

TWO NEW SPECIES OF CAVERNICOLOUS TRECHINES FROM SOUTHERN CHINA KARST (COLEOPTERA: CARABIDAE: TRECHINAE)

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Abstract: Two new species of subterranean trechine beetles are described and illustrated: *Sinaphaenops mochongensis* n. sp. from a limestone cave called Yueliang Dong, in Duyun, southern Guizhou, and *Luoxiaotrechus yini* n. sp. from Shuilian Dong, in Lianhua, western Jiangxi. A key to all species of the genus *Sinaphaenops* Uéno et Wang, 1991 is provided.

INTRODUCTION

As the largest karstic area in the world (Waltham, 2009), southern China is also one of the hottest of the four world hotspots for cave biodiversity, and the only one in the subtropics (Deharveng, 2012). For example, the trechine cave beetles, typical representatives of terrestrial troglotitic animals, in southern China have undergone impressive radiations and exhibit extreme morphological adaptations to subterranean habitats (Uéno and Wang, 1991; Deuve, 1993, 2002; Deuve et al., 1999; Tian et al., 2014). More than one hundred species, included in thirty-three genera, of cavernicolous and eyeless trechines live in this region (Tian, 2008, 2014; Tian and Clarke, 2012; Tian and Yin, 2013; Tian and Huang, 2014; Tian and Luo, 2015).

Sinaphaenops Uéno et Wang, 1991 is the first and a highly modified troglotitic trechine genus reported from China. It was set up to contain *S. mirabilissimus* Uéno et Wang, 1991 from a limestone cave in the Maolan karst of southern Guizhou. Several years later, Magrini (1997) described *Thaumastaphaenops pulcherrimus* from a cave in the Ziyun karst. Uéno and Ran (1998) added two new species into *Sinaphaenops*; both are very close to *S. mirabilissimus* and are living also in the Maolan karst. Then Uéno (2002) described three new species of this genus from caves in Sandu, Pingtang, and Ziyun counties. In the same paper, he treated *Thaumastaphaenops* as a junior synonym of *Sinaphaenops* and transferred *T. pulcherrimus* to *Sinaphaenops*. Deuve and Tian (2014) described a new subgenus based on *Sinaphaenops* (*Dongaphaenops*) *xuxiakei*, a species from westernmost Guizhou. They confirmed the valid status of *Thaumastaphaenops* as a subgenus of *Sinaphaenops*. To date, the genus *Sinaphaenops* is composed of eight species in three subgenera, all endemic to Guizhou Province, except *Sinaphaenops* (*s. str.*) *wangorum* Uéno et Ran, 1998, which also occurs in the Mulun karst of northern Guangxi Zhuang Autonomous Region (Tian et al., 2010). In recent years, several visits to Yueliang Dong, a limestone cave located in Mochong karst, Duyun, southern Guizhou, led

to the discovery of two female trechine specimens that represent a new *Sinaphaenops* (*s. str.*) species.

The semi-aphaenopsian trechine genus *Luoxiaotrechus* was proposed by Tian and Yin (2013) for a species (*L. deuvei*

