metaventrite. A little convex medially covered by lightly coloured recumbent setae. Without femoral lines, without other specific characters. Membranous wings vestigial.

Legs. Tarsal formula 5-5-4 in male, 4-4-4 in female. Basal segment of pro- and mesotarsi slightly dilated in male, simple in female. Posterior margins of metafemora simple linear in both sexes. All tibiae slim.

Genitalia. Aedeagus of type G with unusually waved basal part (Figs. 23-24). Operculum very narrow pyramid shaped with widened base. Spermatheca slim with short simply curved distal part, with twisted basal part (Fig. 21).

Variation. The length ratio of antennomeres III:II varies in the range 2.5-3.1. Some of the paratypes are lightly chest-nut coloured; in this case elytra possess light strip along suture.

Etymology. The name draws the attention to the unusually waved basal part of the aedeagus (Latin undulatus means waved in English).

Differential diagnosis. *Agathidium* (*Cyphoceble*) *undulatum* sp. nov. is similar to *Agathidium* (*C.) geniculatum* Angelini & De Marzo 1995 from Taiwan. It differs in the larger size, larger length ratio 3rd/2nd antennal segment, longer and stronger sutural striae and mainly by the shape of the both male and female genitalia.

Agathidium (*Cyphoceble*) *lineatum* sp. nov.

(Figs. 25-29)

Type material. Holotype (♂): "CHINA: YUNNAN Prov./ Gaoligong Mts NNR, 2.1 km E of/ Kongshu vill., 25°43.18'N,/ 98°39.35'E,/ J. Hájek & J. Růžička leg.// (Ch27) 1.vii. 2016; 2100 m, sift/ #18, wet debris in bamboo grove,/ narrow valley with brook,/ near small farm", (NMPC). Paratype (1 ♂): the same data (ZSPC).

Description. Length 2.8-3.0 mm. Length of body in holotype 3.0 mm, maximum length of head 0.6 mm, of pronotum 0.8 mm, of elytra 1.6 mm; width of head 1.2 mm, pronotum 1.7 mm, elytra 1.8 mm, antenna 1.0 mm, aedeagus 0.41 mm. Shape of body as in Figs. 25, 27. Dark brown, spot on front, clypeus, pronotal margins and narrow strips along suture, lighter. Legs and antenna reddish, antenna almost unicolorous AIX and AX a very slightly infuscate. Ventral surface yellow-brown, margins of coxal holes, trochanteres and metaventrite darker.

Head. Broadest at the temples which are approximately half as long as eye length, ratio of eye length to temple length = 1.9. Temples behind eye smooth supraocular carina present, subocular carina absent. Supraocular carina very low. Clypeal line very fine, superficially impressed. Clypeus straight not emarginate. Shape of head as on Fig. 26. Antennal club 3-segmented. Ratio of length of antennomeres II-XI (AII=1.0) = 1.0-2.1-0.8-0.8-0.8-0.8-0.6-1.2-1.4-2.5. Ratio of width of AII-AXI (AII=1.0): 1.0-0.8-1.0-1.2-1.3-1.8-1.8-2.7-3.0-2.7. W/L of AII-AXI= 0.6-0.2-0.8-0.9-1.0-1.4-1.8-1.3-1.3-0.6. Puncturation double, fine, punctures separated by about 3-6 times their diameters. Some distinctly smaller punctures interposed. No microsculpture evident.

Pronotum. With double puncturation. Punctures fine small weak, puncturation sparser than those on head, separated by about 5-8 times their diameter. Posterior and anterior pronotal angles undetectable, lateral outline broadly rounded laterally seen. No microsculpture evident. Shape of pronotum as in Figs. 25, 27.

Elytra. With double puncturation. Punctures fine small weak rare, separated by about 4-6 times their diameter. Several rare smaller punctures interposed. Sutural striae are clearly impressed from apex to anterior third of length.

Mesoventrite. Longitudinal carina lacking, lateral lines developed, complete. Caudal part deepened.

Metaventrite. Flat. Without femoral lines, without other specific characters. Membranous wings vestigial.

Legs. Tarsal formula 5-5-4 in male, female unknown. Basal segment of pro- and mesotarsi is slightly dilated in male. Posterior margins of metafemora simple, linear. All tibiae slim.

Genitalia. Aedeagus of type B (Figs. 28-29). Operculum U-shaped.

Variation. The length ratio of antennomeres III:II varies in the range 1.9-2.1.

Etymology. The name draws the attention to the completely developed lateral lines on mesoventrite (Latin word linea means English line).

