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广西兴安早石炭世晚期三叶虫新资料

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内 容 提 要

记述了产于广西兴安早石炭世晚期大塘阶双切尾虫亚科的1新亚属——*Paladin* (*Sinopaladin*) subgen. nov. 及其3新种: *P.* (*S.*) *guibeiensis* sp. nov., *P.* (*S.*) *subcylindricus* sp. nov., *P.* (*S.*) *xinganensis* sp. nov.。

关键词 广西 早石炭世大塘期 三叶虫

笔者于1982年5月和1983年4月,在广西兴安东北约7.5km兴安至界首公路西侧下石炭统大塘阶的泥质灰岩中采得三叶虫化石10余件,经研究属于矽头虫科、双切尾虫亚科骑士虫属的1新亚属,定名为中华骑士虫 *Paladin* (*Sinopaladin*) subgen. nov.,其中包括3新种: *P.* (*S.*) *guibeiensis* sp. nov., *P.* (*S.*) *subcylindricus* sp. nov. 和 *P.* (*S.*) *xinganensis* sp. nov.。本文所描述的三叶虫标本大部分为卷曲的虫体,头部与尾部等大、平整接触。与之共生的化石有少量的头足类 *Goniatites*, 丰富的腕足类 *Gigantoproductus*, *Pugilis* 和珊瑚 *Yuanophyllum*, *Dibunophyllum*, *Clisiophyllum*, *Kueichouphyllum*, *Arachnolasma*, *Heterocaninia*, *Lithostrotion* 等,这些化石都是早石炭世晚期的重要分子,中华骑士虫所属的3种也应属早石炭世晚期。

化 石 描 述

矽头虫超科 Superfamily Proetacea Hawle and Corda, 1847

矽头虫科 Family Proetidae Hawle and Corda, 1847

双切尾虫亚科 Ditomopyginae Hupé, 1953

骑士虫属 Genus *Paladin* Weller, 1936

模式种 *Griffithides morrowensis* Mather, 1915

亚属 *Paladin* (*Paladin*) Weller, 1936; *P.* (*Kaskia*) Weller, 1936; *P.* (*Weberides*) Reed, 1942; *P.* (*Paragriffithides*) Reed, 1943; *P.* (*Neokaskia*) G. Hahn, R. Hahn and Owens, 1991 和 *P.* (*Sinopaladin*) Subgen. nov.。

特征 头鞍梨形至次柱形，前叶通常在前部膨大，在γ处明显收缩，前端宽圆，具1—3对侧头鞍沟，其中后一对深而长，与颈沟相连，形成明显的头鞍基底叶。前颈环叶通常缺失。颈环显著，无侧颈叶。头部边缘宽而平缓凸起。眼叶及眼大，位于头鞍相对位置的中后部。面线后支具或不具短的直线段ε—ξ。活动颊窄，具中等至长的颊刺。胸部分9节。尾部为等尾型，半圆形至长半椭圆形，中轴分9—21节，肋部分6—13对肋脊。肋沟深，间肋沟很浅。边缘宽而平坦或略下凹。尾边缘沟浅或缺失。壳面具瘤点装饰或光滑。

讨论 骑士虫是一个广泛分布于北半球的石炭—二叠纪三叶虫属，目前已发现和建立的种有近70余种，其中大部分的种归属于骑士虫亚属和卡斯克虫亚属。卡斯克虫亚属见于早石炭世晚期至早二叠世，它不同于骑士虫亚属的主要特点是尾部略短，中轴分10—17节，肋部分6—12对肋脊，头鞍较长，凸起强烈，其前缘覆盖大部分的前边缘，仅后一对头鞍沟发育，眼叶较小，位置靠前，面线后支直线段ε—ξ较发育，固定颊在眼叶之前较窄。韦氏虫亚属见于早石炭世晚期和晚石炭世早期，主要特征是其尾部的后缘向后延伸成一个长的中刺。拟粗柿壳虫亚属仅见于早石炭世晚期，种的数量极少，其特点是尾轴中部似脊状凸起，因此横切面呈三角形。新卡斯克虫亚属仅见于早二叠世，它不同于其它几个亚属的特征是头部边缘窄而凸起，近乎直立，头鞍基底叶(L_1)大，尾部很短，中轴分9—11节，肋部具6—7对肋脊。

时代分布 早石炭世至中二叠世；北美、欧洲、亚洲。

中华骑士虫(新亚属) *Paladin* (*Sinopaladin*) subgen. nov.

