

## FINDINGS OF NEW ARMORED DINOSAURS IN MONGOLIA

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Nature 1: 109-112, Jan. 1953, Published by the Academy of Sciences U.S.S.R.

[translator unknown]

Among the numerous findings made by the paleontological expedition of the Academy of Sciences of the U.S.S.R. (1946-1949) in the territory of the Mongolian People's Republic - sites Bayn-Dzak, Bayn-Shire, Shiregiin-Gashun, Ulan-osh (the Gobi Desert) - the remnants of armored dinosaurs of the Cretaceous period, discovered for the first time, occupy an important place.

The suborder of armored dinosaurs, or ankylosaurs, comprises huge herbivores. Their outward skeleton consists of a series of heavy bony plates, reinforcements and spines, which make up the protective armor. Of all the dinosaurs of the Jurassic and Cretaceous periods in the history of the earth, these reptiles possessed the best protective covering. The powerful bony armor sheltering their bodies gained them the popular appellation of "super dreadnoughts of the animal world", "armor-clad dinosaurs" or "reptile tanks". So far remains of such animals have been found in the lower Cretaceous deposits of England and the Upper Cretaceous formations in North America. Some incomplete skeletons have also been discovered in the Upper Cretaceous deposits of France and Lower Austria. For a long time paleogeographers of the continent had been puzzled by their absence from the vast mainland of Central Asia which, in its Mesozoic strata, buries a number of extremely rich cemeteries of various dinosaurs. The discovery of new sites of armored dinosaurs made by the Soviet expedition is, therefore, of a great paleogeographical interest, and allows us to draw certain conclusions with regards to the composition of the dinosaur fauna found in the Upper Cretaceous deposits of Central Asia and the Asiatic part of the U.S.S.R.

The armored dinosaurs of the Upper Cretaceous formations of Mongolia are grouped in two families vastly different in the degree of their evolution: Syrmosauridae - the more primitive representatives of the suborder, the remains of which have been found in Bayn-Dzak, Shiregiin-Gashun, Ulan-osh, and genuine Ankylosauridae found in Bayn-Shire.

The Syrmosauridae of the Mongolian sites comprised huge quadruped dinosaurs with a light protective armor composed of separate osseous spines (Fig. 1). Their characteristic feature was a flat, bulky body, like in the Upper Cretaceous ankylosaurs. A small head crowned the short neck provided with a special levator, viz. skewed articulated surfaces of the cervical vertebrae; the posterior part of the vertebra is lower than the anterior. The ability to raise the head and neck in an animal with a bulky and flat trunk was a typical and biologically important adaptation to the habitat, which enabled the reptile to embrace a wider horizon than it would have been possible in the normal position of the head. The teeth are poorly developed, having a low, leaf-like, and sulcate crown, and a long cylindrical root. This points to the juicy, soft vegetation as the only possible basic food of the Syrmosauridae; the latter, indeed, was in abundance on the shores of slowly flowing rivers and muddy deltas. The dorsal vertebrae are long, with low centra slightly depressed at the ends. The dorsal had a moderate convexity. Such a structure of the spinal column would indicate that the outward armour was not very heavy.



Fig. 1 Syrmosaurus, one of the oldest representatives of the Upper Cretaceous ankylosaurs. Bayn-Dzak. Reconstruction by N.A. Yanshinova.

Long arcuate ribs of the trunk were loosely linked without fusion with the transverse processes of the vertebrae; such a structure allowed a certain mobility of the spinal column. The pelvis was quadriradiate in shape, the ossa iliaca [ilium] are strongly elongated anteriorly, and broader and thicker in the coxal area; the poorly developed pubis is narrowly tapering. The short sacrum is composed of 3 true sacral vertebrae, - an undoubtful sign that the structure of the spinal column was primitive and the animal moved slowly. The limbs were short but massive. A five toed carpus, the fifth toe being rather poorly developed, the hind foot has three toes only. The toes were provided with a special device - a flat hoof shaped structure which rendered easier movement on aeolian dunes.

The long tail comprised 35/40 vertebrae (fig. 2) covered with numerous ligaments and osseous tendons forming a peculiar sheath, whose inferior cavity was filled with the bodies of the vertebrae. The posterior caudal vertebrae were firmly interarticulated and almost immobile. This structure of the tail indicates that its posterior half was devoid of the ability to move and converted into a kind of "rod" or mace" (1.3 m long) which was provided at the end with two long knife blade shaped spines forming a two-headed "hatchet".

