

中国的水龙兽

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内 容 提 要

本文综述了中国新疆发现的水龙兽 (*Lystrosaurus*) 七个种的材料;依据头骨形态和结构的相似性,将原订的宽额种 (*L. latifrons*) 归并入粗壮种 (*L. robustus*)。对步氏种 (*L. broomi*)、赫氏种 (*L. hedini*)、杨氏种 (*L. youngi*)、粗壮种 (*L. robustus*) 等水龙兽种的特征进行了补充和修订。并对中国的水龙兽与南非水龙兽之间的关系进行了初步探讨。

自中国新疆第一个水龙兽化石(袁复礼、杨钟健, 1934) 被报道以来,随着野外工作的开展,水龙兽的材料,特别是头骨材料不断地被发现。迄今为止,在中国已建立了七个种,它们都采自天山以北的吉木萨尔(旧称孚远)和天山以南的吐鲁番地区。其中除魏氏种 (*Lystrosaurus weidenreichi*) 仅仅保留了头后骨骼以外,其余的六个种都主要是依据头骨材料而建立的。国外的一些研究者(Cluver, 1971; Colbert, 1974) 在讨论南非和南极的水龙兽时,曾对中国的材料进行了论评,对有的种的独立存在提出了置疑。

1983年野外工作期间,古脊椎所野外队在准噶尔盆地南缘和吐鲁番盆地,又采集到了水龙兽十余个完整或不完整的头骨及少量的头后骨骼。在对这批材料进行工作的过程中笔者发现有必要对中国的水龙兽进行综合研究,对各种的特征给予补充和修订。

1. 步氏水龙兽 (*Lystrosaurus broomi* Young 1939)

1934年袁复礼和杨钟健第一次记述了产自新疆吉木萨尔的一水龙兽近于完整的头骨(No. 600065, 古脊椎动物与古人类研究所标本登记号 RV 39060),并将其归入了依据南非材料而建立的水龙兽穆氏种 (*L. murrayi*)。1939年在深入工作的基础上,根据泪骨的特殊形态及与南非间的地理隔离,杨钟健认为新疆的材料可以代表一独立的种,命名为步氏水龙兽。在以后一些研究者的文章中,都曾提到步氏种与穆氏种之间的密切关系。Colbert 于 1974 年再一次否定了步氏种存在的意义,仍将它放入穆氏种。这一作法似乎是缺乏依据的。步氏种与穆氏种之间的区别除了泪骨的结构特征以外,二者的头骨形态是截然不同的。穆氏种的头骨短而深,它的头骨顶面可分为顶骨—前顶骨平面、额骨平面和前颌骨平面三部分。从侧视图上可见吻的前表面与顶骨—前顶骨平面几乎互相垂直。而步氏种吻部不是向下,而是向前下方伸展,头骨顶面三分性不明显。顶骨—前顶骨平面与额骨平面间夹角大,额骨平面和前颌骨平面共同构成一稍显弯曲的面,这样吻的前表面

与顶骨—前顶骨平面之间的角度增大为 125° 的钝角(图 1)。穆氏种上有清楚的额鼻脊(frontonasal ridge), 额骨节瘤(frontal boss)和放射状的额脊系统(radiating system of frontal ridges), 而在步氏种的头骨上除了一对生于近眼眶边缘的额骨节瘤之外, 上述构造均不存在。步氏种以它的扁而宽的吻部, 顶骨—前顶骨平面与额骨平面间大的夹角(148°), 而区别于中国其它各种水龙兽。

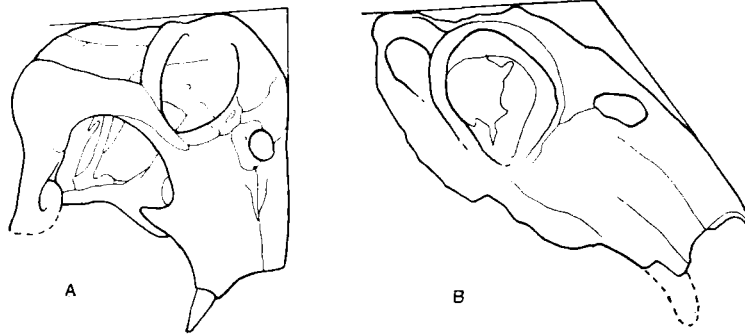


图 1 穆氏水龙兽(A)和步氏水龙兽(B)头骨形态比较图

Fig. 1 Comparison of the skull shape in lateral view of *Lystrosaurus murrayi* (A) and *Lystrosaurus broomi* (B)