模式种 *Paradin* (*Sinoparadin*) *xinganensis* subgen. sp. nov.

等尾型三叶虫。头部和尾部近乎半圆形，中等凸起。头盖近方形，后侧翼除外。头鞍棍棒形至次柱形，平缓凸起，前叶近乎两侧平行或略扩大，其最大宽度在基部，在γ处略收缩，前端宽圆，伸达前边缘沟，具1—3对侧头鞍沟，其中后一对(S_1)深而长，并与颈沟相连，形成小的三角形至次卵形基底叶。颈沟深。颈环横向宽，向两侧微收缩变窄。背沟清楚。前边缘宽而平缓凸起。边缘沟浅。眼叶中等，位于头鞍相对位置的中后部。固定颊在γ和ε处宽。面线后支具短的直线段ε—ζ。活动颊窄，颊区窄，其宽度(横向)与侧边缘近乎相等。眼大，凸起呈新月形。颊刺细长。胸部9节。尾部半圆形至长半椭圆形，中轴分15—19节，肋部分9—13对肋脊，其中前肋脊带宽于后肋脊带。肋沟深，间肋沟极浅。尾边缘宽平或略下凹。边缘沟不显。

讨论 就头鞍的形态，特别是基底叶的存在，宽而平缓凸起的头部边缘，较大的眼叶和眼及尾部的一般形态特征新亚属与骑士虫亚属十分相似[模式种：*Paladin* (*P.*) *morrowensis* (Mather, 1915)参见(G. and R. Hahn, 1991, Taf. 1, Fig. 3)]，两者的主要区别是新亚属具有较短、凸度小、两侧近乎平行的头鞍，很小的头鞍基底叶，很宽的固定颊。在头鞍的形状，宽的固定颊及尾部的一般形态特征等方面新亚属与产于意大利早二叠世的微菲利普虫 *Microphillipsia* Ruggieri, 1959 很相像(模式种：*M. tetraptera* Ruggieri, 1959, p. 6—9, pl. 1, figs. 1—9, text-figs. 1—4; G. and R. Hahn, 1991, p. 158, Taf. 1, Fig. 7)，但后者具有前颈环叶，更宽的固定颊，更长大的眼叶和眼，短的活动颊颊刺，短而分节少的尾部。新亚属与菲利普虫[*Phillipsia* Portlock, 1843, 模式种：*Phillipsia kellyi* (Osmólska), 1970, p. 80, pl. 10, figs. 7, 11a, b, text-figs. 6 G-H; G. Hahn, R. Hahn and Brauckmann, 1982, S. 164—165, Taf.

1, Fig. 1—2, Abb. 1 a—g]相比，两者有许多共同之处，如头鞍的凸度小且较细长，颈环横向宽，面线后支具直线段 ε—ζ，固定颊较宽。但新亚属的头鞍不作切锥形，基底叶发育，眼和眼叶较长大，固定颊更宽，活动颊很窄，头部边缘及尾边缘宽而平坦，尾部的中轴长，向后伸达尾边缘，两者易于区分。在头鞍的形状，眼叶的大小和位置，面线的历程和尾部的一般形态特征等方面，新亚属与莱茵粗栉虫也很相似（*Rhenogriffides* G. Hahn, R. Hahn and Brauckmann, 1987；模式种：*Asaphus dalmani* Emmrich, 1839；G. Hahn, R. Hahn and Brauckmann, 1986, S. 92, Abb. 4—6；G. and R. Hahn, 1991, S. 156—157, Abb. 10），但新亚属具有宽而平坦的头部边缘，极宽的固定颊，极小的头鞍基底叶和较长分节多的尾部。值得注意的是新亚属头盖的形态与菲利普虫某些种的幼虫的头盖形态十分相似，例如 *Phillipsia gemmulifera* (Phillips, 1836)(G. Hahn, R. Hahn and Brauckmann, 1982, S. 167—170, Taf. 1, Fig. 6a—b, Abb. 6a—b)。正如 G. 和 R. Hahn, 1991 (P. 158) 指出的那样 *Microphillipsia* 具有 *Ditomopyge ladronensis* (G. and R. Hahn, 1991, S. 162—173, Taf. 3, Fig. 1—17; Taf. 4, Fig. 1—17; Taf. 5, Fig. 1—10; Abb. 21—28)和 *Hentigia bulbops* (Haas, G. Hahn and R. Hahn, 1980, S. 83—100, Taf. 1, Fig. 1—4; Taf. 2, Fig. 1—16; Taf. 3, Fig. 1—8; Taf. 4, Fig. 1—14; Abb. 5—22; Tab. 1)幼虫期的那些特征，如固定颊宽，头鞍向前扩大不明显，尾部较短，很可能是类似这些种幼型形成的产物，是三叶虫幼态持续的一个例证。因此我们认为新亚属也有可能是菲利普虫或骑士虫的某些种演化过程中幼型形成的产物。

