



论寒武纪小山城子属*

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提要 根据唐山市丰润区左家坞镇半壁山寒武系炒米店组下部含海绿石灰岩夹竹叶状灰岩中采集的三叶虫标本, 对小山城子虫属的定义和时代进行了修订, 将后平壤虫 *Metapianaspis* Qian, 1994, 扎浪滩虫 *Zhalangtania* Zhou in Zhou *et al.*, 1996 与小山城子虫属合并; 对其时代和分类位置进行了讨论, 将小山城子虫属归于唇头虫科 *Cheilocephalidae* Shaw, 1956, 在华北寒武系苗岭统顶部新建了 *Liostracina simesi-Placosema convexa* 带, 对于华北浅水台地相区和华南深水斜坡相区地层对比具有重要意义。

关键词 小山城子虫修订 寒武系苗岭统 *Liostracina simesi-Placosema convexa* 组合带

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DISCUSSION ON THE CAMBRIAN GENUS *SHANCHENGZIELLA*

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Abstract Based on the new material collected from the medium bedded to thin-bedded glauconitic limestone in the lowermost part of the Chaumitien Formation, the diagnosis and occurrences of the genus *Shanchengziella* Lu and Qian, 1983 have been revised. *Metapianaspis* Qian, 1994 and *Zhalangtania* Zhou in Zhou *et al.*, 1996 are considered as synonymous with *Shanchengziella*, which is grouped within the family *Cheilocephalidae* Shaw, 1956. The trilobite *Lio-*

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stracina simesi-Placosema convexa Zone has been established for the last occurrence of Miaolingian Series in North China Platform. It is very useful and significant for the stratigraphical correlation between North China Platform and South China Slope.

SYSTEMATIC PALEONTOLOGY

Superfamily Dameselloidea Kobayashi, 1935

Family Cheilocephalidae Shaw, 1956

Genus Shanchengziella Lu and Qian, 1983

Type species *Shanchengziella elongata* Lu and Qian, 1983, from *Chuangia* Zone, *Chuangia subquadrangulata* Subzone of the Chaomitien Formation, close to Shanchengzi Town, Manzu Autonomous County, Benxi City, Liaoning.

Other species *Shanchengziella valleculata* (Zhou in Zhou *et al.*, 1996); *S. conula* (Qian, 1994)

Diagnosis (Revised) Cheilocephalidae has the following Characteristics: glabella long, truncatedly conical, with rounded anterior margin and 3–4 pairs of shallow lateral furrows; S1 deeper and long, slanting backwards; anterior border narrow, gently convex, slightly bending forward; fixed genae very narrow between palpebral lobes(tr.); eye ridge brawny and convex; palpebral lobe short, slightly upturned, situated at anteromedially opposite to glabella; posterior area of fixigenae wide (tr.) and long (exsag.); posterior border furrow deep, bending forwards abaxially; posterior border narrow (exsag.) and convex, bending forwards abaxially, with a small flange or “elbow” near the middle portion of posterior margin. Pygidium semi-elliptical in outline, pygidial axis narrow and short in adult specimen, distinctly tapering backwards, with 5–6 axial rings and a short posterior axial ridge; pleural field wider than axial

region, pleural furrows distinct, slanting backwards, at midway shallowing and bending backwards, interpleural furrows short and shallow, with 5 pairs of pleural ribs, of which anterior bands short and narrow, posterior bands wide, broadening outwards, then narrowing near pygidial border; prosopon of fine densely spaced granules.

Discussion In general configuration of cranidium, *Shanchengziella* is quite similar to *Protaitzehoia* Yang in Yin and Lee, 1978, with *P. yuepingensis* Yang in Yin and Lee as the type species (Yin and Lee, 1978; Yang, 1978; Peng *et al.*, 2004a). However, the latter (which one?) has a glabella with a slightly expanded anterior lobe, a more or less developed notch in sagittal line anteriorly, 4 pairs of well incised glabellar furrows, distinct fossulae, palpebral lobe located posteriorly, posterior (?) area of fixed genae narrow (exsag.), longer pygidial axis undeveloped posterior axial ridge. In general outline of cranidium and pygidium, *Shanchengziella* bears the closest resemblance to *Cheilocephalus* Berkey, 1898 from North America (type species *Cheilocephalus st. croixensis* Berkey, 1898), however, *Cheilocephalus* differs from *Shanchengziella* in having a shorter wider (?) glabella, with almost effaced glabellar furrows, shorter palpebral lobe, located more anteriorly, pygidium with longer and broader axis, less tapering backwards, without posterior axial ridge, and narrower pleural field.

