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云南盘溪地区节甲类鱼化石

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关键词 云南盘溪 中泥盆世晚期 节甲类

内 容 提 要

本文记述了采自云南盘溪地区一节甲类鱼化石。作者1982年曾根据在该地区采获的少数骨片定为 *Dunkleosteus yunnanensis*。通过对原标本和新材料的仔细观察以及与有关属种对比，认为原定的 *Dunkleosteus yunnanensis* 应为 *Eastmanosteus yunnanensis*。

Eastmanosteus 是 Obruchev (1964) 建立的。在这之前，目前包括在这个属的所有种都放在 *Dinichthys* 或 *Perissognothus* 里。属型种 *E. pustulosus* (*D. pustulosus*) 是由 Eastman (1897) 记述的，它采自美国威斯康星州的中泥盆世。此后，该类化石在不少地区陆续被发现，但多数是在北美，只有少数化石在欧洲发现。该类化石在西亚、北非和澳大利亚发现得较晚。在我国，它的发现和详细描述尚属首次。

1982年，作者曾记述过邓氏鱼一新种 (*Dunkleosteus yunnanensis*)，当时所依据的材料仅四件不完整的骨片。1984年作者与中国科学院植物研究所古植物室耿宝印同志前往云南邓氏鱼 (*D. yunnanensis*) 产地进行考察，在相同地点同一层位采得保存较好的鱼化石。修理后通过对新、老材料的仔细观察以及与有关属种比较，作者认为原定的 *Dunkleosteus yunnanensis* 应为 *Eastmanosteus yunnanensis*。

在 Denison (1978) 的 "Handbook of Paleoichthyology" 中，*Eastmanosteus* 属包括10个种。1987年 Dennis 详细描述了发现于澳大利亚西部 Gogo 地区晚泥盆世的新材料，并根据这一保存非常完整的材料对前人所描述的种作了修订。她认为只有 *Eastmanosteus calliaspis*, *E. pustulosus*, *E. licharevi*, *E. magnificus* 和 *E.* sp 1 Janvier 等五个种属于该属，而其它一些种则分别属于 Dinichthyidae 科的其它属. *E. yunnanensis* 应为这个属的第六个种。

化 石 记 述

真节甲鱼目 Euarthrodira Gross 1932

恐鱼科 Dinichthyidae Newberry 1888

伊氏鱼属 *Eastmanosteus* Obruchev 1964

云南伊氏鱼种 *E. yunnanensis*

（图版 I、II；图 1—7）

1982 *Dunkleosteus yunnanensis*，王俊卿，181—186 页，图版 I,1—3，图 1、2

正型标本　一件不完整的左眶下片（V6603.1）（见王俊卿，1982）。

补型标本　一不完整的头甲，包括部分中心片，较完整的中颈片和右侧副颈片大部（V6603.4）。

其它材料　一件较完整的中背片（V6603.5），二件较完整的前背侧片（V6603.6,7），一件较完整的后侧片（V6603.8），部分眶后片、边缘片和部分中心片呈自然状态连在一起的头甲部分（V6603.9）。

时代与产地　云南盘溪，中泥盆世晚期。

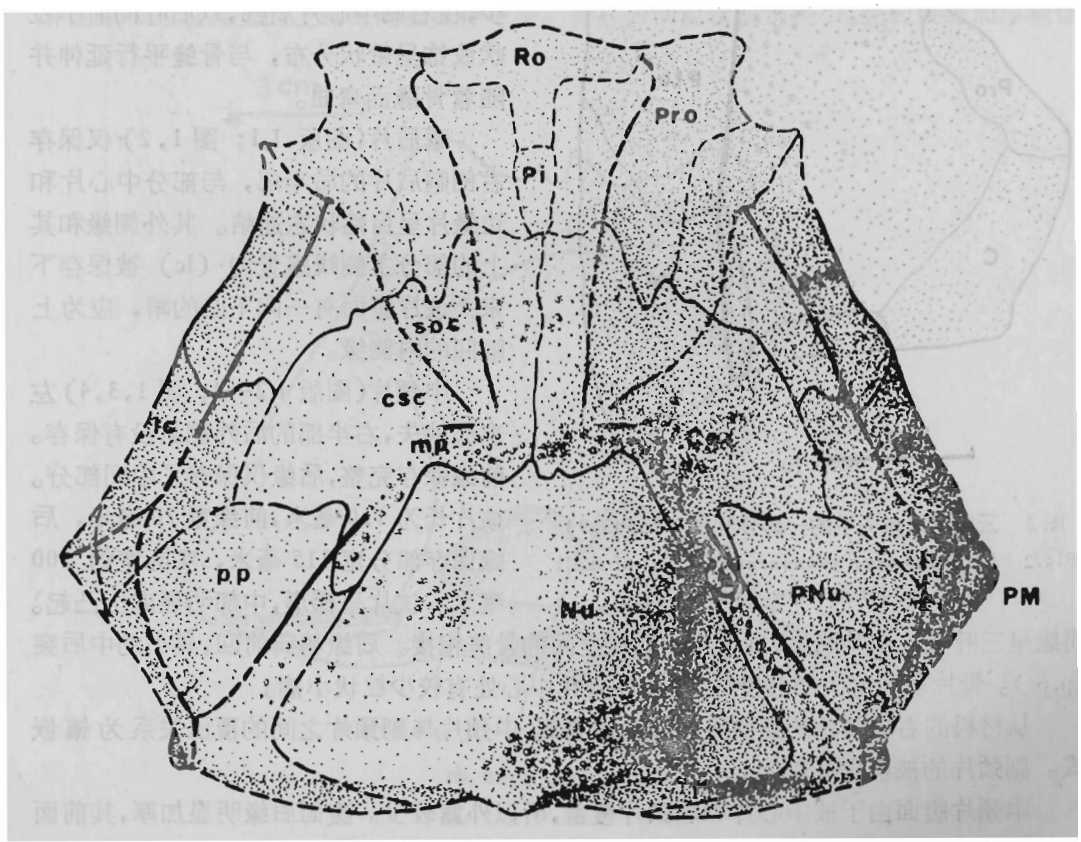

图 1　云南伊氏鱼头甲复原图 背视（主要依据 V6603.4，V6603.9）

Fig.1　Restoration of *Eastmanosteus yunnanensis* based mainly on V6603.4, V6603.9, in dorsal view