时代分布　早石炭世晚期；广西。

兴安中华骑士虫（新亚属、新种）

***Paladin* (*Sinopaladin*) *xinganensis* subgen. et sp. nov.**

（图版 I，图 1—7）

除了具亚属的一般特征外，还具有以下的特征：头鞍前叶微向前膨大，中部略收缩，基底叶呈长三角形。γ 和 ε 远离背沟。面线前支平行或微向外分散向前延伸。尾部近乎半圆形，中轴分 16—18 节，肋部具 12—13 对肋脊。

描述　共有 2 块较完整的头胸尾卷曲标本，1 块头、胸尾半卷曲标本，1 块头盖和 3 块尾部标本。

头部近乎半圆形，平缓凸起。头盖近方形，后侧翼除外。长与宽之比约为 1.2—1.3∶1，前端宽圆。头鞍棍棒状至次柱形，长与宽之比为 1.6—1.7∶1，细长而平缓凸起，前叶微向前扩大，中部略收缩，前端宽圆，具 3 对浅的侧头鞍沟，前 2 对短而微向后斜伸，后一对长而向后内斜伸，与颈沟相连，将头鞍基部两侧切下一个长三角形基底叶。颈沟宽而深。颈环宽（横向）而长（纵向），向两侧略收缩变窄。背沟清楚。前边缘沟极浅。前边缘具中等宽度，平缓凸起，外侧有 2—3 条阶梯状脊线。眼叶中等大小，超过头鞍长度的 1/3，位于头鞍相对位置的后部。面线前支长，自眼叶前端略向外分散向前延伸，后支具很短的直线段 ε—ζ；γ 和 ε 离背沟较远，β 圆润，位于 δ 纵长线之上或之内。固定颊前部宽（横向），与前边缘的长度（纵向）相等。后边缘窄而长。活动颊具有宽而平坦的侧边缘和窄的颊区。眼窄长，新月形。侧边缘沟浅，后边缘沟宽而深。颊刺细长，末端伸达第 3 至第 4 个胸节位置。胸部具 9 个胸节，胸节末端呈铲形，但未伸长成刺，轴环沟宽而深，肋沟清楚。尾部近乎半圆形，平缓凸起，长与宽之比

约为1∶1.2—1.3。中轴宽而长，约占尾宽的1/3，逐渐向后收缩，末端伸达尾边缘，分16—18节，轴环节沟深，近背沟处变浅，中轴横切面呈梯形。背沟清楚，在尾轴后缘变浅。肋部分12—13对肋脊，其中前肋脊带宽，后肋脊带极窄，向肋沟成陡坡。肋沟深，间肋沟极浅，仅在前3个肋脊上隐约可见。尾边缘宽而微下凹。边缘沟不显。壳面光滑。

度量(mm)

标本登记号	头盖长	头鞍长	颈环长	眼叶长	头鞍最大宽	β-β宽	γ-γ宽	δ-δ宽	ω-ω宽
*GPIN 96936	9.7	7.0	1.3	2.7	4.7	7.0	6.0	7.0	13.3
96938	7.7	5.1	1.3	2.7	3.7	6.3	4.6	6.3	8.6
96939	8.9	6.1	1.3	2.9	3.9	6.3	4.9	6.6	8.6
96940	9.7	6.5	1.4	2.8	5.0	6.8	5.5	7.5	10.6
	尾长	尾轴长	尾宽	尾轴宽	轴节数	肋脊对数			
96936	10.7	8.7	12.7	4.3	16	12—13			
96937	8.8	7.5	11.8	4.0	17	13			
96940	9.8	8.5	12.0	3.8	16	12			
96947	9.4	7.7	13.7	4.6	17	13			
96948	12.0	10.6	15.3	5.0	18	13			

* Holotype

产地层位 广西兴安东北7.5km；下石炭统大塘阶。

次柱形中华骑士虫(新亚属、新种)

***Paladin* (*Sinopaladin*) *subcylindricus* subgen. et sp. nov.**

(图版Ⅰ，图8；图版Ⅱ，图6，7)