Occurrence Late Miaolingian (Guzhangian), Liaoning, Tangshan, Hebei, Shandong and Lajishan Qinghai.

Key words revision of *Shanchengziella*, Miaolingian Series, *Liostracina simesi-Placosema convexa* Assemblage Zone

1 前 言

在华北地台寒武系崮山组浅灰色中薄层至中层竹叶状灰岩夹页岩和砂屑灰岩之上的炒米店组,其底部往往发育一套灰紫色或暗紫色中薄层灰岩夹深灰色中薄层鲕粒灰岩,或浅灰色至灰白色含海绿石灰岩夹竹叶状灰岩,富产三叶虫化石,如: *Parachangshania*、*Pseudagnostus*、*Pseudowent-suia*、*Wenshuia*、*Metapianaspis*、*Shanchengziella*

和 *Onchonotellus* 等(钱义元, 1994)。近几年笔者在唐山市丰润区左家坞镇半壁山(39°56′11.737″ N, 118°12′21.027″ E)、瓦房店市白家山(39°26′26.100″ N, 121°40′38.585″ E)以及山东省临朐县寺头镇南照村(36°15′2.190″ N, 118°24′5.169″ E),于炒米店组底部的灰岩中采集了大量的三叶虫标本。笔者将陆续发表针对这些剖面的三叶虫的描述、分类和时代讨论。本文就小山城子虫 *Shanchengziella* 的有效性、分类位置和地层学意义进行讨论。

2 小山城子属的头尾搭配, 有效性及其分类位置的讨论

小山城子属 *Shanchengziella* Lu and Qian, 1983 建立时仅根据一块不完整的头盖标本(卢衍豪、钱义元, 1983, 图版 2, 图 3), 此标本采自辽宁省本溪满族自治县山城子。1994 年, 钱义元将同层所产 2 个比头盖还大并几乎呈半椭圆形的尾部与头盖相匹配(钱义元, 1994, 图版 4, 图 3, 5)。笔者认为, 造成此结论的原因是由于钱义元对小山城子属的头盖形态认识发生了偏差, 在建立小山城子新属时就认为其与 Yinitidae 科的保康虫属 *Paokannia* Ho and Lee, 1959 (模式种 *P. chinensis* Ho and Lee, 1959)相似, 并与 *Paokannia magna* Qian and Yao in Zhang *et al.*, 1980 (张文堂等, 1980, 197 页, 图版 55, 图 13; 图版 56, 图 1-2)进行比较。因此钱义元(1994)在鉴定小山城子属的尾部时, 就选择了与保康虫有些相似的尾部。笔者认为这样的尾部很可能属于长山虫科内某个属的尾部, 具体归属将在本文中进行讨论。其实, 在钱义元(1994)发表的专著中, 小山城子属的尾部在同层采集的标本中确实是存在的, 但他以这样的尾部为正模建立了新属后平壤虫 *Metapianaspis* Qian, 1994 (模式种 *M. conulus* Qian, 1994)。后平壤虫就是小山城子虫的晚出异名, 而后平壤虫的头盖(钱义元, 1994, 图版 33, 图 9, 11)则是赛马饰边虫 *Sailoma* (Schränk, 1975)。笔者认为巴伊卡达姆虫属 *Baikadamaspis* Ergaliev, 1980 (模式种 *B. proprius* Ergaliev, 1980, p. 145-146, pl. 10, figs. 7-10)很可能就是赛马饰边虫属的晚出异名, 但这个属在地层学上具有十分重要的意义, 因为 *S. propria* (Ergaliev, 1980)与 *Glyptagnostus reticulatus* 在哈萨克斯坦卡拉套地区几乎同时出现(Ergaliev *et al.*, 2008), 对于缺少 *G. reticulatus* 的地台区来划定芙蓉统底界具有重要意义。在华北地台上炒米店组底部和下部的灰岩中赛马饰边虫较常见, 笔者发现有多多个种, 其中也包括了 *S. propria* (Ergaliev, 1980), 我们将另文发表。值得一提的是, 有学者将后平壤虫 *Metapianaspis* Qian, 1994 作为赛马饰边虫 *Sailoma* Schränk, 1975 (模式种: *S. loma* Schränk, 1975, p. 602-603, pl. 8, figs.