Differential diagnosis. *Agathidium* (*Cyphoceble*) *lineatum* sp. nov. can be compared to *Agathidium* (*C*.) *wangianum* Angelini, 2002 from China (Hubei, Sichuan) and *A*. (*C*.) *vesiculum* sp. nov. in the similar size, type of head puncturation presence and length of sutural striae. The new species differs from *A*. (*C*.) *wangianum* by distinctly double punctured elytra, which are almost impunctate in *A*. (*C*.) *wangianum*. All the mentioned species differ from each other by the shape of the genitalia.

Agathidium (*Cyphoceble*) *vesiculum* sp. nov.

(Figs. 30-35)

Type material. Holotype (♂): "P.R. China, Yunnan E// slope N Gaoligongshan, N27º46.8′ E098º33.1′"// 12.-15. vi.2009, 2000-/ 3000m, sifting 1-7/ V.Grebennikov", (CNCO). Paratypes: (1 ♂, 8 ♀♀): the same data (CNCO, ZSPC); (1 ♀): "P.R. China, Yunnan E/ slope N Gaoligong-/shan, N27º47´51.7′′/ E098º34´56.4′′// 01.vi.2010/ 2100m, sifting 25/ V.Grebennikov", (CNCO); (1 ♂, 1 ♀): "P.R. China, Yunnan E/ slope N Gaoligong-/shan, N27º45´40.8′′/ E098º35´34.5′′// 02.vi.2010/ 2600m, sifting 26/ V.Grebennikov", (CNCO); (5 ♂♂, 4 ♀♀, 11 specimens sex indet.): "P.R. China, Yunnan E/ slope N Gaoligong-/shan, N27º45´40.8′′/ E098º36°3.2′′, 2536 m// 3.vi.2010/ sifting 27/ V.Grebennikov", (CNCO, ZSPC).

Description. Length 2.3-2.6 mm. Length of body in holotype 2.4 mm, maximum length of head 0.4 mm, of pronotum 0.7 mm, of elytra 1.3 mm; width of head 1.0 mm, pronotum 1.4 mm, elytra 1.4 mm, antenna 0.8 mm, aedeagus 1.04 mm, spermatheca 0.18-0.19 mm. Shape of body as in Figs 30, 33.

Elytra chest-nut coloured, head and pronotum light chest-nut. Legs and antenna reddish, antenna almost unicolorous AIX and AX a very slightly infuscate. Ventral surface light red-brown, margins of coxal holes and tibial margins darker.

Head. Broadest at the temples which are approximately half as long as eye length, ratio of eye length to temple length = 1.9. Temples behind eye with some seta supraocular carina present, subocular carina absent. Supraocular carina very low. Clypeal line very fine, superficially impressed. Clypeus straight not emarginate. Shape of head as on Fig. 31. Antennal club 3-segmented. Ratio of length of antennomeres II-XI (AII=1.0) = 1.0-2.0-0.9-0.8-0.6-0.9-0.6-1.3-1.3-2.2. Ratio of width of AII-AXI (AII=1.0): 1.0-0.8-0.8-1.0-1.0-1.3-1.3-2.2-2.3-2.3. W/L of AII-AXI= 0.7-0.3-0.6-0.9-1.2-1.1-1.8-1.1-1.2-0.7. Puncturation double, fine, larger punctures separated by about 2-4 times their diameters. Some distinctly smaller punctures interposed. No microsculpture evident.

Pronotum. With double puncturation. Punctures fine, puncturation sparser than those on head, separated by about 5-8 or more times their diameter. Posterior and anterior pronotal angles undetectable, lateral outline broadly rounded laterally seen. No microsculpture evident. Shape of pronotum as on Figs 30, 33.

Elytra. With double puncturation. Punctures distinctly stronger and larger than those on head and pronotum, separated by about 4-5 times their diameter. Toward suture, puncturation stronger and denser. Many smaller punctures interposed, separated by about 3-5 or more times their own diameter. Sutural striae are clearly impressed from apex to half elytral length.

Mesoventrite. Longitudinal carina lacking, lateral lines developed, shortened. Caudal part deepened.

Metaventrite. Flat. Without femoral lines, without other specific characters. Membranous wings vestigial.

Legs. Tarsal formula 5-5-4 in male, 4-4-4 in female. Basal segment of pro- and mesotarsi distinctly dilated in male. Posterior margins of metafemora simple, linear. All tibiae slim.

Genitalia. Aedeagus of type E (Figs. 34, 35). Operculum oval membranous, with longitudinal line. Spermatheca with bladder-shaped basal part and with simply bent distal part (Fig. 32).