头部强烈向前拱曲，近乎三角形。头鞍次柱形，前叶两侧平行或略向前收缩，中部收缩不明显，具三对头鞍沟，其中前二对短，呈坑状，后一对深而长并与颈沟相连，切头鞍基部呈次卵形的头鞍基底叶。背沟较浅。尾部长半椭圆形至舌形，中轴宽，分15—16节，肋部具9—10对肋脊。尾边缘宽而略下凹，边缘沟不显。

描述 有1块头胸尾近乎完整的卷曲标本，1块头部标本和1块尾部标本。头部中等凸起，强烈向前拱曲，近乎三角形，长与宽之比为1∶1.6—1.8。头鞍细长，平缓凸起，次柱形，长与宽之比为1.3—1.5∶1，前叶两侧平行或略向前收缩，中部收缩不明显，最大宽度在基部，前端宽圆，伸达前边缘沟，具3对头鞍沟，其中前2对短，呈坑状，后一对长，向后内斜伸并与颈沟相连，头鞍基底叶呈次卵形。颈沟中部直而窄，两侧加宽加深，略向后弯曲。颈环横向宽，两侧略变窄。背沟浅。前边缘具中等宽度及凸度，中部强烈向前拱曲，外侧具4—5条阶梯状脊线。眼叶较长，向外凸出，约占头鞍长的1/2，位于头鞍相对位置的中后部。面线前支自眼叶前端微向外分散向前延伸，后支具短的直线段ε—ζ。γ和ε离背沟较远，β圆润，大于120°，位于δ纵长线之内。固定颊较宽。后边缘窄而长。活动颊颊区窄。眼长大，新月形。侧边缘较宽。胸部具9节。尾部长半椭圆形至舌形，长与宽之比为1∶1.1—1.2，后端圆润。中轴长而粗壮，约占尾宽的1/3，横切面呈弧形，分15—16节，轴环节沟中部清楚，近背沟处

变浅而模糊。肋部平缓凸起,具 9—10 对肋脊。肋沟窄而清楚,间肋沟模糊不清。尾边缘宽而略下凹,边缘沟不显。

度量(mm)

标本登记号	头盖长	头鞍长	颈环长	眼叶长	头鞍最大宽	β-β 宽	γ-γ 宽	δ-δ 宽	ω-ω 宽
* GPIN 96944	8.3	7.4	1.3	2.9	4.4	6.3	5.4	7.7	11.4
96945	8.3	6.0	1.4	2.6	3.7	5.4	4.3	6.3	8.9
	尾长	尾轴长	尾宽	尾轴宽	轴节数	肋脊对数			
96943	8.9	7.7	10.3	3.6	16	10			
96944	10.3	8.9	12.6	4.2	15	9			

* Holotype

比较　在头盖的凸度、头鞍的形态、面线的历程和宽的固定颊等方面次柱形中华骑士虫(新种)与模式种兴安中华骑士虫很相似,所不同的是新种的头盖强烈向前拱曲,呈三角形,头鞍前叶不向前膨大,背沟较浅,眼叶较长大,颈沟两侧向后弯曲,尾部长半椭圆形至舌形,分节较少,中轴横切面呈弧形。就尾部的外形和具有宽而下凹的边缘来看,新种与产于美国阿拉斯加东北部 Feratrovich 组的 *Paladin* (?) *ploto* (G. and R. Hahn, 1991, S. 174—176, Abb. 31a—b, 32)和产于波兰早石炭世晚期的 *Paladin czarnieckii* (Osmólska, 1970, p. 147—149, pl. 17, figs. 1—6, 9—11, 12, 16)很相似。新种与阿拉斯加的种的主要区别是后者尾部的凸度大,间肋沟较清楚,肋沟、间肋沟伸入到尾边缘内。新种与波兰的种的区别是中轴较宽,分 15—16 节,表面不具瘤点装饰,头鞍不向前膨大,头盖向前强烈拱曲呈三角形,固定颊很宽。

产地层位　同上。

桂北中华骑士虫(新亚属、新种)

***Paladin* (*Sinopaladin*) *guibeiensis* subgen. et sp. nov.**

(图版 Ⅱ,图 1—5,8)