5-6; Text-fig. 3)的晚出异名(Zhu, 2008)。但是笔者认为后平壤虫的模式种正模是一个尾部, 而这个尾部正是小山城子虫的尾部。

小山城子属的有效性一直存在争议, 有学者认为此属是原太子河虫 *Protaitzehoia* Yang in Yin and Lee, 1978 的晚出异名(Peng *et al.*, 2004a; Peng, 2008), 而另一些学者则认为它是有效属名(卢衍豪、钱义元, 1983; 钱义元, 1994; Jell and Adrain, 2003; Zhu, 2008)。根据笔者最新研究发现, 小山城子属不同于原太子河虫之处有以下几点: 头鞍前叶圆润, 中线处没有向后的凹陷, 4 对头鞍沟较浅, 眼脊之前的背沟内前坑不明显, 尾轴较粗壮, 尾轴上没有两列纵向较大的瘤, 肋部相对较窄。此外, 周志强(1996)根据产自青海拉脊山的 2 个不完整头盖的三叶虫标本而建立的扎浪滩虫 *Zhalangtania* Zhou in Zhou *et al.*, 周志强, 1996 (模式种 *Z. vallecuculata* Zhou in Zhou *et al.*, 周志强, 1996, 40, 41, 50 页, 图版 4, 图 13-15), 曾被认为是 *Cheilocephalus* Berkey, 1898 的晚出异名(袁金良、尹恭正, 2001; 林天瑞等, 2013)。但是笔者从目前发现的头盖来看, 扎浪滩虫更像小山城子虫, 两者没有明显的区别。因此笔者认为, 扎浪滩虫属应归于苗岭统(武陵统)上部, 而 *Cheilocephalus* Berkey, 1898 属于芙蓉统。

小山城子属、后平壤虫属和扎浪滩虫属的科级分类单元目前比较混乱, 总结有以下几种意见:

- (1) 归属于 Yinitidae Hupé, 1953 (卢衍豪、钱义元, 1983; 钱义元, 1994);
- (2) 置于 Leiostegiidae Bradley, 1925 (Jell and Adrain, 2003; Zhu, 2008; Peng, 2008);
- (3) 置于 Damesellidae Kobayashi, 1935 (Peng *et al.*, 2004a, Peng, 2008; Lin *et al.*, 2013);
- (4) 置于 Papyriaspidae Whitehouse, 1939 (钱义元, 1994; Jell and Adrain, 2003);
- (5) 归属于 Cheilocephalidae Shaw, 1956 (袁金良、尹恭正, 2001; Jell and Adrain, 2003)。

笔者针对以上意见的观点是:

(1) Yinitidae Hupé, 1953 主要分布于寒武系第二统中部, 除了有横穿头鞍沟发育外, 还有尾部大、尾轴很宽、胸部有大肋刺的特点。因此, 小山城子虫与此科的关系不大。

(2) Leiostegiidae Bradley, 1925 科内的三叶虫,

其头盖上的后边缘沟在外侧不会有向前的折曲,眼叶位置一般靠后,尾部的边缘很窄,因此小山城子虫也不适宜置于该科内。

(3) Damesellidae Kobayashi, 1935 科内的三叶虫的尾部通常具有数对尾边缘刺,更何况小山城子虫是在 Damesellidae Kobayashi, 1935 科三叶虫灭绝后出现的三叶虫,置于 Damesellidae 科也欠妥。

