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SEGNOSAURIA, A NEW INFRAORDER OF CARNIVOROUS DINOSAURS

BARSBOLD, R. and PERLE, A. 1980. Segnosauria, a new infraorder of carnivorous dinosaurs. *Acta Palaeont. Polonica*, 25, 2, 187—195, July 1980.

A new infraorder of theropod dinosaurs, Segnosauria, is established which includes a single family Segnosauridae Perle, 1979. Representatives of this infraorder display a highly distinctive, opisthopubic pelvis, a slender mandible and anteriorly edentulous lower and upper jaw. A new, alti-iliac type of saurischian pelvis is distinguished, which is characteristic of Segnosauria. *Erlikosaurus andrewsi* Perle gen. et sp. n. is preliminarily described; a short description of *Segnosaurus galbinensis* Perle, 1979 and of a fragmentary pelvis determined on the infraordinal level are included.

Key words: Dinosauria, Saurischia, Theropoda, Cretaceous, Mongolia.

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INTRODUCTION

The dinosaur material collected by the Soviet-Mongolian Paleontological Expeditions has lately been supplemented by the fragmentary skeletons of unusual carnivorous dinosaurs—the segnosaurids (Perle 1979). The remains of these dinosaurs come from the late Cretaceous deposits of several localities in SE Mongolia. From this collection, *Segnosaurus galbinensis* Perle, 1979 has been described up to now (Perle 1979). In the present paper, other representatives of this group are preliminary reported: *Erlikosaurus andrewsi* Perle gen. et sp. n. and a specimen determined as “segnosaurian indet.” (“dinosaur from Khara Khutul”: Barsbold 1979: fig. 1c). All the specimens provide relatively complete data on the morphology of these peculiar carnivorous dinosaurs.

The material of *Segnosaurus*, *Erlikosaurus* and of one undetermined generically segnosaurian specimen provides evidence of their relatively close mutual relationships. At the same time, it shows that they are essentially different from all other theropod groups, although they also

display some similarities with them. In the present authors' opinion, they deserve the erection of a new, separate infraordinal unit — Segnosauria nov., within the suborder Theropoda.

The material described here is housed at the Department of Paleontology and Stratigraphy, Geological Institute, Mongolian Academy of Sciences, in Ulan Bator (abbreviated as GIN).

DESCRIPTION

Infraorder *Segnosauria* nov.

Definition. — Medium to large-sized theropods with a comparatively small skull. Jaws edentulous anteriorly, provided during life with a horny beak. "Cheek" teeth small. Cervical vertebrae large, elongated. Pelvis opisthopubic, alti-iliac (see below), with widely separated ilia; a cubic projection is present on the lateral surface of the posterior iliac wing. Pes tetradactyl with short, non-compact metatarsus.

Included family: Segnosauridae Perle, 1979.

Distribution. — As for the Segnosauridae, see below.

Remarks. — The character of dentition, the edentulous anterior portion of jaws provided instead with a horny beak, the disproportionately large cervicals, the atypical structure of the pelvis and pes differ segnosaurians from all other theropods. Although the opisthopubic pelvis was also reported in deinonychosaurians (Barsbold 1979), in the representatives of the latter infraorder it was developed within the dolichoiliac type of pelvis. On the contrary, the opisthopubic pelvis of segnosaurians displays an extremely deep, broad anterior wing of the ilium (fig. 1) and very short posterior wing, resembling neither the dolichoiliac nor the brachyiliac type of pelvis (Colbert 1964). This prompted the senior author (Barsbold MS) to establish the third type of saurischian pelvis called the alti-iliac type, characteristic of the segnosaurians.

The replacement of the anterior teeth by a horny beak, while the "cheek" teeth are still present, is characteristic of the herbivorous ornithischians. The large cervicals, associated with the relatively small skull, are typical of sauropods. The pes with short, non-compact metatarsus occurs in some ornithopods. However, all the above features exhibit only general, superficial resemblances. When each of them is considered in detail, their distinctness in segnosaurians is evident. The Segnosauria constitute the most aberrant group among late, carnivorous dinosaurs and differ in many respects from the recently known various theropods (Barsbold 1976, 1977).

