

Revision of the *Melolontha guttigera* Group (Coleoptera: Scarabaeidae) With a Key and an Annotated Checklist of the East and South-East Asian *Melolontha* Groups

CHUN-LIN LI,¹ PING-SHIH YANG,² AND CHUAN-CHAN WANG³

Ann. Entomol. Soc. Am. 103(3): 341–359 (2010); DOI: 10.1603/AN09088

ABSTRACT The Oriental *Melolontha guttigera* species group is revised with synopsis, a key to species, description of a new species, redescrptions of known species, remarks, illustrations, and distribution map. The *guttigera* species group is the only representative of the genus with its distribution extending southward from the eastern Himalayas to Indochina and crossing the equator to Java. Five species are known in this group, including a new species, *M. setifera*, from Myanmar. Lectotypes are designated for *Melolontha guttigera* Sharp and *Melolontha weyersi* Brenske. A key for the East and South-East Asian species group of the genus is provided. An annotated checklist of *Melolontha* species recorded in the region is updated in which several nomenclatural changes are proposed as follows: *Hoplosternus carinata* Brenske, *Hoplosternus malaccensis* Moser, *Hoplosternus incana* Motschulsky, and *Hoplosternus shanghaiana* Brenske are transferred to *Melolontha*; *Melolontha fuliginosa* Fairmaire and *Melolontha laticauda* Bates are transferred to *Exolontha*; *Hoplosternus laevipennis* Blanchard is transferred to *Tocama*; *Hoplosternus heydeni* Moser n. syn. = *Melolontha chinensis* (Guérin-Ménéville); *Melolontha nitidicollis* Blanchard n. syn. = *Melolontha indica* Hope; *Hoplosternus bifurcatus* Brenske n. syn. = *Melolontha fuscienanda* Ancy; *Melolontha albidiventris* Fairmaire n. syn. = *Tocama rubiginosa* (Fairmaire); *Hoplosternus squamulatus* Frey n. syn. = *Tocama laevipennis* (Blanchard); *Melolontha hualiensis* Kobayashi et Chou n. syn. = *Melolontha minima* Kobayashi.

KEY WORDS Scarabaeidae, Melolonthinae, *Melolontha*, East and South-East Asia

The genus *Melolontha* F., 1775 is a phytophagous scarab group constituting the type genus of the subfamily Melolonthinae. These scarabs occur throughout the Palearctic and Oriental regions between 68° N and 8° S. Economically, there are four to five species occurring in the plains or open lowland plantations across Eurasia. That are often recorded as crop pests as foliage-feeding adults and root-damaging larvae (Novák 1976, Liu et al. 1997).

Among the species of *Melolontha*, including those of *Oplosternus* Guérin-Ménéville (previously misspelled as *Hoplosternus*) species, there are some 35 species described from East and South-East Asia, roughly from the Himalayas to Japan including mainland China, Indochina, and Taiwan (≈62% of *Melolontha* species worldwide) with at least 20 undescribed species (C.-L.L., unpublished data). The greatest species diversity of *Melolontha* in the region is in southwestern China and northern Indochina, where habitats are significantly differentiated from sea level to ≈3,600 m

in elevation. However, most species are found in forests of mid-elevation montane areas.

Most species currently known were described by two French entomologists, Léon Fairmaire (Fairmaire 1878, 1889, 1891, 1896) and Charles Émile Blanchard (Blanchard 1851, 1871), and a German coleopterist, Ernst Brenske (Brenske 1894, 1896a, 1896b, 1900, 1903). The specimens were originally collected from China and India. World War II limited work by western researchers on Oriental *Melolontha* species due to the unavailability of type specimens deposited in Berlin (cf. Arrow 1946). Instead, Japanese researchers studied the fauna of the Japan archipelago to Taiwan (Nijijima and Kinoshita 1923; Nomura 1952, 1977a,b).

Recently, several efforts were made to study Oriental *Melolontha* species in the region (Li and Yang 1999; Keith 2004, 2006, 2008; Keith and Li 2005). Li and Yang (1999) proposed a new genus, *Clypeolontha*, to accommodate *Melolontha alboplagiata* Brenske with three new species of the genus discovered from Indochina. They also noted other genera from East and South-East Asia (*Oplosternus*, *Schoenherria* Burmeister, *Tocama* Reitter, and *Exolontha* Reitter) that are closely related to *Melolontha* and often confused with *Melolontha* shown in earlier taxonomic works made by European researchers listed above. Furthermore, the genus *Oplosternus* is now a junior synonym of

¹ Department of Life Science, National Taiwan University, Taipei City 107, Taiwan.

² Corresponding author: Department of Entomology, National Taiwan University, Taipei City, 107, Taiwan.

³ Corresponding author: Department of Life Science, Fu Jen Catholic University, Taipei County 24205, Taiwan (e-mail: gwennywang@gmail.com).

Melolontha (Bezdek 2006) based on a set of character states of male genitalia. The value of male genitalia has been recognized in the taxonomy of *Melolontha* species (Coca-Abia 2004, 2007), and the status of the other three genera are reconfirmed. Several species currently included in *Melolontha* are here moved to other genus (see checklist herein).

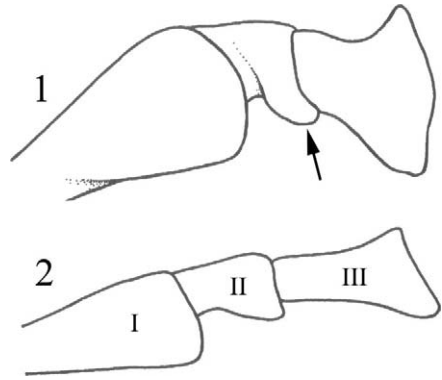
The oldest known scarab fossil belonging to the melolonthine lineages can be dated to the Lower Cretaceous (Krell 2006). Meanwhile, fossil and/or subfossil remains of two *Melolontha* species have been described. *Melolontha greithiana* Heer was found in Oligocene deposits in Greith, Switzerland. *Melolontha solitaria* Novák was described with only an elytron from Miocene deposits in the Czech Republic to be a doubtful species (Krell 2000). China was considered as one of the richest scarab fossil fauna in the world (Krell 2006). Interestingly, there is no fossil formally recorded as member of *Melolontha* so far from China as well as its neighboring areas where are the most diverse regions of extant *Melolontha* species and their close relatives.

The Palearctic and Oriental *Melolontha* generic groups are in need of comprehensive study to ascertain their phylogenetic relationship. Herein, we provide an annotated checklist of *Melolontha* species in the Oriental and east Palearctic regions and assign them to 10 species groups based mainly on male genitalia. We propose several nomenclatural changes resulting from comparison of type specimens of several species. In addition, we revise the *guttigera* species group, which is morphologically peculiar with its dorsal setiferous patches and different ecology compared with other species groups of *Melolontha*.

Materials and Methods

Specimens examined in this study were on loan from the following institutions (names of curators in parentheses) or from private collections: BMNH, The Natural History Museum, London, England (Maxwell Barclay and Malcolm Kerley); CCLI, Collections of Chun-lin Li, Taipei, Taiwan; ISNB, Institut Royal des Sciences Naturelles de Belgique, Bruxelles, Belgium (Patrick Grootaert, Martina Peeters); MNHN, Muséum National d'Histoire Naturelle, Paris, France (Jean Menier, Thierry Deuve); NSMT, National Science Museum, Tokyo, Japan (Shûhei Nomura); and ZMHB, Museum für Naturkunde der Humboldt Universität, Berlin, Germany (Manfred Uhlig, Johannes Frisch).

Morphological terms, particularly those of male genitalia, and measurements used in the description follows Li and Yang (1999, 2003). Specimens were studied and drawn using an MZ12.5 stereomicroscope (Leica, Wetzlar, Germany) equipped with a drawing tube. A measurement was made for the largest and smallest individuals of each species. The body length was measured from the apex of the clypeus to the apex of the elytra, and the body width was measured at the base of the pronotum. Each male specimen was dissected and the male genitalia were removed, if possible. Specimens were cleaned and softened in a dish of hot water, the abdomen was separated from the body, and the aedeagus was extracted



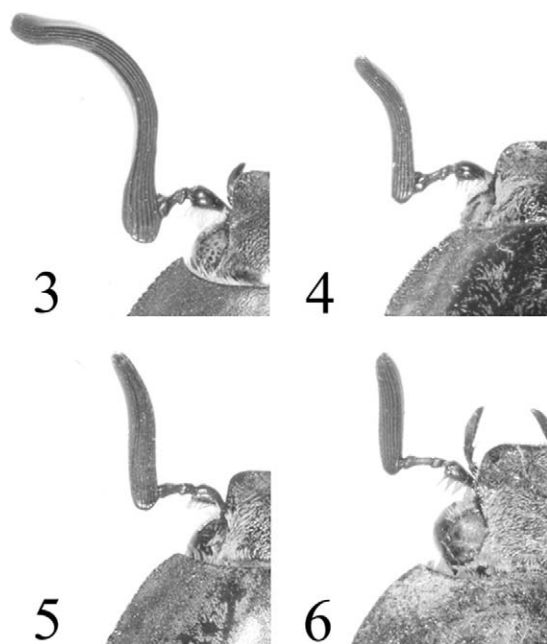
Figs. 1–2. Antennal stem segments of *M. phupanensis* (1) and *M. chinensis* (2).

from the abdomen. The abdomen was then glued to the body to keep the specimens intact. The aedeagus was further cleaned and disarticulated in a hot water solution of 10% KOH and then removed to glycerin for dissection. All parts of the aedeagus were washed in 95% ethanol after examination and glued to a point of paper or stored in a glass vial with glycerin that was attached to the specimen.

Labels that were attached with each specimen were examined and abbreviated as a handwritten (W) or printed (P). Separate labels are indicated by double slashes. The geographical distribution and the flight season of each species were determined from data on the label.

Key to Species Group of *Melolontha* Based on Males in East and South-East Asia (Including Eastern and Southwestern China, the Russian Far East, Korean Peninsula, Japan, Ryukyu Archipelago, Taiwan, Indochina, Malay Peninsula, Sumatra, Java, Indian Subcontinent, Himalaya, and Tibet)

1. Disc of elytron almost glabrous or sparsely setiferous; color of elytron light olive to dark green 2
- 1'. Disc of elytron with dense setae; color of elytron dark brown to yellowish brown 3
2. Pronotum dorsally shining, without metallic reflection; elytron with one posthumeral and two to three basal setiferous patches; apex of interval 1 deeply depressed along elytral disc; parameres (Figs. 41–45) weakly to strongly asymmetric, lateral convexity completely absent *M. guttigera* group
- 2'. Pronotum with dorsal metallic green reflection; elytral base without patches of setae, instead with scattered setae; apex of interval 1 weakly depressed along elytral disc; parameres (Fig. 11) symmetric in shape with lateral convexity weakly developed *M. virescena* group
3. Basal segment of antenna swollen apically with antennomeres 2 and 3 compressed (Fig. 1), club strongly to moderately curved outwardly (Figs. 3–5); dense setae on vertex longer than



Figs. 3–6. Types of male antennal clubs in *Melolontha* spp. (3) *M. phupanensis*. (4) *M. insulana*. (5) *M. incana*. (6) *M. chinensis*.

those of clypeus; mesometasternal process weakly produced, slightly surpassing base of middle coxae; stout setae on inner surface of middle and hind tibiae long 4

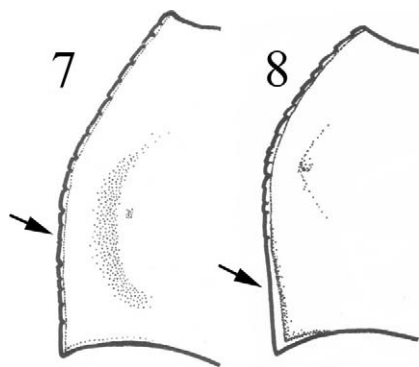
- 3'. Basal segment of antenna moderately swollen apically, antennomeres 2 and 3 elongated (Fig. 2), club weakly to moderately curved outwardly (Figs. 5–6); thin setae on vertex as long as those of clypeus; mesometasternal process strongly produced and surpassing base of middle coxae; stout setae on inner surface of middle and hind tibiae short. 7

4. Antennal club strongly curved outwardly (Fig. 3), 3.5 times length of basal segments; apical portion of first metatarsus distinctly swollen; outer metatibial spur subequal in length to combined length of first and second metatarsomeres *M. phupanensis* group

- 4'. Antennal club moderately curved outwardly, <3 times length of basal segments; apical portion of first metatarsus weakly swollen, outer metatibial spur subequal to length of first metatarsus 5

5. Pronotum shallowly punctate, small in size; elytral base moderately or slightly ridged marginally; pygidium usually gradually narrowed apically; apical process of paramere normally developed or enlarged 6

- 5'. Pronotum unevenly, deeply punctate, variable in size; elytral base distinctly ridged marginally; apical portion of pygidium abruptly nar-



Figs. 7–8. Left margin of pronotum of *M. frater* (7) and *M. carinata* (8).

rowed; apical process of paramere decreased in size and/or asymmetrical (Fig. 12).

