

PALEONTOLOGY
AND BIOSTRATIGRAPHY
OF MONGOLIA

THE JOINT SOVIET-MONGOLIAN
PALEONTOLOGICAL EXPEDITION

(Transactions, vol. 3)

EDITORIAL BOARD:

N. N. Kramarenko (editor-in-chief)
B. Luvsandansan, Yu. I. Voronin, R. Barsbold,
A. K. Rozhdestvensky, B. A. Trofimov, V. Yu. Reshetov

1976

**A NEW CARNOSAUR FROM THE LATE CRETACEOUS
OF NOGON-TSAV, MONGOLIA***

The Upper Cretaceous locality of Nogon-Tsav, located in the Zaltaika Gobi, 20 km NW of Mt. Ongon-Ulan-Ula, was discovered by geologists of the MNR. Then, in a series of years (1969–1971, 1973) the joint Soviet-Mongolian Geological Expedition investigated the site. According to the oral report of B. Yu. Reshetova, the deposits in this region are composed basically of sandstone and clay, clearly subdivided into two deposits. The lower great thickness contains many complete skulls, separate bones of tarbosaurids, ornithomimids, and claws of therizinosaurs. The upper red-colored beds are characterized only by scattered fragments of skulls. The fragments described below are of a new carnivorous dinosaur, *Alioramus remotus* (coll. South Gobi region), from the family Tyrannosauridae, which occurs in the lower gray beds.

Genus *Alioramus* Kurzanov, gen. nov.

Genus name from *alius* (Lat.) – other, *ramus* (Lat.) – branch; masc.

Genotype — *A. remotus* Kurzanov, sp. nov., Upper Cretaceous, Nemegetinskaya suite, southern Mongolia.

Diagnosis. Tyrannosaurid of average size. Skull low, with highly elongated jaws. Nasals with well-developed separate crests of 1–1.5 cm height. Second antorbital fenestrae displaced forward, reaching the anterior end of the 5th tooth. Labial foramina in two rows on the jaws. Orbital bones smooth. Laterosphenoid forms the ventral part of the upper temporal cavity and contacts the postorbitals on the posterior edge of the latter. The opening for nerve III formed by the prootics. Teeth are narrow and oval in transverse section, slightly compressed in the middle. The maxilla bears 16 teeth, the dentary — 18.

Composition of the genus. Monotypic.

Comparisons. In addition to *Alioramus* another six valid genera enter into the composition of the tyrannosaurid family, only two of which are known from Mongolia — *Tarbosaurus* (Maleev, 1955. 1955a, 1974; Rozhdestvensky, 1965) and *Prodeinodon* (Osborn, 1924), and one from China — *Alectrosaurus* (Gilmore, 1933).

Alioramus is differentiated from *Tarbosaurus*, found in the same layers as the described type, basically by its smaller size and more delicate appearance. In contrast to *Tarbosaurus*, the postorbitals do not have rugosities, and in contrast they are developed on the nasals. There are three extra teeth in the upper and lower jaws. The descending process of the postorbital is almost straight and does not curve inside the orbit. The lacrimal sinus opens to the outside not through

* Original citation: Kurzanov, S. M. 1976. Noviy pozdnemelovoy karnozavr is Nogon-Tsava, Mongoliya. In Kramarenko, et al. (eds.), *Paleontology and Biostratigraphy of Mongolia. The Joint Soviet-Mongolian Paleontological Expedition, Transactions* 3: 93-104. Translated by Catherine Siskron and Samuel P. Welles. Generously donated by the Museum of Paleontology, University of California, Berkeley and courtesy of Patricia Holroyd and William Clemens. Original typescript transferred to electronic format and edited by Matthew Carrano, Smithsonian Institution, October 2006.

an opening but through a fenestra. The posterior surangular foramen is relatively larger. The angular passes behind its posterior edge.

