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记利沃鱼(*Livosteus*)一新种

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摘要 详细记述了发现于云南武定早泥盆世晚期利沃鱼(*Livosteus*)的新材料。依据其特征，建立一个新种。这是该属除在拉脱维亚以外在世界上的第二个种，因此具有重要的古生物地理意义。

关键词 云南武定，早泥盆世，粒骨鱼科

笔者在整理过去多年来在云南武定泥盆系地层所采获的鱼化石材料时，偶然发现几块保存在黑色页岩内的材料，经过拼接和修理，认为该材料为利沃鱼(*Livosteus*)眶下片的印痕，一左一右，其中右侧眶下片与后眶下片和下缘片呈自然连接状态被保存下来，可惜骨片均被风化掉，仅以外模形式保存下来。尽管如此，特征仍十分明显，属节甲鱼目粒骨鱼科利沃鱼属。

化 石 记 述

节甲鱼目 Arthrodira Woodward，1891

短胸鱼亚目 Brachythoraci Gross，1932

粒骨鱼科 Coccosteidae Traquair，1888

利沃鱼属 *Livosteus* Obrucheva，1962

中华利沃鱼(新种) *Livosteus sinensis* sp. nov.

(图 1a；图版 I)

正型标本 一较完整的右侧颊板骨外模，包括眶下片，后眶下片和下缘片，V9764.1。

副型标本 左眶下片外模，V9764.2。

产地与层位 云南武定旧城附近的早泥盆世晚期的旧城组。

种的特征 个体较大的粒骨鱼类。骨片厚，其上具较大的瘤状纹饰。眶下感觉沟下支和口上感觉沟在眶下片骨化中心处不相遇，两者呈“)(”形。眶下片的眶下叶上缘有一明显的嵴。眶下叶较长。

描述 武定材料为两块保存较好的外模。从正型标本 V9764.1 下部保存情况看，骨片相当厚。

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眶下片(Suborbital plate)右侧者保存较完整，仅眶下叶的前部和上部以及眶后叶的后下部略缺失。

从外形看，整个骨片像把短柄"刀"，眶下叶相当"刀把"，眶后叶相当"刀身"。前者窄长，后者短宽。眶下叶背缘和眶后叶前缘一起构成眶孔的下后缘。该骨片前后长，达120mm，其最宽处位于骨化中心之后，约70mm。右眶下片基本没有变形，向外凸出不明显。

由于眶下叶前端缺失，因此与眶前片的接触关系不清楚。眶下叶背缘上的嵴在V9764.2上保存较清楚，该嵴较宽，与巩膜片相接。

头甲上的眶下感觉沟(ioc)的眶后支(ioc. pt)在上述嵴的后端进入眶下片，在骨化中心处弯曲后一直向前伸到眶下叶的前下端，为眶下感觉沟的眶下支(ioc.sb)。口上感觉沟(sorc)发育，在骨化中心处弯曲，上支(sorc.as)短，下支(sorc.ds)长，后者与眶下

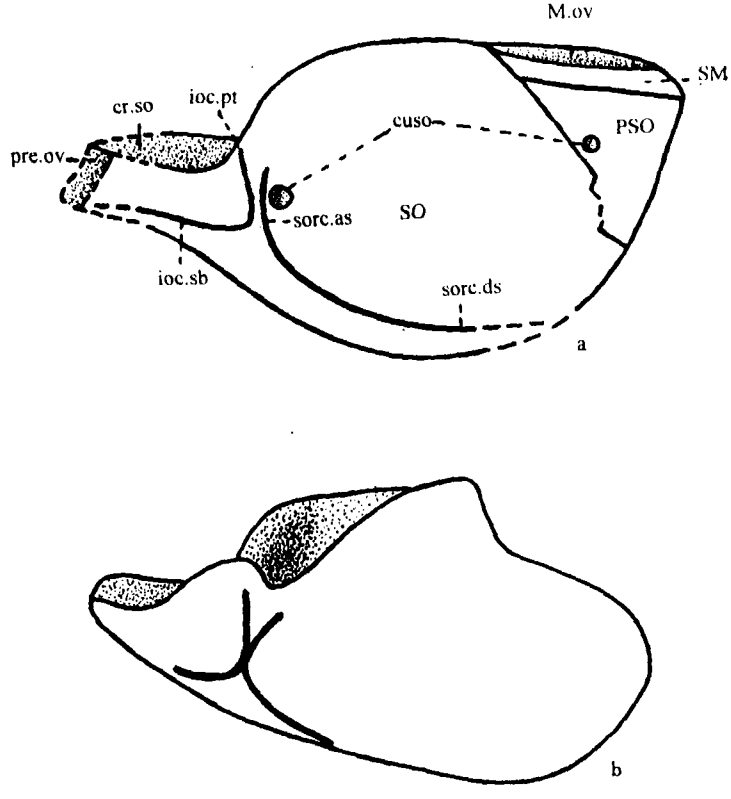

图1　利沃鱼(*Livosteus*)

a：中华利沃鱼(新种，V9764.1)右侧颊板骨复原图，×2/3。b：大利沃鱼(依Denison，1978)

Fig.1　a. Reconstructions of the cheek unit of *L. sinensis* sp. nov.

b. Left suborbital plate of *L. grandis*, redrawn from Denison 1978.