Variation. The length ratio of antennomeres III:II varies in the range 1.7-2.0. Some of the paratypes with completely lightly coloured unicolorous antenna and/or dorsum.

Etymology. The name draws the attention to the shape of the basal part of spermatheca (Latin word vesicula means English bladder).

Differential diagnosis. *Agathidium* (*Cyphoceble*) *vesiculum* sp. nov. can be compared with *A*. (*C*.) *lineatum* sp. nov. in the similar size, double puncturation of dorsum, presence and length of sutural striae. It differs by the shape of the male genitalia which resembling *A*. (*C*.) *wangianum* Angelini, 2002. The new species differs from *A*. (*C*.) *wangianum* by distinctly punctured elytra, by the strongly narrowed tegmen toward apex in lateral view and also by the bladder shape of the basal part of spermatheca.

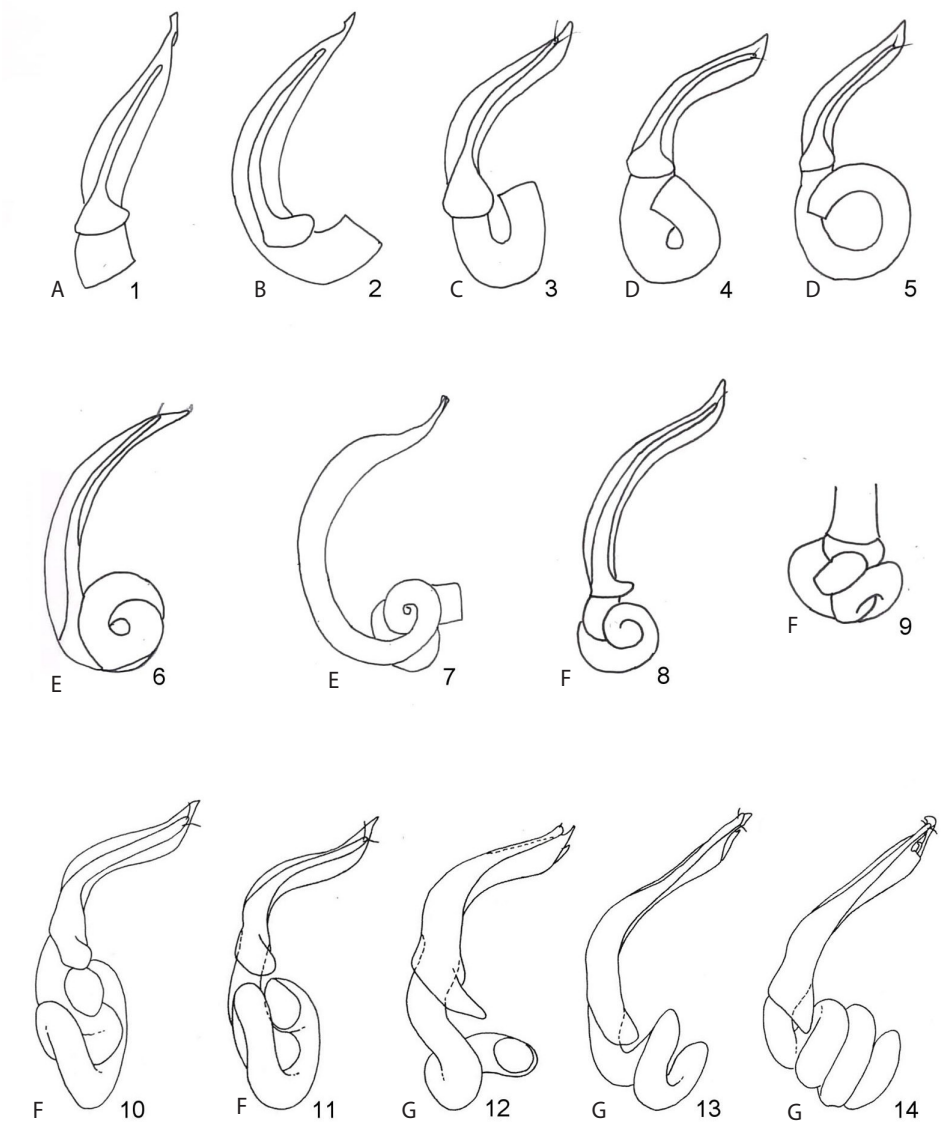
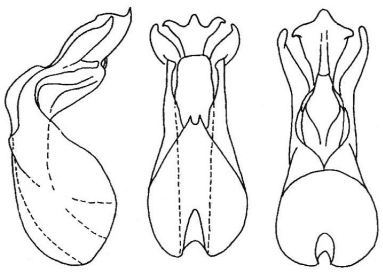