种的特征[1]：个体较大的节甲鱼类。中颈片呈梯形，前缘呈三叶状，后缘稍向前凹入，具小的后中突。中心片呈三叶状，并与边缘片相接。眶下片的眶后叶长而宽，眶下叶短而窄。中背片较长，侧缘呈波状，龙骨嵴发育；嵴突粗大，向后超过该片后缘。前背侧片短宽，髁突发育。除骨化中心部位和感觉沟两侧具较密集的小粒状纹饰外，其它部位纹饰稀少或无纹饰。

标本记述 头甲骨片保存有中颈片、中心片、眶后片、边缘片和副颈片。除中颈片和右侧副颈片大部分保存外，其它骨片只保存少部分，但特征清楚，仍可辨认。

中心片(图版 I,1,2; 图 1,2)：保存不完整，右侧保存较多而左侧较少。从保存部分看，该片应是三叶形。后叶保存完整，位于中颈片和副颈片之间。两中心片之间的骨缝较直，齿状弯曲不明显。中点线沟 (mp) 和中心感觉沟 (csc) 的一部分十分清晰。骨片外表面小粒状纹饰稀少；在右侧中心片后部，从后叶向前小粒状纹饰呈带状分布，与骨缝平行延伸并随着骨缝而弯曲。

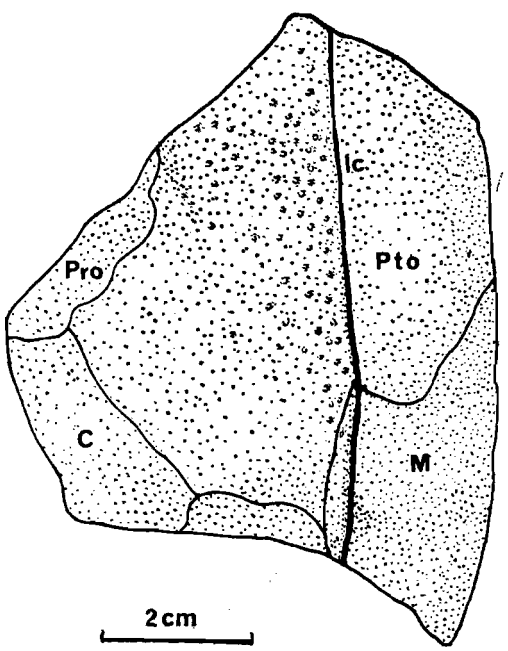

图 2 云南伊氏鱼头甲的一部分背视 (V6603.9)

Fig.2 *Eastmanosteus yunnanensis* a part of skull roof in dorsal view (V6603.9)

眶后片(图版 I,1; 图 1,2) 仅保存右侧眶后片的后半部，与部分中心片和边缘片呈自然状态连结。其外侧缘和其上的部分主侧线感觉沟 (lc) 被保存下来。该片腹面有一向下凸的嵴，应为上眶凹的内侧缘。

中颈片(图版 I,2—4; 图 1,3,4) 左半部缺失，右半部的后外侧角没有保存。前缘保存完整，后缘仅保存了中间部分。该片长为 110 毫米，前缘宽 70 毫米，后缘保存部分宽 115 毫米，实际宽约 200 毫米。该片呈梯形，中部明显向上凸起。前缘呈三叶状，中叶明显，顶端与中心片之间的骨缝相接。后缘稍向前凹，具小的中后突 (p.pr)。骨片表面绝大部分没纹饰，仅在骨化中心处有较少粒状小瘤。

从材料的右后侧角的断面可以清楚地看到，中颈片与副颈片之间的覆压关系为镶嵌式。副颈片的被覆压区较宽。

中颈片腹面由于被中心片和副颈片覆盖，所以外露较少。腹面后缘明显加厚，其前面有一对凹窝 (p. pts. Nu)，位于较浅的凹槽内，被低窄的中隔嵴 (m. sept. Nu) 分开。中隔嵴与前面的纵向浅槽相连。在凹窝后面，中颈片腹面向上斜形成头甲后上升叶 (la. asp)，中间有一嵴，在其两侧各有一卵圆形凹陷区 (dp. mc)。与中心片和副颈的覆压区

1) 由于材料增加，种的特征有所补充。

(cf. C, cf. pNu) 均较宽。

副颈片(图版 I,2；图 1)与中颈片呈自然连接。仅保存右侧的大部分。骨片向上稍凸。从保存情况看，整个骨片较薄，内侧缘加厚不明显而且较窄，而外侧缘明显加厚，因此其腹面的僧冠凹较发育。后点线沟 (pp) 发育，前部由小孔排列构成，后部则为封闭的管，向前伸达中心片。骨片外表面大部光滑无纹饰，但在骨化中心和后点线沟两侧有粒状小瘤，后者呈带状分布。

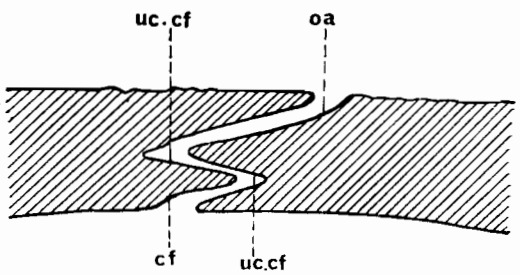

图 3　云南伊氏鱼示头甲骨片之间的覆压关系

Fig.3　*E. yunnanensis* Terminology used for overlap relations between plates in skull roof