Genus *Segnosaurus* Perle, 1979

Type species: *Segnosaurus galbinensis* Perle, 1979

Diagnosis. — Large segnosaurids with thick, laterally non-compressed pedal unguals.

Genus monotypic, distribution as for the type species.

Segnosaurus galbinensis Perle, 1979 (fig. 1)

1979. *Segnosaurus galbinensis* Perle: 45, figs. 1—7.

1979. Segnosaurid: Barsbold: 792, fig. 1b.

Material.—GIN 100/80 holotype specimen including: mandible, disarticulated bones of fore and hind limb, pelvic girdle, fragmentary vertebral column, from the Bayan Shireh svita (= Bayn Shireh svita: Maryańska 1977), Upper Cretaceous, locality Amtgay, SE Mongolia;

GIN 100/81 right tibia and fibula, same locality and horizon;

GIN 100/82 right hind limb with incomplete pes, fragments of ribs, ilia, fragmentary ischium and pubis, Bayan Shireh svita, locality Khara Khutul;

GIN 100/83 left scapulocoracoid, ulna, radius, unguals of manus, fragment of a cervical.

Diagnosis as for the genus.

Description (comp. Perle 1979).—Mandible. The occlusal edge of the anterior portion of the mandible is edentulous and somewhat bent outwards. The dentary has a large angular process. The splenial does not reach the short symphysis, and has long, triangular anterior and angular processes. The coronoid is absent, the adductor region is low, gently sloping. Twenty-four to twenty-five comparatively small teeth are closely arranged in each branch of the mandible. The anterior teeth are somewhat curved backwards, the posterior ones are straight, diminishing towards the rear.

Vertebral column. The cervical vertebrae are platycoelous and have large, massive centra and low neural arches. Six coalesced sacral vertebrae form the sacrum; their centra are broad and robust, the transverse processes gradually elongate throughout the series of sacrals. The neural spines are narrow, reach up to the dorsal edge of the ilium and fuse with each other along the top. The proximal caudal vertebrae are platycoelous, with low neural arches and massive zygapophyses.