Table 1. Types A-F of aedeagus in the genus *Agathidium*. Figs 1-8 and 10-14: aedeagus in lateral view; Fig. 9: base of aedeagus dorsally. 1- type A: *Agathidium* (*Cyphoceble*) *paracuminatum* Park & Ahn, 2014; 2- type B: *A*. (*C*.) *pseudoyushanicum* Cooter & Švec, 2011; 3- type C: *A*. (*Macroceble*) *bicornigerum* Švec, 2017; 4- type D: *A*. (*Agathidium*) *circulum* Švec, 2017; 5- type D: *A*. (*A*.) *cephalotum* Švec, 2017; 6- type E: *A*. (*C*.) *wangianum* Angelini, 2002; 7- type E: *A*. (*C*.) *vesiculum* sp. nov.; 8- type F: *A*. (*A*.) *gordicum* Švec, 2016; 9- type F: *A*. (*A*.) *gordicum*; 10- type F: *A*. (*A*.) *dobaticum* Angelini & De Marzo, 1985; 11- type F: *A*. (*Macr.*) *breve* Angelini & De Marzo, 1981; 12- type G: *A*. (*A*.) *darjeelingense* Angelini & De Marzo, 1981; 13- type G: *A*. (*A*.) *madurense* Portevin, 1937; 14- type G: *A*. (*Microceble*) *schuhi* Angelini & De Marzo, 1995.



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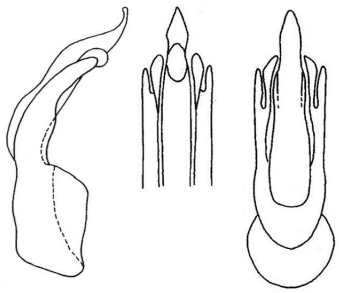

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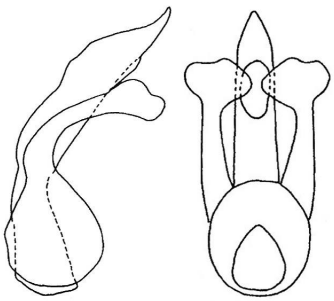

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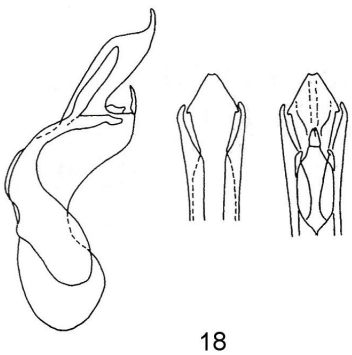

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Table 2. Examples of the variability of the aedeagal type A in *Agathidium*. Figs. 15-18: lateral, ventral and/or dorsal view. 15- *A*. (*Macroceble*) *abominable* Angelini & De Marzo, 1981; 16- *A*. (*Macr.*) *fraternum* Angelini, 1992; 17- *A*. (*Macr.*) *fungivorum* Angelini & De Marzo, 1989; 18- *A*. (*Macr.*) *crinitum* Angelini & De Marzo, 1994.

DISCUSSION

It is generally believed that the genus Agathidium seems to be polyphyletic. Therefore not only currently stated subgenera, or the genus *Agathidium* but also the tribe Agathidiini request a deep critical revision. The main problem lies in the great number of the species attributed to the genus that comprises so many taxons morphologically standing far apart. It is necessary to take into account that 999 known species (more than 800 of them were examined by the second author) have been ascribed to the Agathidiini tribe divided into 12 genera. This makes reflect the complexity of the tribe Agathidiini and the phylogenetic relationships between the various genera and *Agathidium* subgenera. It is also appropriate to admit that genera belong to those specific categories of subjective character frequently described with the sole purpose to make taxonomy and identification of the various taxa easier, not reflecting the phylogenetic aspects.

The studies so far conducted on different generic or sub-generic level taxa or groups of species have turned out to bring non-definitive approaches even if some of them were

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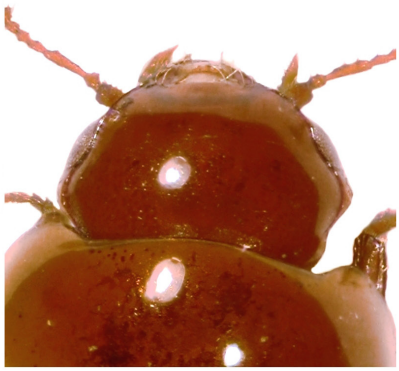

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Figs. 19-24: *Agathidium* (*Cyphoceble*) *undulatum* sp. nov. 19- body dorsal; 20- head dorsal; 21- spermatheca; 22- body lateral; 23- aedeagus dorsal; 24- aedeagus lateral.