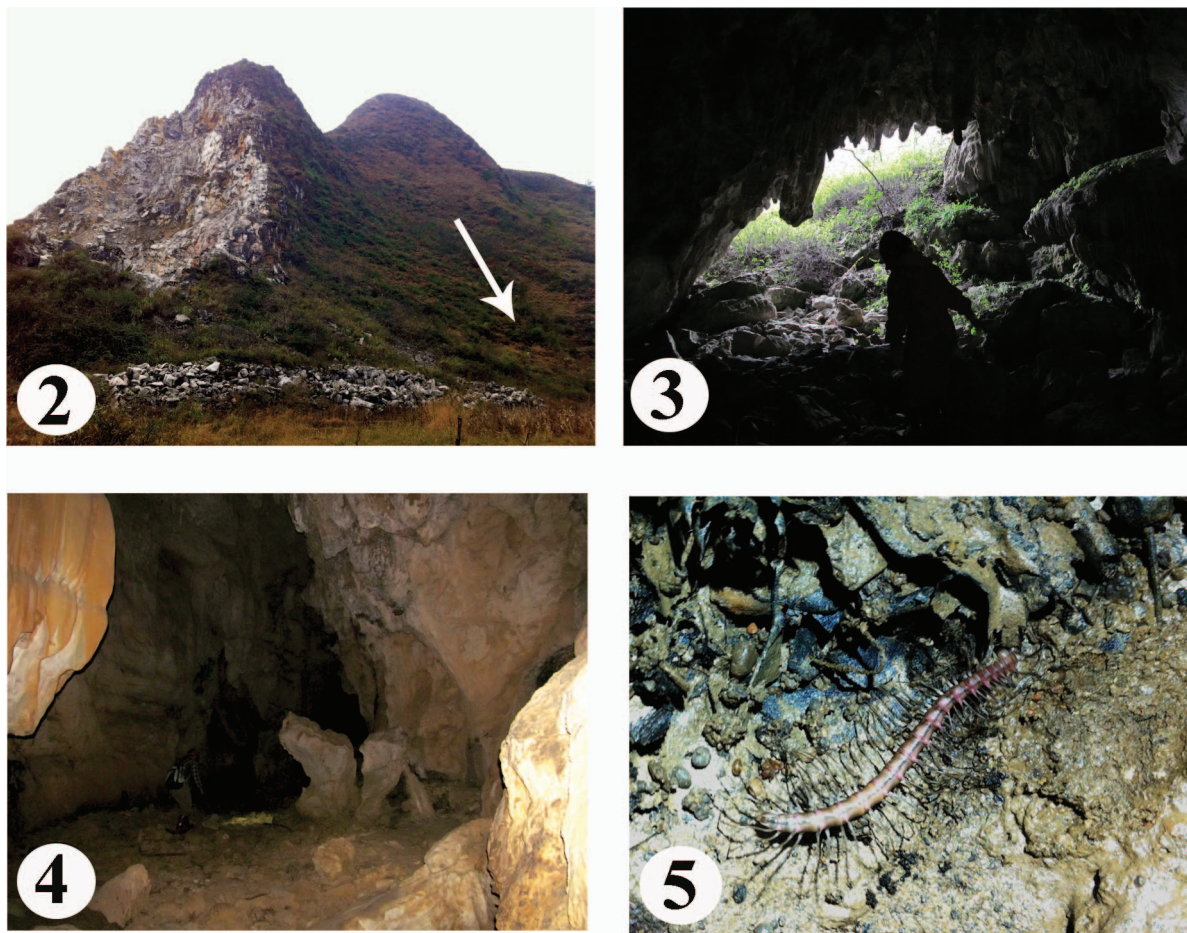


Figure 1. Habitus of *Sinaphaenops mochongensis* n. sp., holotype, female.

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Table 1. Key to species of the genus *Sinaphaenops* Uéno et Wang, 1991.

Number	Characteristics
1	Right mandible tridentate, elytra without preapical pore, protibiae with a longitudinal sulcus (subgenus <i>Sinaphaenops</i> Uéno et Wang).....2
2	Right mandible bidentate, elytra with preapical pore, protibiae without a longitudinal sulcus.....8
3	Body stout, neck constriction comparatively wide (Fig. 6).....3
4	Body slender, neck constriction distinctly narrowed (Fig. 7) (<i>mirabilissimus</i> species group).....6
5	Three dorsal pores present on 3 rd elytral stria (<i>trisetiger</i> species group).....4
6	Two dorsal pores present on 3 rd elytral stria (<i>orthogenys</i> species group).....5
7	1 st pore of humeral group of the marginal umbilicate pores at behind the level between 2 nd and 3 rd <i>S. (S.) bidraconis</i> Uéno, 2002
8	1 st pore of humeral group of the marginal umbilicate pores at before the level of 2 nd pore..... <i>S. (S.) trisetiger</i> Uéno, 2002
	Body stouter, head with three pairs of supraorbital pores, neck constriction indistinct, hind pronotal angles rectangular..... <i>S. (S.) mochingensis</i> n. sp.
	Body slenderer, head with two pairs of supraorbital pores, neck constriction distinct, hind pronotal angles rounded..... <i>S. (S.) orthogenys</i> Uéno, 2002
6	Posterior supraorbital seta absent (in Maolan karst) or present (in Mulun karst), aedeagus slenderer, but apical lobe broader..... <i>S. (S.) wangrum</i> Uéno et Ran, 1998
7	Posterior supraorbital seta present, aedeagus stouter, but apical lobe narrower.....7
7	Head thinner, lateral margin of elytra visible from above..... <i>S. (S.) gracilior</i> Uéno et Ran, 1998
8	Head thicker, lateral margin of elytra invisible from above..... <i>S. (S.) mirabilissimus</i> Uéno et Wang, 1991
	Pronotum with two pairs of latero-marginal setae, 1 st pore of the humeral group of the marginal umbilicate series located much behind 3 rd , both pores of the middle set markedly posteriad located, about 1/4 from apex of elytra, protarsi in male with only protarsomere 1 dilated, and inermous (subgenus <i>Dongaphaenops</i> Deuve et Tian)..... <i>S. (D.) xuxiakei</i> Deuve et Tian, 2014
	Pronotum without latero-marginal setae, 1st pore of the humeral group of the umbilicate marginal series located at same level with 3 rd both pores of the middle set located at about middle of elytra, protarsi in male with both protarsomeres 1 and 2 dilated, and inermous (subgenus <i>Thaumastaphaenops</i> Magrini, Vanni et Zanon)..... <i>S. (T.) pulcherrimus</i> Magrini, Vanni et Zanon, 1997