Alectrosaurus — a more ancient type, characteristic for the beginning of the Late Cretaceous. Its skull, unfortunately, is not known, so comparison is possible only with the metatarsal bones. The pes of *Alectrosaurus* shows typical ornithomimid proportions, differentiated only by its greater massiveness. In *Alioramus* the teeth are typical for carnivores of the Late Cretaceous.

The genus *Prodeinodon* is sufficient in the skull provisionally because it was established only the basis of three teeth. The complete teeth of *Alioramus* are also unknown, so this differentiation could only be established on the shape of the ventrolateral section — by their narrower oval. Besides that, *Prodeinodon* — is a genus from the Lower Cretaceous.

Alioramus is fairly clearly differentiated from the most recent North American carnosaur — *Tyrannosaurus* (Osborn, 1912). First of all by its slender, more elongated features of the skull, absence of outgrowths on the postorbitals, completely different shape of the frontoparietal sutures, the presence of the fenestra of the lacrimal sinus instead of opening, and other outlines of some of the skull bones.

Alioramus is similar in general proportions to carnivores from North America — *Albertosaurus* (Russell, 1970), but differentiated by the shape of the frontoparietal suture and separate bones of the skull.

Alioramus and *Daspletosaurus* from Alberta, Canada (Russell, 1970) are basically different. In addition to the features pointed out in the diagnosis of the new genus, other relations of the skull bones are observed. The sutures between the postorbital and frontal bones are different. In contrast to *Alioramus*, in *Daspletosaurus* the angular does not reach to the posterior edge of the surangular foramen. The exits of the third and fourth cranial nerves of *Alioramus* are not connected in one opening as in *Daspletosaurus*.

In comparison with all the tyrannosaur skulls, that of *Alioramus* is very long and low, which is easy to evaluate, comparing the ratio of the length of the skull (in our example taken from the lower jaw) to the height (from the edge of the quadrate condyle to the edge of the temporal crest). It is in *Alioramus remotus* — 3.6; *Daspletosaurus torosus* — 2.5; *Albertosaurus libratus* — 2.5; *Tarbosaurus bataar* — 2.5; *Tyrannosaurus rex* — 2.1. In connection with this it is interesting to note that the elongation of the skull of *Alioramus* is the result of the retention of a large number of teeth and some ventral bending of some of the posterior part of the lower jaw.

Alioramus remotus Kurzanov, sp. nov.

Fig. 1

Species name from *remotus* (Lat.) — remote.

H o l o t y p e — No. 3141/1, PIN AN SSSR; incomplete skull, fragments of the postcranial skeleton; Ingenii-Khoburskaya hollow, southern Mongolia, upper half of the Upper Cretaceous.

M a t e r i a l. Skull, four middle dorsal vertebrae, proximal parts of several ribs, incomplete tibia and fibula, left pes.

D e s c r i p t i o n. The length of the skull of the described specimen is 65–66 cm, that is the given specimen is of the same size as that of a *Tarbosaurus* in the PIN, No. 552/2 — 5–6 meters in length and 2.5–3 meters tall. However, the skeleton of *Alioramus* belongs to a rather mature animal, which can be judged by the fused sutures of the skull and the fused centra and arches of the vertebrae.

The skull is weakly deformed, with the anterior part destroyed, but with a preserved separate nasal, upper jaw, lacrimal, and jugal. Therefore one can say about the anterior part of the skull that it was similar to *Tyrannosaurus* but with a narrower and more elongate proportion. The cranium is unsatisfactorily preserved, and interpretation of fine details of construction is possible only in rare cases.

Skull roof

Figs. 2, 3

With their broken anterior and posterior edges, the nasals have an unclear relationship with the premaxilla and frontal. It is apparent only that they become wider and flatter posteriorly, and curve ventrally at their anterior edge. Six small rugosities are located near the anterior end of the nasal; the first four one after the other, the last two side by side, almost across from one another. Such well-developed horns have not yet been found on the nasals of tyrannosaurids. Even in *Tarbosaurus* and *Tyrannosaurus*, practically twice as large as *Alioramus*, the surface of the nasal is simply rough, in places slightly hilly, although with age the coarse features of the skull must express themselves more strongly. According to Gilmore (Gilmore, 1920), the horn in the North American *Ceratosaurus* is much more developed than in *Alioramus*, and may turn out to be a secondary sexual feature. The same is apparently true in relation to the Mongolian genus. However, naturally a decision on this question is impossible on the basis of a single specimen.