片下缘近平行向后伸。眶下感觉沟的眶后支和眶下支与口上感觉沟的上支和下支，在眶下片的骨化中心处不相遇，形成“)(”型。在V9764.1里，口上感觉沟的上下支呈弧形相接，而在V9764.2里，两者近直角相接。在V9764.1里，于口上感觉沟上支顶端后面，在眶后叶上有一近圆形的坑，其功能是用来容纳皮肤感觉器。在V9764.2上该坑则不十分清楚。

由于材料是以外模形式保存下来的，因此骨片的内面结构无法观察到。

后眶下片(Postsuborbital plate)仅在V9764.1上被保存下来，而在V9764.2上没有保存。该骨片与眶下片呈自然状态连接，近三角形，位于眶下片的后部。前后长为25mm，上下宽为40mm。因材料仅为其外模，所以观察不到覆压区。但在与眶下片相接的骨缝清晰可见，通常为近圆滑的曲线如 *Coccosteus* (Miles, 1968, Fig 13a,b)而在新的材料里，骨缝上部圆滑，下部则呈“之”字形。在该骨缝中部的后面，于骨化中心的前上方有一个深而小的圆坑，皮肤感觉器藏于此坑。

下缘片(Submarginal plate)在V9764.1上与眶下片、后眶下片呈自然连接状态保存下来。该骨片呈长条状，位于后眶下片的背上方，它覆压在眶下片的后背上角和后眶下片的背缘上，其上缘被边缘片覆压。该骨片上没有感觉沟和容纳皮肤感觉器的坑。

纹饰 上述三个骨片表面均具有瘤状纹饰。眶下片上的瘤较大，多分布在骨化中心和骨片下缘的上方。后眶下片上的瘤中等大小，而下缘片上的瘤细小。

比较与讨论 *Livosteus* 属系1962年前苏联学者Obrucheva建立的一个新属，材料少而且分散。除了仅有一件完整的眶下片外(Obrucheva 1966图版III.4)，余者均不完整。骨片非常厚，可达250mm，其上的瘤状纹饰特别大，但无明显排列规律。另外，一个最明显的特点，是眶下片的感觉沟呈“)(”型，这在粒骨鱼科里也是独一无二的。因此，极易与该科其它各属区别开。

从前文的描述不难看出，云南武定发现的这一新材料，无疑应归 *Livosteus* 属。

该属仅有一个种，即属型种 *L. grandis* (Gross) 1933，眶下片的感觉沟呈“)(”型，眶下叶上有一明显的上突，并与眶后叶一起形成一个较深的凹刻。在武定的新材料里，眶下片上的感觉沟呈“)(”型，即眶下感觉沟和口上感觉沟两者在该骨片的骨化中心处不相遇；另外，眶下叶上没有上突，但与巩膜片相接的嵴宽而长；再有，就是在眶下片和后眶片上均有容纳皮肤感觉器的坑，这在属型种里是不存在的。此外，在新材料里，大的瘤状纹饰均分布在骨化中心和骨片下缘之上，在属型种里大的瘤分布在口上感觉沟的后上面，骨片下面则较小。基于上述诸多不同，笔者认为云南武定的材料应为一新种，即中华利沃鱼(*Livosteus sinensis* sp. nov.)

Livosteus 鱼属，包括新种在内，只有两个种。新种发现于我国云南武定，其时代为早泥盆世晚期的Emsian阶(王俊卿，朱敏，1995)，属型种发现于拉脱维亚，从中泥盆世早期的Eifelian阶到晚泥盆世早期的Frasnian阶，均有发现，时代延续较长。

现在拉脱维亚和我国云南相距相当远，但 *Livosteus* 属目前在世界上只在这两个地方被发现，说明在泥盆纪时，至少是从早泥盆世晚期开始，两地的沉积环境和气候条件是相似的。*Livosteus* 不仅个体大而且具有非常厚的重骨甲，表明它只能生活在浅海或滨海，过着底栖生活，因此它们根本不可能越过大的地理阻隔屏障，在相距甚远的水域自