步氏种的修订特征 头部顶骨—前顶骨平面宽短, 与额骨平面间夹角大; 额骨与前额骨的缝合部微隆起成脊, 具额骨节瘤, 吻部低而宽, 中脊不明显; 泪骨上突插入鼻骨和前额骨之间; 长牙向前下方伸出, 与吻部延伸方向一致, 牙齿的横切面呈椭圆形, 表面具纵向沟纹。

2. 赫氏水龙兽 (*Lystrosaurus hedinii* Young 1935)

赫氏种的正型标本包括近于完整的头骨、下颌和大部分的头后骨骼 (No. 500010, 古脊椎动物与古人类研究所标本登记号 RV 35012), 是迄今为止中国发现的水龙兽中最为完整的一个。它的头骨上显示了一些难于解释的特征。如吻部的前缘, 前颌骨与上颌骨相接触的部位强烈地向后凹入, 成一湾状的构造, 正如杨钟健 (1935) 指出的此处找不到丝毫破损的痕迹。它可能为自然状态, 也可能是在化石的修理过程中人为造成的。更令人迷惑不解的是枕部表面, 枕髁之上出现了两个孔, 上枕骨在两孔之间左右相连形成一横向的中隔。对于上面的孔, 杨钟健解释为一卵圆形的凹。这一现象是独特的, 且很难对它作出功能解释。很可能这一“中隔”仅存在于浅部, 将枕骨大孔一分为二, 而在深部, 这上下两部分是相通的。这一现象与前述的吻前缘的向后凹入一样, 并不具普遍意义, 在众多的头骨材料中, 它们只出现在这一个头骨上, 如果真是一种自然状态的话, 也是特殊变异的结果。

杨钟健 (1935) 在记述这一标本时认为它的长牙已缺失, 仅有靠近齿根部的横断面露出。这一头骨保存完好, 仅仅丢失了长牙也是可能的。可是仔细观察标本, 在左右两侧都没有明显的破断痕迹。在左侧仅有一很小的齿尖自上颌齿突前端的下侧露出。右侧的牙

齿与左侧等长,但在它的外侧有一斜面切过齿尖和包围它的上颌骨齿突,斜面上可见牙齿的同心环状构造。这一斜面很可能是由不断地磨擦所造成的,是使用的痕迹。

仔细观察赫氏种的头骨,发现顶孔周围的结构与杨钟健(1935)所记述的不完全相同。前顶骨呈一尖端指向前方的心形,与周围骨片的缝合线呈锯齿状。在前顶骨的后缘,顶孔周围的骨片稍有破断,并没有清楚地表明前顶骨包围了顶孔前缘和左右两侧。它很可能与中国的其它各种水龙兽一样,前顶骨占据顶孔边缘的前半部分,这一点在一些归入到赫氏种的头骨上(V 3248等)得到了证实。赫氏种的泪骨也并不象杨1935年图2所示的那样特殊,而是与中国其它种的水龙兽特征一致,泪骨呈不规则形状,与前额骨、鼻骨、隔颌骨和上颌骨相连。

赫氏种的修订特征 头骨较窄,前额骨发育,微向上翘起,但未强烈地向两侧扩展,它的宽度与上颌骨齿突的宽度相等,小于头骨弯曲长度的50%;无额骨节瘤和明显的横向的额鼻脊;在额骨和吻部具纵向的中央脊。前颌骨平面与额骨平面间夹角大,弯曲不强烈,吻部伸向前下方。

3. 杨氏水龙兽 (*Lystrosaurus youngi* Sun 1964)