边缘片(图版 I,1;图 1，2)只保存了右侧的前半部，与眶后片和部分中心片为自然连接。边缘片与中心片相接。部分外侧缘和通过其上的主侧线沟被保存下来。骨片表面粒状纹饰稀少。腹面侧缘加厚较低。

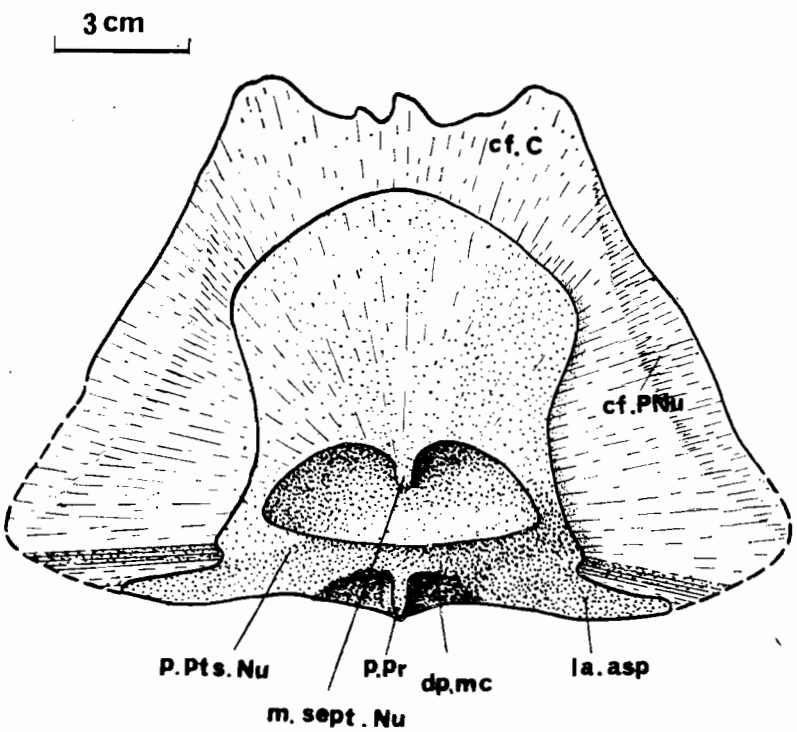

图 4　云南伊氏鱼　中颈片，腹视 (V6603.4)

Fig.4　*E. yunnanensis* visceral surface of nuchal plate, outline after V 6603.4

躯甲部分被保存下来的骨片有较完整的中背片，左右两前背侧片和后侧片。

中背片 (图版 II, 1—3；图 5)　保存了该片中间大部分而两侧则缺失。保存长度为 150 毫米，宽为 55 毫米。横向凸起明显。后缘中部保存完整，由此可以看出后缘向后凸

但不具后中突。该片侧缘虽没保存，但从前背侧片被覆压区的轮廓可以判断其侧缘呈波状，前侧角明显前伸，其角度小于 90°。其形状大致与 *Titanichthys clarki* 和 *T. agassizi* 的中背片形状相近。外表面纹饰较少，仅在骨化中心处有小的粒状瘤。

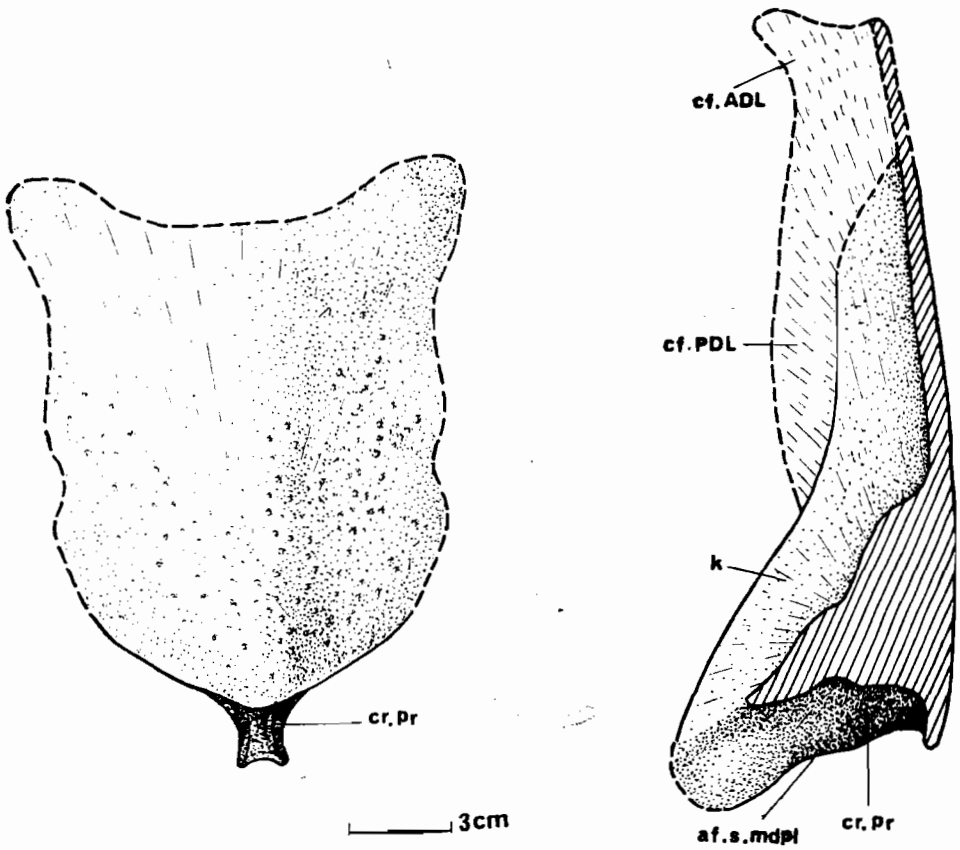

图 5 云南伊氏鱼 中背片复原图
左：背视 右：纵切面（V 6603.5）

Fig.5 *E. yunnanensis* Restoration of median dorsal plate based on V6603.5 left: dorsal view; right: sagittal view