头鞍次柱形,前叶两侧几乎平行,中部略收缩,具 1 对清楚的侧头鞍沟,基底叶呈三角形。前边缘宽而平坦。γ 和 ε 靠近背沟,固定颊较窄。面线前支较强烈地向外分散向前延伸,后支具有较长的直线段 ε—ζ。尾部宽长,略呈三角形至半圆形,后端尖圆。中轴窄长,向后收缩较快,分 18—19 节,轴环节窄(纵向),轴环节沟宽而深。肋部具 12—13 对肋脊。尾边缘中等宽度,向后略变宽。边缘沟不显。

描述　2 块头胸尾呈卷曲的标本,1 块头胸卷曲标本,1 块尾胸卷曲标本及 2 块尾部标本。头部平缓至中等凸起,前部宽圆,呈半圆形,具有宽而平坦的边缘。头盖次方形,后侧边缘除外。头鞍平缓凸起,次柱形,前叶两侧几乎平行,中部略收缩,具一对清楚的头鞍沟,后端与颈沟相连,头鞍基底叶呈三角形。颈沟深而直。颈环粗壮,两侧略收缩变窄。背沟浅。前边缘沟浅。眼叶中等大小,向外凸出。面线前支自眼叶前端较强烈地向外分散向前延伸,后支具短的直线段 ε—ζ;γ 和 ε 离背沟较近,β 圆润,位于 δ 纵长线之上。固定颊在 γ 和 ε 处较窄,后边缘窄而长(横向)。活动颊较宽。眼叶长大、新月形。侧边缘宽平,外侧具 2—3 条阶

梯状脊线。侧边缘沟清楚，颊区平缓凸起，宽度(横向)与侧边缘宽度近乎相等。胸部具9节。尾部较宽而长，三角形至半圆形，长与宽之比为1∶1.3—1.4。中轴窄而长，向后收缩快，宽度不到尾宽的1/3，分18—19节。轴环节窄而凸起，轴环节沟深而宽。肋部宽，具12—13对肋脊，肋沟窄而清楚，间肋沟浅。尾边缘中等宽度，向后略变宽。边缘沟不显。壳面光滑。

度量(mm)

标本登记号	头盖长	头鞍长	颈环长	眼叶长	头鞍最大宽	β-β宽	γ-γ宽	δ-δ宽	ω-ω宽
*GPIN 96946	7.6	5.1	1.0	2.3	3.4	5.3	4.0	5.8	9.5
96947	9.5	6.3	1.3	2.8	4.2	5.5	4.8	6.5	10.5
96949	6.2	—	—	2.2	—	4.4	—	4.6	—

	尾长	尾轴长	尾宽	尾轴宽	轴节数	肋脊对数
96946	7.3	6.3	9.5	2.8	18	12
96948	8.0	7.0	10.8	3.0	18	12
96949	6.6	5.8	8.8	2.4	19	13
96950	11.7	10.0	9.3	3.0	19	13
96951	7.7	6.9	9.7	3.2	19	12

* Holotype

比较 桂北中华骑士虫(新种)与模式种兴安中华骑士虫的主要区别特征是头鞍前叶两侧平行，具1对头鞍沟，γ和ε离背沟较近，固定颊较窄，背沟较浅，尾部较长，呈次三角形，尾轴细长，分节较多，轴环节沟宽而深，轴环节窄而凸起，尾边缘较窄。新种与次柱形中华骑士虫的不同之处是后者头部强烈向前拱曲呈三角形，头鞍前叶略向前收缩，有3对头鞍沟，固定颊在γ和ε处较宽，尾部为长半椭圆形，中轴粗分节较少，尾边缘宽而略下凹。就次柱形头鞍，三角形基底叶及细长的尾轴等特征新种与产于英国维宪期的 *Paladin barkei* (Woodward, 1902, p. 484, pl. 20, figs. 14—15; Osmólska, 1970, p. 141, pl. 21, fig. 9)有些相似，但后者头鞍基底叶大，眼叶和眼的位置靠后，面线前支较长，后支无直线段ε—ζ，固定颊较窄，γ和ε更靠近背沟，背沟极深，尾部分节也较少。

产地层位 同上。

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NEW DATA OF EARLY CARBONIFEROUS TRILOBITES FROM XING'AN, GUANGXI

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Key words Trilobita, Early Carboniferous, Datang Stage, Guangxi

Summary

The trilobites described here come from the dark-grey thin to medium-bedded muddy limestone in the upper part of the Lower Carboniferous Datang Stage (Upper Visean) about 7.5km northeast of Xing'an County, Guangxi, South China, including 1 new subgenus and 3 new species, namely, *Paladin (Sinopaladin) xinganensis* subgen. et sp. nov., *P. (S.) subcylindricus* subgen. et sp. nov., *P. (S.) guibeiensis* subgen. et sp. nov. The trilobites occur together with abundant brachiopods, corals and a few ammonoids, such as *Goniatites*, *Gigantoproductus*, *Pugilis*, *Yuanophyllum*, *Dibunophyllum*, *Arachnolasma*, *Lithostrotion*, *Clisiophyllum*, *Heterocaninia* and *Kueichouphyllum*. These index fossils indicate the late Early Carboniferous age of the trilobites.