本种是1964年孙艾玲依据122毫米长的小头骨建立的。这一正型标本的野外编号为63005—4,古脊椎动物与古人类研究所标本登记号为V 8532。杨氏种广泛分布于新疆地区,有许多大小不同,保存完好的头骨被归入本种。大量化石的发现使我们对种的特征有了更全面的认识。如在正型标本中额骨表面平滑且呈弧状弯曲,而在后来发现的杨氏种较大个体中,左右额骨的前部表面微下凹,它们相接部位呈一不高的额中脊,额骨表面也出现了零散的小凹坑。Colbert(1974)依据头骨形态将这一种归入了*L. curvatus*,如果考虑到泪骨的特殊形态的话——杨氏种也具有中国的水龙兽的特点,泪骨上突伸入到前额骨和鼻骨间,这一合并是有疑问的。

杨氏种的修订特征 小到中等大小的水龙兽,额鼻部呈弧状弯曲;前额骨不大发育,其宽度小于头骨长度的50%;额骨表面平滑或有零散的凹坑,额骨前部不下凹或微下凹;眼孔大,鼻孔位置较靠前,没有显著的鼻孔后沟;上颌骨齿突向前下方伸出,牙齿不大。

4. 粗壮水龙兽 (*Lystrosaurus robustus* Sun 1973)

这是一类较大型的水龙兽,它与水龙兽宽额种(*L. latifrons* Sun 1973)之间有很多相似之处。二者的区别仅仅是后者具有更宽的前额部和较窄的间颞部。在工作过程中发现,这两个特征并不总是同时出现的,有的标本具有宽的前额部,但间颞部却不窄。如果不考虑间颞部的宽度,在其它特征一致的情况下,前额部宽度本身可能只反映水龙兽个体之间的差异或两性差异,而并不具有划分种的意义,因此建议将宽额种并入粗壮水龙兽。

粗壮种的修订特征 头骨较大,顶骨—前顶骨平面与额骨平面间夹角较小;表面棱脊构造较发育,具额骨节瘤,额骨和吻部的纵向中脊;前额骨发育但不上翘,前额部宽,其宽度为头骨弯曲长度的50%以上;吻部较为短小,窄而高;吻的前表面为一平面,与两侧面呈角度相交。

为了较全面地介绍中国的水龙兽,现将魏氏种和石长沟种的特征引述如下。魏氏种仅保留了头后骨骼,难于与已知各种进行比较,而石长沟种,笔者未能观察到它的正型标本也很难予以论评。

5. 魏氏水龙兽 (*Lystrosaurus weidenreichi* Young 1939)

个体较大,肩胛骨外侧强烈弯曲,远端部分特别扩张;肩胛骨上的肩峰突位置低;与赫氏种比较,胸骨较长一些。

6. 石长沟水龙兽 (*Lystrosaurus shichangouensis* Cheng 1986)

头骨大型,顶平面与吻平面相交近直角;颞颥孔短而宽,间颞部较短宽。前顶骨大,呈菱形,松果孔小;额骨参与眼眶上缘窄,后额骨几乎被挤出眼眶上缘。前额骨特肿厚而直立。鼻孔高,靠近眼孔。鼻孔下方沟棱发育。泪骨呈三角形,与前额骨、鼻骨、上颌骨和隔颌骨相连;枕部高,鳞骨扩张不超过颞弓宽。下颌缝合部长,与后分支近直角;下颌孔大,其上有一突出的棱脊。股骨较瘦长,股骨头颇发育;桡骨短扁,两端甚扩张。

讨论 水龙兽已从南非、南极、印度、苏联、老挝和中国等地被报道。目前从所发现的种类和数量来计,中国的新疆很可能居第二位,仅次于水龙兽的最重要产地南非。大量化石材料的发现充实了我们对这一分布广泛而又特化的动物的认识,为讨论与其它地区水龙兽的关系提供了较为坚实的基础。