(4) Papyriaspidae Whitehouse, 1939 科的三叶虫一般有较宽的鞍前区,是小尾型三叶虫,这一点与小山城子虫完全不同。

(5) 笔者认为 Cheilocephalidae Shaw, 1956 科内的三叶虫,如 *C. expansus* (Palmer, 1968, p. 67–58, pl. 9, figs. 1–7) 的特征与小山城子虫很相似,如:在头盖外形、粗壮的眼脊、眼叶的位置与大小、宽大的后侧翼、后边缘沟的外侧向前弯曲伸展、活动颊的形态、尾部的肋沟和间肋沟发育并伸向宽的尾边缘等。因此小山城子虫置于该科内最合适。当然,两者还是有区别的,如:后者的头鞍更宽大、两眼叶之间的固定颊更窄、尾轴之后没有轴后脊等。

3 小山城子虫的时代

小山城子虫自建立以来都被认为属于长山期(芙蓉统) *Chuangia* 带或 *Prochuangia-Chuangia-Paracoosia* 带(卢衍豪、钱义元, 1983; 钱义元, 1994; Jell and Adrain, 2003; Zhu, 2008)。但是笔者在仔细查阅有关长山期生物地层的文章后,在 *Chuangia* 带或 *Prochuangia-Paracoosia* 带内并没有发现 *Shanchengziella* 一属(郭鸿俊、张梅生, 1992; 张梅生, 1999)。另外,从小山城子虫所产出的层位来看并没有与 *Chuangia*、*Prochuangia* 等三叶虫共生,而是与 *Parachangshania*、*Pseudagnostus*、*Ochonetellus* (= *Placosema*) 等三叶虫共生(钱义元, 1994)。此外,该层位中还产出 *Liostracina simesi*、*Sailoma*、*Liotrops*、*Fenghuangella*、*Placosema*、*Jimachongia*、*Proceratopyge*、*Paracoosia*、*Yuepingia*? 等三叶虫。其中以 *Parachangshania* 最为常见。这套生物群组合出现在 Damesellidae 科三叶虫灭绝后, *Prochuangia mansuyi* 带出现前的一段地层内,即 *Dicerato-*

cephalus armatus 带和 *Prochuangia mansuyi* 带之间。Park 和 Choi (2011) 曾在这段地层内建立了 2 个化石带:下部为 *Liostracina simesi* 带,上部为 *Fenghuangella laevis* 带,并将芙蓉统的底界划在 *Fenghuangella laevis* 带之底。根据笔者的野外观察,在唐山和辽南的地区里,这 2 个带不易分开,且所占地层厚度不大,通常为数十厘米或 2–3 m 不等。因此,笔者以这段地层中的三叶虫建立 *Liostracina simesi-Placosema convexa* 带,以 *Placosema convexa* 的首现作为这个带的开始。而以 *Prochuangia mansuyi* 的首现作为中朝地台区芙蓉统(排碧阶)的底界是合适的(Wang *et al.*, 2020), *P. mansuyi* 带大体相当以往的 *Prochuangia-Paracoosia* 带(张梅生, 1988, 1999; 郭鸿俊、张梅生, 1992)。从横向对比来看, *Diceratocephalus armatus* 带和 *Liostracina simesi-Placosema convexa* 带大体相当于斜坡相区 *Glyptagnostus stolidotus* 带,而 *Liostracina simesi-Placosema convexa* 带则大体相当 *Glyptagnostus stolidotus* 带的上部,有关整个生物群的研究和不同相区详细的地层对比,我们将另文发表。

4 系统古生物学

三叶虫纲 Class Trilobita Walch, 1771

裂肋虫目 Order Lichida Moore, 1959

德氏虫超科 Superfamily Dameselloidea Kobayashi, 1935

唇头虫科 Family Cheilocephalidae Shaw, 1956

小山城子属 Genus *Shanchengziella* Lu and Qian, 1983

Shanchengziella Lu and Qian, 卢衍豪、钱义元, 1983, 245, 252 页。

Shanchengziella Lu and Qian, 钱义元, 1994, 56 页。

Shanchengziella Lu and Qian, Jell and Adrain, 2003, p. 444, 473.

Shanchengziella Lu and Qian, Peng *et al.*, 2004a, p. 112.

Shanchengziella Lu and Qian, Peng, 2008, p. 187.