. *M. aeneicollis* group

6. Inner side of eye with patch consisting of overlapping, white, scale-like setae; midline fovea of pronotum well developed; immediate side of midline well delimited from lateral portion of pronotum by bearing setae significantly different in shape, size, and color; maculation along lateral side of abdominal sternites 1–5 large; dorsal process of paramere enlarged and outwardly convex (Fig. 13).

. *M. rufocrassa* group

- 6'. Inner side of eye without patch; midline fovea of pronotum barely developed or completely absent; lateral portion and side of midline not delimited from each other; maculation along lateral side of abdominal sternites 1–5 barely present; apical process of paramere distinctly enlarged with dorsal process absent (Fig. 14). *M. reichenbachii* group

7. Antennal club usually shorter (Fig. 6), weakly curved; irregular serration of pronotum developed along lateral margin (Fig. 7); pygidium with apical portion gradually enlarged (Fig. 9) 8

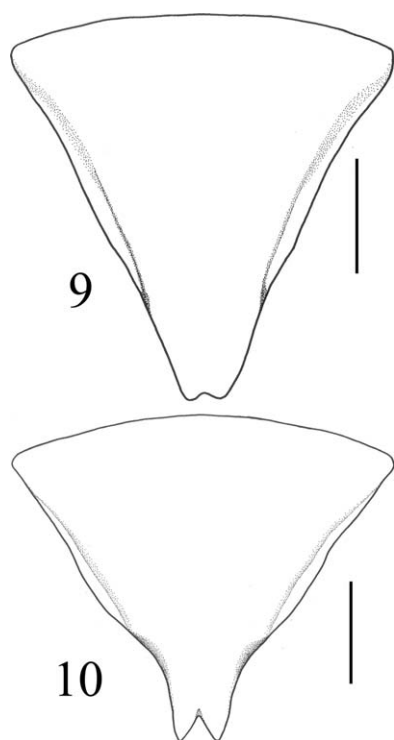
- 7'. Antennal club usually longer, moderately curved (Figs. 4–5); serration of pronotum developed anteriorly with basal one half to one third of margin smooth (Fig. 8); pygidium with apical portion abruptly narrowed (Fig. 10) or slightly enlarged 9

8. Dorsal process of paramere with tip sharpened, surpassing outer margin of paramere (Fig. 15), outer margins of parameres parallel at apical three fourths, apical process normal in size with scattered, tiny setae on surface when viewed caudally (Figs. 19–20)

. *M. chinensis* group

- 8'. Dorsal process of paramere absent, outer margins of parameres distinctly narrowed at apical one third, apical process decreased in size (Fig. 16), with surface glabrous

. *M. japonica* group



Figs. 9–10. Pygidium of male *M. chinensis* (9) and *M. flabelate* (10). Scale bar = 1 mm.

9. Central disc of pronotum evenly, densely punctate; midline of pygidium ridged completely (Fig. 21) or incompletely (Fig. 22); apical and dorsal process and lateral convexity of paramere well developed (Fig. 17)
 *M. carinata* group
- 9'. Central disc of pronotum unevenly punctate; midline of pygidium smooth; apical process of paramere distinctly enlarged posteriorly, fusing with dorsal process, lateral convexity broadly swollen laterally (Fig. 18)
 *M. incana* group

Checklist of *Melolontha* Species Groups from East and South-East Asia

1. Guttigera Group

- M. guttigera* Sharp, 1875: 87. Northern India.
M. javanica Keith and Li, 2005: 2. East Java, Indonesia.
M. maculata (Chang, 1983): 395. (*Hoplosternus*) Yun-nan, China.
M. setifera Li, **new species**. Myanmar.
M. weyersi (Brenske, 1900): 152. (*Hoplosternus*) northern Sumatra, Indonesia.

2. Virescena Group

- M. virescena* (Brenske, 1896): 202. (*Hoplosternus*) Darjeeling, India.
M. amplipennis Frey, 1975.

3. Phupanensis Group

- M. phupanensis* Keith, 2008: 345. Northern Vietnam.

4. Rufocrassa Group

- M. rufocrassa* Fairmaire, 1889: 20. Sichuan, China.

5. Aeneicollis Group

- M. aeneicollis* Bates, 1891: 16. Himachal Pradesh, northwestern India.
M. costipennis Fairmaire, 1889: 19. Sichuan, China.
M. cuprescens Blanchard, 1871: 811. Sichuan, China.
M. sculpticollis Fairmaire, 1891: 10. Hubei, China.

6. Reichenbachi Group

- M. reichenbachi* Keith, 2008: 347. Tibet.

7. Chinensis Group

- M. chinensis* (Guérin-Méneville, 1838): 63. (*Hoplosternus*) China.
Hoplosternus heydeni Moser, 1913: 288. **New synonym**. Type specimens at the ZMHB examined.

Remarks. Moser (1913) described *H. heydeni* based on one male and one female specimen from southwestern China. We failed in locating the original type of *H. chinensis* at MNHN where is believed that housed all Guérin-Méneville types. However, based on the original description by Guérin-Méneville (1838) and a male specimen supposedly compared with the type by Rudolph Petrovitz at ZMHB as well a number of specimens examined by us, we considered that *H. heydeni* is conspecific with *M. chinensis* and hereby regard *M. heydeni* to be a junior synonym of *M. chinensis*.

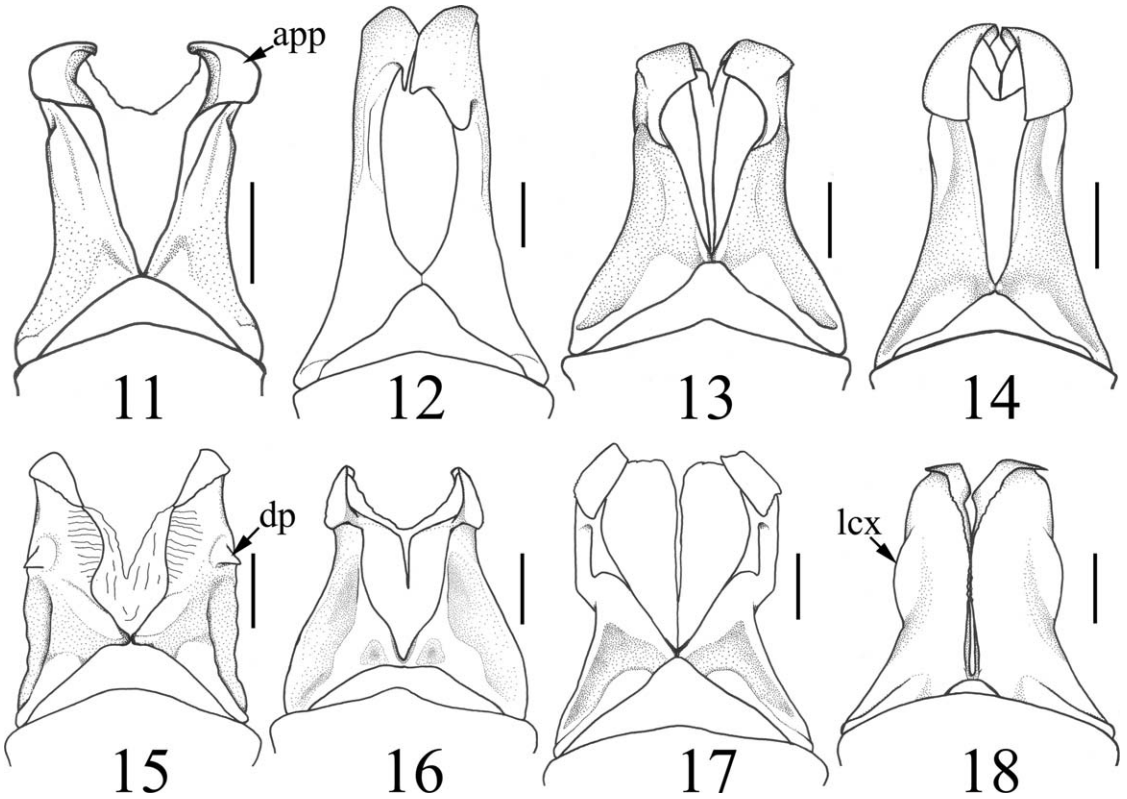
- M. frater* Arrow, 1913: 400. Japan.
M. masafumii Nomura, 1952: 29. Ishigaki Island, Japan.
M. taihokuensis Nijima and Kinoshita, 1923: 65. Taiwan.
M. frater taiwana Nomura, 1952.
M. tamina Nomura, 1964: 54. Amami Island, Japan.

8. Japonica Group

- M. japonica* Burmeister, 1855: 420. Japan.
Hoplosternus haroldi Moser, 1913.
M. satsumaensis satsumaensis Nijima and Kinoshita, 1923: 62. Shimabara, Japan.
Hoplosternus kinoshitai Tesar, 1938.
M. satsumaensis shikokuana Nomura, 1977a: 78. Ehime, Japan.
M. wushana Nomura, 1977b: 103. Taiwan.

9. Carinata Group

- M. carinata* (Brenske, 1896): 164. (*Hoplosternus*) Nagaland, India. **New combination**.
M. indica Hope, 1831: 23. Northern India.



Figs. 11–18. Types of male genitalia in *Melolontha* species group. (11) *M. virescens*. (12) *M. aeneicollis*. (13) *M. rufocrassa*. (14) Undetermined species of the *reichenbachii* group from China. (15) *M. chinensis*. (16) *M. japonica*. (17) *M. carinata*. (18) *M. incana*. app, apical process; dp, dorsal process; lax, lateral convexity. Scale bar = 1 mm.

M. nitidicollis Blanchard, 1851: 158. **New synonym.**
Type specimens at MNHN examined.

Remarks. Blanchard (1851) described *Melolontha nitidicollis* based on one female specimen from northern India. After a careful comparison with the female lectotype of *M. indica* at BMNH, we concluded that *M. nitidicollis* is conspecific with *M. indica* and hereby propose *M. nitidicollis* to be a junior synonym of *M. indica*.

M. malaccensis (Moser, 1913): 289. (*Hoplosternus*) Malacca, Malaysia. **New combination.**

M. nepalensis (Blanchard, 1851): 158. (*Hoplosternus*) Northern India.

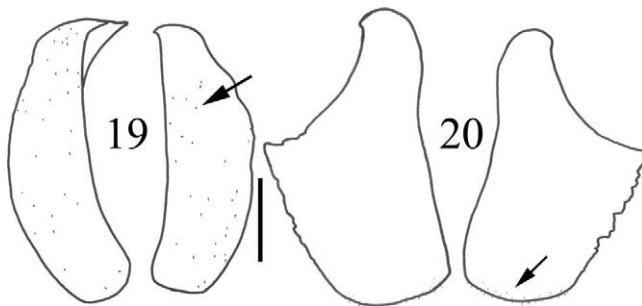
10. Incana Group

M. incana (Motschulsky, 1854): 46. (*Hoplosternus*) China. **New combination.**

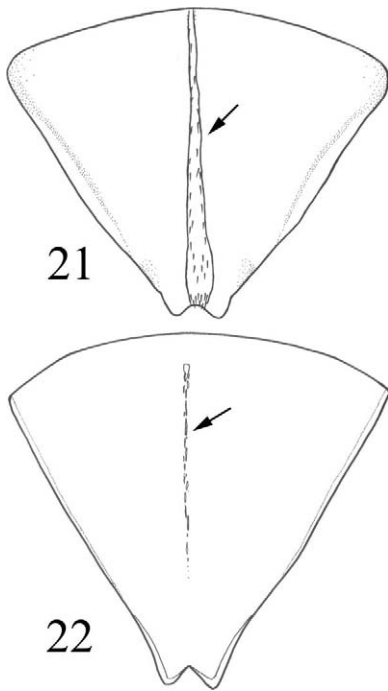
M. flabelata Sharp, 1876: 86. India.

M. furcienanda Ancey, 1881: 412. Kashmir, India.

Hoplosternus bifurcatus Brenske, 1896: 164. **New synonym.** Type specimens at ZMHB examined.



Figs. 19–20. Caudal view of male genitalia of *M. chinensis* (19) and *M. frater* (20). Scale bar = 1 mm.



Figs. 21–22. Pygidium of *M. indica* (21) and *M. nepalensis* (18).