As in the remaining representatives of the family, the nasal bones fuse not along the whole length, but only in the region of the horn outgrowth. Various canals that fed the blood-carrying vessels (apparently branches of the superior nasal artery) perforate through the entire thickness of the nasals, and are especially intense in the development of the "horns", affirming the presence of a horny covering to the latter. Anterior to the nasal exist characteristic features different from other genera, without widening.

The frontals form the anterior part of the skull roof. In the posterolateral corner within a small area they border immediately with three bones: the postorbital, parietal, and laterosphenoid. All three sutures have clearly expressed fine serrations, apparently including the possibility of some sort of kinesis in this area. On the ventral side the frontals form a similar type of serrated contact with the orbitosphenoid but are tucked under them. In the posterior part the frontals are highly thickened from the edge to the orbitosphenoid suture, forming in this manner a region of the front break. The outline of this thickening is well noticed both on the dorsal side of the roof, and posteriorly along the contact with the parietal, in front on the small crest that leads to the orbit. The frontoparietal suture is highly fused. Its anterior extension is marked by a short line, slightly concave posteriorly. Here the bone is considerably expanded.

The frontals are, in general features, of a shape common for tyrannosaurids. The feature that attracts attention, more than in other genera, is the anteriorly projected suture with the parietal, and the contact with the laterosphenoid, serrated in places, which once again underlines the solidity of the cranium. In the mid-section the parietals are strongly narrowed, as a result of which the ventral edge of the upper temporal cavity is formed by the laterosphenoid, a feature that is not characteristic for other tyrannosaurids. The contact with the prootic is straight and directed slightly dorsally. The parietal crest is tall (3 cm above the surface of the skull roof), with an anteriorly curved dorsal edge. On its posterior surface, directly above the supraoccipital, are located two small cavities. They are analogous to such cavities in crocodiles, lizards, and hadrosaurs, except that they are located on the *parietals* instead of the *supraoccipital*. Their

function seems clear to many authors (Osborn, 1912; Oelrich, 1956; Ostrom, 1961) — attachment of the nuchal ligament. The transition of the place of articulation of the neck with the supraoccipital bone (in herbivorous dinosaurs, crocodiles) to the increased parietal crest (in large carnosaur) gives a direct increase in strength, because it increases the distance from the axis of rotation of the occipital condyle to the point of application of the force. This process, possibly along with the appearance and development of the parietal crest, and strengthened by the attached neck musculature, appears as a necessary result of specific food consumption, that is, the tearing of large pieces of meat, not only with the help of sharp teeth, but mainly as a result of sharp movements of the head.

The *postorbitals* are without any clearly expressed outgrowths. The articular cavity for the ascending process of the laterosphenoid is not positioned ventrally as in many carnosaur, but posteriorly, at the end of the suture with the frontal. The external orbital rim is slightly thickened. The descending process is straight, with a narrowed anterior edge. On the front of the postorbital, approximately in the middle of the descending process on the inside, there is a well expressed furrow that runs at an angle anteroventrally. Its position, practically on the anterior surface of the upper flat space for the pseudotemporalis muscle, could be the result of either the infraorbital artery itself, or one of its branches. Exactly in this place in contemporary sauropsids the temporal artery is divided into the superior and inferior orbital arteries (O'Donoghue, 1921; Oelrich, 1956), but the first usually lies higher and more medially. The foramen for the infraorbital artery, which supplies the blood for the upper jaws, is very small (its diameter is approximately 2 mm); in addition, on the maxilla is preserved a much larger increase in this direct consideration — the superior alveolar artery. Thus it is most likely that the furrow on the postorbital belongs to one of the derivatives of the infraorbital artery, possibly the coronoid artery, which passes in the same direction toward the coronoid recess. Why the furrow is developed only on the right side remains a mystery.