作为同一属不同种的成员,中国标本与南非的大量材料之间既相似又有区别。Cluver (1971) 依据头骨的一定形态特征,将南非的水龙兽划分为两种类型。这种划分方式似乎也适用于中国的水龙兽。与南非的 *L. curvatus* 和 *L. platyceps* 相对应的,是以杨氏水龙兽为代表的一种类型。具有适度发育的吻部,较小的长牙,平滑而弯曲的头骨顶面。而与南非的 *L. murrayi*, *L. mccaigi* 等相对应的是以步氏水龙兽、粗壮水龙兽等为代表的另一种类型,它们具有发育的吻部,粗壮的长牙,头骨顶面与额面间呈角度相交,表面棱脊系统较为发育。

在工作的过程中发现,中国的材料具有一些特点或发展倾向可以区别于世界其它地区的水龙兽:

1. 中国的水龙兽泪骨形态与南非各种的不同。在头骨的侧视面上可见泪骨较大,且外形不规则,它与周围的前额骨、鼻骨、隔颌骨和上颌骨相连。泪骨自主体部伸出一或长或短的上突,夹于前额骨和鼻骨之间。它的后下角,以两侧分别与隔颌骨、上颌骨相连,或呈突状夹于二骨之间。水龙兽的眶前部似乎是结构上的薄弱环节,往往发生破损而使泪骨的界线不清。但在目前能观察到的保存完整的标本中,泪骨的形态、结构都毫无例外地如上所述(图2)。孙艾玲(1973)曾指出:“根据步龙(Broom, 1932)在南非的水龙兽内从未见过泪骨的上角插入前额骨和鼻骨间的,由此在我们的标本内不存在南非的分子”。目前大量材料的发现证明这一结论是正确的。

2. 中国的水龙兽顶骨—前顶骨平面与额骨平面、额骨平面与前颌骨平面间夹角大,因此中国的水龙兽吻部一般是向前下方伸出的,很少有象南非 *L. murrayi*, *L. curvatus* 那样吻部强烈下弯,其前表面与头骨顶面互相垂直的情况。

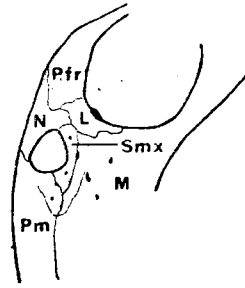


图 2 杨氏水龙兽 (83025②) 眶前部结构示意图

Fig. 2 The structure of preorbital region in *Lystrorhynchus youngi* (83025 ②)

L. 泪骨 (Lacrimal); M. 上颌骨 (Maxilla); N. 鼻骨 (Nasal);
Pfr. 前额骨 (Prefrontal); Pm. 前颌骨 (Premaxilla)

3. 中国的水龙兽头骨表面的棱脊构造不如南非的发育。在所有的标本中都未见到清楚的额鼻脊,鼻骨往往包含在额骨平面之内,吻部向下弯折的部位往往发生在前颌骨上突的顶部,额骨平面与前颌骨是圆滑过渡的。在中国的标本上,即使在很大的个体上,也未见到过放射状的额脊系统,能够观察到的仅仅是在额骨和吻部上的低的纵向中脊,额骨、前额骨缝合部的微微上升和额骨上的一对节瘤。

综合上述各点似乎可以得出这样的结论: 中国的水龙兽各种之间存在着较密切的亲缘关系,推测它们作为一个整体类群可能与南非的水龙兽为姐妹群的关系。

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LYSTROSAURS OF XINJIANG, CHINA

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Key words Xinjiang; Early Triassic; *Lystrosaurus*

Summary

Since the first report on Chinese lystrosaurids made by Yuan and Young in 1934, abundant material has been collected from the Early Triassic of Jiuchaiyuan Formation of Jimusar (Fuyuan), Junggar basin and Taoshuyuan, Turpan basin. Up to now 7 species of *Lystrosaurus*—*L. broomi*, *L. hedini*, *L. weidenreichi*, *L. youngi*, *L. robustus*, *L. latifrons* and *L. shichangouensis*, have been erected in China. All the species were described based on almost complete skulls, except *L. weidenreichi*, which was on some materials of postcranial skeleton. It was thought generally that *L. broomi* and *L. youngi* are closely related to the South African *L. murrayi* and *L. curvatus* respectively. Furthermore, the two Chinese species were considered as synonymous with their counterparts of South Africa by Colbert in 1974, when he revised this genus. The characters of the Chinese lystrosaurids, however, appeared to give no support to Colbert's suggestion. A comprehensive study of the Chinese lystrosaurids based on the type specimens and the additional materials, and the revised diagnoses for 4 species are given in the present paper.