The external armor of the Syrrosauridae is composed of separate carinate bone spines arranged in symmetrical rows on the upper and lateral surfaces of the neck trunk and tail. The spines are not coalesced with one another and do not form thick osseous "armor" plates. Total length of the skeleton with the skull is 4-5 meters, whereas the height is never beyond 1 meter.

A comparison between the Mongolian dinosaurs of the Cretaceous period of Europe and those of North America has shown that even if there is a general similarity, there are essential differences. The latter concern mainly the structure of the axial skeleton and armor. The spinal column of the Syrmosauridae is composed of low, long vertebrae, and the sacrum of three vertebrae only. The ribs of the lumbar area are not fused with the transverse processes of the vertebrae; the armor is lighter. The exterior skeleton of the tail has no compact osseous rings and pointed spines at the end of the mace (club).

This structure allows us to consider the Mongolian Syrmosauridae as representatives of a special evolutionary line of the ankylosaurs and classify them as an independent family of primitively armored dinosaurs of Central Asia. As far as the evolutionary level is concerned, the latter are older than any known armored dinosaurs of the Cretaceous period of Europe and N. America; we may say that they occupy a transitory place between the armored ankylosaurs of the Upper Cretaceous deposits and the spinous ankylosaurs of the Lower Cretaceous strata.

The ankylosaurs of Bayn-shire are represented by the new genus *Talarurus plicatospineus* (fig. 3). The huge quadruped dinosaurs possessed a heavy protective armor; many features of their structure made these analogous with the armor-clad animals - Glyptodons of the Cenozoic era, but of still larger dimensions. The body of the ankylosaurs is

broad and flat, the skull is small, with trapezoidal contours. The bones of the skull roof (ossa cranii) are reinforced and covered with a peculiar mosaic of larger and comparatively minute plates and spines, which no doubt, make up a solid defense for the head. The poorly developed teeth had a compressed lanceolate crown of a similar structure as that in the *Syrmosauridae*. Not more than 18/25 teeth were to be found in each of the jaws. The anterior margins of the jaws had no teeth and were probably covered with a horny sheath. The massive high dorsal vertebrae were slightly depressed at the extremities, a typical feature of a solid and massive spinal column, which offered reliable support for the heavy body armor. The ribs were long and arcuate. The lumbar ribs (4-5 pairs) were firmly fused to the transverse processes of the vertebrae; this represented a considerable reinforcement for the spinal section of the pelvis area which had to carry the thickest section of the armor. The iliac bones of the pelvis are broad, long and shaped like a trough. The acetabulum is directed straight inward as is typical for ankylosaurs; the long sacrum consists of 9 vertebrae. Thus, the sacrum enlarged at the expense of lumbar and tail vertebrae added to the strength of the pelvis, and that, no doubt, due to the development of heavy bony armor.



Fig. 2. *Syrmosaurus*. The skeleton of the tail from the ventral side. 1/12th natural size. Drawn by N.A. Yanshinov.

The limbs are massive but short; the toes are crowned by flat, hoof-like phalanges. The long tail comprises from 20-25 vertebrae. The anterior caudal vertebrae are short with tall centra; the last vertebrae are long, low, with well developed neural and haemal arches, by means of which they are closely joined with one another, forming the slapping part of the tail or the "mace", which serves the cumbersome inert animal as an active organ of self defense. The *syrmosaurus* and *glyptodons* were also provided with a similar "mace" (club).

The entire back and sides of the body were covered with heavy bony armor consisting of carinate plates 25-50 mm in thickness. They were joined with one another by a mobile suture and formed cervical, dorsal, pelvic shields of the armor. The size of the plates composing the shields increased towards the pelvic area. The outward surface of the shields, limbs and tail were covered with symmetrical, hollow, osseous spines varied in form and having a corrugated design, which make up the outward ornament of the armor. The length of the skeleton, with the skull amounted to 4-5 meters.