Figures 2–5. Yueliang Dong, type locality of *Sinaphaenops mochongensis* n. sp. (2. the site of entrance, indicated by arrowhead; 3. entrance; 4. passage; 5. a dragon millipede *Desmoxytes* sp. in cave).

Tian et Yin, 2013) from a cave in the Youxian karst, eastern Hunan Province. Thanks to Dr. Ziwei Yin, School of Life Science, Shanghai Normal University, we received several interesting specimens that are very similar to *L. deuvei* but were collected from a cave in Lianhua County, western Jiangxi Province, about 20 km from Haitang Dong, the type locality of *L. deuvei*. Further investigations confirmed that it is a new species of *Luoxiaotrechus*, and the second subterranean trechine species known from Jiangxi Province, following *Jiangxiaphaenops longiceps* Uéno et Clarke, 2007.

MATERIAL AND METHODS

The beetles were collected by hand or by using an aspirator and kept in 55% ethanol before study. Dissections and observations were made under a Leica MZ75 microscope. Dissected genital pieces, including the median lobe and parameres of aedeagus, were glued on small paper cards and pinned under the specimen. Digital pictures were taken using a Canon EOS 40D camera, and then processed by means of Adobe Photoshop CS5 software. Length of body is measured from apex of right mandible (in opened position) to elytral apex.

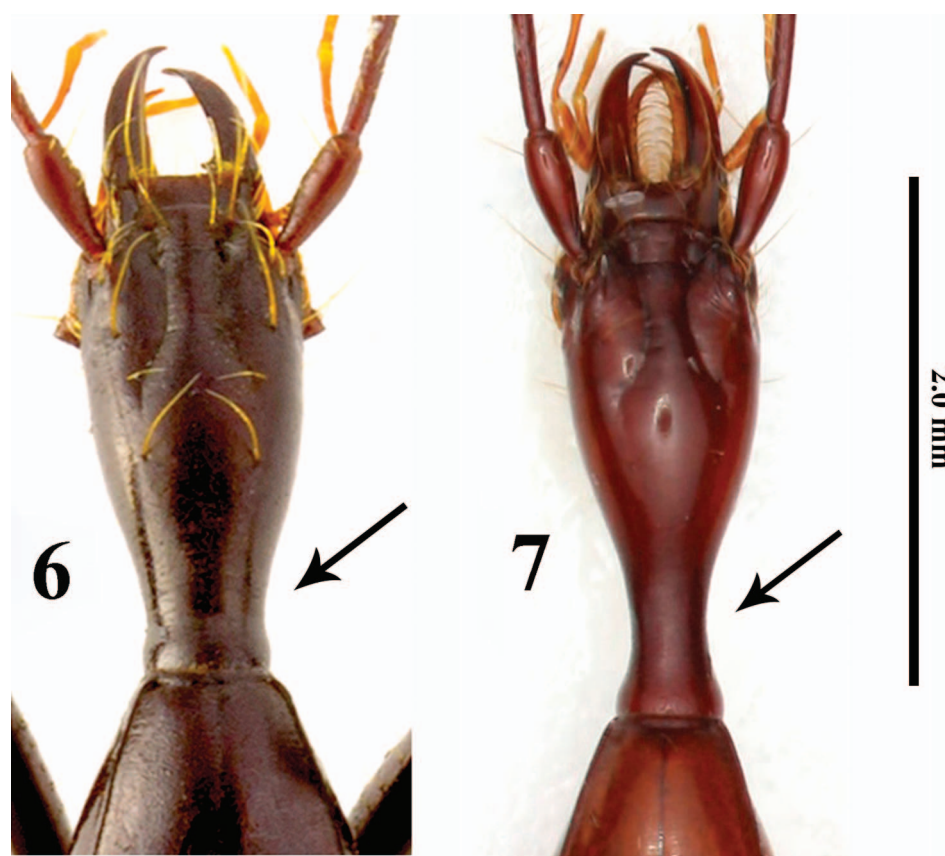
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Abbreviations of other measurements used in the text are:

HLm:	length of head including mandibles, from apex of right mandible to occipital suture;
HLl:	length of head excluding mandibles, from front of labrum to occipital suture;
HW:	maximum width of head;
PL:	length of pronotum, along the median line;
PW:	maximum width of pronotum;
PtW:	maximum width of prothorax;
PfW:	width of pronotum at front;
PbW:	width of pronotum at base;
EL:	length of elytra, from base of scutellum to elytral apex;
EW:	maximum width of combined elytra.

Abbreviations for the specimens' depositories are:

IOZ:	National Museum of Zoology, Institute of Zoology, Chinese Academy of Sciences, Beijing;
MNHN:	Muséum National d'Histoire Naturelle, Paris;
SCAU:	South China Agricultural University, Guangzhou;
SHNU:	Shanghai Normal University, Shanghai;
ZUBM:	Biological Museum of Zhongshan University, Guangzhou.



Figures 6–7. Head of *Sinaphaenops* species (6. *S. mochongensis* n. sp.; 7. *S. wangorum*).

TAXONOMY

SINAPHAENOPS MOCHONGENSIS N. SP.

Holotype. female, Guizhou: Qiannan: Duyun: Mochong: Yueliang Dong, 26°02'36.24" N, 106°26'39.46" E, 901 m, 29-I-2011, leg. Mingyi Tian; paratype: 1 female, same cave, 25-VIII-2014, leg. Mingyi Tian. All are deposited in SCAU.

Description. Length: 8.1–8.2 mm; width: 1.1–1.2 mm. Habitus as in Figure 1.

Large sized, dark brown in holotype, except elytra, tarsi, and palps which are pale or reddish brown; reddish brown in the paratype; body moderately shiny, impunctate; head with a few hairs on genae, glabrous on frons and vertex, prothorax and elytra glabrous; microsculptural engraved meshes transverse striate on head and pronotum, moderately transverse on elytra.

Head much longer than wide, $HLm/HW=2.91$, $HLI/HW=2.08$; slightly stouter than in *S. orthogenys* Uéno, 2002, frontal impressions longer, ending point closer to posterior supraorbital pores than to anterior ones; three pairs of supraorbital setae present, the median pair slightly shorter than others in holotype, but as long as in the paratype, and close to anterior ones; widest at about middle, neck constriction indistinct, a little more than half width of head, without hourglass-shaped part; labial suture well defined,

submentum 10-setose, mentum bisetose; ligula adnated with paraglossae, with two long setae apically, and 10-setose subapically; apex slightly protruding; sparsely setose on ventral head, pair of suborbital setae present at a little before the constricted part; antennae slightly shorter than in *S. orthogenys*.

Prothorax much shorter than head, $PL/HLm=0.61$, $PL/HLI=0.86$; widest at a little behind middle, without lateral marginal setae; propleura distinctly expanded and visible from above, $PtW/PW=1.18$; pronotum slightly wider than head, $PW/HW=1.17$; prothorax strongly wider than head, $PtW/HW=1.38$; base distinctly wider than front, $PbW/PtW=1.54$.

Elytra slenderer than in *S. orthogenys*, elongate ovate, quite similar in *S. bidraconis* Uéno, 2002, but humeral part more pronounced; elytra as long as head (including mandibles) plus pronotum, $EL/(HLI+PL)=1.22$; much wider than prothorax, $EW/PtW=1.88$; much longer than wide, $EL/EW=1.82$; widest at about middle, and nearly parallel-sided; two dorsal pores present on the site of third stria, at about 1/5 and 2/5 of elytra from base respectively; preapical pore absent; chaetotaxal pattern of the marginal umbilicate pores similar in *S. orthogenys*, but first pore of the humeral group just behind the level of anterior dorsal pore, and fourth pore behind level of posterior dorsal pore.



Figure 8. Habitus of *Luoxiaotrechus yini* n. sp., paratype, male.

Prosternum sparsely setose; meso- and metasterna unsetose, abdominal ventrites setose, setae shorter than those on prosterna; epipleura smooth and unsetose; ventrite VII 6-setose, each of IV-VI bisetose.

Male. Unknown.