Remarks. Brenske (1896) described *Hoplosternus bifurcatus* based on one male and one female specimen from Kashmir. After a careful comparison with the type of *M. furcienanda* at MNHN, we concluded that *H. bifurcatus* is conspecific with *M. furcienanda* and is synonymized here.

M. insulana (Moser, 1918): 246. (*Hoplosternus*) Taiwan.

M. pseudofurcicauda Keith, 2008: 343. Tibet.

M. shanghaiana (Brenske, 1896): 203. (*Hoplosternus*) Shanghai, China. **New combination.**

Ungrouped Species Due to Uncertain Type Identity or Type(S) Unseen

1. *M. costata* Nonfried, 1891: 266. Central China.

2. *M. davidis* Fairmaire, 1878: 97. Central China.

3. *M. albopruinosa* Fairmaire, 1878: 98. Central China.

4. *M. mandarina* Fairmaire, 1878: 98. Central China.

5. *M. tenuicauda* Fairmaire, 1896: 87. Tibet.

6. *M. tricastata* Brenske, 1903: 335. Tibet, not Qinghai as in Bezdek (2006).

Species of *Melolontha*/*Hoplosternus* Excluded from Checklist

1. *Melolontha albidiventris* Fairmaire, 1889: 21. Anhui, China. Type at MNHN examined. **New junior synonym** of *Tocama rubiginosa* (Fairmaire, 1889).

Remarks. Fairmaire (1889) described *M. rubiginosa* and *M. albidiventris* consecutively in his publication,

the former was by males and the latter was based on a female. However, the sexual dimorphism of *Tocama rubiginosa* is distinct in size, color, antennal club and body shape. Based upon examination of a number of specimens of *T. rubiginosa* and the type of *M. albidiventris*, we herein determined that these two taxa are conspecific.

2. *Exolontha fuliginosa* (Fairmaire, 1889): 22. Sichuan, China. **New combination** from *Melolontha*. Types at MNHN examined.

Remarks. The type specimens of *M. fuliginosa* at MNHN with nine well-defined elytral striae clearly indicate that the identity of species is a member of *Exolontha* Reitter. We hereby transfer *M. fuliginosa* to *Exolontha*.

3. *Tocama laevipennis* (Blanchard, 1851): 158. Guangdong, China. **New combination** from *Hoplosternus*. *Hoplosternus squamulatus* Frey 1969: 114. Southern Vietnam. **New synonym.** Holotype at Naturhistorisches Museum, Basel, Switzerland, examined.

Remarks. With their specific male genitalia character states, this and the next species are clear to be a member of *Tocama* (sensu Keith 2006). During the course of this study, we have examined the types of *Hoplosternus laevipennis* at the MNHN as well a large number of specimens from southern China, Vietnam, and Laos.

4. *Tocama formosana* (Yu, Kobayashi & Chu, 1998): 27. Taiwan. **New combination** from *Melolontha*.

5. *Exolontha laticauda* (Bates, 1891): 77. Sichuan, China. **New combination** from *Melolontha*.

Remarks. According to the original description, Bates (1891) explicitly stated that this species is morphologically allied to *M. serrulata* and *M. umbraculata*, both of which are currently attributed to the genus *Exolontha* Reitter. Accordingly we propose to transfer *M. laticauda* from *Melolontha* to *Exolontha* without examining the type material.

6. *Hoplosternus shillongensis* Brenske, 1899.

Remarks. This name appeared in a melolonthine list of Indian museum collections (Barlow 1899), which was based on a specimen deposited in the Shillong museum with a determination label by E. Brenske as a new species. This name was never published and is a nomen nudum noted by Sabatinelli (1992).

7. *Melolontha minima* Kobayashi, 1985: 20. Taiwan.

Remarks. This and following two unusual species with their peculiar external and genital character states reflect a need to reconsider their systematic position within the tribe Melolonthini. We shall conduct an analysis in the future.

Melolontha hualiensis Kobayashi and Chou, 2009: 49. Taiwan. **New synonym.**

Remarks. With the examination of a number of specimens, we conclude that the character states (including the variation of body color, clypeus, protibia, pygidium, and shape of male genitalia) of *M. hualiensis* fall within the parameters of *M. minima*. Moreover, there is no geographical barrier existed where the population is distributed on the plains of eastern Taiwan and up to $\approx 1,500$ -m elevation. We therefore synonymized the name *M. hualiensis* under *M. minima*.

8. *Melolontha cochinchinae* Brenske, 1894: 82. Southern Vietnam.

9. *Melolontha siamensis* Nonfried, 1891: 230. Thailand.

Synopsis of *guttigera* Species Group

With some 60 described species/subspecies within the genus *Melolontha* (Keith and Li 2005), there are two species, *Melolontha weyersi* (Brenske) and *Melolontha javanica* Denis & Li, which belong to the *guttigera* species group that are the only representatives in the genus with their distribution south of the equator into Sumatra and Java. This unusual distribution pattern implies a characteristic divergence within the *Melolontha* lineage. The *guttigera* species group is distinctive in having diverse morphological traits. An attempt was made by Bunalski (2002) to separate the group from *Melolontha* by establishing the genus *Zhangia*, which was based on *Z. margaritae* to accommodate another known species, *Hoplosternus maculatus* Chang, 1983. However, Zidek (2003) proposed *Zhangia* as a junior synonym of *Melolontha* and transferred the *Zhangia* species into the subgenus *Tocama*. This arrangement caused *Tocama* to be a polyphyletic group, because *Zhangia* species are differentiated both morphologically and ecologically from *Tocama* (sensu Keith 2006).

The taxonomic history of the *guttigera* species group has been scattered across the literature (cf. Brenske 1900, Chang 1983, Keith and Li 2005) since the first species of the group, *M. guttigera*, was described by Sharp (1876) from northern India. Brenske (1900) transferred *M. guttigera* to the genus *Hoplosternus* (sic!) based upon the structure of the mesometasternal process and combined it with a second, *H. weyersi*, from Sumatra. Chang (1983) named the third species, *H. maculatus*, based only on a female collected in Yunnan, southwestern China. The latest species, *M. javanica*, described by Keith and Li (2005) is morphologically close to *H. weyersi* corresponding to a tightly tie in geological history, fauna and flora between Sumatra and Java.

Unlike other relatives within the genus that usually have adult activity during the wet season, species of the *guttigera* group appeared during the dry season, roughly from September to December. There are few congeneric species in Asia whose adults also appear during the arid and cool season, e.g., *Melolontha masafumii* Nomura and the monotypic genus *Tricholontha* with its species, *Tricholontha papagena* Nomura, both distributed in the Ryukyu archipelago, Japan. However, the Japanese cases are not identical with those of

the *guttigera* group, because the adults of the former species can be observed in the wet and hot season as well.

This article is the first attempt to provide a comprehensive review of the species contained in the *guttigera* species group, including a description of a new species from Myanmar and a key to the known species.

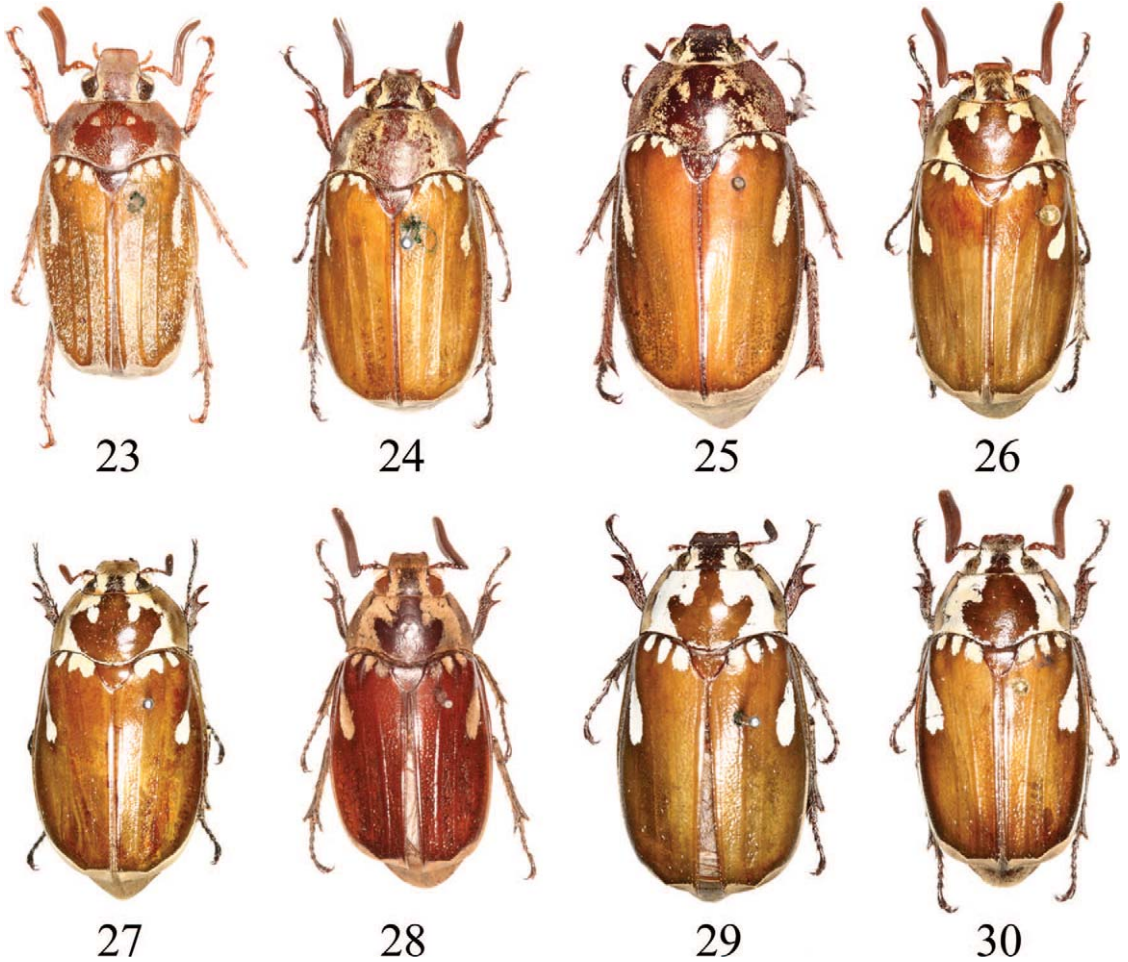
Systematics of the *M. guttigera* Species Group

This group is distinguished from all other groups within the genus *Melolontha* by the following combination of characters: body size medium to large (21.2–24.9 mm), elytral color light olive green, elytral disc usually glabrous with one posthumeral and two to three basal patches that comprised of overlapping, white, scale-like setae, apices of elytral interval 1 with costae 2–4 depressed along plane of disc, declivity at elytral apex densely setiferous, and parameres of male genitalia weakly to strongly asymmetric, each with a vertically curved, elongated tip when viewed laterally.

Distribution. Eastern Himalaya (Nepal, Sikkim); Indochina; southwestern China (southern Yunnan); northern Sumatra; eastern Java (Fig. 61).