DESCRIPTION OF NEW GENUS AND SPECIES

Superfamily Proetacea Hawle and Corda, 1847

Family Proetidae Hawle and Corda, 1847

Subfamily Ditomopyginae, Hupé, 1953

Genus *Paladin* Weller, 1936

Type species *Griffithides morrowensis* Mather, 1915

Assigned subgenera *Paladin (Paladin)* Weller, 1936; *P. (Kaskia)* Weller, 1936; *P. (Weberides)* Reed, 1942; *P. (Paragriffithides)* Reed, 1943; *P. (Neokaskia)* G. Hahn, R. Hahn et Owens, 1991 and *P. (Sinopaladin)* subgen. nov.

Revised diagnosis Glabella pyriform to subcylindrical in outline; frontal lobe commonly expanded forward, distinctly constricted between γ—γ, broadly rounded anteriorly,

bearing 1—3 pairs of oblique glabellar furrows, with S_1 the deepest, and isolated suboval to subtriangular L_1; preoccipital lobe commonly absent; occipital ring prominent, without lateral occipital lobe; anterior border flat; palpebral lobe and eye long, situated posteromedially; facial suture with or without short straight section ε—ξ; fixed cheek narrow to broad (tr.); free cheek with moderately long to long genal spine; thorax of 9 segments; pygidium isopygous, semicircular to semielliptical in outline; axis long, with 9—21 rings; pleural area bearing 6—13 pairs of pleural ribs, with anterior bands broader (exsag.) than posterior bands; pleural furrows deep, with interpleural furrows very shallow to obsolete; pygidial border broad and flat; border furrow shallow or absent; surface sculptured with fine granules or smooth.

Stratigraphical and geographical occurrence Lower Carboniferous-Middle Permian; Eurasia and North America.

***Paladin (Sinopaladin)* Subgen. nov.**

Type species *Paladin (Sinopaladin) xinganensis* subgen. et sp. nov.

Glabella cudgel-shaped to subcylindrical in outline, gently vaulted, frontal lobe weakly expanded or parallel forwards, slightly constricted between γ—γ, broadly rounded and reaching anterior border furrow anteriorly, widest at the base, bearing 1—3 pairs of shallow glabellar furrows, with S_1 being the isolated relatively smaller L_1; occipital furrow deep, and occipital ring prominent, slightly narrowing laterally; anterior border broad and slightly padded; border furrow very shallow; palpebral lobe medium in size, gently projecting outwards, situated posteromedially; γ and ε distant from the dorsal furrows; facial suture with short straight section ε—ζ; fixed cheek broad (at γ and ε); free cheek narrow, with narrower cheek area and longer, slender genal spine; eye long and narrow, crescent in outline; thorax of 9 segments; pygidium isopygous, semicircular to semielliptical in outline; axis long, with 15—19 rings; pleural area bearing 9—13 pairs of pleural ribs with anterior bands broader (exsag.) than posterior bands; pleural furrows deep, with interpleural furrows shallow or absent; pygidial border broad and somewhat concave.

Discussion The new subgenus bears the closest resemblance to *Paladin (Paladin)* in the shape of glabella, especially the presence of isolated basal glabellar lobe (L_1), the broader, flatter cephalic and pygidial border, the larger palpebral lobe and eye as well as the general configuration of pygidium, with *Griffithides morrowensis* Mather, 1915 as the type species from the lower Upper Carboniferous of North America (G. Hahn and R. Hahn, 1991, Taf. 1, fig. 3); however, it differs from the latter mainly in having shorter, slender, less forward-expanded glabella, with much smaller L_1, and much broader fixed cheek (at γ and ε). The new subgenus is also quite similar to *Microphillipsia* Ruggieri, 1959 in the shape of glabella, the presence of relatively broader fixed cheek and the general configuration of pygidium, with *M. tetraptera* as the type species from the Lower Permian