The *squmosa l* repeats the features that are seen in other tyrannosaurs in detail. It is only interesting to note that the medial process rests on the upper part of the suture between the laterosphenoid and the prootic.

Lateral surface of the skull

Figs. 4, 5

The *maxilla e* are relatively elongate and low. The ventral edge is very even. The slightly dorsally curved area of the dorsal edge marks the beginning of the second antorbital fenestra, which is displaced anteriorly the width of 1-2 teeth in comparison with other tyrannosaurids. Between the teeth is preserved a rising, approximately 1 cm interdental plate of pentagonal shape. A clearly expressed furrow passes through its base and branches into the space between — traces of the paths of blood vessels that supplied the teeth, noticed in many tyrannosaurids (Maleev, 1974; Osborn, 1912). Within the thickness of the maxilla pass two canals that are not connected with one another. The anterior part in the dorsal edge of the maxilla, above the alveolus of the eighth tooth, gradually descends to approximately the middle and travels horizontally anteriorly, positioned laterally relative to the teeth. This canal, approximately 7 mm in diameter, corresponds to the position of the dental artery (O'Donoghue, 1921; Oelrich, 1956), which supplies blood to the front teeth and the skin on the anterior part of the face. The latter forms paired upper and lower branches that perforate the bone and form two rows of radial openings. The posterior canal, 3-4 mm in diameter, also travels anteriorly itself beginning from the last tooth, connecting in an analogous manner with the external surface of the

jaw and the alveoli, that is via two branches. This is most likely the canal for the posterior branch of the maxillary artery, which supplies the teeth and the skin of the posterior part of the jaw. In principle, the same position is preserved in contemporary lizards and crocodiles, in contrast to *Alioramus* where the anterior and posterior branches articulate. The double wall of the labial openings of *Alioramus* is identified among other genera of the family. In North American types they are larger and positioned in approximately one row, but in *Tarbosaurus* they are simply scattered without any order.

L a c r i m a l s . Only the descending process of the lacrimal is well preserved. The external surface is flat, narrowing ventrally, and curved posteriorly. The crest is position on the internal side, rounded from the front and curved anteriorly. Toward the dorsal edge it is perforated by the lacrimal canal, directed anteriorly and slightly ventrally. The internal opening of the lacrimal canal — oval, the external into the nasal region — vertically cleft-like. Above that is preserved the region, noted in more primitive forms — *Allosaurus* and *Ceratosaurus* (Gilmore, 1920) and expressed in all tyrannosaurids, but to a considerably lesser degree. In the North American *Albertosaurus* and *Daspletosaurus*, the lacrimal sinus opens externally to the fenestra (Russell, 1970), and in *Tyrannosaurus* and *Tarbosaurus* (Osborn, 1912; Maleev, 1955b, 1974) — it is a small opening. The lacrimal of *Alioramus* carries a clear sign of the fenestra in the front upper angle. It is hard to judge the functional meaning of the sinus; it is only necessary to note that usually it is large with a highly developed lacrimal horn — in *Allosaurus* and *Ceratosaurus*. In our specimen the sinus is small with a fenestra, as in *Albertosaurus*. It is possible that this is why *Alioramus* had a similarly developed lacrimal horn, no greater than the one in the mentioned type. Above the lacrimal region passes a canal with a diameter of 2 mm, with an unclear function.

The **j u g a l** is not differentiated considerably from those of other tyrannosaurids. The regions of the sutures are broken off. From the external side, apparently exactly in the middle, existed growth with radial construction of the bone and tubercular surface, that was for a possible horny covering. The ventral side of the jugal is slightly convex. From the medial side directly under the orbit there is a smooth, elongated indentation through which enters the ectopterygoid at its lateral end.