Key to Species of *M. guttigera* Species Group

1. Intervals of elytron glabrous or with sparse scattered setae 2
- 1'. Intervals of elytron evenly distributed with dense, scale-like setae (Fig. 23); Myanmar *M. setifera* Li sp. nov.
2. Body size large (BL \geq 24.7 mm); brownish setae of pronotum normal in shape, central disc densely punctate; protibia tridentate with basal tooth well-developed; parameres with weakly asymmetric dorsal and apical processes (Fig. 42); eastern Nepal and Sikkim *M. guttigera* Sharp
- 2'. Body size small (BL \leq 22.3 mm); whitish setae of pronotum scale-like, densely concentrated, forming maculation on each side of midline, central disc sparsely punctate; protibia usually bidentate with basal tooth, if any, vestigial; parameres with strongly to moderately asymmetric dorsal and apical processes . . . 3
3. Pronotal maculation on middle of each side at base triangle-like, usually separated from apical patch (Fig. 26); post humeral patch smaller, reniform; abdominal sternites lacking lateral maculation; southwestern China (Yunnan), Indochina and southeastern Myanmar. *M. maculata* (Chang)
- 3'. Pronotal maculation on middle of each side widened and comprising a long patch; post humeral patch elongated and larger, oval; abdominal sternites 1–5 each with lateral maculation 4
4. Antenna with basal segment moderately swollen apically; pronotum deeply punctate at base of midline in a small, well-defined area;



Figs. 23-30. Dorsal habitus of *Melolontha* spp. (23) *Melolontha setifera* sp. nov., holotype male. (24) *M. guttigera*, male. (25) *M. guttigera*, female. (26) *M. maculata*, male. (27) *M. maculata*, female. (28) *M. weyersi*, holotype male. (29) *M. weyersi*, female. (30) *M. javanica*, male.

setae on ventral surface of metafemur slender, shorter; dorsoapical process of right paramere weakly protuberant when viewed laterally (Fig. 54); northern Sumatra

- *M. weyersi* (Brenske)
 4'. Antenna with basal segment distinctly swollen apically; basal half of pronotal midline shallowly punctate in a larger area; setae on ventral surface of metafemora moderately long and dense; top of right paramere distinctly protuberant when viewed laterally (Fig. 55); eastern Java *M. javanica* Keith and Li

***Melolontha setifera* Li, sp. nov.**

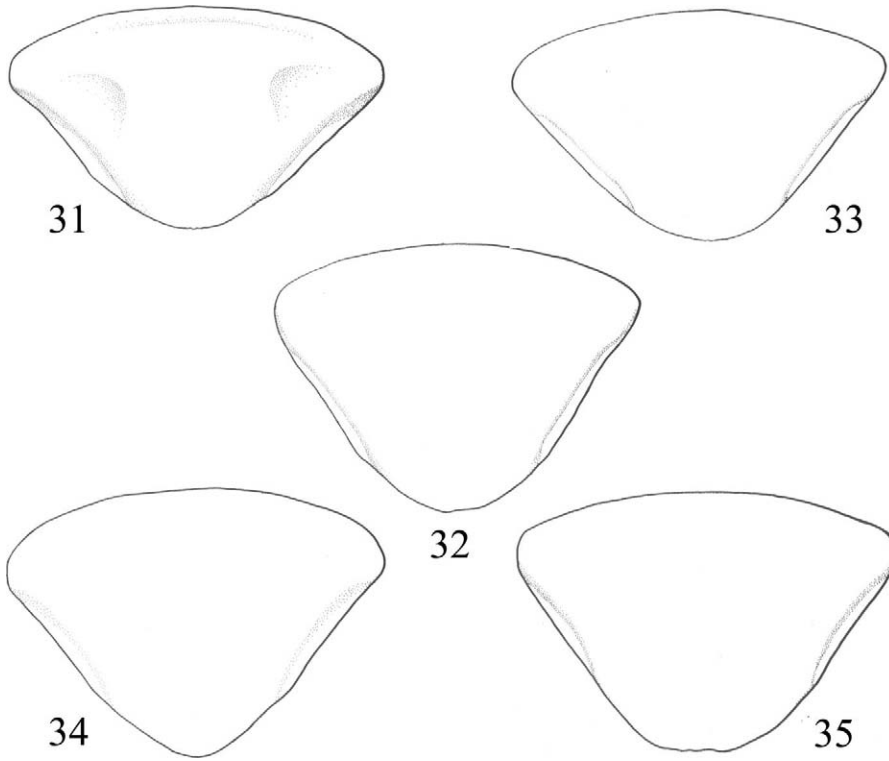
(Figs. 23 and 31, 36, 41, 46, 51, 56, 61)

Holotype ♂. Burma (H) // Andrewes Bequest. B. M. 1922-221 (P) // Hoplosternus sp. (H) // HOLOTYPE (P) *Melolontha setifera* Li, sp. nov. (H) (BMNH).

Diagnosis. *M. setifera* can be easily distinguished from all other species in the *guttigera* group by the

following combination of characters: side of eyes heavily setose, setae same as those on clypeus; center of frons feebly convex; labrum transversally developed; setae at sides of pronotal midline brownish, normal in shape; costal intervals of elytra evenly distributed with moderately dense, scale-like setae; apex of mesometasternal process reaching posterior margin of procoxae; Abdomen lacking lateral maculation; protibia bidentate; male genitalia as in Figs. 41 and 46, 51, 56.

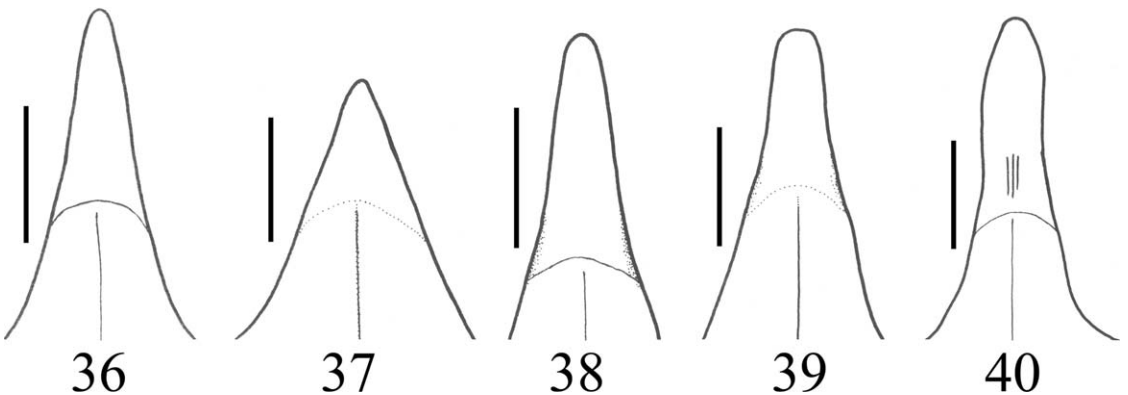
Holotype Male (Fig. 23). Length 21.5 mm, width 9.5 mm. Head, pronotum, scutellum, venter and legs reddish brown, elytra light olive green. **Head:** Clypeus rectangular, slightly widened basally, apex perpendicularly reflexed, middle feebly convex with lateral angles planar, surface densely and evenly punctate, punctures large, each bearing a short, robust, semierect seta, setae light brown; clypeofrontal suture complete; center of frons feebly convex, surface sparsely setose, side of eyes heavily setose, setae same as those on clypeus; sides slightly



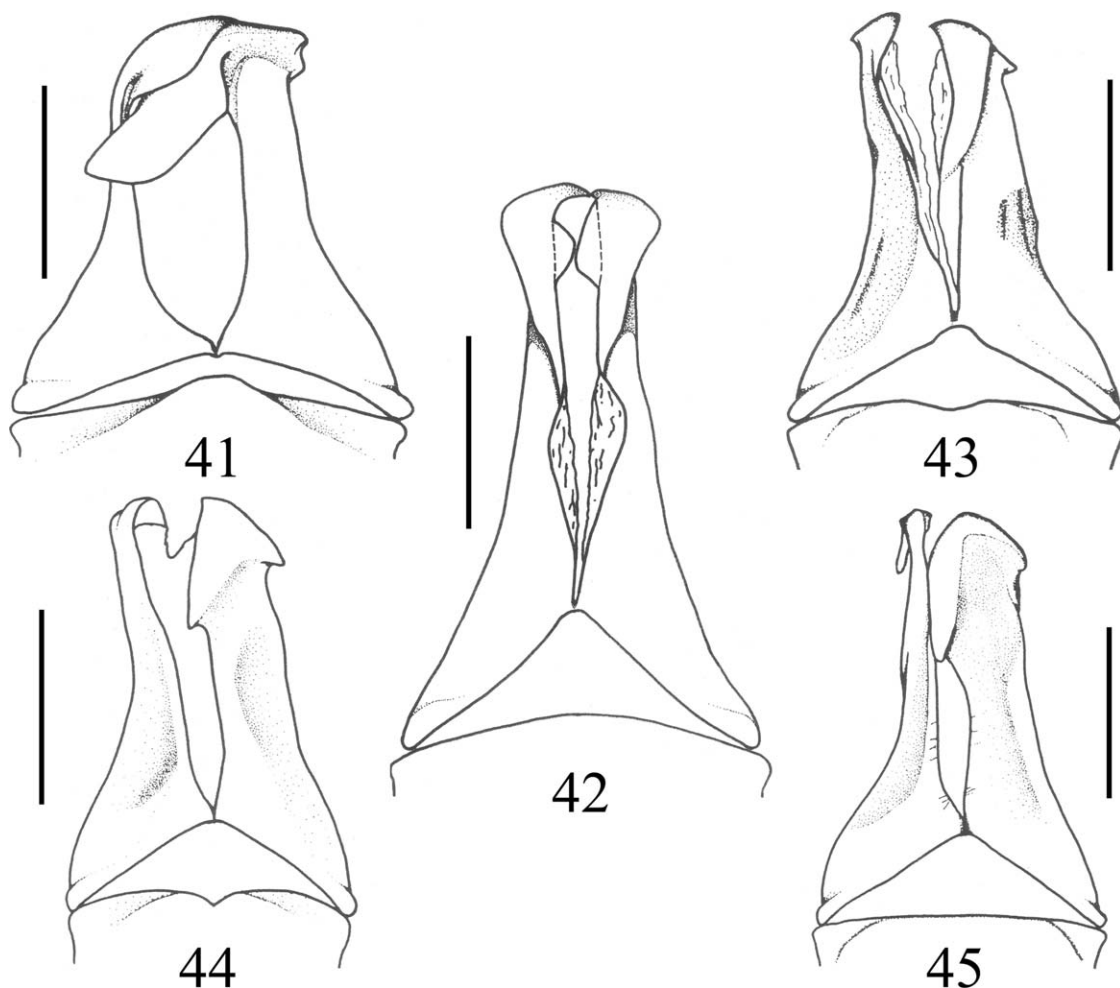
Figs. 31–35. Pygidium of male *Melolontha* spp. (31) *M. setifera* sp. nov. (32) *M. guttigera*. (33) *M. maculata*. (34) *M. weyersi*. (35) *M. javanica*.

narrowed making eyes larger. Antenna 10-segmented with seven-segmented club; lamellae curved slightly outwardly, ≈ 2.27 times as long as stem, first basal segment somewhat slender, apical segment elongate, apparently longer than second segment. Labrum symmetrically bilobed, each lobe transversally developed. Mentum slightly concave centrally, surface almost glabrous with only a few scattered setae. Maxillary palpus with apical palpomere slightly shorter than combination of palpomeres 2–3. Ocular canthus heavily covered with brownish setae. *Pronotum*: Form

transverse, widest at middle, basomedially protuberant posteriorly. Surface densely to confluent punctate in broad band along lateral margin, each puncture with a tiny, brownish seta, setae becoming longer and more robust toward center; center of pronotal disc sparsely punctate, punctures moderately large; sides of midline setose with spot consisting of concentrated brownish setae each apical side of midline; setae denser along basomedial margin; serration of lateral margin poorly developed anteriorly, basal half of margin with completed bead. Scutellum oval, surface



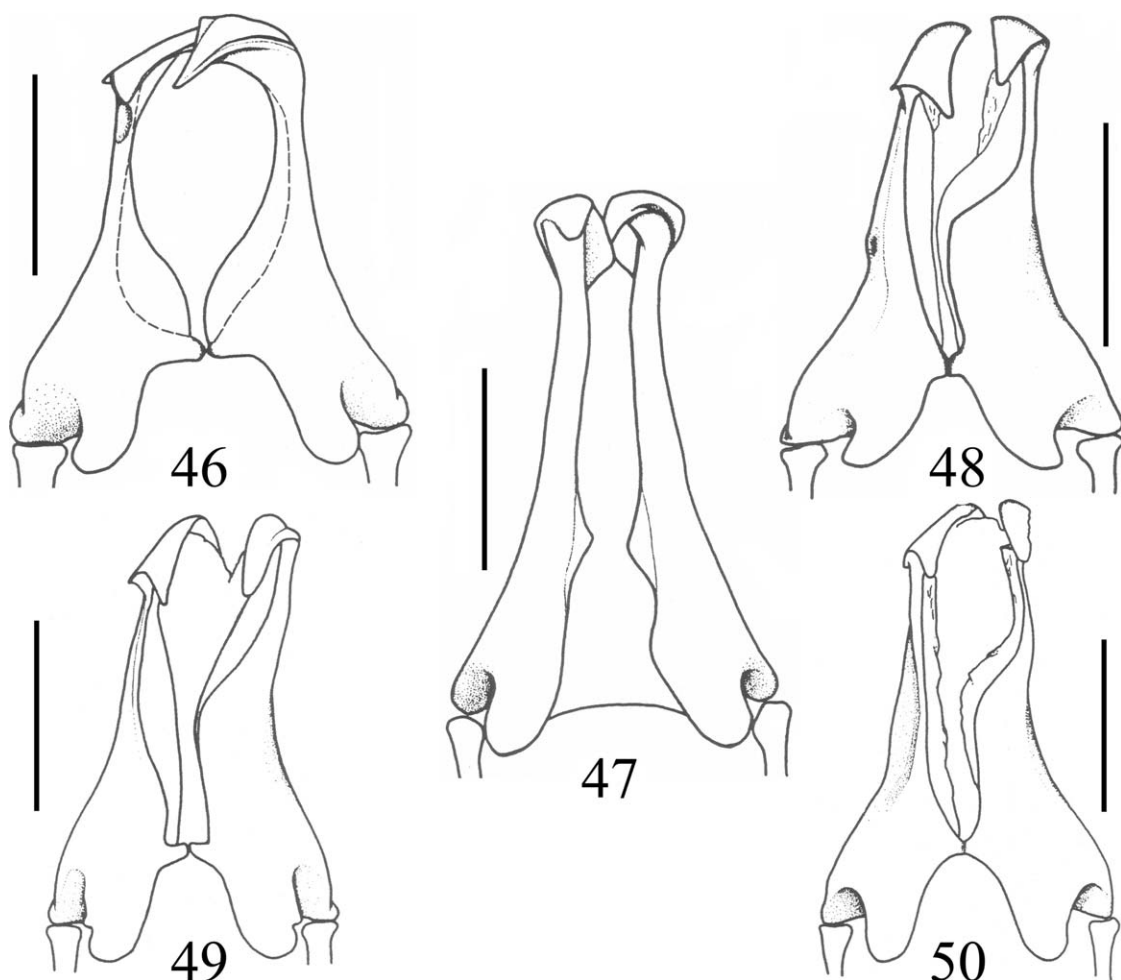
Figs. 36–40. Mesometasternal process of male *Melolontha* spp. (36) *M. setifera* sp. nov. (37) *M. guttigera*. (38) *M. maculata*. (39) *M. weyersi*. (40) *M. javanica*. Scale bar = 1 mm.