of Sicilia (Ruggieri, 1959, p. 6—9, pl. 1, figs. 1—9, text-figs. 1—4; G. Hahn and R. Hahn, 1991, p. 158, Taf. 1, Fig. 7), but the latter has preoccipital lobe, much broader fixed cheek, longer palpebral lobe and eye, much shorter genal spine, much shorter occipital ring (tr.) and shorter, less-segmented pygidium. It is quite like *Rhenogriffides* Hahn, Hahn and Brauckmann, 1987 in the shape of glabella, the size and position of palpebral lobe, the course of facial suture and general configuration of pygidium, with *Asaphus dalmani* Emmrich, 1839 as the type species from the Lower Carboniferous (cu Ⅱ β—γ) of Ratingen, Rheinland (G. Hahn, R. Hahn and Brauckmann, 1986, p. 92, Abb. 4—6; G. Hahn and R. Hahn, 1991, p. 156—157, Abb. 10); however, it can be distinguished from the latter chiefly by its much broader fixed cheek, much smaller L_1, broader cephalic border and longer, more segmented pygidium. It also shares several distinctive characters including slender, less convex glabella, broader (tr.) occipital ring, shorter straight section ε—ζ on facial suture, and relatively broader fixed cheek with *Phillipsia* Portlock, 1843 which was revised and redefined by Osmólska (1970, p. 78—80), with *Phillipsia kellyi* Portlock, 1843 as the type species (see Osmólska, 1970, p. 80, pl. 10, figs. 7, 11a—b, text-figs. 6 G—H; G. Hahn, R. Hahn and Brauckmann, 1982, p. 164—165, Taf. 1, Fig. 1—2, Abb. 1 a—g). Nevertheless, the new subgenus differs in having weakly forward-expanded glabella, well-developed L_1, longer palpebral lobe and eye, much broader fixed cheek (at γ and ε), narrower (tr.) free cheek, broader and flatter pygidial and cephalic border, and longer pygidial axis which reaches the posterior border posteriorly. It should be pointed out that the cranidia of *P. (Sinopaladin) xinganensis* and the juvenile cranidium of *Phillipsia gemmulifera* (Phillips, 1836) (G. Hahn, R. Hahn and Brauckmann, 1982, Taf. 1, Fig. 6a—b; Abb. 6a—b) are quite similar to each other in having shorter subcylindrical glabella, faint glabellar furrows, isolated L_1 and broader fixed cheek. The new subgenus likely may be regarded as a paedomorphosis of certain *Phillipsia* or *Paladin (Paladin)* species.

Stratigraphical and geographical occurrence Lower Carboniferous; Guangxi, South China.

Paladin (Sinopaladin) xinganensis subgen. et sp. nov.

(Pl. Ⅰ, figs. 1—7)

Diagnosis Glabella somewhat expanded forwards, weakly constricted between γ—γ; basal glabellar lobe (L_1) elongately subtriangular in outline; γ and ε more distant from the dorsal furrows; fixed cheek broad (tr.); anterior branch of facial suture parallel or slightly divergent forwards; pygidium semicircular in outline; axis broad, with 16—18 rings; pleural area with 12—13 pairs of pleural ribs.

Locality and horizon About 7.5km northeast of Xing'an County, Guangxi, South China; Upper part of Datang Stage, Lower Carboniferous (Upper Visean).

***Paladin (Sinopaladin) subcylindricus* subgen. et sp. nov.**

(Pl. Ⅰ, fig. 8; Pl. Ⅱ, figs. 6, 7)

Diagnosis Cephalon strongly arched forwards, subtriangular in outline; glabella subcylindrical; frontal lobe with parallel sides or slightly tapering forwards, hardly constricted between γ—γ; 3 pairs of glabellar furrows, with anterior two pairs very short, pit-like, while posterior pair being isolated suboval L_1; dorsal furrow very shallow; pygidium elongated-semielliptical to tongue-shaped in outline; axis broad, with 15—16 rings; pleural area with 9—10 pairs of pleural ribs; pygidial border broad and somewhat concave, without border furrow.