中背片腹面向上拱起明显，其横断面呈半圆形。龙骨嵴（k）特别发育，其后部高度达 50 毫米，但较薄，厚度仅有 5 毫米。该嵴由前向后高度逐渐增大，厚度也随之增加。龙骨嵴向后伸出形成粗壮的龙骨突（cr. pr）。龙骨突的侧向支持嵴发育，如图 5 所示，它起于骨化中心腹面并向后下方延伸。在所记述材料里，两侧支持嵴的基部明显不对称，左侧者呈半球状，而右侧者则近四边形。这种情况不可能是在化石形成过程中受压而成，可能鱼活着时就是如此，是一种畸形。龙骨突侧嵴的前下方分别有一浅窝，其功能尚不清楚，可能为肌肉的固着点。从后面看，龙骨突的后面有一浅窝（af. s. md. pl），它可能是与次中背片相连接的关节。

前背侧片（图版 II，4—7；图 6）比 1982 年记述的保存部分较多，但仍不完整。左前背侧片保存较多，右前背侧片保存则少些。除两者前缘中部及髁突（kd）保存完整外，

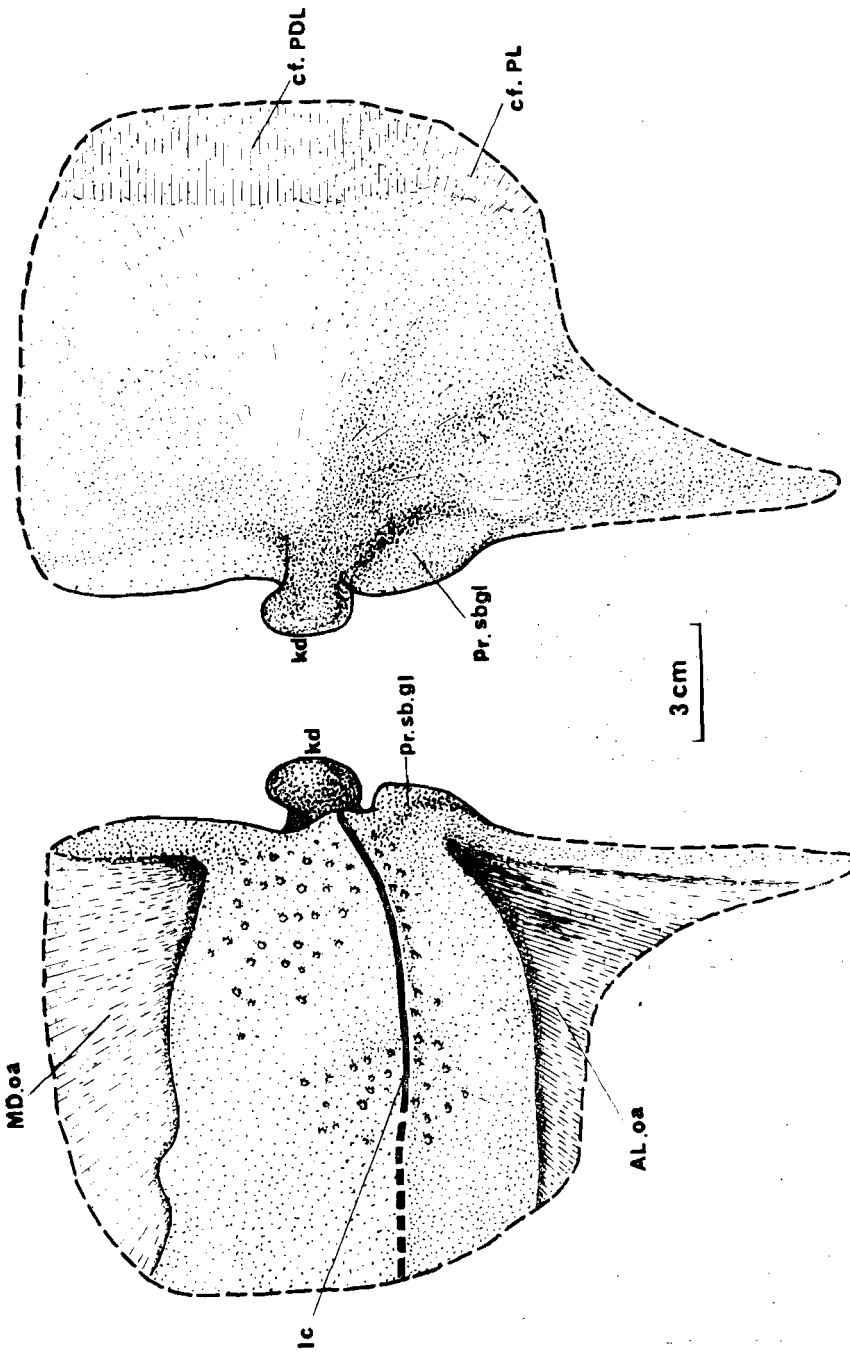

图 6　云南伊氏鱼　前背侧片复原图（主要依据 V6603.6,7）
左：外侧视　右：内侧视

Fig.6　*E. yunnanensis* Restoration of anterior dorsolateral plate based on V6603.6,7 left: external view; right: internal view

其背缘被中背片所覆压的覆压区（MD. oa）及部分后缘与后背侧片覆压面（cf. PDL）和近前缘的下覆压区（AL. oa）均有少部分被保存下来。复原图 6 是根据两者保存情况绘制的。