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Figs. 25-29: *Agathidium* (*Cyphoceble*) *lineatum* sp. nov. 25- body dorsal; 26- head dorsal; 27- body lateral; 28-aedeagus dorsal; 29- aedeagus lateral.

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Figs. 30-35: *Agathidium* (*Cyphoceble*) *vesiculum* sp. nov. 30- body dorsal; 31- head dorsal; 32- spermatheca; 33 - body lateral; 34- aedeagus dorsal; 35- aedeagus lateral.

appropriate while some others could be a subject of serious doubts (Park & Ahn 2014). According to our opinion Park & Ahn (2014) replaced erroneously two *Agathidium* names following their own idea about the identity of the genera *Agathidium* and *Sphaeroliodes* Portevin, 1905 not having enough information and more over not seeing the types or not trying to obtain information from the authors of the taxa. On the other hand it is not important if the *Sphaeroliodes* should be synonymised to *Agathidium* under the present state of knowledge or not because the attitude to the tribus should be completely new. We believe that next studies most likely bring the status of *Spaeroliodes* back again.

The way to solve the phylogenetic and taxonomical problems have been indicated already in 2004 by Wheeler & Miller (2004) who expressed that "We recommend that were *Agathidium* and/or *Anisotoma* found to be paraphyletic, a more desirable solution would be to subdivide the genera into more evidently monophyletic groups than to synonymize them with other genera." Miller & Wheeler (2004) also mentioned some of the previous attempts and advances (e.g. Angelini and Peck 2000, Newton 1998) contributed to a more stable and a clear system and the identification of some genera of the Agathidiini tribe. They mentioned that the genus *Agathidium* is a huge group without a single unambiguous apomorphy. Its status is based on the presence of certain combination of generic characters with emphasizing of conspicuous exceptions. Miller & Wheeler (2004) compared the genus to other genera, noting how morphologic exceptions were frequent or how often the characters distinguishing the genera or the subgenera were vague. The comparison was conducted not only on American species but it is obvious that similarities and exceptions concerned also the species of the Palaearctic and fauna of the Oriental region.

Another good example illustrated the difficulties in seeking of any clear synapomorphy within Agathidiini is the genus *Gelae* Miller & Wheeler, 2004 known from the Northern and Central America. Miller & Wheeler (2004) provided following diagnosis of the genus that can be distinguished from other genera of Agathidiini by the combination of the following characters: 1. the antennae with 11 antennomeres and a distinct 3-segmented club (antennomere VII similar in size and shape to antennomere VI), 2. postocular temporum absent, 3. supraocular carina absent (or if indistinctly present anteriorly then not extending posterad of the eye), 4. anterior clypeal margin extending distinctly anterad of the anterolateral margins of the front, 5. elytra moderately to very finely and sparsely punctate with the punctures not forming longitudinal series.

The supraocular carina seems to be the most significant character although the European *Agathidium aglyptoides* Reitter, 1885 and the Asian *A. kyotoense* Angelini & De Marzo, 1990 also lack the supraocular carina, while some *Gelae* possess the carina, even it is not protracted behind eyes. Also the species of the genus *Liodopria* Reitter, 1909 lack supraocular carina but it is separated by distinctly shaped antennomeres although it is necessary to admit that some *Agathidium* possess a little similar shape of some antennomeres - especially AVII and AVIII. The authors differed also the genus *Gelae* from *Liodopria* Reitter, 1909 in the generic key of Agathidiini on the basis of the different tarsal formula of the female and the different distribution. While the first character is very variable in some genera (with females having tarsal formula 5- 4-4 or 4-4-4) the geographical distribution can be indicative. It suffices to recall the genus *Decuria* Miller & Wheeler, 2004 that comprises only two species are known

- one from Mexico, Costa Rica and Bolivia and second from Taiwan, South Korea and Japan The two species, although very distant geographically, are very similar in exoskeleton and aedeagal characters. Interesting distribution can be recognized regarding *Pseudoagathidium* Angelini, 1993. Nine species of the genus are known from the Afrotropical region, 1 from the Oriental region and one from Central America (West Indiens). This type and the reason of the distribution request deeper studies.