A comparison of the ankylosaur of *Byan-Shire* with other specimens had shown that among the best known Cretaceous ankylosaurs Europe and North America, as far as the structure of the skull, axial skeleton and armor is concerned, they are most similar to the genera of ankylosaur found in the upper and middle strata of the Upper Cretaceous deposits of the U.S.A. However, the Mongolian ankylosaurs differ from the representatives of the genus *Ankylosaurus* in many particulars: The Mongolian form has a flatter and narrower skull; the carinate and keel-shaped plates of the armor only resemble those of genus *Ankylosaurus*, whereas all the remaining forms have flat, triangular and multi-angular plates. Finally, the corrugated outward ornamentation of the armor spines make the ankylosaurs of *Byan-Sire* different from all the known representatives of the family *Ankylosauridae*.

The quoted characteristics are so essential as to exceed the limits of generic and specific differences and constitute a basis for the classification of the armored dinosaurs of Byan-Shire as a new independent genus and species of the family Ankylosauridae, viz. *Talarurus plicatospineus*. This name stems from the structure of the armored spines.

The Ankylosauridae obviously were the last herbivorous dinosaurs inhabiting the lost continent [i.e., Asia] at the-end of the Cretaceous Period, and probably the last dinosaurs of the Age of Reptiles.

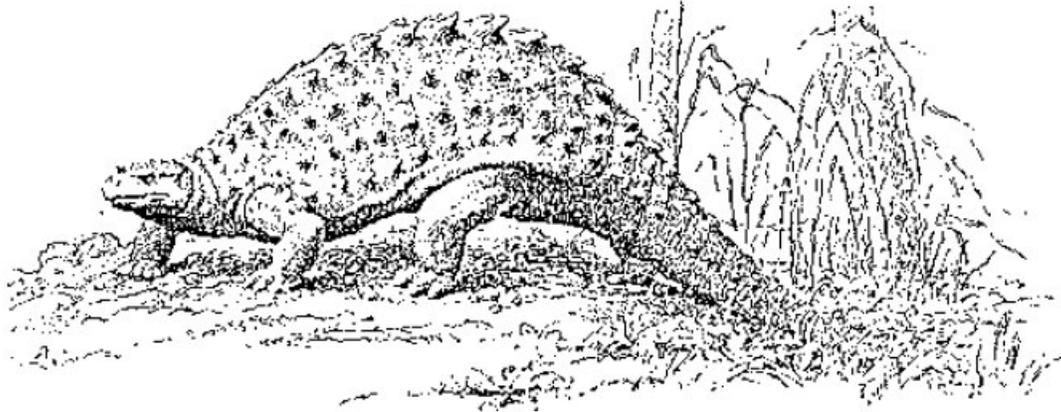


Fig. 3. *Talarurus plicatospineus*. The largest representative of the Upper Cretaceous ankylosaurs of Central Asia. Byan-Shire. Reconstructed by N.A. Yanshinov.

The differences in the structure of the skeleton of the Syrmosauridae and Ankylosauridae of Mongolia points to different biological characteristics and different ways of life of these two groups of armored dinosaurs.

The Syrmosauridae, as the most primitive representatives of sub-order Ankylosauridae, adapted themselves to the habitat of the open space on the continent by burrowing into the sand. They lived on the banks of rivers and in the shallow waters of deltas, where the aeolian sand dunes were prevalent; this supposition has been fully confirmed by the geological data gathered at the sites. The Syrmosauridae burrowed in the sand exactly as the contemporary phrynosoms: by swaying the trunk, the animal dug a small hole in the sand with the force of its weight, then it shoveled the sand to its sides with its fore- and hind limbs, leaving only a small part of the back uncovered. This manner of burrowing is customary to practically all reptiles of the desert. It appeared in the evolutionary process as a defensive reaction of the organism against the attack of predatory dinosaurs and the influence of climate. All reptiles are capable of changing the temperature of the body or are cold blooded (i.e. the temperature of the body changes depending on the atmosphere around them. A sudden rise and fall of temperature of the surrounding medium is unfavorable to their vital activity).

It is obvious that the evolution of the ankylosaurs – Talaruridae, was parallel with the inhabiting of open zones of the continent, often far from rivers and muddy deltas. This habitat favored the development of an extremely strong axial skeleton and heavy bony armor which in certain Ankylosauridae was 100 mm thick. It was a reliable protection against the effects of high temperatures and probably also served as a defense against the most powerful predatory animals that inhabited the Earth – gigantic tyrannosaurs.