该骨片近方形，短而宽。背腹方向上呈弧形，没有明显的侧嵴。前半部弯曲明显后半部变的较平。主侧线沟（lc）细而明显，起于髁突下方，稍弯后向后延伸达后缘中点下方。背缘覆压区较大，边缘不规则，这表明中背片侧缘的轮廓大致与 *Titanichthys clerki* 和 *T. agassizi* (Lehman 1956, 图 13, 14) 有些相似。覆压区前缘为较窄的嵴所限而不达前缘；腹缘被前侧片所覆压，前部亦被嵴所限，但不如前者长和显著。

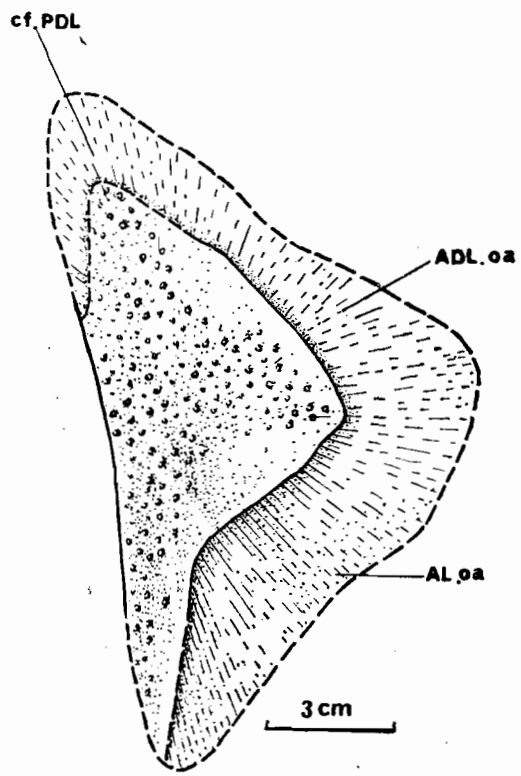

图 7 云南伊氏鱼 后侧片复原图 侧视 (V6603.8)

Fig.7 *E. yunnanensis* Restoration of posterior lateral plate in external view based on V 6603.8

髁突（kd）位于前缘中部，呈圆柱状。副关节突（pr. sb. gl）不明显，仅为一粗糙面。髁突由背、腹和后嵴支持着。髁突的长轴与骨片背叶相交成 60° 角。

骨片表面具有粒状纹饰，主要集中在骨化中心或骨片边缘上，而大部分则较光滑或无纹饰。

后侧片（图版 II,8；图 7）保存大部分，后边缘大部保存，其它边缘则缺失。该骨片大致呈三角形。与后背侧片的覆压区（cf. PDL）、前背侧片的覆压区（ADL. oa）、前侧片的覆压区（AL. oa）均可见。骨化中心位置较后，在该处有很稀少的粒状纹饰。

比较与讨论 作者在 1982 年曾根据在盘溪地区所获得的材料将其定为 *Dunkleosteus*。1984 年作者再次赴化石产地采集化石并获得一些保存较好、数量稍多的标本。虽然多是些分散的骨片，但特征明显，如中颈片为梯形，其前缘为三叶状；中心片为三叶型；骨片表面具小粒状纹饰等，均为 *Eastmanosteus* 属的典型特征，而与 *Dunkleosteus* 属的特征有较明显区别，因此应将 *Dunkleosteus yunnanensis* 订正为 *Eastmanosteus*。

本文所记述的材料与 *Eastmanosteus pustulosus* 较相近，如中颈片和中心片的形状，中背片有较发育的龙骨嵴和粗壮的龙骨突等方面。而下面三点两者则明显不同：1) *E. pustulosus* 的骨片表面布满小的星状纹饰，在盘溪材料上骨片表面大部光滑无纹饰，只在骨片的骨化中心或感觉沟附近有小的粒状纹饰；2) 中背片的形状，在 *E. pustulosus* 里，中背片短而宽 (Denison 1978, 图 68A)，具有小而钝的后中突，侧缘较平直。盘溪

材料虽然保存不全，但从保存部分和前背侧片上覆压区可以推测，盘溪材料的中背片较长，不具后中突，前缘凹入，侧缘呈波状，前侧角长，小于 90°；3）在 *E. pustulosus* 里，中颈片前侧缘明显向前侧方突出，因此整个前缘为不明显的三叶型，而在 *E. yunnanensis* 里，中颈片前缘为明显的三叶型。基于上述三点很容易将两者分开。

虽然 *E. yunnanensis* 与 *E. calliaspis* 在中颈片和中心片的形状上以及在中背片和眶下片的结构上均非常相似，但在骨片纹饰上却明显不同。在 *E. calliaspis* 里，骨片表面布满较大的瘤状纹饰（Dennis 1987, 图 11A, 12A），在骨化中心更集中些，同时瘤的基部呈星状。

本文由侯晋封先生绘图，张杰先生照相，在此一并致谢。

（1990 年 9 月 3 日收稿）

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A FOSSIL ARTHRODIRA FROM PANXI, YUNNAN

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Key words Panxi, Yunnan; upper Middle Devonian; Arthrodire

Summary

Dunkleosteus yunnanensis was erected on the basis of an incomplete suborbital and a few other materials which collected from Panxi, Yunnan Province in 1982. Some materials of arthrodire, which included an incomplete skull-roof and an incomplete median dorsal plate and two incomplete anterior dorsolateral plates, were found by the author from the same locality and horizon in 1984. Reexamination of all the materials at hand convinced me that the specimens

originally identified as *Dunkleosteus yunnanensis* supposedly represent the first record of a true member of *Eastmanosteus* in China.

Systemitic Description

Order Euarthrodira Gross 1932

Family Dinichthyidae Newberry 1888

Genus Eastmanosteus Obruchev 1964

Eastmanosteus yunnanensis

1982 *Dunkleosteus yunnanensis* Wang, pp. 181—186, pl. 1, 1—3; fig. 1. 2.