Although the diagnosis of *Gelae* can be applied without any doubts to majority at least of the *Agathidium* species, we believe that the genus *Gelae* has been erected rightfully (Švec 2018).

The completely different attitude was chosen by Park, Leschen & Ahn (2013). They analyzed by morphological phylogenetic methods beside ten *Agathidium* further 20 species of 11 other genera of Agathidiini, among them one of three known species of the genus *Sphaeroliodes*. Similarly as some others papers this suffers at least by the shortage of the assessed taxa. Only ten species of four subgenera of *Agathidium* were selected in from the known amount more than 800 species, letting aside all the American *Agathidium* (100 species), all the representatives of the numerous (61 species) and complicated subgenus *Macroceble*, *Euryceble* and also with one exception also the subgenus *Microceble* Angelini & De Marzo, 1986. Due to the small number of the species examined the different characters, especially in the genus *Agathidium* but not only that, were wrongly or partially interpreted or not considered at all. The main taxonomical conclusion, in the cited paper, was the proposal to synonymize *Sphaeroliodes* with *Agathidium.* According to our opinion the synonymy of the both mentioned genera without clearing of the status of subgenera and species groups is a small step that can inspire further studies but simultaneously a debatable step. Some important morphological characters of *Sphaeroliodes rufescens* Portevin, 1905 that was included in the mentioned analyses were not assessed in according to the factual state. As the example the characters of the head can be cited. The mentioned analyses includes altogether 72 characters, among them 28 of head. The assessment of the third of the characters concerning to head did not agree with the real status in *Sphaeroliodes rufescens.* They are as follows: - character 1: head shape, 2: head width, 3: compound eyes, 12: antennomere 7-10, 13: antennomere 8, 14: antennomere 11, 15: apical shape of antennomere 11, 26: labrum shape, 27: anterior margin of labrum. We did not compared analyzed characters of "Harmann's organ" (sic! - citation, instead of correctly Hamann's organ). It is obvious that the main problem stands not only in using of the limited number morphological characters but also in the interpretation.

It was stated in the paragraph Introduction, that despite the published phylogenetic analyses concerning the tribe Agathidiini recently, the phylogenetic relationships of the genus and the allied genera and also within the genus *Agathidium* is still open issue. It would be obvious when the tribus Agathidiini is more extensively assessed. The borders between *Agathidium* subgenera and between almost all Agathidiini genera are established on very weak base. We recognize the validity and justification of all the taxa on the generic level currently known nevertheless we are well aware that the distinction of the individual subgenera and genera within Agathidiini is based on very poor evidences mainly due to the enormous number of 999 species ascribed to the tribus and therefore the existence of taxa forming transitions between genera or subgenera.

The present paper deals with the subgenus *Cyphoceble* that can also be chosen as a very good example supporting the statements expressed in the previous text. The difference between the subgenera *Cyphoceble* and *Neoceble* Des Gozis, 1886 is not based on any qualitative but on the quantitative character - length of postocular tempora in the comparison to eye length. It is obvious that it is necessary to find new ways and choose and asses additional characters. New view on the genus requests at least studies not only the Old World fauna. As we are not able to study the substantial part of the American taxa not having the material at our disposal, we perceived the subgenus *Cyphoceble* in the traditional view. Although many morphological characters of the *Agathidium* species were pointed in some already published basic works (e.g. Angelini 2004, 2005 or Wheeler & Miller 2005, Miller & Wheeler 2005), it still seems to us that the present state of knowledge makes possible only premature results and therefore the solving of the taxonomy of Agathidiini still waits for next studies.

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Appendix 1 - The Catalogue of the subgenus *Cyphoceble* Thomson, 1859

New nomenclatorial proposals.

Park & Ahn (2014) renamed *Sphaeroliodes acuminatus* Švec, 2002 using new name *Agathidium paracuminatum* Park & Ahn, and also transferred *Sphaeroliodes rufescens* Portevin, 1905 in the genus *Agathidium* without attributing them to any subgenus. Apart from our opinion regarding the accuracy of the mentioned nomenclatorial act, we found some morphologic characters in those two species that enable one to attribute *Agathidium paracuminatum* Park & Ahn, 2014 to the subgenus *Cyphoceble* and *Agathidium rufescens* (Portevin, 1905) to the subgenus *Neoceble*.

subgenus *Cyphoceble* Thomson, 1859: 59. Type species: *Anisotoma staphylaeum* Gyllenhal, 1810 (= *Agathidium nigrinum* Sturm, 1807) (original designation).
Saccoceble des Gozis, 1886: 17. Type species: *Agathidium discoideum* Erichson, 1845 (original designation).
Distr.: Palaearctic and north Oriental region (31 species).