Figs. 41–45. Dorsal aspect of parameres of *Melolontha* spp. (41) *M. setifera* sp. nov. (42) *M. guttigera*. (43) *M. maculata*. (44) *M. weyersi*. (45) *M. javanica*. Scale bar = 2 mm.

sparsely punctate, each with a seta same as those on pronotal central disc. *Elytron*: Broadest at base. Costae 1–3 (costa 1 as sutural costa) glabrous and well developed, costae 2 and 3 broadly fused on apical umbone, costa 4 feebly developed and hardly observable; outer margin of costa 1 with aligned row of whitish, scale-like setae. Intervals rugose, intermixed with two kinds of whitish setae, one lanceolate and scale-like and the other slender and smaller; both moderately dense in distribution. Posthumeral and three basal patches composed of overlapping, white, scale-like setae, posthumeral patch slender in shape, apical area of elytron steeply depressed below plane of disc where densely covered with whitish brown, tiny setae. Humeral umbone moderately swollen. *Pygidium* (Fig. 31): Width 1.75 times length, anterior half with long, hair-like setae in male, remainder intermixed with yellowish white, scale-like setae. Disc either side of middle slightly depressed, surface densely covered with whitish brown, short setae, setae evenly distributed; apex broadly rounded. *Venter*: Thorax setose

except mesometasternal process glabrous; mesometasternal process well developed (Fig. 36), apex reaching posterior margin of procoxae, slender in lateral view. Abdominal sternites moderately setose, setae tiny, whitish brown, becoming lanceolate in shape and thinning medially, transversely intermixed with very scattered, long, hair-like setae; abdominal lateral maculation absent; sternites 2–5 weakly fused medially, suture well defined. *Legs*: Protibia bidentate laterally, apical tooth acute; tarsal claws symmetrically unidentate, abruptly curved apically with a small, vertical tooth at base. Femora of front and middle legs transversely flattened, surface densely clothed with long, hair-like, brown setae, posterior femur stouter, with shorter setae; dorsal surface of all tibiae and tarsi moderately clothed with pale white, scale-like, short setae; meso- and metatibiae with two elongate apical spurs, mesotibial spurs slightly shorter than length of mesotarsomere 1, outer spur of metatibia distinctly longer than metatarsomere 1, inner spur sub-



Figs. 46–50. Ventral aspect of parameres of *Melolontha* spp. (46) *M. setifera* sp. nov. (47) *M. guttigera*. (48) *M. maculata*. (49) *M. weyersi*. (50) *M. javanica*. Scale bar = 2 mm.

equal in length to metatarsomere 1. **Genitalia** (Figs. 41 and 46, 51, 56): Parameres strongly asymmetrical, right paramere with apical process distinctly developed upwardly and downwardly when viewed laterally; lower surface of both apical processes with scattered, tiny setae in caudal view; basal piece subequal in length to paramere.

Female. Unknown.

Etymology. The specific epithet “*setifera*” is a Latin noun (seta + ferre) referring to the distinctive character of the new species by bearing setae distributed within the elytral intervals that are uniquely featured among species of the *guttigera* group. The name is feminine in gender.

Distribution. Myanmar (previously Burma) (Fig. 61).

Remarks. The label on the holotype, which came from the collection of the late British coleopterist, H. E. Andrewes, bears only the word “Burma” making it impossible to know any detail regarding the collecting locality. However, Andrewes (1929) mentioned that he had received many of Henry Walter Bates’s

types from the Burmese collection formed by the Italian naturalist, Lenonardo Fea, who was well-known for his long-term stay in Burma and who had accumulated a large number of specimens during the 1880s. Therefore, if the holotype of *M. setifera* is one of Fea’s collection, then it is possible to determine a few of possible localities by tracing back Fea’s exploring history in Myanmar.

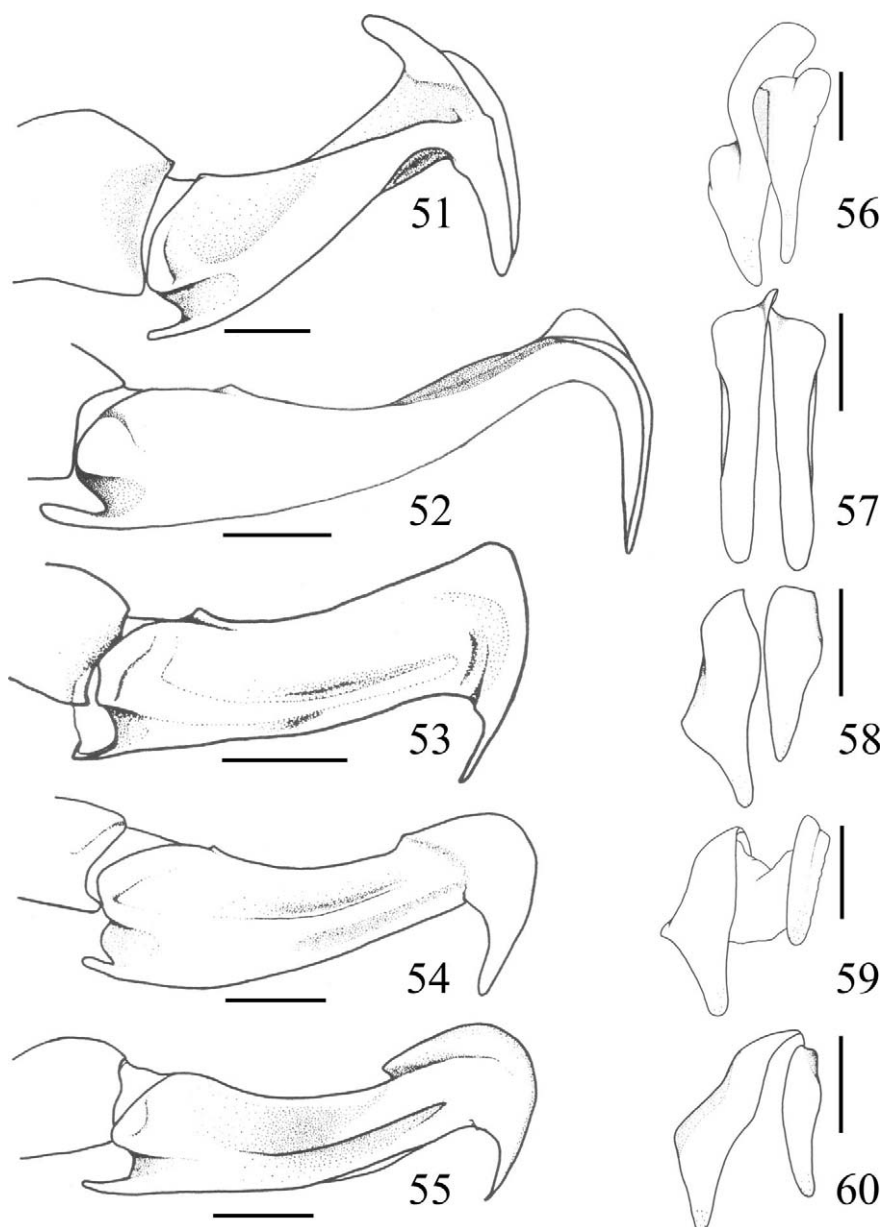
Melolontha guttigera Sharp, 1875

(Figs. 24 and 25, 32, 37, 42, 47, 52, 57, 61)

Melolontha guttigera Sharp, 1875: 87 (lectotype in the Museum National d’Histoire Naturelle, Paris, France).

Hoplosternus guttigera Brenske, 1900: 154 (diagnosis); Dalla Torre, 1912: 264 (catalog); Sabatinelli, 1992: 613 (catalog).

Diagnosis. *M. guttigera* can be distinguished from other species in the *guttigera* group by the following



Figs. 51-60. Parameres of *Melolontha* spp. in dorsal view (51-55) and in caudal view (56-60). (51, 56) *M. setifera* sp. nov. (52, 57) *M. guttigera*. (53, 58) *M. maculata*. (54, 59) *M. weyersi*. (55, 60) *M. javanica*. Scale bar = 1 mm.

combination of characters: surface of clypeus with short, slender setae; side of eyes heavily setose, anterior half with setae long in male, remainder intermixed with yellowish white, scale-like setae at base; center of frons feebly convex; labial lobe weakly developed, symmetrical or asymmetrical; disc of pronotum with densely setiferous punctures, sides of pronotal midline with poorly defined maculation composed of yellowish white setae; costal intervals of elytra with tiny, scattered setae; mesometasternal process weakly developed, produced weakly beyond mesocoxae to posterior margin of procoxae; abdominal sternites with-

out lateral maculation, surface with setae whitish brown in color, slender, scale-like, and becoming slender medially; protibia tridentate; male genitalia shown as Figs. 42 and 47, 52, 57.

Description. Male (Fig. 24). Length 24.7-24.9 mm, width 11.6-12.2 mm. Head, pronotum, scutellum, venter, and legs reddish brown with feeble copper green, metallic luster on pronotum and scutellum, elytra light olive green. **Head:** Clypeus rectangular with apical angles rounded, apex perpendicularly reflexed, weakly bisinuate in frontal view with middle part planar, clypeal surface densely punctate, punctures

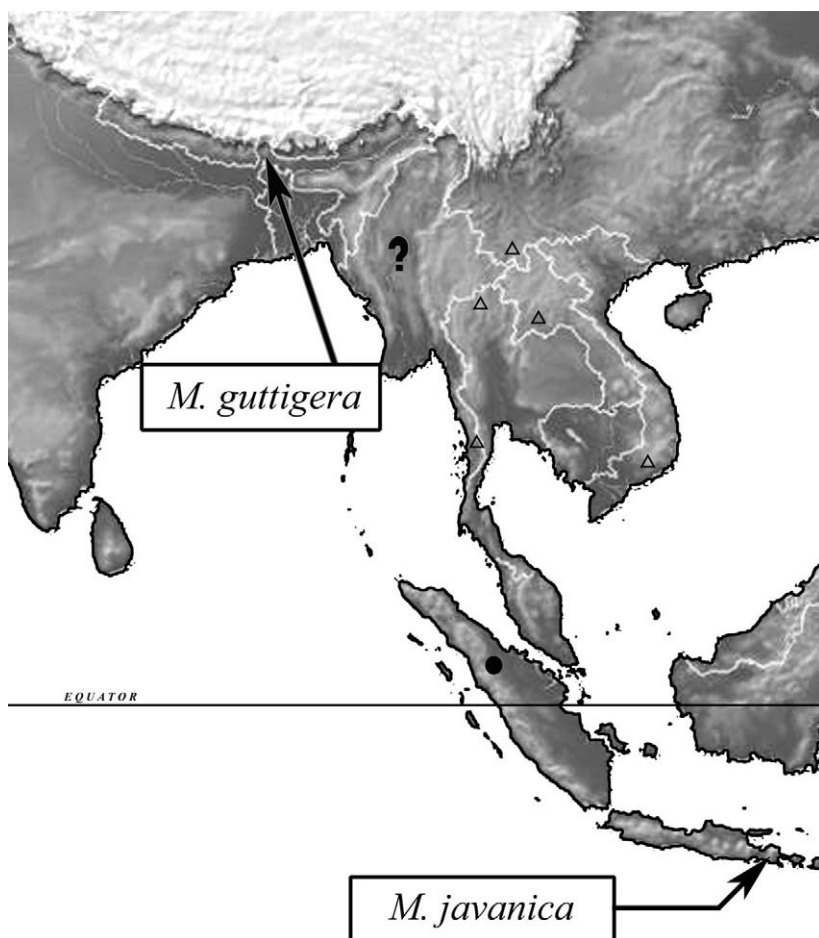


Fig. 61. Distribution map of *M. guttigera* species group: *M. maculata* (triangle), *M. weyersi* (black circle), and *M. setifera* sp. nov. with question mark indicating a lack of detailed collecting locality.