Shanchengziella Lu and Qian, Zhu, 2008, p. 143, 148, 155.

Metapianaspis Qian, 钱义元, 1994, 133, 134 页。

Metapianaspis Qian, Zhu, 2008, p. 140, 153.

Metapianaspis Qian, Jell and Adrain, 2003, p. 406, 475.

Zhalangtania Zhou, 周志强等, 1996, 40, 41, 50 页。

Zhalangtania Zhou, 袁金良, 尹恭正, 2001, 344 页。

Zhalangtania Zhou, Jell and Adrain, 2003, p. 463, 468.

Zhalangtania Zhou, Peng, 2008, p. 173, 178, 194.

Zhalangtania Zhou, 林天瑞等, 2013, 441 页。

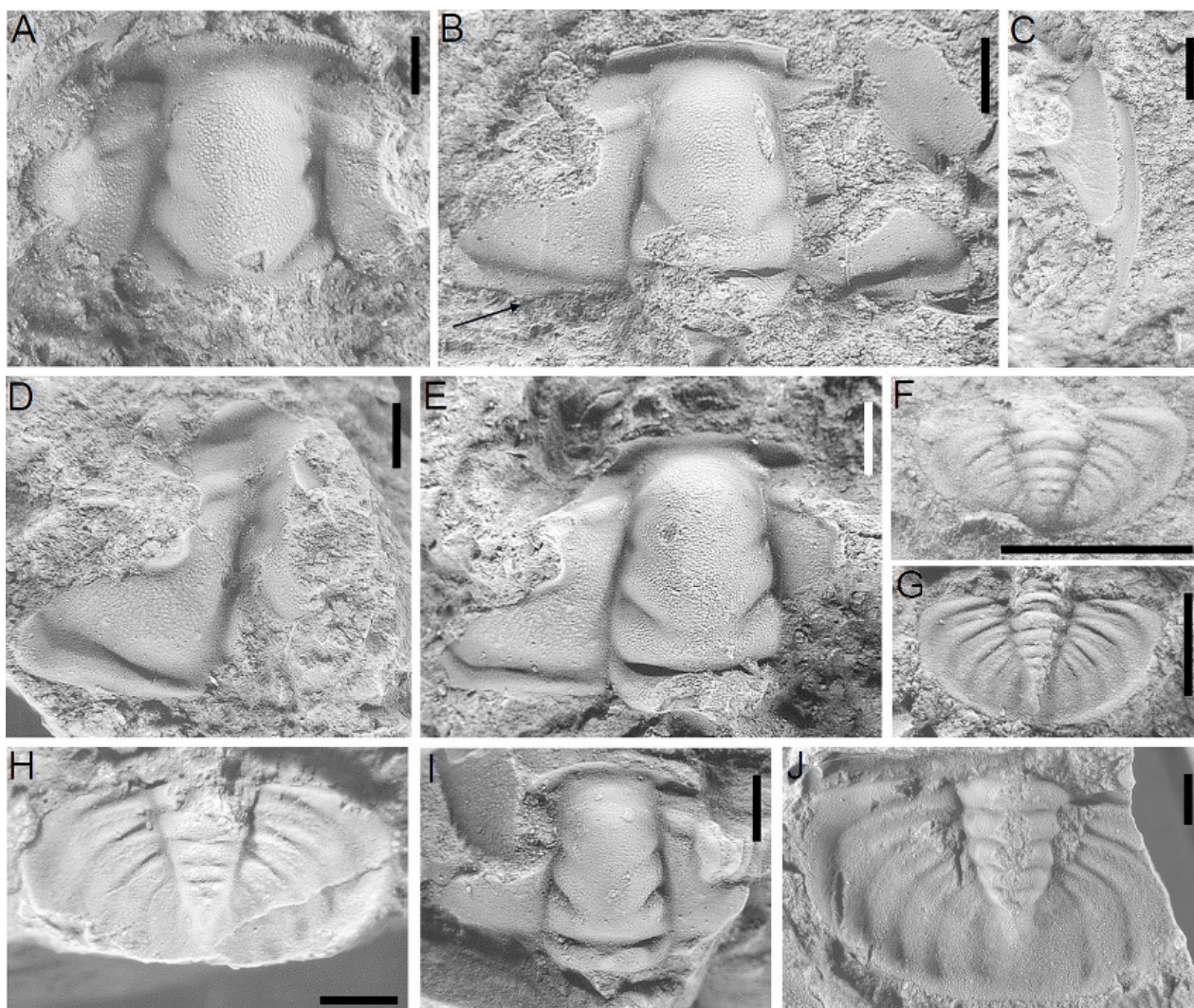


图 1 长鞍小山城子虫和圆锥形小山城子虫

Fig. 1 *Shanchengziella elongata* Lu and Qian, 1983 and *Shanchengziella conula* (Qian, 1994)

A-I. 长鞍小山城子虫; A-H. 采集号: BBS1.35m; A. 不完整头盖, 登记号: NIGP170958; B. 头盖, 登记号: NIGP170959; C. 活动颊, 登记号: NIGP170960; D. 不完整头盖, 登记号: NIGP170961; E. 头盖, 登记号: NIGP170962; F. 小尾部, 登记号: NIGP170963; G. 尾部, 登记号: NIGP170964; H. 尾部, 登记号: NIGP170965; I. 头盖, 正模, 采集号: BE955, 登记号: NIGP73152. J. 圆锥形小山城子虫, 尾部, 正模, 采集号: BE953, 登记号: NIGP111987. 所有标本保存在中国科学院南京地质古生物研究所标本室, 比例尺为 1 mm.