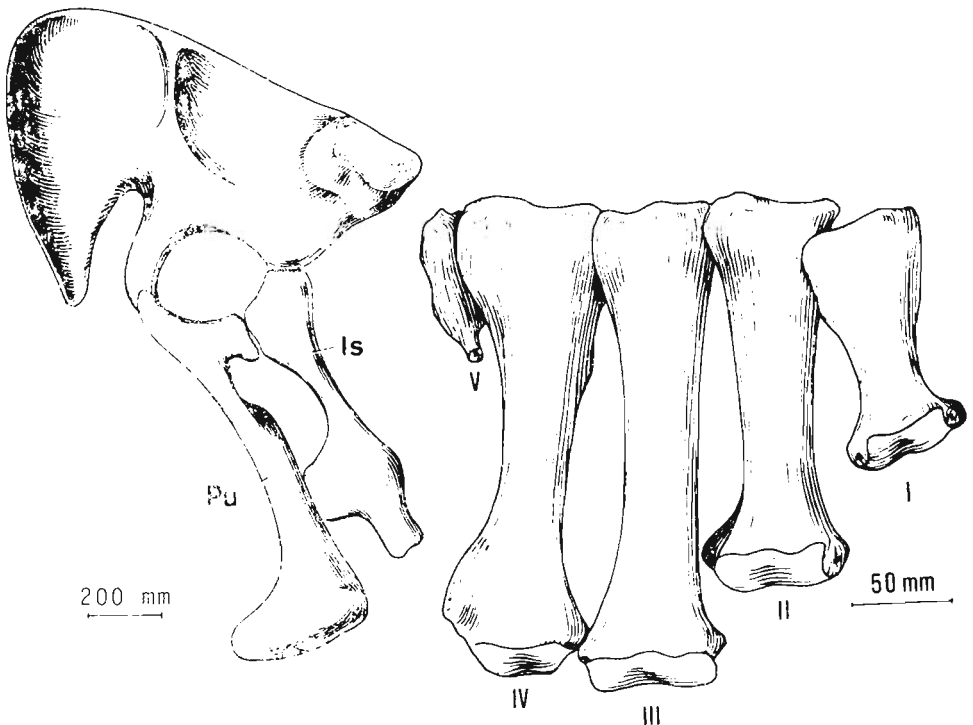


Fig. 1. *Segnosaurus galbinensis* Perle, 1979; holotype (GIN 100/80); Amtgay, SE Mongolia, Bayan, Shireh svita, Upper Cretaceous: left left lateral view of pelvis, right dorsal view of right metatarsus; *is* ischium, *pu* pubis.

Pelvis. The ilia are broadly separated from each other, concave laterally; the anterior wing of the ilium is strongly bent outwards, the posterior wing is very short, laterally bearing a large cubic projection (fig. 1 *left*); the upper surface of this projection merges with the upper edge of the posterior iliac wing. The pubic peduncle of the ilium is long whereas the ischiac peduncle is short. The pubis is directed posteroventrally, parallel to the ischium; its shaft is long, flattened and widened, bearing a longitudinal, medial crest on its posterior symphyseal margin. The distal extremity of the pubis has an ellipsoidal shape, with an elongated, laterally compressed anterior part and narrow, dorsal ad-symphyseal edge. The ischium is slightly shorter than the pubis, and it is laterally flattened; a subquadratic obturator process joins the symphyseal crest of the pubis above the distal end of the latter. A longitudinal, gentle projection is present on the posterior margin of the ischium, opposite the obturator process. The process for articulation with the pubis is shortened. The acetabulum is large, open.

The fore limbs are shortened. The humerus has widened epiphyses and a moderately developed deltoid process. The manus is tridactyl, with weakly compressed unguals.

Hind limb. The femur is weakly sigmoidal and has a massive articular head and a distinct neck. The fourth trochanter is placed somewhat above the middle of the shaft. The tibia is slightly shorter than the femur. The astragalus has a relatively short ascending process, which is broad across the base. The calcaneum is massive, relatively large, probably it does not fuse with the astragalus. The pes is short. The metatarsus is non-compact (fig. 1 *right*). The metatarsals are massive with widened articular extremities, the proximal ones as well. Metatarsal I is the shortest, contributing to the laterally extended proximal articulation of the pes. The remaining metatarsals, except the rudimentary Mtt. V, are about equal in size. The first pedal digit is the shortest; the second and third are equally long; the fourth is the thinnest. The phalanges of the first three digits display a more or less equal structure, they are massive, gradually becoming shorter distally. Phalanges 2 and 3 of the fourth digit are strongly shortened, discoidal. The unguals are massive, recurved, only indistinctly compressed laterally.

Stratigraphic and geographic range.—SE Mongolia: Amtgay, Khara Khutul, Baysheen Tsav localities; Upper Cretaceous, Bayan Shireh svita.

Family Segnosauridae?

Genus *Erlikosaurus* Perle gen. n.

Type species. *Erlikosaurus andrewsi* Perle sp. n.

Derivation of the name: Erlik (Mong.)—the lamaist deity, king of the dead.

Diagnosis.—Medium-sized segnosaurids with laterally compressed pedal unguals.

Genus monotypic, distribution as for the type species.

Remarks.—*Erlikosaurus* Perle gen. n. differs from the type genus of the family *Segnosaurus*. Perle, 1979 in smaller size and lateral compression of the pedal unguals.

Erlikosaurus andrewsi Perle sp. n.

(fig. 2)

Holotype: GIN 100/111, specimen including skull with mandible, disarticulated cervical vertebrae, left humerus, left and right pes; fig. 2.