Remarks. *Sinaphaenops mochongensis* n. sp. is close to *S. orthogenys* from the Sandu karst, southern Guizhou, but easily distinguished from the latter by: three pairs of supraorbital pores present on head (two pairs in *S. orthogenys*); neck constriction wider (narrower in *S. orthogenys*); fore body stouter, but with slenderer elytra than in *S. orthogenys*. A key to genus *Sinaphaenops* is shown in Table 1.

Etymology. Refers to Mochong karst, the type locality of this new species.

Distribution. China (southern Guizhou). Known only from the type locality, a limestone cave called Yue-liang (=moon, in Chinese) Dong (Figs. 2–5). The cave is 157 m long, 315 m wide, and 68 m high, with a seasonal underground river inside (Chen, 1997). The beetles were found and collected on wall of the cave in an area about 6080 m from the entrance. The first author has visited Yue-liang Dong four times since 2010, but failed to find more

beetles. Nobody knows what will happen to Yue-liang Dong and its fauna in near future, because several caves in the Mochong karst have been destroyed by a large cement factory.

LUOXIAOTRECHUS YINI N. SP.

Holotype. male, China: Jiangxi: Pingxiang: Lianghua: Gaotan: cave Shuilian Dong, 27°25'00" N, 113°58'23" E, 520 m, 17-X-2013, leg. Mingyi Tian, Weixin Liu, Haomin Yin, and Yanjing Wang, in SCAU. Paratypes: 11 males, 3 females, *ibid*, in SCAU; 2 males, same cave, 24-VII-2013, leg. Ziwei Yin, Xiaobin Song and Yiming Yu; 3 males, 3 females, same cave, 29-X-2013, leg. Zhong Peng and Jiawei Shen, in SCAU, SHNU, IOZB, ZUBM and MNHN, respectively.

Description. Length: 6.3–7.8 mm (mean 6.9 mm), width: 1.5–1.9 mm (mean 1.7 mm). Habitus as in Figure 8. Very similar to *Luoxiaotrechus deuvei* Tian et Yin, 2013.

Medium sized, light dark brown, but lighter in two individuals (immature); head glabrous and smooth on frons and vertex, pronotum with dense and long setae on disc, elytra covered with short and sparse setae, ventral side of head and thorax sparsely setose.

Head much longer than wide, $HLm/HW=1.86-1.88$, $Hl/HW=1.28-1.38$; labial suture developed, mentum bisetose, submentum 4 to 7-setose, mental tooth bifid.

Prothorax much shorter than head (including mandibles), $PL/HLm=0.72-0.75$, or almost as long as head (excluding mandibles), $PL/Hl=0.98-1.10$; propleura invisible from above; pronotum slightly wider than head, $PW/HW=1.17-1.22$; base distinctly narrower than front, $PbW/PfW=0.77-0.82$.

Elytra longer than head (including mandibles) plus pronotum, $EL/(HLm+PL)=1.17$; $EL/(Hl+PL)=1.21-1.27$; much wider than pronotum, $EW/PtW=1.67-1.77$; much longer than wide, $EL/EW=1.84-2.00$; chaetotaxal pattern similar in *L. deuvei*.