由往来。所以两地不仅具有相似的环境和气候方面的条件，而且在当时生存它们的水域是相通的或者说就是一个水域，至于以后如何才分开并且离的如此远，则是其它地质历史原因造成的。

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插图简字说明

cr. so—— crista subocularis of So. 眶下片上的下巩膜嵴

cuso—— pit for cutaneous sensory cells. 容纳皮肤感觉细胞小坑

ioc. pt—— postorbital branch of infraorbital sensory canal 眶下感觉沟的眶后支

ioc. sb—— suborbital branch of infraorbital sensory canal 眶下感觉沟的眶下支

M. ov—— overlap area for marginal plate. 边缘片的覆压区

pre. ov—— overlap area on So for preorbital attachment of skull-roof and cheek. 眶下片上的与脑顶甲和颊部的眶前覆压区

PSO—— postsuborbital plate. 后眶下片

SO—— suborbital plate. 眶下片

SM—— submarginal plate. 下缘片

sorc. as—— ascending branch of supraoral sensory canal. 口上感觉沟上支

sorc. ds—— descending branch of supraoral sensory canal. 口上感觉沟下支

THE DISCOVERY OF *LIVOSTEUS* FROM THE LOWER DEVONIAN OF YUNNAN, CHINA

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Key words Wuding; Yunnan; Lower Devonian; Coccosteidae

Summary

A new species of the Arthrodira, *Livosteus sinensis* sp. nov., is described from the Jiucheng Formation (Emsian, Lower Devonian) of Wuding, Yunnan. *Livosteus* was originally found in Latvia. Its discovery in the Jiucheng Formation represents the second occurrence of the genus in the world, and provides a basis for comparing continental formations and for studying paleogeography, since these two localities are far away from each other.

Order Arthrodira Woodward, 1891

Suborder Brachythoraci Gross, 1932

Family Coccosteidae Traquair, 1888

Genus *Livosteus* Obrucheva, 1962

***Livosteus sinensis* sp. nov.**

(Fig. 1a; Pl. I)

Diagnosis Large coccosteids with massive bone and ornamentation of large tubercles. Infraorbital and supraoral sensory canals not contacting in the radiation center of the suborbital plate. Cutaneous sense organs present on the suborbital and postsuborbital plates.

Holotype A nearly complete cheek unit which is composed of three bones, *i.e.*, the suborbital, postsuborbital and submarginal plates. V9764.1.

Locality and horizon Wuding, Yunnan. Jiucheng Formation, Emsian, Lower Devonian.

Referred material A nearly complete left suborbital plate. V9764.2.

Remarks *Livosteus sinensis* is most suggestive of *L. grandis* in the shape of the suborbital plate, the ornamentation with large tubercles, and the massive bone. The differences between them are as follows. 1) The infraorbital and supraoral sensory canals do not link each other in the radiation center of the suborbital plate, and look like the shape of ")(" in the new species, whereas these two canals are contact, and X-shaped in *L. grandis*. 2) There is an ascending process in the suborbital plate of

L. grandis, in contrast, this process is absent in the new species. 3) The suborbital lamina of the suborbital plate in the new species is longer than that of *L. grandis*. 4) A cutaneous sense organ is present in the suborbital plate of the new species, and it is absent in *L. grandis*.

Brief description This is a large coccosteid. The preserved length of the holotype is about 145mm, and its maximum breadth is about 70mm. The reconstruction of the cheek bone unit is made in lateral view.

The suborbital plate can be subdivided into two laminae, the slender suborbital lamina (the handle part) and the broad postorbital lamina (the blade part). The postorbital branch of the infraorbital sensory canal runs in a curved groove across the surface, and passes off the suborbital plate near the antero-ventral corner of the suborbital lamina. The supraoral sensory canal is fairly long and curved, and is out of contact with the infraorbital sensory canal at the radiation center of the plate. The ascending branch of the supraoral sensory canal is short. However, its descending branch is much longer and curves posteroventrally to leave the suborbital plate at its posteroventral corner. A pit which probably housed cutaneous sense organs is visible on the postorbital lamina. This fairly shallow pit is somewhat round in shape. The ornamentation consists of the tubercles of uniform size, and no obviously regular arrangement is shown.

The anterior end of the infraorbital lamina was not preserved in both specimens, however, the crista subcularis of the lamina was preserved in V9764.2. The upper part of the posterior margin of the postorbital lamina is overlapped by the submarginal plate.

The postsuborbital plate is triangular in shape. Anteriorly, it is overlapped by the suborbital plate. Along the dorsal margin, it is overlapped by the submarginal plate. The groove for the postsuborbital sensory canal is absent. A deep pit probably for cutaneous sense organs is situated near the anterior margin of the plate. The similar pit is found on the suborbital plate. Small tubercles are irregularly scattered on the surface of the plate.