large, each bearing a short, slender seta, setae whitish brown; clypeofrontal suture complete; center of frons feebly convex, sparsely setose, setae moderately longer and more robust than those on clypeus, side of eyes densely setose, anterior half with setae long, hair-like in male, remainder intermixed with yellowish white, scale-like setae at base; sides slightly narrowed making eyes larger. Antenna 10-segmented with seven-segmented club; lamellae slightly curved outwardly, ≈ 2.70 – 2.86 times as long as stem, first basal segment distinctly swollen apically, apical segment moderately elongate, ≈ 2 times as long as second segment. Labrum symmetrically to weakly asymmetrically bilobed, each lobe weakly developed. Mentum slightly concave centrally, surface almost glabrous with only a few scattered setae. Maxillary palpus with apical palpomere subequal in length to combination of palpomeres 2–3, apical segment spindle-like. Ocular canthus covered with dense, yellowish white, robust setae. **Pronotum:** Form transverse, widest at middle, basomedially protuberant posteriorly. Surface densely to confluent punctate in narrow band along lateral margin, each puncture with a tiny, brownish seta, disc

along midline of pronotum with deep, setiferous punctures unevenly distributed, basal part denser than anterior part, each puncture with a short, slender seta; sides of pronotal midline with poorly defined maculation composed of yellowish brown setae, setae denser than those along midline; serration of lateral margin moderately developed entirely. Scutellum oval, surface overall deeply punctate with a short seta in each puncture. **Elytron:** Broadest at base. Costae 1–3 (costa 1 as sutural costa) glabrous and well developed, costae 2 and 3 broadly fused on apical umbone, costa 4 weakly developed; outer margin of costa 1 with aligned row of whitish setae. Intervals almost glabrous with sparse, whitish, small setae. Posthumeral and three basal patches consisting of whitish, lanceolate, scale-like setae; posthumeral patch small, oval in shape; basal patches less developed with inner two patches fused basally, apical area of elytron steeply depressed below plane of disc and densely covered with whitish brown setae, size of setae becoming gradually smaller apically. Epipleuron entirely setose, whitish brown setae becoming gradually denser apically, posterior one third in a band. Humeral umbone

moderately swollen. *Pygidium* (Fig. 32): Width 1.35–1.41 times length. Disc either side of middle slightly depressed, surface densely covered with whitish brown, short setae, setae evenly distributed or moderately scattered along midline; apex broadly rounded. *Venter*: Thorax setose except mesometasternal process glabrous; mesometasternal process weakly developed, produced weakly beyond mesocoxae to posterior margin of procoxae, with smooth surface front of mesometasternal suture (Fig. 37), slender in lateral view. Abdominal sternites 1–5 without lateral maculation; abdominal surface moderately setose, setae tiny, whitish brown, becoming robust and thinning medially, transversely intermixed with scattered, hair-like setae; sternites 2–5 weakly fused medially, suture well defined. *Legs*: Protibia tridentate laterally, basal tooth well developed; tarsal claws symmetrically unidentate, abruptly curved apically with a small, vertical tooth at base. Femora of front and middle legs transversely flattened, surface densely clothed with long, hair-like, whitish brown setae; posterior femur stouter, with shorter, robust setae moderate in density; dorsal surface of all tibiae and tarsi moderately clothed with pale, white, short setae; meso- and metatibiae with two elongate, apical spurs, mesotibial spur distinctly shorter than length of mesotarsomere 1, outer spur of metatibia distinctly longer than metatarsomere 1, inner spur subequal in length to metatarsomere 1. *Genitalia* (Figs. 42 and 47, 52, 57): Parameres moderately symmetrical, ventroapical process of paramere distinctly elongate and gradually acuminate apically with a small, crest-like protuberance on top of right paramere when viewed laterally; lower surface of both apical processes glabrous in caudal view; basal piece subequal in length to paramere.

Female (Fig. 25). Similar to male, differing in the following characters: overall body shape more robust, body length 25.3–28.3 mm, body width 13.7–14.7 mm; apex of clypeus moderately reflexed; setae on sides of eye and those forming pronotal maculation scale-like; antennal club shorter than combined length of basal segments 1–4; mesometasternal process distinctly longer and more robust, reaching anterior margin of procoxae; metafemur stouter.

Type Material Examined. Lectotype ♂ at the MNHN (here designated) labeled: India (H)// LAFERTÉ (P) 3018 (H)// *Melolontha guttiger*, India. ♂ Type D.S. (H)// Ex.Musæo D. Sharp 1890 (P)// Lectotype (H).

Other Specimens Examined. N. India (P) (1♂, ZMHB). Sikkim (P)// Coll. Brenske (P)// *guttigera* Shp. (H) (1♀, ZMHB). Nagri Spur, Darjeeling, 5,000 feet 1912–83. (P) (1♂, BMNH). 3771 (H)// Phooobsering, Lebong, 5,000 feet (P)// *Hoplosternus guttiger* Shp. (H)// Andrewes Bequest., B. M. 1922–221 (P) (1♂, BMNH). Gopaldhara, Rungbong Vall., Sikkim. H. Stevens. 1916–218 (P) (1♀, BMNH). TAPLEJUNG DIST., Sangu, c 6,200', Mixed vegetation by stream in gully. IX–X 1961. (P)// BRIT. MUS. East Nepal Exp. 1961–1962. R.L. Coe Coll., B.M. 1962–177 (P) (2♀♀, BMNH). Darjeeling 1904 R. P. Verschraegen, Coll. P. de Moffarts (P) (1♀, ISNB).

Distribution. Eastern Nepal; Sikkim (Fig. 61).

Remarks. Arrow (1913) discussed *M. guttigera* and questioned whether the sexually dimorphic character of the mesometasternal process could place two sexes of the same species in two different genera. Arrow's conclusion was unclear and seemed to imply that one sex possessed the mesometasternal process, whereas the other lacked the process. Nevertheless, the mesometasternal process is present in both sexes of *M. guttigera*. The difference in size of the mesometasternal process between males and females is actually common and representative of sexual dimorphism among Oriental *Melolontha* species.

Melolontha maculata (Chang, 1983)

(Figs. 26 and 27, 33, 38, 43, 48, 53, 58, 61)

Hoplosternus maculatus Chang, 1983: 395 (holotype in Tianjin Museum, China, not examined); Itoh 1995: 201 (new record).

Zhangia margaritae Bunalski, 2002: 409 (synonymized by Zidek 2003).

Diagnosis. *M. maculata* is distinguished from other species in the *guttigera* group by the following combination of characters: side of eyes heavily setose, anterior one third with long, hair-like setae in male, remaining setae yellowish white and scale-like in shape; center of frons feebly convex; labial lobe moderately developed; sides of pronotal midline with separate maculations of yellowish white to whitish scale-like setae, apex and base of pronotal midline deeply punctate in a small area; costal intervals of elytra almost glabrous; apex of mesometasternal process reaching posterior margin of procoxae; abdominal sternites without lateral maculation, surface with setae overall whitish brown in color, lanceolate in shape and becoming slender medially; protibia bidentate; male genitalia as Figs. 43 and 48, 53, 58.

Description. **Male** (Fig. 26). Length 21.2–22.3 mm, width 10.0–10.3 mm. Head, venter and legs reddish brown, pronotum, scutellum and elytra light olive green. *Head*: Clypeus rectangular, base as wide as apex, apex perpendicularly reflexed, weakly to strongly trisinate in frontal view, middle moderately to sharply convex, with lateral angles almost planar, clypeal surface densely punctate, punctures large, each bearing a long, slender seta, setae brown to whitish brown; clypeofrontal suture complete; center of frons feebly convex, sparsely setose, setae slightly longer than those on clypeus, side of eyes densely setose, anterior one third with long, slender setae, posterior setae yellowish white and scale-like; sides slightly narrowed making eyes seem larger. Antenna 10-segmented with seven-segmented club; lamellae slightly curved outwardly, ≈ 2.94 – 3.20 times as long as stem, first basal segment distinctly swollen apically, apical segment not elongate, subequal in length to second. Labrum symmetrically to weakly asymmetrically bilobed, each lobe moderately to weakly developed. Mentum slightly concave centrally, surface almost glabrous, with only a few scattered setae. Max-

illary palpus with apical palpomere slightly longer than combination of palpomeres 2–3, apical segment spindle-like. Ocular canthus heavily covered with lanceolate, yellowish brown scale-like setae. **Pronotum:** Form transverse, widest at middle, basomedially protuberant posteriorly. Surface densely to confluent punctate in narrow band along lateral margin, each puncture with a tiny brownish seta; maculation on sides of midline well-defined and separately developed, patch of overlapping yellowish white, scale-like setae behind eye with a small, oval, white patch near bottom of inner side, basal triangle-like maculation of each side with yellowish brown setae at apical side of maculation; center of pronotal disc almost glabrous, base and apex at middle shallowly punctuate, setiferous punctures moderately distributed; serration of lateral margin moderately developed anteriorly, basal half of margin with complete and broad bead. **Scutellum** oval, surface shallowly punctate to impunctate, with tiny setae basally. **Elytron:** Broadest at base. Costae 1–3 (costa 1 is sutural costa) glabrous and well developed, costae 2 and 3 broadly fused on apical umbone, costa 4 feebly developed and barely observable; row of whitish, scale-like setae on outer margin of costa 1 usually worn off among old specimens. Intervals almost glabrous, with sparse whitish, lanceolate scale-like setae scattered individually around posterior half. Posthumeral and three basal patches consisting of whitish setae similar to those on pronotum, posthumeral patch smaller, reniform, inner two basal patches fused basally, apical area of elytron steeply depressed below plane of disc and covered with dense, brownish setae, size of setae becoming gradually smaller apically. Epipleuron setose in band along posterior one third, setae brown with a few whitish setae at inner margin. Humeral umbone moderately swollen. **Pygidium** (Fig. 33): Width 1.37–1.49 times length. Disc either side of middle slightly depressed, surface densely covered with whitish brown to yellowish brown, short setae, setae evenly distributed along midline; apex broadly rounded. **Venter:** Thorax setose except mesometasternal process glabrous; mesometasternal process well developed, with smooth surface in front of mesometasternal suture (Fig. 38), apex almost reaching posterior margin of procoxae, slender in lateral view. Abdominal sternites 1–5 without lateral maculation; abdominal surface moderately setose, setae tiny, lanceolate, whitish brown, becoming yellowish brown, slender medially, transversely distributed with scattered, slender setae in line; sternites 2–5 weakly fused medially, suture well defined. **Legs:** Protibia bidentate laterally, apical tooth acute; tarsal claws symmetrically unidentate, abruptly curved apically, with a small, vertical tooth at base. Femora of front and middle legs transversely flattened, surface densely clothed with long, slender, brown setae; posterior femur stouter, with shorter, stout setae moderate in density; dorsal surface of all tibiae and tarsi moderately clothed with pale, white, scale-like, short setae; meso- and metatibiae with two elongate, apical spurs, mesotibial spur distinctly shorter than length of mesotarsomere 1, outer spur of metatibia distinctly longer

than metatarsomere 1, inner spur subequal in length to metatarsomere 1. **Genitalia** (Figs. 43 and 48, 53, 58): Parameres moderately asymmetrical, ventroapical process of right paramere thin apically with top upwardly protuberant in lateral view; lower surface of both apical processes with scattered, tiny setae in caudal view; basal piece subequal in length to paramere.

Female (Fig. 27). Similar to male, differing in the following characters: overall body shape more robust, length 22.5–24.2 mm, width 11.3–12.7 mm; apex of clypeus moderately reflexed; sides of eye completely encompassed by scale-like setae; antennal club shorter than combined length of basal segments 1–4; mesometasternal process longer and more robust, reaching posterior margin of procoxae; protibia tridentate laterally; metafemur stouter.

Specimens Examined. S. W. CHINA: Yunnan Prov, Xishuangbanna, October 1996, P.-s. Yang (1♀, CCLI). N. W. THAILAND: Chiang Mai, Doi Suthep, 1,200 m Chw., 23 October 1983, M. Owada leg. (1♂, NSMT); Chiang Mai Doi Saket, September–October 1998 (3♂♂4♀♀). SE. MYANMAR: Tenasserim, Adamson's Coll., 1908–102 (P) (1♀, BMNH). LAOS: Lak Xao, Bolokhamsai, 4–6 November 2004, M. Satô leg. (2♂♂1♀, CCLI); Vang Ving, 21 November 1998, T. Matsuura leg. (1♀, CCLI). S. VIETNAM: Bao Loc, October 1999 (8♂♂, CCLI).