1. *Lystrosaurus broomi* Young 1939

The species was originally described as a South African lystrosaurid, *L. murrayi* in 1934 by Yuan and Young based on a skull (No. 600065, IVPP RV 39060)—The first record of lystrosaurids in China. On the basis of its particular shape of the lacrimal, its differential relations between the lacrimal and the adjacent bones and the wide geographical separation between China and South Africa, Young (1939) designated this taxon to *L. broomi*. Besides the differences pointed out by Young, *L. broomi* can be distinguished from *L. murrayi* in many other respects. For example, the skull is short and deep with the anterior surface of the snout at right angle to the parietoparietal plane in *L. murrayi*, while it is wide and flat with the anterior surface of the snout at an obtuse angle about 125° to the parieto-preparietal plane in *L. broomi* (Fig. 1). The smooth surface of the skull with only a pair of frontal bosses near to the margins of orbits in *L. broomi* is in contrast to that with distinctive frontonasal ridge, frontal bosses and radiating system of frontal ridges in *L. murrayi*. *L. broomi* is also distinguishable from the other Chinese lystrosaurids by its wide and low snout and the large angle (148°) of frontal plane to parieto-preparietal plane.

Emended Diagnosis Parieto-preparietal plane wide and short, angle of parieto-preparietal plane to frontal plane large; frontal bosses present; snout low and wide, with an obscure longitudinal central ridge; nasal and prefrontal separated partly by the upper pro-

cess of lacrimal; tusk oval in crosssection and with faint longitudinal grooves on its surface.

2. *Lystrosaurus hedini* Young 1935

The type specimen of the species, included skull, lower jaw and most part of postcranial bones (No. 500010, IVPP RV 35012) represents the most complete skeleton of *Lystrosaurus* found in China so far. Some characteristics of the skull are too peculiar to interpret their functional significance. For example, the anterior margin of maxilla and premaxilla are marked by a large embayment which is not present in any other Chinese *Lystrosaurus*, even in the specimens referred to *L. hedini*. It could be a natural result of the slicing action of premaxilomaxillary rim against the lateral surface of the dentary symphysis during the masticatory cycle. However a possibility, that the embayment was caused by preparation under misunderstanding the skull structure, can not be entirely excluded.

It is more puzzled that the two fenestrae are located above the occipital condyle. Young (1935) considered the upper one as an oval fossa only, but gave no interpretation. The fact that the total size of two fenestrae is as large as usual foramen magnum in *Lystrosaurus*, suggests that the foramen magnum in the type specimen is separated by a transverse septum—supraoccipital into two parts. The transverse septum appears to be a surface bone and the two parts may confluent in deep. Except RV 35012, no anomalous structure has been observed in any other specimen, so it may be of individual variation.

Several points about the features of skull and tusks are worth mentioning here. A polished oblique facet, which indicates clearly wearing action, occurs on the lateral surface of right tusk and on its surrounding maxillary process as well, suggests that the tusks were worn out rather than were lost assumed by Young (1935). A fissure about 2—4 mm wide, crosses the parietal foramen and the posterior end of preparietal, so it can hardly tell the parietal foramen enclosed by the preparietal from three sides. On the contrary, the preparietal seems to occupy the half margin anterior of the parietal foramen as in other Chinese *Lystrosaurus*.

Emended Diagnosis Skull narrow; prefrontal developed and elevated slightly at lateral end, the width at the prefrontal level shorter than 50 percent of the curved skull length; obscure longitudinal central ridge present on snout and the suture of two frontals, but frontal bosses and transverse frontonasal ridge absent; the angle between frontal plane and premaxilla plane large and snout extending forward and downward.