The **q u a d r a t o j u g a l** is remarkable only for its more pointed anterior process, which rests on the jugal. On the medial side between the quadratojugal and the quadrate there is a tall oval opening (larger diameter 3 cm) analogous to the opening in *Tyrannosaurus* (Osborn, 1912). It is also seen in labyrinthodonts, theriodonts, ichthyosaurs, and lizards. In the Lacertilia, where it is completely repositioned within the quadrate bone and relatively much smaller, the anastomosing branch of the posterior condylar artery passes along with the branch of nerve III to the capsule of the jaw condyles (Oelrich, 1956). It seems completely logical to connect the existence of the quadrate opening in *Alioramus* with a highly developed anastomosing network of the anterior and posterior condylar arteries around the jaw articulation.

The **q u a d r a t e** is significantly bowed anteriorly in the middle parietal region. The pterygoid process is tall, slightly convex laterally, reaches to the level of basiptyergoid processes, and clearly rests on the quadrate process of the pterygoid. allowing their mutual mobility. Immediately above the medial part of the condyle in the body of the bone there is a large sinus, limited from the side by two crests, leading approximately to the middle along the ventral edge of the pterygoid process. The ventral contact surface with the quadratojugal is convex, preserving the possibility of progressive motion.

Posterior skull and cranium

Fig. 6

The *supraoccipital* takes up relatively the same area as in other carnosaurs. The edges of the completely fused sutures with the paroccipital processes are visible slightly more medially than the edges of the parietal crest. In contrast to other tyrannosaurs, the supraoccipital of *Alioramus*, with its upper trunk-like part resting in the rear of the parietal, is convex and has an upwardly curved edge with a narrow, short furrow in the middle.

The *exoccipitals* are completely fused with the basioccipital and the supraoccipital in the region of the foramen magnum, and thus it is hard to say to what extent they participate in the formation of the foramen magnum. The contact with the basioccipital can only partially be followed, passing from the edge of the ventral process of the latter to the jugular foramen, apparently formed laterally the same way as the basioccipital. On the lateral surface of the cranium, toward the opening for the trigeminal nerve, the suture with the basisphenoid can be observed. The exit for nerves IX and X also appears lateral to the occipital condyle, above the rounded opening, along with two foramina (for nerves XI and XII) that cannot be identified more precisely because of deformation and displacement of the bones. The contact with the prootic is observed only in the region of the fenestra ovalis, which is limited posteriorly by the paroccipital process. This suture extends almost horizontally posteriorly from the dorsal edge of the foramen ovale.

The *basioccipital* forms a ventrally directed outgrowth that rests on the basisphenoid and forks ventrally into projections similar to the basiptyergoid processes. These forking processes are more developed than in *Tarbosaurus*, shorter and more massive than in *Albertosaurus lancensis* (Gilmore, 1946), and are not extended into one line as in *Tyrannosaurus*.

The *basisphenoid* has from the rear a large triangular region (in the plane) with the subquadrate opening. In its upper angle are found two symmetrically located openings, oval entrances for the sinus, as noticed in *Albertosaurus* and *Daspletosaurus* (Russell, 1970). The powerful basiptyergoid processes are movably articulated with the hook-like processes of the pterygoids. The small, triangular perimeter sinus is located in the anteroventral part of the basisphenoid. On the lateral surface, under the foramen for nerve VII, is located the entrance to the canal for the inner carotid artery.

The *prootics* mostly occupy the standard position for tyrannosaurids, and are only differentiated by the fact that they grow anteriorly and completely encompass the trigeminal foramen. This is a large difference from the analogous relationship in other representatives of the family, where the inclusion of the laterosphenoid is necessary in the formation of the trigeminal foramen (Gilmore, 1920; Osborn, 1912; Russell, 1970).