Distribution. Indochina (Thailand, Vietnam, Laos, eastern and southern Myanmar); southwestern China (Yunnan) (Fig. 61).

Remarks. The third species of the *guttigera* group was originally named as *Hoplosternus maculatus* by Chang (1983) and was based on a single female from southern Yunnan, China. Itoh (1995) reported many specimens of *H. maculatus* from northern Thailand as well as other records that we document in this study, thus suggesting that this species is common and widely spread throughout Indochina. However, there are few historic specimens found in older European collections.

Melolontha weyersi (Brenske, 1900)

(Figs. 28 and 29, 34, 39, 44, 49, 54, 59, 61)

Hoplosternus weyersi Brenske, 1900: 152 (lectotype in ISNB); Dalla Torre, 1912: 287 (catalog).

Melolontha weyersi Denis and Li, 2005: 4 (generic combination; illustrations).

Diagnosis. *M. weyersi* can be distinguished from other species by the following combination of characters: side of eyes heavily setose, setae whitish, scale-like; center of frons moderately convex; labial lobe moderately developed; sides of pronotal midline with longitudinal maculation composed of whitish, scale-like setae, basal half of pronotal midline densely punctate in a small, well-defined area; costal intervals of elytra almost glabrous; apex of mesometasternal process reaching posterior margin of procoxae; abdominal sternites 1–5 with lateral maculation, surface with setae becoming yellowish brown in color, lanceolate and

becoming slender medially; protibia bidentate; male genitalia as in Figs. 44 and 49, 54, 59.

Description. Male (Fig. 28). Length 22.3 mm, width 10.0 mm. Head, venter and legs reddish brown, pronotum, scutellum and elytra light olive green. *Head*: Clypeus rectangular, base as wide as apex, apex perpendicularly reflexed, moderately trisinate in frontal view, middle broadly convex with lateral angles equally protuberant, clypeal surface densely and evenly punctate, punctures large, each bearing a short, robust, semierect seta, setae light brown; clypeofrontal suture complete; center of frons moderately convex, sparsely setose, setae longer than those on clypeus, side of eyes densely setose, setae whitish, overlapping, lanceolate; sides slightly narrowed making eyes seem larger. Antenna 10-segmented with seven-segmented club; lamellae slightly curved outwardly, ≈ 2.86 times as long as stem, first basal segment moderately swollen apically, apical segment not elongate, subequal in length to second segment. Labrum symmetrically bilobed, each lobe round moderately developed. Mentum slightly concave centrally, surface almost glabrous with only a few scattered setae. Maxillary palpus with apical palpomere longer than combination of palpomeres 2–3, apical segment spindle-like. Ocular canthus covered with dense, whitish, lanceolate setae. *Pronotum*: Form transverse, widest at middle, basomedially protuberant posteriorly. Surface densely to confluent punctate in narrow band along lateral margin, each puncture with a tiny, brownish seta; broad, white maculation consisting of whitish, lanceolate setae on sides of midline longitudinal and gradually decreased basomedially; center of pronotal disc almost glabrous, basomedially punctate with dense, setiferous punctures distributed in a small area; serration of lateral margin moderately developed anteriorly, basal half of margin with complete and broad bead. Scutellum oval, surface with punctures well-defined, dense, each with a whitish, scale-like seta. *Elytron*: Broadest at base. Costae 1–3 (costa 1 is sutural costa) glabrous and well developed, costae 2 and 3 broadly fused on apicalumbone, costa 4 feebly developed and hardly observable; outer margin of costa 1 with row of whitish, scale-like setae. Intervals glabrous, with sparse, whitish, lanceolate setae scattered individually in posterior half. Posthumeral and three basal patches composed of overlapping, whitish lanceolate setae, posthumeral patch oval in shape, apical area of elytron steeply depressed below plane of disc with dense, brownish setae, setae gradually becoming smaller apically. Epipleuron setose in band along posterior half, whitish setae gradually becoming brown apically. Humeral umbone moderately swollen. *Pygidium* (Fig. 34): Width 1.45–1.56 times length. Disc either side of middle slightly depressed, surface densely covered with whitish brown, short setae, setae evenly distributed or scattered along midline; apex broadly rounded. *Venter*: Thorax setose except for mesometasternal process; mesometasternal process well developed, with smooth surface in front of mesometasternal suture (Fig. 39), apex reaching posterior margin of procoxae, robust in lateral view. Ab-

dominal sternites 1–5 each with a lateral maculation consisting of yellowish brown, scale-like setae, maculation on sternite 6 nearly obsolete; abdominal surface moderately setose, setae tiny, whitish brown, becoming yellowish brown, lanceolate and becoming slender medially, transversely distributed with scattered, longer setae in line; sternites 2–5 weakly fused medially, suture well defined. *Legs*: Protibia bidentate laterally, apical tooth acute; tarsal claws symmetrically unidentate, abruptly curved apically with a small vertical tooth at base. Femora of front and middle legs transversely flattened, surface densely clothed with long, slender, brown setae; posterior femur stouter, with shorter, robust, moderate dense setae; dorsal surface of all tibiae and tarsi moderately clothed with pale, white, scale-like, short setae; meso- and metatibiae with two elongate, apical spurs, mesotibial spur slightly shorter than length of mesotarsomere 1, outer spur of metatibia distinctly longer than metatarsomere 1, inner spur subequal in length to metatarsomere 1. *Genitalia* (Figs. 44 and 49, 54, 59): Parameres moderately asymmetrical, ventroapical process of right paramere acuminate apically with top feebly protuberant when viewed laterally; lower surface of both apical processes with scattered, tiny setae in caudal view; basal piece subequal in length to paramere.

Female (Fig. 29). Similar to male, differing in the following characters: overall body shape more robust, length 25.0 mm, width 12.3 mm; apex of clypeus weakly reflexed; antennal club shorter than combined length of segments 1–4; mesometasternal process longer and more robust, reaching anterior margin of procoxae; metafemur stouter.

Type Material Examined. Lectotype ♂ (here designated) labeled as follows: *Hoplosternus weyersi* type. Brenske unicum. (H)// Coll. F. de Moffarts (P)// Holotype (P) (ISNB).

Other Specimens Examined. 1 ♀, Sumatra, Medan (H)// Doherty (H)// 67164 (P)// Fry Coll., 1905–100. (P)// Determined from description. G.J.A. (P) *Hoplosternus weyersi* Brenske (H) (BMNH).

Distribution. Northern Sumatra (Fig. 61).

Remarks. In the original description of *M. weyersi* by Brenske (1900), the male body color should be similar to that of other species within the *guttigera* group. It seems likely that the holotype apparently underwent some treatment that resulted in the change of body color as shown in Fig. 28. Therefore, we modified the description for body color following the observation of the female specimen we examined.

Brenske (1900) clearly listed both sexes under the name of *H. weyersi*, and thus there should have been two or more syntypes of *H. weyersi*. In our search for type specimens of *H. weyersi*, we found a male type with a handwritten Brenske label in ISNB but failed to find the female that was mentioned in the original description. In addition to the handwritten label, there is another holotype label in red printing attached with the male type. However, the German coleopterist, Ernst Brenske, has never been known to use the term holotype for any new species he named. Accordingly, we conclude that the correct status of the name-

bearing type deposited in the ISNB should be a lectotype which we designate here.

With the exception of the type specimens, there is only one additional female specimen known to us collected near the type locality in the 1900s deposited in the BMNH. It seems that *M. weyersi* has a narrow distribution.

***Melolontha javanica* Keith and Li, 2005**

(Figs. 30 and 35, 40, 45, 50, 55, 60, 61)

Melolontha javanica Keith and Li, 2005: 2 (holotype in ISNB).

Diagnosis. *M. javanica* resembles *M. weyersi* and can be distinguished from it by the following combination of characters: apex of clypeus slightly concave medially, making lateral angle weakly protrudent; basal segment of antenna distinctly swollen apically; basal half of pronotal midline shallowly punctate in a broad area; apex of mesometasternal process usually with 1–3 longitudinal notches in front of mesometasternal suture; setae on ventral surface of metafemora moderately longer and dense; male genitalia shown as Figs. 45 and 50, 55, 60.

Description. Male (Fig. 30). Length 21.6–24.3 mm, width 9.5–11.0 mm. Head, venter and legs reddish brown, pronotum, scutellum and elytra light olive green. **Head:** Clypeus rectangular, base as wide as apex, apex perpendicularly reflexed, moderately trisinate in frontal view, middle broadly convex with lateral angles equally protuberant, clypeal surface densely and evenly punctate, punctures large, each bearing a short, robust, semierect seta, setae light brown; clypeofrontal suture complete; center of frons moderately convex, sparsely setose, setae longer than those on clypeus, side of eyes densely setose, setae whitish, overlapping, lanceolate; sides slightly narrowed making eyes seem larger. Antenna 10-segmented with seven-segmented club; lamellae curved slightly outwardly, ≈ 2.50 – 2.78 times as long as stem, first basal segment distinctly swollen apically, apical segment not elongate, subequal in length to second segment. Labrum symmetrically bilobed, each lobe moderately developed. Mentum slightly concave centrally, surface almost glabrous with only a few, scattered setae. Maxillary palpus with apical palpomere longer than combination of palpomeres 2–3, apical segment spindle-like. Ocular canthus covered with dense, whitish, lanceolate setae. **Pronotum:** Form transverse, widest at middle, basomedially protuberant posteriorly. Surface densely to confluent punctate in narrow band along lateral margin, each puncture with a tiny, brownish seta; broad, white maculation consisting of whitish, lanceolate setae on sides of midline, maculation longitudinal and gradually decreased basomedially; center of pronotal disc almost glabrous, basomedially punctate with setiferous punctures moderately distributed; serration of lateral margin moderately developed anteriorly, basal half of margin with complete and board bead. Scutellum oval, surface shallowly punctate, moderate in

density, each usually with a whitish, scale-like setae. **Elytron:** Broadest at base. Costae 1–3 (costa 1 is sutural costa) glabrous and well developed, costae 2 and 3 broadly fused on apical umbone, costa 4 weakly developed, barely observable; outer margin of costa 1 with row of whitish, scale-like setae. Intervals glabrous, with sparse, whitish, lanceolate setae scattered in posterior half. Posthumeral and three basal patches composed of overlapping, whitish, lanceolate setae, posthumeral patch oval, apical area of elytron steeply depressed below plane of disc with dense, brownish setae, size of setae gradually becoming smaller apically. Epipleuron setose in band along posterior half, whitish setae gradually becoming brown apically. Humeral umbone moderately swollen. **Pygidium** (Fig. 35): Width 1.45–1.56 times length. Disc either side of middle slightly depressed, surface covered with dense, whitish brown, short setae, setae evenly distributed or moderately scattered along midline; apex broadly rounded. **Venter:** Thorax setose except for mesometasternal process; mesometasternal process well developed, usually with 1–3 longitudinal notches in front of mesometasternal suture (Fig. 40), apex reaching posterior margin of procoxae, robust in lateral view. Abdominal sternites 1–5 each with a lateral, triangular maculation consisting of yellowish brown, scale-like setae, maculation on sternite 6 nearly obsolete; abdominal surface moderately setose, setae tiny, whitish brown, becoming yellowish brown, lanceolate and becoming slender medially, transversely distributed with scattered, longer setae; sternites 2–5 weakly fused medially, suture well defined. **Legs:** Protibia bidentate laterally, apical tooth acute; tarsal claws symmetrically unidentate, abruptly curved apically, with a small vertical tooth at base. Femora of front and middle legs transversely flattened, surface densely clothed with long, slender, brown setae; posterior femur stouter, with shorter, robust, moderate dense setae; dorsal surface of all tibiae and tarsi moderately clothed with pale, white, scale-like, short setae; meso- and metatibiae with two elongate, apical spurs, mesotibial spur slightly shorter than length of mesotarsomere 1, outer spur of metatibia distinctly longer than metatarsomere 1, inner spur subequal in length to metatarsomere 1. **Genitalia** (Figs. 45 and 50, 55, 60): Parameres moderately asymmetrical, ventroapical process of right paramere acuminate apically with top roundly protuberant when viewed laterally; lower surface of both apical processes with scattered, tiny setae in caudal view; basal piece subequal in length to paramere.

Female. Similar to male, differing in the following characters: overall body shape more robust, length 27.0–28.5 mm, width 12.4–13.6 mm; apex of clypeus indistinctly reflexed; antennal club shorter than combined length of basal segments 1–4; mesometasternal process longer and more robust, reaching anterior margin of procoxae; metafemur stouter.