Type A left suborbital plate (V6603.1) (see Wang, J. Q. 1982)

Metatype an incomplete skull-roof (V6603.4).

Locality and age Panxi, Yunnan Province; upper Middle Devonian.

Diagnosis Dinichthyid arthrodire of moderate to large sized *Eastmanosteus*. Nuchal plate is trapeziform with straight or only slightly emarginated posterior border which has a single posteromedian process, and with double nuchal pits on the ventral surface. Central plate conspicuously tri-lobed and suturing with the marginal plate. Median dorsal plate with a well-developed keel and carinal process on its ventral surface that projects beyond the hind margin. Head- and trunk-shield plates with a finegrained tubercular dermal ornement.

Description Skull-roof: The central plate (Pl. I, 1,2; figs. 1,2) is in contact with the paranuchal, preorbital, postorbital and nuchal plates, its posterolateral margin is embayed for the reception of the anteromedial part of the paranuchal plate of the same side, a notch in its posteromedial margin corresponds to the anterolateral corner of the nuchal plate. Laterally, its suture with the marginal plate is farilystraight. The sharp posterolateral corner of the central plate points outward and backward. There is a sensory line for the central sensory canal (csc). The middle pit line groove (mp) is obvious, but the posterior pit line groove is not visible.

The nuchal plate (Pl. I, 2—4; figs. 1,3,4) is very broad in its posterior part narrowing in transverse width anteriorly. Its anterior margin is trifid obviously as in many *Eastmanosteus* species (Obruchev, 1964; Denison 1978; Dennis 1987), its lateral margin is produced into a obscure process between the adjoining part of the paranuchal and central plates just as in Coccosteitids (Denison 1978). The posterior margin is slightly embayed and has a single posteromedian process (p.pr.), this is flanked at either side by a smaller, less conspicuous process beyond which there is a horizontally elongated depression (dp. mc). From this margin, the descending posterior lamina extends downwards and forwards ending at the nuchal thinking.

The visceral surface of the nuchal plate is largely dominated by contact surface, which is gently concave in the freely exposed central region and bears a pair of pits situated in a shallow transverse trough, and are divided by a stout septum from the anterior wall of the trough. Through the transverse axis of the pits the visceral surface of nuchal plate turns up to form a posterior lamina ascending to the skull-roof.

The paranuchal plate (Pl. I, 2; fig. 1) is incomplete, the lateral articular fossa and para-articular process is not preserved in this specimen. The outer surface is transversely convex and carries sensory line grooves for the main lateral line (lc) which is not preserved, and the posterior pit-line (pp) crosses the bone obliquely on its external surface, but its continua-

tion on the central plate of the same side is doubtful.

The visceral surface comprises a thick posterior region and a much thinner anterior area known as the cucullaris depression for the cheek musculature. The canal for the endolymphatic duct runs parallelly to the anterior border of the posterior consolited arch.

The postorbital plate (Pl. I,1; figs. 1,2) is incomplete, only the posterior part of it is preserved, It is rathar large showing a posterior process protruding into the marginal plate. At the inside of the point, the groove for the main line sensory canal passes from the marginal plate into the postorbital plate. Whether a medial dermal process was developed as in *Eastmanosteus* calliaspis or not is unknown.

The visceral surface is characterized by a broad thickening which forms the lateral consolideted part of the skull-roof.

The marginal plate (Pl. I,1; figs. 1,2) is incomplete. Only the anterior part of it is preserved. The marginal-postorbital suture is more complicated. The marginal plate overlaps the posterorbital dorsally, but ventrally, below the sensory line, the postorbital plate overlaps the marginal plate. This is also present in *E. calliaspis*.

Thoracic armour: Median dorsal plate (Pl. II, 1—3; fig. 5) is incomplete, but most of it was preserved. It is strongly arched transversely, particularly in the mid-region where the lateral margins reach a maximum angle of 30° with the horizontal. The hind margin is rounded without a posterior spine and main lateral line groove.

The dominant feature of the visceral surface is the ventral keel which rises in the anterior part of the plate in midline, gradually increases in depth and width posteriorly and ends in a stout carinal process (cr. pr) which beyond the posterior margin of the plate. The posterior face of the swollen carinal process is deeply hollowed to give an articular surface for the submedian dorsal plate, its ventral margin is arched, the root of the carinal process takes its origin from the surface of the bone near the radiation centre and its origin is marked at each side by strongly developed anterolaterally rinning ridges on the visceral surface of the main transversely arched lamina of the plate. The anterior aspect of each ridge just lateral to the median keel, is excavated by anteriorly facing pits of unknown function previously considered to be for the anchorage of muscles or lige meets concerned with the raising of the head (e.g. Miles 1966, p. 17).

Anterior dorsolateral plate (Pl.II, 4—7; fig. 6): The main body of the plate is dorsoventrally arched except posteroventrally where it is flat. It carries the glenoid condyle (kd) and subgleniod process of the neck-joint. The groove for the main lateral line (lc) runs back from just below the glenoid condyle but its course is visible, it drops down very gradually and runs almost parallelly to the ventral (external) edge. There are two substantial overlap area for the median dorsal plate (MD. oa) dorsally and for the anterior lateral plate (AL.oa) ventrally.

The glenoid condyle lies midway along the anterior face with the subglenoid process below it. The condyle is cylindrical, transverly enlongated and extends on to the visceral surface. It forms an angle of approximately 60° with the dorsolateral lamina of the plate, compared with 50° in *Coccosteus cuspidatus* and 70° in *Dunkleosteus* and differs from the *Eastmanosteus calliaspis* in which this angle about 40° (Dennis 1987, p34). The subglenoid process is a small patch of rough bone which slides against the out side of the paraarticular process on the paranuchal plate. Other features of the internal surface of this plate include contact faces on the posterior edge for the posterior dorsolateral plate dorsally and posterior lateral plate ventral-

ly.