Comparison This new species differs from the type species *P. (S.) xinganensis* mainly in having subtriangular strongly forward-arched cephalon, subcylindrical glabella which hardly expands forwards or slightly tapers forwards, shallower dorsal furrow, longer palpebral lobe, elongated-semielliptical to tongue-shaped pygidium, less axial rings and pleural ribs, and broader, somewhat concave pygidial border. In general configuration of pygidium, the new species also resembles *Paladin* (?) *ploto* from the Feratrovich Formation (Upper Visean) of SE Alaska, USA (G. Hahn and R. Hahn, 1991, p. 174—176, Abb. 31 a—b, 32) and *Paladin czarnieckii* from the Lower Namurian of Poland (Osmólska, 1970, p. 147—149, pl. 17, figs. 1—6, 9, 11, 12, 16). However, it can be distinguished from *P.* (?) *ploto* mainly by its rather flat pygidium, shallower or absence of interpleural furrows discontinuing to run onto the pygidial border; and from *P. czarnieckii* principally by the broader pygidial axis with 15—16 rings instead of 14—15 in the latter, the forward-tapering glabella, much broader fixed cheek and the smooth surface of the exoskeleton.

Locality and horizon Same as the preceding species.

***Paladin (Sinopaladin) guibeiensis* subgen. et sp. nov.**

(Pl. Ⅰ, figs. 1—5, 8)

Diagnosis Glabella subcylindrical in outline; frontal lobe parallel-sided, weakly constricted between γ—γ, with 1 pair of oblique glabellar furrows; L_1 small, subtriangular; fixed cheek relatively narrow (at γ and ε); anterior branches of facial sutures weakly divergent forwards, while posterior branches with comparatively longer straight sections ε—ξ; pygidium long and broad, subtriangular to semicircular in outline; axis long and narrow, with 18—19 narrow (sag.) and convex rings; axial ring furrows deep and broad; pleural area with 12—13 pairs of pleural ribs; pygidial border moderately broad, somewhat broadening posteriorly, without border furrow.

Comparison This new species differs from the type species in the less forward-expanded glabella with only 1 pair of glabellar furrows, the narrower fixed cheek (at γ and

ε), the shallower dorsal furrow, the longer subtriangular pygidium with much narrower axis, the deeper and broader axial ring furrows and the narrower pygidial border. In the shape of glabella and the general configuration of pygidium the new species is also quite similar to *Paladin barkei* (Woodward, 1902) from Upper Visean of England (Woodward, 1902, p. 484, pl. 20, figs. 14, 15; Osmólska, 1970, p. 141, pl. 21, fig. 9), but the latter has larger L_1, longer anterior branch of facial suture, no straight section ε—ζ on facial suture, narrower fixed cheek (at γ and ε), deeper dorsal furrow and less segmented pygidium.

Locality and horizon Same as the preceding species.

图 版 说 明

标本保存在中国科学院南京地质古生物研究所。标本产自广西省兴安县城东北约 7.5km 处下石炭统大塘阶上部。

图 版 Ⅰ

1—7. *Paladin* (*Sinopaladin*) *xinganensis* subgen. et sp. nov.

1. 近乎完整卷曲个体，Holotype，均×3，a)头部背视，b)侧视，c)尾部背视，登记号：GPIN 96936。2. 部分边缘破碎的尾部，×4，登记号：GPIN 96937。3. 头部及部分胸节，×3.5，登记号：GPIN 96938。4. 头盖，均×3.5，a)背视，b)侧视，登记号：GPIN 96939。5. 近乎完整卷曲个体，均×4，a)头部背视，b)侧视，c)尾部背视，登记号：GPIN 96940。6. 尾部外模，×3.5，登记号：GPIN 96941。7. 尾部，×3，登记号：GPIN 96942。

8. *Paladin* (*Sinopaladin*) *subcylindricus* subgen. et sp. nov.

尾部及部分胸节，×3.5，登记号：GPIN 96943。

图 版 Ⅱ

1—5，8. *Paladin* (*Sinopaladin*) *guibeiensis* subgen. et sp. nov.

1. 近乎完整卷曲个体，Holotype，均×4，a)头部背视，b)侧视，c)尾部背视，登记号：GPIN 96946。2. 头部，×4，登记号：GPIN 96947。3. 尾部，×4，登记号：GPIN 96948。4. 近乎完整卷曲个体，均×5，a)头部背视，b)尾部背视，登记号：GPIN 96949。5. 不完整尾部，×3，登记号：GPIN 96950。8. 尾部及部分胸节，×3.5，登记号：GPIN 96951。

6，7. *Paladin* (*Sinopaladin*) *subcylindricus* subgen. et sp. nov.

6. 近乎完整卷曲个体，Holotype，均×3.5，a)头部背视，b)侧视，c)尾部背视，登记号：GPIN 96944。7. 头部，×3.5，登记号：GPIN 96945。