aeneonigrum Angelini, 2000b: 111. Type loc.: China, Yunnan, Lijiang. Type dep.: FAC-MSNG. Distr.: China (Yunnan).
angusticolle Reitter, 1898a: 53. Type loc.: Russia, east Siberia, Irkutsk. Type not in HNHM, MNHN and NHMW. Distr.: Russia (east Siberia).
annulatum Hisamatsu, 1957: 2. Type loc.: Japan, Honshu, Mt. Amagi. Type dep.: EUMJ.
notatum Hlisnikovský, 1964: 18. Type loc.: Japan, Nowato. Type dep.: BMNH. Distr.: Japan (Honshu, Shikoku, Kyushu).
arcticum Thomson, 1862: 54. Type loc.: Lapland. Lectotype dep.: MZLU.
rhinoceros Sharp, 1866: 451. Type loc.: Scotland, Rannoch. Type dep.: BMNH.
Distr.: Central and northern Europe (not Germany and Poland), Ukraine, Turkey?, Siberia, Mongolia.
belovi Perkovsky, 1990: 55. Type loc.: Russia, Far East, Amur Territory, Zeja Nat.Res. Type dep.: ZMAS. Distr.: Russia (Far East, Amur Region).
bockshini Hoshina & Park, 2003: 606. Type loc.: South Korea, Gangwon prov., Sangwonsa, Mt. Odaesan. Type dep.: CNUIC. Distr.: South Korea.
discoideum Erichson, 1845: 103. Type loc.: Austria. Type dep.: ZMUB.

discoideiforme Hlisnikovský, 1967: 244. Type loc.: Mongolia, Central Aimak, Ulan-Baator, Bogdo. Type dep.: HNHM. Distr.: Europe (not recorded from Belgium, The Netherlands, Denmark and British Isles), European Russia, east Siberia and Mongolia.

geniculatum Angelini & De Marzo, 1995a: 191. Type loc.: Taiwan, Nantou Hsien, Yushan National Park, Mun-Li Cliff. Type dep.: MHNG, FAC-MSNG, NMNS. Distr.: Taiwan.

glabrum Angelini & De Marzo, 1986c: 829. Type loc.: Nepal, Sankhuwasawa prov., Khosi, NE Kuwapani. Type dep.: MHNG, FAC-MSNG. Distr.: Nepal.

hayashii Hoshina, 1999b: 126. Type loc.: Japan, Honshu, Ishikawa Pref., Suzu-Jinja, Suzu-Shi. Type dep.: KUEC. Distr.: Japan (Honshu).

inquisitor Angelini & De Marzo, 1995a: 188. Type loc.: Taiwan, Taichung Hsien, Hsuehshan, Shan-Liu Gieu Hut. Type dep.: MHNG. - Distr.: Taiwan.

kataseae Hoshina, 2010: 6. Type loc.: Domoto, Utougi, Shizuoka city, Shizuoka Pref., Honshu. Type dep.: MNHA. Distr.: Japan (Honshu).

kurofuense Angelini & De Marzo, 1988b: 78. Type loc.: Japan, Honshu, Mt. Kurofu. Type dep.: MHNG, FAC-MSNG. Distr.: Japan (Honshu, Shikoku, Kyushu).

lineatum Švec & Angelini, 2019: 481. Type loc.: China, Yunnan Prov. Gaoligong Mts NNR, 2.1 km E of Kongshu vill., 25°43.18'N, 98°39.35'E, 2100 m. Type dep.: NMPC. Distr,: China (Yunnan).

microps Portevin, 1907a: 77. Type loc.: Japan, Honshu, Kyoto. Type not in MNHN. Distr.: Japan (Honshu), Russia (Far East, Amur region).

muryeongi Hoshina & Park, 2003: 601. Type loc.: South Korea, Gangwon prov., Sangwonsa, Mt. Odaesan. Type dep.: CNUIC. Distr.: South Korea.

nigrinum Sturm, 1807: 56. Type loc.: Austria. Lectotype dep.: ZMUB.

rubicundum Reitter, 1878: 47. Type loc.: Maramaros, Rahò. Type dep.: HNHM.

staphylaeum Gyllenhal, 1810: 569 (*Anisotoma*). Type loc.: Sweden. Type not in UZIU.