The posterior lateral plate (Pl. II, 8; fig.7) is incomplete. It sutures with the anterior dorsolateral, posterior dorsolateral and anterior lateral plates. On both surface, there is a substantial contact face for the posterior dorsolateral (cf. PDL), The postodorsal wing fitting into a deeply incised posterior dorsolateral overlap area. Anteriorly there is another overlap area for the anterior dorsolateral (ADL. oa) and anteroventral plates, where the posterior lateral plate broadens. There is an overlap for the anterior lateral plate (AL. oa). Only a small pecentage of this plate is exposed in the articulated trunk-shield.

Discussion The genus *Eastmanosteus* was erected by Obruchev (1964, p. 146) for *Dinichthys pustulosus* Eastman, whose generic whereabouts had been discussed before by Eastman (1898). It differs from *Dunkleosteus* in its tubeculated ornamentation, the form of nuchal plate and more mazy course of the suture in its skullroof. As far as it can be judged from the available material, the specimens from Panxi region referred to above as *Eastmanosteus yunnanensis* show great similarity to *Eastmanosteus pustulosus*. Comparing with *E. pustulosus* in the form and structure of the suborbital plate, but *E. yunnanensis* differs from *E. pustulosus* in the form of nuchal and median dorsal plates. In the former the anterior margin of nuchal plate is trifid obviously and the median dorsal plate long and narrow without posterior process, and there is a mid-lateral process on the lateral margin of median dorsal plate; in the latter, the nuchal plate has distinct anterolateral projection and a small posterior process (Denison 1978, Dnnis 1987) without mid-lateral process on the lateral margin of the plate. *E. yunnanensis* is very similar to *E. calliaspis* in the form and structure of nuchal, median dorsal and suborbital plates, but there are a member of differences between them. The most obvious of them is the size. *E. yunnanensis* is much larger than *E. calliaspis*. In addition, most of the plates of the head- and trunk-shield bear ornament in *E. calliaspis*, the tubercles are small and rounded with stellete bases which are randomly distributed over the surface of the plates but tend to be concentrated at the radiation centres and thin out towards plate margin. In *E. yunnanensis*, most parts of each plate are smooth, only at the radiation centre have some small and rounded tubercles without stellete bases, and some tubercles on the head shield plate arrange in a row which is parallel to the sensory line canal. In this point *E. yunnanensis* is different from *E. pustulosus*. Although the anterior margin of nuchal plate of *E. licharvi*, *E. magnificus* and *E. yunnanensis* are very similar, the ornaments of *E. licharvi* and *E. magnificus* differ from *E. yunnanensis*. The tubercles are small stellete in *E. licharvi*, and small and most closely crowded in *E. magnificus*.

图　版　说　明

图　版　I

1.头甲的一部分，包括右侧部分眶后片，边缘片和中心片 a part of head shield including a part of right post-orbital, marginal and central plates V6603.9，背视，dorsal view，× 1

2.头甲的一部分，包括部分中心片、中颈片和右副颈片 a part of head shield including a part of central, nuchal and paranuchal plates V6603.4，背视 dorsal view，× 1/2

3. V6603.4 的腹视 ventral view，× 1/2

4. V6603.4 的后视 posterior view，× 1

图　版　II

1.一件不完整的中背片，an incomplete median dorsal plate, V6603.5，侧视 in lateral view，× 1/2

2. V6603.5 的背视 dorsal view，× 1/2

3. V6603.5 的腹视 ventral view，× 1/2

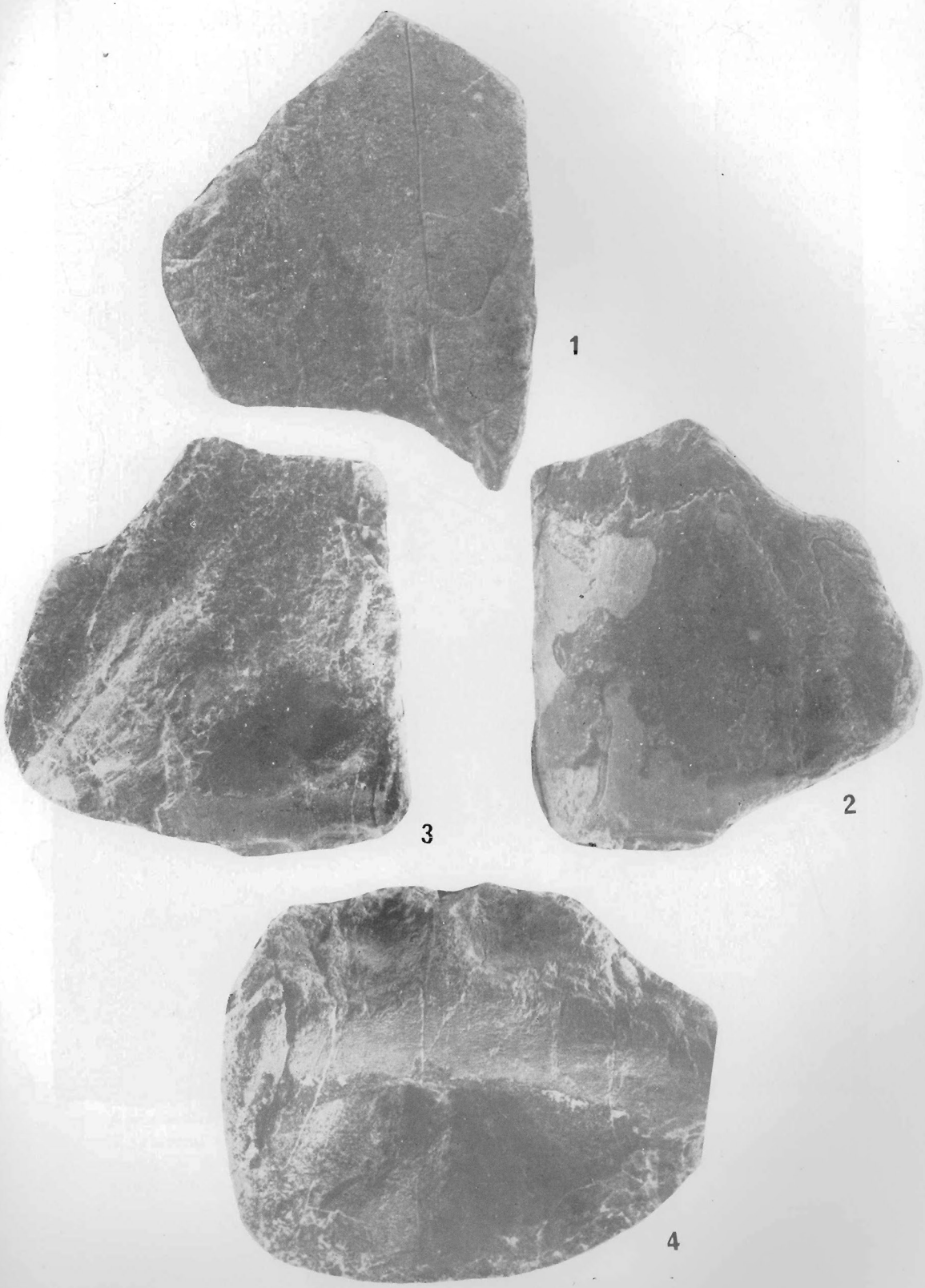
4.一件不完整的前背侧片 an incomplete anterior dorsolateral plate, V6603.6 前视 anterior view，× 1