Type horizon: Bayan Shireh svita, Upper Cretaceous.

Type locality: Baysheen Tsav, SE Mongolia.

Derivation of the name: in honour of Dr. R. Ch. Andrews, leader of the American Asiatic Expeditions in 1922—1930.

Diagnosis as for the genus.

Material.—Only the holotype is known.

Description.—Skull (fig. 2A). The snout is moderately elongated and displays long external nostrils. The premaxilla and the anterior portion of maxilla are edentulous and, judging from the traces left on their external surface, this part of the snout was covered by a horny sheet during life. There is no basisphenoidal capsule, but the volume of the basicranium is distinctly enlarged. The basiptyergoidal process

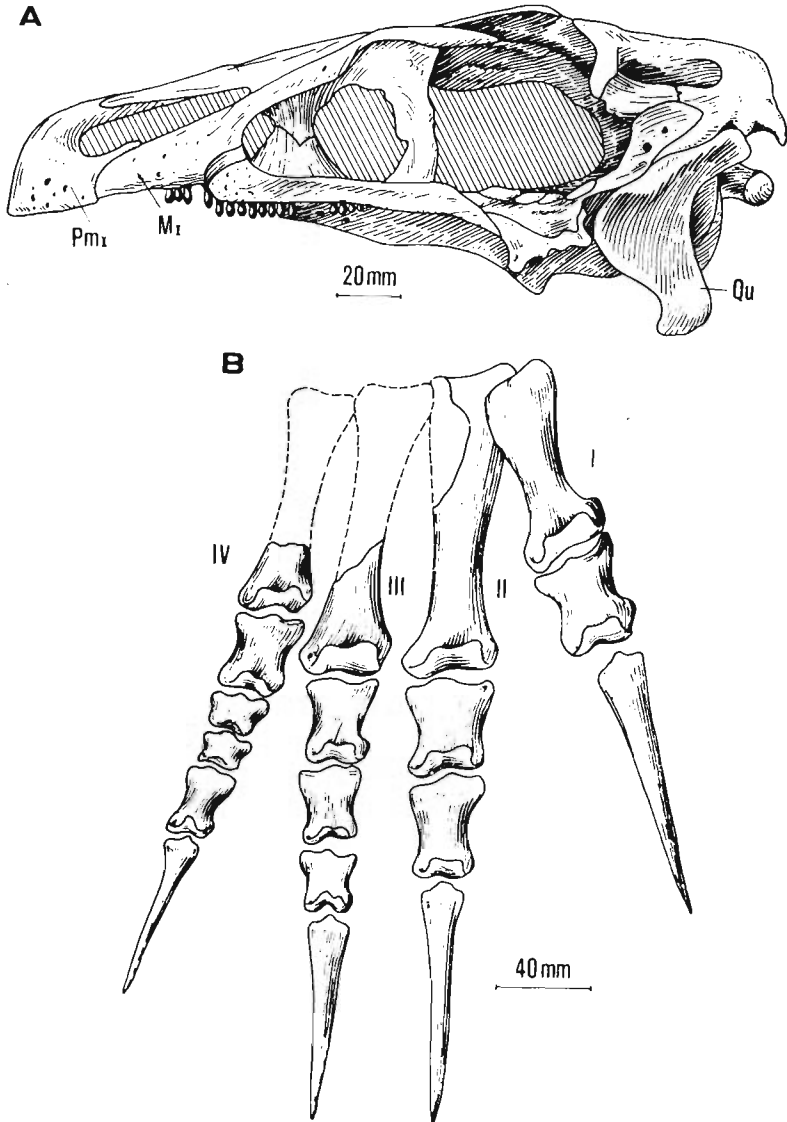


Fig. 2. *Erlikosaurus andrewsi* Perle gen. n. et sp. n.; holotype (GIN 100/111); Baysheen Tsav, SE Mongolia, Bayan Shireh svita, Upper Cretaceous: A left lateral view of skull (jugal arch and postorbital bar removed), slightly reconstructed, B dorsal view of right pes.

is weakly pronounced, the basiptyergoid joint probably being blocked. The interptyergoid vacuity is reduced. The posterior process of the vomer is very long, lamellar, co-ossified ventrally with its fellow along the sagittal axis, so that they form a "V" in cross section; they extend farther posteriorly to join the basicranium below the base of the basisphenoidal rostrum. The vomerine process of the pterygoid is very short.