Distr.: Europe (not Albania and Ireland).

nipponicum Angelini & De Marzo, 1988b: 70. Type loc.: Japan, Honshu, Mt. Kongo. Type dep.: MHNG, FAC-MSNG, MRSN. Distr.: Japan (Honshu).

paracuminatum Park & Ahn, 2014 : 398.

acuminatus Švec, 2002: 192 (*Sphaeroliodes*). Type loc.: Taiwan, Nantou Pr., Hoshuanshan Exp. Stat., 24°09'N, 121°17'E, 3100 m. Type dep. HNHM.

Distr.: Taiwan

pseudoyushanicum Cooter & Švec, 2011b: 22. Type loc.: China, Sichuan Prov., Micang Shan Mountains, environs of Daba. Type dep.: MPCP, JCCH. Distr.: China, (Sichuan).

stygium Perkovsky, 1991b: 175. Type loc.: Russia, Far East, Magadan Region, Olsky Region, Chelomdzha. Type dep.: ZMAS. Distr.: Russia (Far East, Magadan Reg.).

subalatum Angelini & De Marzo, 1988b: 77. Type loc.: Japan, Honshu, Mt. Yokodake. Type dep.: HFC. Distr.: Japan (Honshu).

subcostatum Portevin, 1905: 420. Type loc.: Japan, Honshu, Alpes de Nikko. Type dep.: MNHN.

flabellum Hlisnikovský, *in litt.*, from Japan, Kyoto and Hakone, in BMNH. (*nomen nudum*, recorded by Angelini, 1995: 48). Distr.: Japan (Honshu, Shikoku, Kyushu, Rishiri Is.), South Korea.

tichomirovae Perkovsky, 1990: 57. Type loc.: Russia, Far East, Radde. Type dep.: ZMAS. Distr.: Russia (Far East, Jewish= Evrei region).

undulatum Švec & Angelini, 2019: 480. Type loc.: China, Sichuan, Emei Shan, N29°33'56" E103°21'24", 1829 m. Type dep.: CNCO. Distr.: China (Sichuan).

vesiculum Švec & Angelini, 2019: 482. Type loc.: China, Yunnan, E slope N Gaoligongshan, N27º46.8′ E098º33.1′", 2000- 3000m. Type dep.: CNCO. Distr.: China (Yunnan).

wangianum Angelini, 2002b: 487. Type loc.: China, Hubei, Wu Tang Shan, Fang hsien. Type dep.: FAC-MSNG. - Distr.: China (Hubei, Sichuan).

wutangshanense Angelini, 2002b: 488. Type loc.: China, Hubei, Wu Tang Shan, Fang hsien. Type dep.: FAC-MSNG. Distr.: China (Hubei).

yasudai Nakane, 1978: 131. Type loc.: Japan, Hokkaido, Mt. Kurodake. Type dep.: EUMJ. Distr.: Japan (Hokkaido).

yoshidai Hoshina, 1999b: 128. Type loc.: Japan, Shikoku, Tokushima Pref., Mt. Tôgû-san, Kamiyama-chô. Type dep.: KUEC. Distr.: Japan (Shikoku).

yushanicum Angelini & De Marzo, 1995a: 186. Type loc.: Taiwan, Nantou Hsien, Yushan National Park. Type dep.: MHNG, FAC-MSNG, NMNS, JCC. Distr.: Taiwan.

Abbreviations of the depository collections

BMNH	British Museum, Natural History, London, Great Britain
CNCO	Canadian Museum of Nature Collection, Ottawa, Canada
CNUIC	Chungnam National University Insect Collection, Daejeon, Korea
EUMJ	Ehime University, College of Agriculture, Matsuyama, Japon
FAC-MCSNG	F. Angelini Collection in Museo Civico di Storia Naturale "G. Doria", Genova, Italy
HFC	H. Franz Collection, Mödling, Austria
JCC	J. Cooter Collection, Hereford, Great Britain
KUEC	Faculty of Agriculture, Kyushu University, Fukuoka, Japan
MHNG	Muséum d'histoire naturelle, Geneva, Switzerland
MNHA	Museum of Nature and Human Activities, Hyôgo, Japan
MNHN	Muséum National d'Histoire Naturelle, Paris, France
MRSN	Museo Regionale di Scienze Naturali, Torino, Italy
MZLU	Museum of Zoology and Entomology, Lund University, Lund, Sweden
NHMW	Naturhistorisches Museum, Wien, Austria
NMNS	National Museum Natural Science in Taichung, Taiwan
NMPC	Národní Muzeum, Praha, Czech Republic
UZIU	Universites Zoologiska Institut, Uppsala, Sweden
ZMAS	Zoological Museum, Academy of Sciences, Petersburg, Russia
ZSPC	Z. Švec, Praha, Czech Republic

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