5. V6603.6 的外侧视 external view，× 1/2

6. V6603.6 的内侧视 internal view，× 1/2

7.一件不完整的前背片 an incomplete anterior dorsolateral plate, V6603.7，外侧视 external view，× 1/2

8.一件不完整的后侧片，an incomplete posterior lateral plate, V6603.8，外侧视 external view，× 1/2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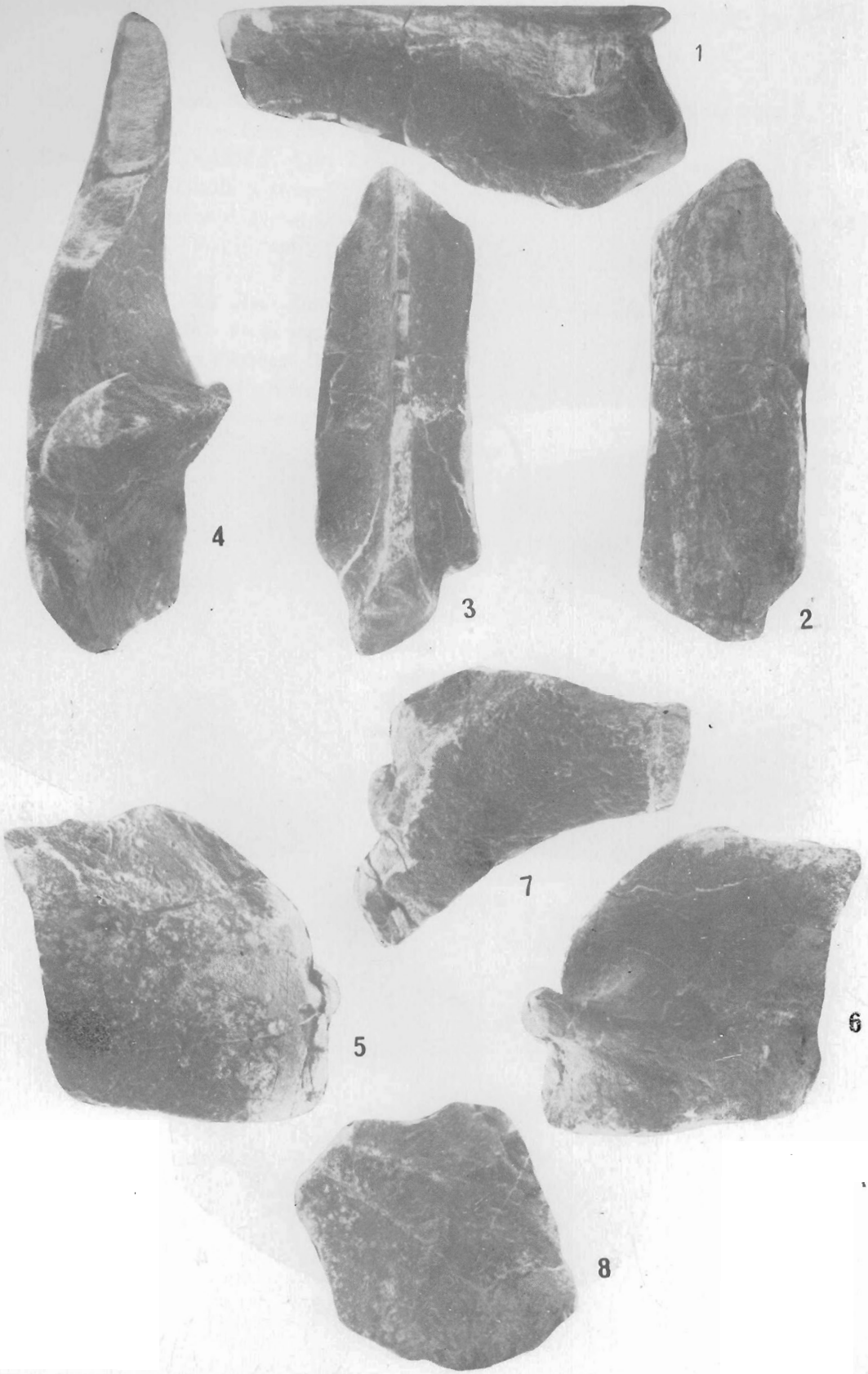
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