Mandible. The mandible is slender, slightly bent downwards in its anterior, edentulous portion. The dentary has a large angular process. The splenial does not reach the symphysis and displays triangularly ending anterior and angular processes. The coronoid is absent and the adductor projection is low, gently sloping. The external mandibular fenestra is elongated. Thirty-one, closely arranged teeth, are present in a mandibular branch, the anterior ones are very weakly curved, the posterior diminish backwards.

Vertebral column. The cervicals are platycoelous with low neural arches.

Fore limb. The fore limb is shortened. The humerus displays widened epiphyses and a moderately large deltoid process.

Hind limb. The pes is short (fig. 2B). The metatarsals are massive, with widened articular extremities, and form the non-compact metatarsus. Metatarsal I is the shortest. It contributes to the laterally extended proximal articular surface of the metatarsus. The remaining metatarsals, except the fifth which is rudimentary, are more or less equal in size. The first pedal digit is the shortest, the second and third ones are similarly long, and the fourth digit is the thinnest. The phalanges of three first digits are short, massive, of comparable structure, the second and third phalanx of fourth digit are shortened, discoidal. The pedal unguals are relatively large, curved and strongly compressed laterally.

Remarks.—The strong resemblance between *Erlikosaurus andrewsi* Perle sp. n. and *Segnosaurus galbinensis* Perle, 1979 concerns the form of the mandible and the character of dentition. Similarity also concerns the humerus, the disproportionately large cervicals, the non-compact, tetradactyl structure of the pes and the structure of pedal digits. Among the differences, it may be noted that: *Erlikosaurus andrewsi* is distinctly smaller, the number of its mandibular teeth is greater, the edentulous portion of the mandible is longer and the pedal unguals are strongly compressed laterally, instead of being thick, non-compressed as is the case in *Segnosaurus galbinensis*. Any data on the pelvis structure is lacking for *Erlikosaurus* and this is the reason why this genus is only tentatively assigned to Segnosauridae.

Segnosaurian indet.

(fig. 3)

1979. Dinosaur from Khara Khutul; Barsbold: 792, fig. 1c.

Material.—GIN 100/84, pelvic girdle lacking the upper portion of the ilia, from the Upper Cretaceous Bayan Shireh svita at Khara Khutul locality, SE Mongolia.

Description.—The preserved bases of the ilia indicate that they were broadly separated from each other, and that their anterior wings were deflected outwards. The cubic projection to the ilium was present, judging from what has been preserved of the ilia. The pubis has a long and narrow shaft and is directed posteroventrally, parallel to the ischium. The pubic "foot" is small and narrow, its dorsal surface at the symphysis displays a deep, longitudinal depression which separates both pubes. The ischium is elongated with a narrow shaft and distally placed, narrow obturator process. The latter coossifies with the pubis some distance above its distal extremity.

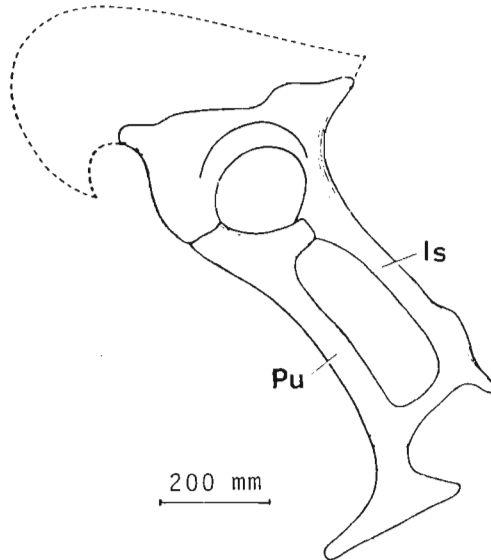


Fig. 3. Segnosaurian indet.; (GIN 100/84); Khara Khutul, SE Mongolia, Bayan Shireh svita, Upper Cretaceous; left lateral view of pelvis, ilium partly reconstructed.