A-I. *Shanchengziella elongata* Lu and Qian, 1983; A-H. Field No.: BBS1.35m; A. Incomplete cranidium, Cat. No.: NIGP170958; B. cranidium, Cat. No.: NIGP170959; C. librigena, Cat. No.: NIGP170960; D. incomplete cranidium, Cat. No.: NIGP170961; E. cranidium, Cat. No.: NIGP170962; F. Small pygidium, Cat. No.: NIGP170963; G. pygidium, Cat. No.: NIGP170964; H. pygidium, Cat. No.: NIGP170965; I. cranidium, holotype, Cat. No.: NIGP73152. J. *Shanchengziella conula* (Qian, 1994), pygidium, holotype, Field No.: BE953, Cat. No.: NIGP111987. All specimens are housed in the Nanjing Institute of Geology and Palaeontology, Chinese Academy of Sciences, Scale bars = 1 mm.

模式种 *Shanchengziella elongata* Lu and Qian, 1983, 辽宁省本溪满族自治县山城子, 上寒武统炒米店组 *Chuangia* 带 *Chuangia subquadrangulata* 亚带。

包括的种 除模式种外尚有 *Shanchengziella vallecullata* (Zhou in Zhou *et al.*, 1996); *S. conula* (Qian, 1994)。

特征(修订) 头鞍切锥形, 前端圆润, 具 3-4 对浅的侧头鞍沟, 其中第 1 对(S1)较深而长, 向后斜伸; 前边缘窄而突起, 微微向前弯曲; 两眼叶之间固定颊极窄(横向), 眼脊粗壮, 突起, 微微向后斜伸; 眼叶短而微微翘起, 位于头鞍相对位置中前部; 固定颊后区宽(横向)而长(纵向); 后边缘沟较深, 在外侧向前弯曲; 后边缘窄而突起, 外

侧向前呈角折状弯曲前伸,后缘中部有一小刺状凸缘(flange)或肘状物(elbow) (Westrop *et al.*, 2008);尾部半椭圆形,尾轴倒锥形,向后明显收缩变窄,分 5–6 个轴节极短的轴后脊,肋部比轴部略宽(横向),肋沟清楚,向后侧方斜伸,近边缘向后弯曲并变宽浅,间肋沟短浅,具 5 对肋脊,前肋脊带短而窄,后肋脊带宽,向外变宽,近尾边缘处变窄,并向后弯曲斜伸;壳面具密集的小瘤点。