The submarginal plate is narrow rectangular in shape. It is a flat plate ornamented with small tubercles of irregular distribution. No trace of sensory canal or pit-line groove is visible on the surface. Its upper margin has a narrow contact face for the marginal plate.

图版说明(Explanation of plate)

图版 I (Plate I)

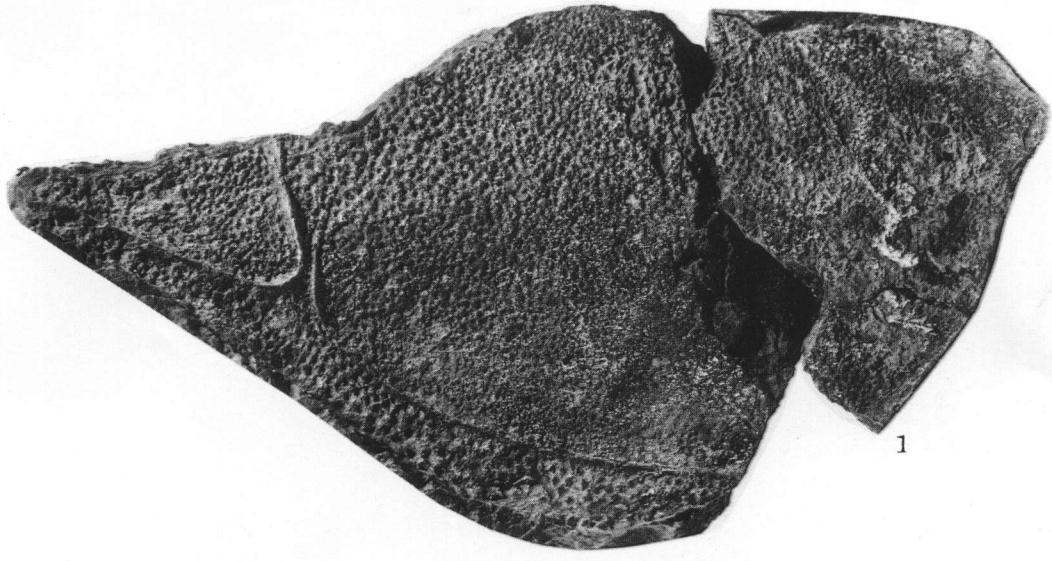
中华利沃鱼(新种) *Liyosteus sinensis* sp. nov.

A: 右颊板骨(眶下片, 后眶下片和下缘片), 侧视, V9764.1; ×1.

Right cheek bones including Suborbital, postsuborbital and submarginal plates in lateral view. V9764.1; ×1.

B: 左侧眶下片 V9764.2; ×1.

Left suborbital plate in lateral view. V9764.2; ×1.



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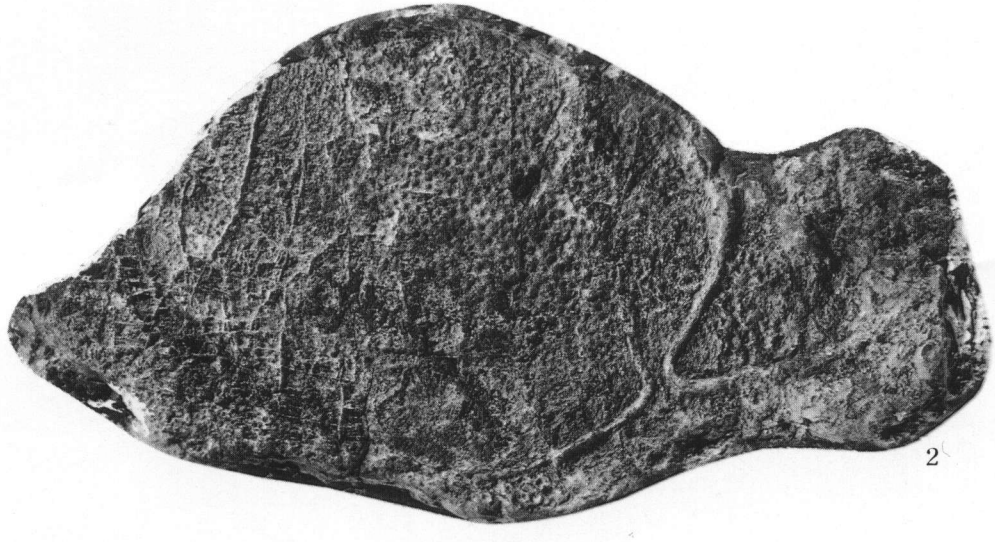

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