Remarks.—The alti-iliac and opisthopubic structure of the pelvis are very distinctly pronounced in this form. The broad separation of ilia and the presence of a cubic projection to the ilium prove that this pelvis is of the segnosaurian type. On the other hand, the pelvis described above is slightly smaller than this in *S. galbinensis* (Segnosauridae). It also differs from the latter in the narrowness of the pubis and ischium, as well as in the distinctly different structure of the pubic “foot” (divided dorsally by a longitudinal depression) and in the narrow but long obturator process. All these features make the form discussed highly distinctive, but any decision concerning its familiar assignment must be postponed until more complete material is found.

CONCLUSIONS

The lack of the pelvic girdle of *Erlikosaurus andrewsi* in the GIN collection, some differences between *Erlikosaurus* and *Segnosaurus*, as well as the occurrence of a pelvic girdle provisionally referred here to as the “segnosaurian indet”, in the material coming from the Khara Khutul locality, make it necessary to discuss three variants concerning the possible assignment of *Erlikosaurus* and of the “segnosaurian indet.”:

1. *Erlikosaurus* may represent Segnosauridae (this assignment is accepted tentatively in the present paper);
2. the “segnosaurian indet.” pelvis from the Khara Khutul locality may belong to *Erlikosaurus*; in such a case the latter genus becomes the nominative genus of a new, separate family;
3. *Erlikosaurus* and the “segnosaurian indet.” pelvis, each represent a new, separate family.

The peculiar morphologic features of Segnosauria evidence that they developed in adaptive zones which were essentially different from those in which typical theropods lived. E.g. the structure of their skull and dentition and of the postcranial ske-

leton, especially of the pelvis and hind limbs, probably reflect an evolutionary direction different from that generally accepted for "true" theropods—where full bipedalism and predatory habits dominated. The latter included mainly efficient, active predators of the offensive type. The small "cheek" teeth and the horny beak, as well as the short, non-compact pes indicate that segnosaurians may have procured their food without developing the powerful armament characteristic of typical theropods. They may have been amphibiotic animals, preying on fish.

In spite of strong differences, the distinctive characters of Segnosauria may be derived from the general theropod and saurischian pattern. We presume that Segnosauria took to their particular mode of life, very different from that of other theropods, relatively early and this fact may be responsible for their deviation far from the basic theropod structure.

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SEGOSAURIA, NOWA GRUPA DRAPIEŻNYCH DINOZAUROW

Streszczenie

Ustanowiono nową grupę drapieżnych dinozaurów — Segnosauria nov. w obrębie podrzędu Theropoda. Segnosauria obejmują jedną rodzinę Segnosauridae Perle, 1979. Przedstawiciele Segnosauria charakteryzują się opistopubiczną miednicą i smukłą

szczęką dolną. Obie szczęki z przodu są bezzębne i za życia pokryte były pochwą rogową. Wyróżniono nowy dla rzędu Saurischia typ miednicy o szerokim rozstawieniu kości biodrowych nazwany "alti-iliac". Ten typ miednicy jest charakterystyczny dla Segnosauria. Wstępnie opisano nowy rodzaj i gatunek *Erlikosaurus andrewsi* Perle sp. n., który został tymczasowo zaliczony do rodziny Segnosauridae. Praca zawiera również krótki opis *Segnosaurus galbinensis* Perle, 1979 oraz miednicy dinosaura o niepewnej przynależności systematycznej, która jednak wykazuje obecność cech charakterystycznych dla Segnosauria.