The *laterosphenoid* has a clear serrated suture on the posterior border with the prootic. The suture starts directly above the exit for cranial nerve V and curves in an S-shape, traveling obliquely ventrally and anteriorly. By this same suture, the oculomotor nerve exits slightly posteriorly and higher, at the base of the pita antotica, to an opening twice as small in diameter, the trochlear. The anteriorly flattened triangular extension of the laterosphenoid rests with its serrated edge on the subjacent thickened part of the frontal. The character of their articulation with the postorbital is very interesting. In most archosaurs it is reminiscent of a joint: the laterosphenoid seems to support the postorbital ventrally with the rounded end of the ascending process. In *Alioramus*, apparently as a result of the elongation of the face, this articulation takes place on the posterior side. In the opinion of L. I. Khozatskog

(Rozhdestvensky, 1968), such a formation in crocodiles, hadrosaurs, and carnivorous dinosaurs could perform the function of amortization, softening the disturbance of the cerebrum upon the sharp closing of the jaws. This explanation does not seem very convincing. First of all, because the disturbance from the closing of the jaws on the cranium is transferred mainly through the temporal bones, whose contact with the laterosphenoid is much greater (in addition it is also immobile and serrated), down through the postorbitals, which do not participate at all in the formation of the neurocranium. This alone makes the amortization role of the laterosphenoid insignificant. Added to that, the fact that in carnosaurus “the joint” is either not very well expressed, or is displaced to the posterior edge of the postorbitals, then the possibility of amortization support in this case is even more diminished. In *Alioramus*, it is important to think it does not exist, inasmuch as the process of displacement of the ascending process reaches a higher degree of expression. But this is a carnivorous dinosaur with clearly elongated jaws, in which the manner of feeding is connected with a sharp closing of the jaws, and therefore is in greater need of amortization of the cranium, at least compared to *Hadrosaurus*. Thus it is completely logical to suppose that either the function of amortization does not appear true (only), or the method of feeding in *Alioramus* did not encourage the development of this quality. However, it is hard to imagine that the latter carries some kind of specific characters different from other carnosaurus. Apparently one should not study the above-described articulation of the laterosphenoid with the postorbital as a biomechanical type of amortization, but only as an inherited ancestral structure, possibly without a defined functional role.

The orbitosphenoid is of the subquadrate type, connected posteriorly by a serrated suture to the laterosphenoid on the side with the frontal. They were apparently in contact with one another medially. In the posterior part there is a small right-angle extension for the contact with the laterosphenoid.

The pterygoids are preserved only in the region of the contact with the pterygoid extension of the quadrate and the basipterygoid extension. Correspondingly this articulation has the character of a simple apposition, allowing the mobility of the palate relative to the cranium.

The alisphenoids (Fig. 7) are elongated, triangular with widened and weakly medially concave lower parts. They are attached by their dorsal edge to the laterosphenoid, slightly above the openings for nerves III and IV at the base of the pita antotica, and ventrally they clearly rested on the medial side of the quadrate extension of the pterygoid.

Lower jaw

Fig. 8

Maximal length 65–66 cm. It is much lower and more elongate than in other representatives of the family. The posterior side is relatively lower. The alveoli of 18 teeth have been preserved. The teeth themselves have been broken. It is only possible to note that they are narrowly oval in cross-section, and that the number of serrations does not exceed 15–17 over 5 mm.

The dentary is thin and low with two clearly expressed rows of lateral openings. The pentagonal medial dental laminae are raised approximately 1 cm above the base of the tooth crowns. A furrow for the blood vessel that supplies the teeth passes through their base. Its interpretation so far is difficult in that there is no analog in contemporary crocodiles and lizards. The entrance to the alveolar canal, containing the mandibular nerve and the inferior alveolar artery, is located at the level of the 16th tooth. Meckel’s groove begins here, exiting exactly in the middle.

The *surangular* has a relatively large posterior surangular foramen (3.5 cm long). A very small anterior surangular foramen, located at the very upper edge, appears apparently as an exit for the external mandibular artery and the cutaneous branch of the mandibular nerve. The dorsal edge of the surangular is weakly convex posteriorly and slightly concave anteriorly. The convex edge forms an attachment surface for the external head of the external adductor muscle. A crest gradually appears toward the attachment with it. As in the case of other tyrannosaurs, the surangular forms the external part of the articular cavity for the quadrate condyles.