Type Material Examined. Holotype ♂, Mt. Gumetir, E. Java, Indonesia, XI-1999, col. Minetti (P) (ISNB). Allotype ♀, near Jember, E. Java, XII-1990, col. Matsumoto (P) (ISNB).

Other Specimens Examined. same data as the holotype (paratype ♂, col. D. Keith); Banyuwangi, E-Java. November 1987 (P) (2♂♂, CCLI); Jember, E. Java, DEC. 1992 (P) (1♂, CCLI); Indonesia: E. Java, Bumitir (P) (1♂, CCLI); Jember, E. Java, 7-X-1983 (H) (1♂, NSMT); Mt. Gunitir, E. JAVA, JAN 2001. (1♂, CCLI).

Distribution. East Java (Fig. 61).

Remarks. Compared with its morphologically closest relative *M. weyersi* in Sumatra, *M. javanica* is a species with a stable population inhabiting the montane areas of eastern Java. Adult activity is from November to March. This is the only species within the group that has its adult activity lasting over five months.

Acknowledgments

We are grateful to the curators of the collections listed for the loan of the specimens. We dedicate this work to the late Professor Masataka Satô for our close beetle-based friendship. Masayuki Fujioka (Tokyo, Japan), Dirk Ahrens (BMNH), Yu-Feng Hsu (Taipei, Taiwan), Takeshi Matsu-moto (Osaka, Japan), and Denis Keith (Chartres, France) kindly provided relevant materials to augment the distribution information of species. We also thank Denis Keith and María Coca-Abia (Zaragoza, Spain) for sending literature and two anonymous reviewers for critical reading of the manuscript. Thanks also to Shun-Chern Tsaour, Shu Fang (both Academia Sinica), and Chau-Ti Ting (National Taiwan University) for providing equipment and opportunities to C.-L.L. This study was financially supported by grants NSC 98-2621-M-002-010 (to P.-S.Y.), NSC 98-2311-B-030-001-MY2 (to C.-C.W.), and NSC 97-2811-B-002-065 (to C.-L.L.) from the National Science Council of Taiwan, Republic of China.

References Cited

- Ancey, C. F. 1881. Descriptions de coléoptères nouveaux. *Naturaliste* 3: 409–414.
- Andrewes, H. E. 1929. The fauna of British India including Ceylon and Burma. Coleoptera: Carabidae, I. Carabinae. Taylor & Francis, London, United Kingdom.
- Arrow, G. J. 1913. Notes on the lamellicorn Coleoptera of Japan and descriptions of a few new species. *Ann. Mag. Nat. Hist.* 12: 394–408.
- Arrow, G. J. 1946. Entomological results from the Swedish expedition 1934 to Burma and British India. Coleoptera: Melolonthidae. Collected by René Malaise. *Arkiv. Zool.* A 36: 1–33.
- Barlow, E. 1899. List of the Melolonthini contained in the collection of the Indian Museum. *Indian Mus. Notes* 4: 236–273.
- Bates, H. W. 1891. Coleoptera from Kulu in N.-W. India. *Entomol.* 24(Suppl.): 7–22.
- Bezdek, A. 2006. Scarabaeidae: Melolonthinae, pp. 181–228. In I. Löbl and A. Smetana [eds.], *Catalogue of Palaearctic Coleoptera*, volume 3. Apollo Books, Stenstrup, Denmark.
- Blanchard, C. É. 1851. *Ordre des Coléoptères*, pp. 129–240. In H. Milne-Edwards, C. É. Blanchard, and H. Lucas [eds.], *Museum d'Histoire Naturelle de Paris. Catalogue de la collection entomologique. Classe des insectes*, volume 1, part 2. Gide & Baudry, Paris, France.
- Blanchard, C. E. 1871. Remarques sur la faune de la principauté thibétaine du Mou-Pin. *Compt. Rendus Paris* 72: 807–813.
- Brenske, E. 1894. Die Melolonthiden der palaearctischen und orientalischen Region in Königlichen Naturhistorischen Museum zu Brüssel. Beschreibung neuer Arten und Bemerkungen zu bekannten. *Mem. Soc. Entomol. Belg.* 2: 3–87.
- Brenske, E. 1896a. Insectes du Bengale. (37e Mémoire.) Melolonthidae. *Ann. Soc. Entomol. Belg.* 40: 150–164.
- Brenske, E. 1896b. Neue Melolonthiden aus Africa und Asien. *Stett. Entomol. Zeitschr.* 57: 178–205.
- Brenske, E. 1900. Contribution à l'étude de la faune de Sumatra (Côte Ouest-Vice-résidence de Païnan) VIII. Melolonthiden gesammelt von J.-L. Weyers. *Mém. Soc. Entomol. Belg.* 7: 141–155.
- Brenske, E. 1903. Drei neue Melolonthiden-Gattungen und Arten vom Kukunor. *München Kol. Zeitschr.* 1: 333–335.
- Bunalski, M. 2002. Melolonthidae (Coleoptera: Scarabaeoidea) of the Palaearctic and Oriental regions. I. Taxonomic remarks on some genera of Melolonthinae. *Polskie Pismo Entomol.* 71: 401–413.
- Burmeister, H. 1855. *Handbuch der Entomologie*, Band IV. Berlin, Germany.
- Chang, Y. W. 1983. A new species of the genus *Hoplosternus* Guérin (Coleoptera: Melolonthidae). *Acta Zootax. Sin.* 8: 395–396.
- Coca-Abia, M. 2004. External morphology and genitalia of *Melolontha melolontha* (L., 1758) (Coleoptera, Scarabaeidae, Melolonthinae). A comparative study with other genera of the Iberian Peninsula. *Laimburg J.* 1: 220–227.
- Coca-Abia, M. 2007. Phylogenetic relationships of the subfamily Melolonthinae (Coleoptera, Scarabaeidae). *Insect Syst. Evol.* 38: 447–472.
- Dalla Torre, K. W. 1912. von Scarabaeidae: Melolonthinae, III, pp. 135–290. In W. Junk and S. Schenkling [eds.], *Coleopterorum catalogus pars.* 49, volume 20. Berlin, Germany.
- Fairmaire, L. 1878. Descriptions de Coléoptères recueillis par M. Lábbe David dans la Chine centrale. *Ann. Soc. Entomol. Fr.* 5: 87–140.
- Fairmaire, L. 1889. Coléoptères de l'intérieur de la Chine (5 partie). *Ann. Soc. Entomol. Fr.* 6: 5–84.
- Fairmaire, L. 1891. Descriptions de Coléoptères l'intérieur de la Chine (6 partie). *Ann. Soc. Entomol. Belg.* 35: 6–24.
- Fairmaire, L. 1896. Coléoptères de l'Inde boréale, Chine et Malaisie. *Notes Leyden Mus.* 18: 81–129.
- Frey, G. 1969. Neue Lamellicornia aus Südostasien und Australien. *Entomol. Arb. Mus. Frey.* 20: 106–116.
- Guérin-Ménéville, F. E. 1838. Insectes du voyage de la Favorite. *Mag. Zool. IX Insect.* 8(1) 3 [1832–1838]: 1–64.
- Hope, F. W. 1831. Synopsis of the new species of Nepaul insects in the collection of Major-General Hardwicke. *Zool. Miscell.* 1831: 21–32.
- Itoh, T. 1995. Melolonthidae (Coleoptera) from Thailand, II. *Elytra.* 23: 195–204.
- Keith, D. 2004. Remarques sur quelques espèces du genre *Exolontha* Reitter, 1902 (Coleoptera, Melolonthidae). *Bull. Soc. Entomol. Fr.* 109: 329–332.
- Keith, D. 2006. Sur le genre *Tocama* (Col. Melolonthidae). *Lambillionea* 106: 223–229.
- Keith, D. 2008. Nouveaux Melolonthini du Sud-Est asiatique (Coleoptera, Scarabaeoidea). *Nouv. Rev. Entomol.* 24: 335–349.
- Keith, D., and C.-L. Li. 2005. Notes on the *Melolontha guttiger* group with description of a new species from Java (Coleoptera, Scarabaeidae, Melolonthinae). *Kogane* 6: 1–7.

- Kobayashi, H. 1985. Scarabaeidae from Taiwan (12). *Gekkan-Mushi*. 173: 20–24.
- Kobayashi, H., and W.-I. Chou. 2009. Description of a new species of the genus *Melolontha* from Taiwan. *Kogane* 10: 49–51.
- Krell, F.-T. 2000. The fossil record of Mesozoic and Tertiary Scarabaeoidea (Coleoptera: Polyphaga). *Invertebr. Taxon.* 14: 871–905.
- Krell, F.-T. 2006. Fossil record and evolution of Scarabaeoidea (Coleoptera: Polyphaga). *Coleopt. Soc. Monogr.* 5: 120–143.
- Li, C.-L., and P.-S. Yang. 1999. A new genus *Clypeolontha* Li and Yang, for the genus *Melolontha* Fabricius (Coleoptera: Scarabaeidae: Melolonthinae) from Southeastern Asia. *Proc. Entomol. Soc. Wash.* 101: 391–411.
- Li, C.-L., and P.-S. Yang. 2003. Notes on the Oriental *Melolontha* (Coleoptera, Scarabaeidae, Melolonthinae). *Spec. Bull. Jpn. Soc. Coleopterol.* 6: 217–225.
- Liu, G.-R., Y.-W. Zhang, and R. Wang. 1997. The colour illustrated of common lamellicornia beetles of northern China. China Forestry Publishing House, Beijing, China.
- Moser, J. 1913. Beitrag zur kenntnis der Melolonthiden (Col.). *Deutsche Entomol. Zeitschr.* 1913: 271–297.
- Moser, J. 1918. Neue Melolonthiden aus der Sammlung des Deutschen Entomologischen Museums zu Berlin-Dahlem (Col.). *Stett. Entomol. Zeitschr.* 79: 209–247.
- Motschulsky, V. 1854. de Diagnoses de Coléoptères nouveaux trouvés, par M. M. Tatarinoff et Gaschkéwitsch aux environs de Pékin. *Etudes Entomol.* 2: 44–51.
- Niijima, Y., and E. Kinoshita. 1923. Die Untersuchungen über japanische Melolonthiden II. Melolonthiden Japans und ihre Verbreitung. *Res. Bull. Coll. Agric. Hokkaido Imp. Univ. Sapporo* 2: 1–253.
- Nomura, S. 1952. Über die *Melolontha*-Arten aus Japan und dessen Umgebung, mit den Beschreibungen einen neuen Gattung und einiger neuer Arten. *Tôhō Gakuhō* 2: 24–34.
- Nomura, S. 1964. Some new forms of the Scarabaeoidea from Loochoo islands. *Entomol. Rev. Jpn.* 16: 54–55.
- Nomura, S. 1977a. Notes on some scarabaeid-beetles from Japan and Taiwan (Coleoptera). *Tôhō Gakuhō* 27: 77–84.
- Nomura, S. 1977b. On the Melolonthini of Taiwan (Coleoptera, Scarabaeidae). *Tôhō Gakuhō* 27: 85–109.
- Nonfried, A. F. 1891a. Neue afrikanische, central-amerikanische und ost-asiatische Melolonthiden und Ruteliden. *Berliner Entomol. Zeitschr.* 36: 221–240.
- Nonfried, A. F. 1891b. Beiträge zur kenntnis einiger neuen exotischen Coleopterenspezies. *Deutsche Entomol. Zeitschr.* 1891: 257–276.
- Novák, V. 1976. Atlas of insects harmful to forest trees, volume I. Elsevier Scientific Publishing Co., Amsterdam, The Netherlands.
- Sabatinelli, G. 1992. Catalogue of the Scarabaeoidea Melolonthidae from Himalaya and North India: Macrodactylini, Hopliini, Diplotaxini, Melolonthini and Sericini (Coleoptera). *Mem. Soc. Entomol. Ital.* 71: 593–636.
- Sharp, D. 1876. Descriptions of some new species of Scarabaeidae from tropical Asia and Malaysia. *Coleopt. Heft.* 15: 65–90.
- Tesar, Z. 1938. Beitrag zur Kenntnis der pal. Lamellicornien. *Entomol. Nachricht.* 12: 165–172.
- Yu, C.-K., H. Kobayashi, and Y.-I. Chu. 1998. The Scarabaeidae of Taiwan. Mu Sheng Co., Taipei, Taiwan.
- Zidek, J. 2003. Comments on *Melolontha* Fabricius and *Exolontha* Reitter (Scarabaeidae: Melolonthinae). *Animma* X 3: 15–22.

Received 19 June 2009; accepted 2 February 2010.