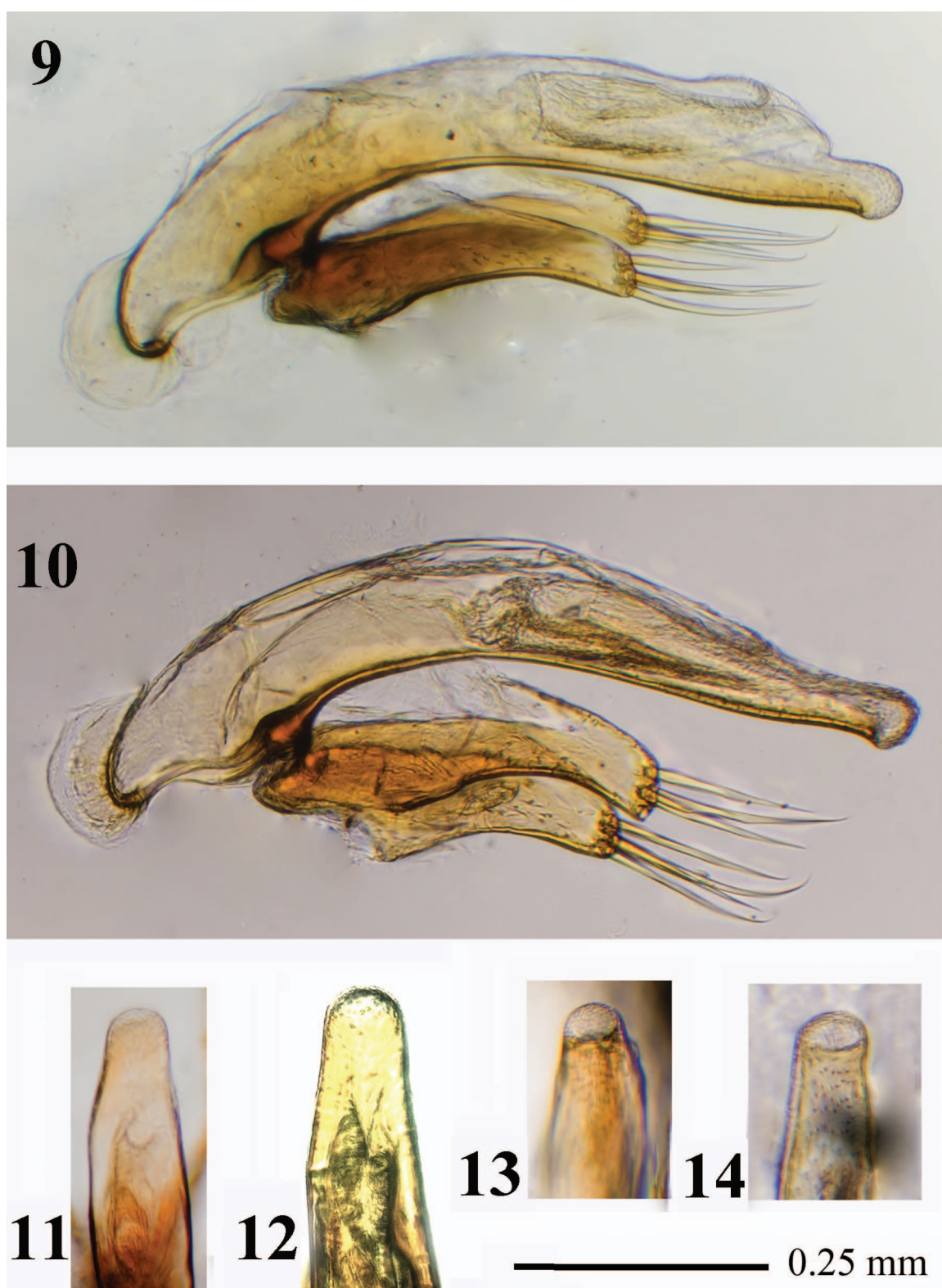
Male genitalia (Figs. 9, 11, 13): Similar in *L. deuvei* (Figs. 10, 12, 14), but shorter, and slightly stouter than the latter, with apical lamella a little narrower in dorsal view and smaller opening hole in ventral view; right parameres with four long setae at apex, while the left with three to four.

Remarks. Allied to *L. deuvei* Tian et Yin, 2013, but recognized by the pronotum slightly narrower, less expanded laterally, slightly sinuate before hind angles (strongly sinuate in *L. deuvei*), base almost straight (distinctly convex medially in *L. deuvei*), hind angles sharper; and male genitalia shorter.

Etymology. Dedicated to Dr. Ziwei Yin, Shanghai Normal University, a specialist of Pselaphidae.

Distribution. China (Jiangxi). It is the first record of a *Luoxiaotrechus* occurring in Jiangxi Province, eastern China.

Shuilian Dong, the type locality, is a beautiful cave and contains interesting fauna (Figs. 15–21). According to the native people it is several kilometers long, but exact length remains unknown. It opens on the side of a mountain near



Figures 9–14. Male genitalia of *Luoxiaotrechus* species (9, 11, and 13: *L. yini* n. sp.; 10, 12, and 14: *L. deuvei*; 9, 10: median lobe and parameres, lateral view; 11, 12: apical lobe, dorsal view; 13, 14: apical lobe, ventral view).



Figures 15–22. Shuilian Dong, type locality of *Luoxiaotrechus yini* n. sp. (15. entrance; 16 and 19: passage and beautiful deposits, showing where the beetles were collected; 17, 18: beetles of *L. yini* n. sp. in cave. 20: millipedes in cave; 21: a *Scutigera* centipede in the cave.

the village Gaotan, with a quite large entrance that is about 5 m high. It is muddy inside the cave, and the floor is covered with a lot of cattle dung and bat guano. There is an underground river inside the cave. The trechine beetles were collected on the ground, under stones, or on the wall, in the dark zone at about 50 to 80 m from the entrance.

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