3. *Lystrosaurus youngi* Sun 1964

The abundance of the well-preserved skulls of *L. youngi* found in Xinjiang has enriched greatly the knowledge of the species. Some features mentioned in the type specimen (No. 63005-4, IVPP V 8532), such as the smoothly curved facial region and unconcaved frontals seem to occur in small individuals only. In larger individuals the surface of frontal with small pits spread is concaved slightly and a central ridge between the two frontals is present. It is unlikely that *L. youngi* could be treated as synonymous with *L. curvatus* for the extending of the upper process of lacrimal between the prefrontal and the nasal in the former.

Emended Diagnosis Small to medium sized lystrosaurs; facial region smoothly curved; frontal with the surface smooth or pitted slightly, unexcavated or somewhat excavated prefrontal less developed, the width at prefrontal level shorter than 50 percent of curved

skull length; orbit large, external narial situated somewhat anteriorly, no prominent post-narial grooves; alveolar regions extending downward, with undeveloped tusks.

4. *Lystrosaurus robustus* Sun 1973

Sun (1973) erected two species of *Lystrosaurus*, *L. robustus* and *L. latifrons*, at the same time. Morphologically there is no much difference between the two forms. Sun distinguished *L. latifrons* from *L. robustus* by the former having a wider prefrontal region and a narrower intertemporal region. It seems to me that these differences can be explained as sexual dimorphism or intraspecific variation. Thus, an assignment of *L. latifrons* to *L. robustus* seems reasonable.

Emended Diagnosis. Skull large; the angle of parietoprepareital plane to frontal plane comparatively small; frontal bosses and the longitudinal central ridges on snout and frontals present; prefrontal developed, the width at prefrontal level longer than 50 percent of the curved skull length; snout short, narrow and high; anterior surface of snout flat, forming an abrupt angle with lateral surface.

For the sake of completeness, the diagnoses of other Chinese *Lystrosaurus*—*L. weidenreichi* and *L. shichangouensis* are quoted below. Comparison and discussion of these two taxa are impossible at the moment because the absence of skull in the former and unavailability of the material in the latter.

5. *Lystrosaurus weidenreichi* Young 1939

Body comparatively large, the external side of scapula curved, with the acromial process placed rather low and the distal end remarkably expanded.

6. *Lystrosaurus shichangouensis* Cheng 1986

Skull large; parietal plane meeting snout plane almost at right angle; temporal fenestra short and wide; intertemporal region comparatively short and wide too; preparietal large, rhomb-shaped; pineal foramen small; the part of frontal at the upper margin of orbit narrow; postfrontal being almost squeezed out from the upper margin of orbit; prefrontal extremely thick and upright; the position of external narial high; ridge and groove below external narial developed; lacrimal triangular joining to prefrontal, nasal, maxilla and septomaxilla; occipital plane high and narrow; symphysis of lower jaws long; mandibular fenestra large; femur long and narrow with a well ossified round femoral condyle; radius short and compressed with expanded ends.

Discussion The Chinese specimens, though belonging to different species of *Lystrosaurus*, have a number of features in common that seem to indicate a general trend of development. These are:

1. In all the specimens with a well preserved pre-orbital region, the lacrimal shows irregular contour, and its dorsal process extends between prefrontal and nasal (Fig. 2).
2. In Chinese lystrosaurids the angle of parieto-preparietal plane to frontal plane is large and the curvature on facial surface is slight, so the snout extends more forward rather than downward;
3. The excrescences on the skull are less developed even on large one—except the

frontal bosses and the low longitudinal central ridges on frontals and snout, the transverse frontonasal ridge and the radiating system of frontal ridges can hardly be discovered from Chinese *Lystrosaurus*.

As the case in *Lystrosaurus* of South Africa (Cluver 1971, Colbert 1974), the species of Chinese *Lystrosaurus* can be placed within two general categories as well. One is represented by *L. youngi* with a moderately developed snout, small tusks, smooth and curved skull surface. The other by *L. broomi*, *L. robustus*, *L. shichanggouensis* with a strong snout, larger tusks and moderately developed excrescences—frontal bosses and the central ridges on snout and frontals. But based on the features mentioned above, it may conclude that the Chinese *lystrosaurus* are more closely related with each other than to the species of South Africa.