讨论 就头盖形态的一般特征来看,小山城子虫与原太子河虫 *Protaitzehoia* Yang in Yin and Lee, 1978 (模式种 *P. yuepingensis* Yang in Yin and Lee, 尹恭正, 李善姬, 1978, 512 页, 图版 170, 图 4; 杨家驊, 1978, 60 页, 图版 13, 图 7; Peng *et al.*, 2004, p. 114–115, pl. 32, figs. 8–13; Text-fig. 14) 较相似。但是,原太子河虫的头鞍前叶微微向前扩大,前缘中线位置往往有不发育的“V 字型”凹口,较深的 4 对侧头鞍沟,眼脊之前的背沟内有前坑,眼叶位置靠后,后侧翼窄(纵向)。此外,尾轴较长,轴后脊不发育。就头盖和尾部的一般形态来看,小山城子虫与北美所产唇头虫 *Cheilocephalus* Berkey, 1898 (模式种 *Cheilocephalus* st. *croixensis* Berkey, 1898, p. 290, pl. 17, fig. 1; pl. 20, figs. 7, 8; pl. 21, fig. 19) 相似,所不同的是唇头虫的头鞍更宽大,头鞍沟几乎消失,眼叶更短小,位置更靠前,尾轴更宽长,向后收缩较慢,无轴后脊,肋部较窄。

时代分布 寒武纪苗岭世晚期(古丈阶);辽宁、河北唐山、山东和青海拉脊山。

长鞍小山城子虫 *Shanchengziella elongata* Lu and Qian, 1983

(图 1-A–1-I)

1983 *Shanchengziella elongata* Lu and Qian, 卢衍豪, 钱义元, 245 页, 图版 2, 图 2。

1994 *Shanchengziella elongata* Lu and Qian, 钱义元, 56, 57 页, 图版 4, 图 4, 非图 3, 5。

正模 头盖, NIGP73152, 辽宁省本溪满族自治县山城子, 上寒武统炒米店组 *Chuangia* 带 *Chuangia subquadrangulata* 亚带。

材料 5 块头盖, 3 块尾部和 1 块活动颊标本。

描述 头盖亚梯形, 前缘微微向前弯曲, 头鞍呈窄长的切锥形, 前端圆润, 具 3–4 对浅的侧

头鞍沟, 其中第 1 对(S1)较深而长, 向后斜伸; 鞍前区缺失; 前边缘窄而突起, 微微向前弯曲; 颈环向两侧变窄, 颈沟深, 在中线位置变浅; 颈环突起, 中后部有一小的颈瘤; 两眼叶之间固定颊极窄(横向), 眼脊粗壮, 突起, 微微向后斜伸; 眼叶短而微微翘起, 位于头鞍相对位置中前部; 固定颊后区宽(横向)而长(纵向); 后边缘沟较深, 在外侧向前弯曲; 后边缘窄而突起, 外侧向前呈角折状弯曲前伸, 后缘中部有一小刺状凸缘(flange)或肘状物(elbow); 尾部半椭圆形, 尾轴倒锥形, 向后收缩明显, 分 5–6 个轴节极短的轴后脊, 肋部比轴部略宽(横向), 肋沟清楚, 向后侧方斜伸, 近边缘向后弯曲并变深, 间肋沟短浅, 具 5 对肋脊, 前肋脊带短而窄, 后肋脊带宽, 向外变宽, 近尾边缘处变窄, 并向后弯曲斜伸; 尾边缘较窄而平凸; 壳面具密集的小瘤点。

产地层位 河北左家坞镇半壁山和辽宁省本溪满族自治县山城子; 寒武系苗岭统顶部炒米店组 *Liostracina simesi-Placosema convexa* 带。

圆锥形小山城子虫 *Shanchengziella conula* (Qian, 1994)

(图 1-J)

1994 *Metapianaspis conulus* Qian, 钱义元, 133, 134, 页, 图版 33, 图 10, 非图 9, 11。

正模 尾部, NIGP111987, 辽宁省本溪满族自治县山城子, 上寒武统炒米店组 *Chuangia* 带。

材料 1 块尾部标本。

比较 此种与模式种的主要不同之处在于尾轴较短粗, 略大于尾长的一半, 仅有 5 个轴环节和一短的轴后脊。

产地层位 辽宁省本溪满族自治县山城子, 寒武系苗岭统顶部炒米店组 *Liostracina simesi-Placosema convexa* 带。

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