The *angulars*, extended in length relative to their general proportions, have a feature characteristic to North American genera, that is, they reach behind the posterior edge of the posterior surangular foramen. This feature was noticed by D. A. Russell (Russell, 1970) in the generic diagnosis of four North American forms, although inasmuch as it is seen to an equal degree of development in several genera, then possibly it cannot have such a meaning.

The *splenia* is of normal type, with the exception of its greater elongation. The anterior mylohyoid foramen — the exit of the artery of the same name — is horizontally extended and positioned immediately behind the entrance to the alveolar canal on the same level.

The *prearticular* has a somewhat larger angle between its rami than in other genera.

The *articular* and *coronoid* were not preserved.

Postcranial skeleton

It is known from separate elements, which are almost undifferentiated from other representatives of the family.

The remains of the *vertebral column* include four sequential middle dorsal vertebrae. The centrum is slightly amphicoelous and oval. The diapophyses are located at the level of the articular extension and directly under an angle of 45° to the axis of the centrum and along the length of the different neural structures. Short parapophyses are located on the anterior edge of the centrum on the base of the arch. Neural processes are slightly thickened dorsally.

The *tibia* has had the shaft destroyed. The cnemial crest is moderately developed.

The preserved proximal end of the *fibula* has the shape of a half-moon in section. The process for the articulation with the tibia is low.

The *metatarsals* (Fig. 9) have had their upper halves destroyed, which does not allow reconstructing their exact length. Metatarsal III is extremely reduced, but nevertheless participates in the intertarsal articulation. In cross-section it is S-shaped. The proximal shaft surfaces of Mt II and IV are weakly concave. On the posterior surface of Mt IV remains an elongated triangular imprint of Mt V. The distal shaft has a well-developed articular cavity, besides an external one that is not fully developed in Mt IV. Mt III has the largest articular surface, which is related to the extended supportive and motile function of the middle toe. The angle of the turn is almost 90°, and of II and IV — only about 45°.

As a whole, *Alioramus* is a little larger than the skeleton of the young *Tarbosaurus* in the Paleontological Museum, No. 552/2, PIN AN SSSR and is very similar to it in the shape of the metatarsals, being differentiated from it only in the greater massiveness.

The phalanges of the first row of digits II and III are equal in length, IV — one third smaller. The dorsal surfaces of each phalanx of digits III and IV have a considerable indentation before the joint, which increases the angle of flexion. The same large claw on digit II (74 mm) is smaller on digits III and IV (55 mm), and smallest on the reduced digit I (40 mm).

CONCLUSION

Alioramus — a carnivorous dinosaur of average dimensions, which bears all the basic features of real tyrannosaurids. At the same time, it has primitive features — the elongated, low skull and the increased number of teeth. This forces us to consider *Alioramus* as a separate, deviated branch of the tyrannosaurs, not directly connected with the other remaining examples of the family. The primitive features of the genus appear possibly as a result of a somewhat different manner of life than the large carnivores. It is possible that *Alioramus* was a small and more mobile predator, hunting after relatively small animals — small forms, armored dinosaurs. At the same time it was probably difficult for it to compete with the contemporary *Tarbosaurus*, and it occupied a separate ecological niche; correspondingly it is rarely found in the same deposits.

REFERENCES

(Not included.)

FIGURE CAPTIONS

Fig. 1. *Alioramus remotus* Kurzanov, sp. nov.

Holotype — No. 3141/1, PIN; skull reconstruction; southern Mongolia, Ingenii-Khobur; Upper Cretaceous.

Fig. 2. *Alioramus remotus* Kurzanov, sp. nov.

Specimen No. 3141/1, PIN; nasals, left lateral view. Southern Mongolia, Ingenii-Khobur; Upper Cretaceous.

Fig. 3. *Alioramus remotus* Kurzanov, sp. nov.

Specimen No. 3141/1, PIN; skull, dorsal view. Bo – basioccipital, Exo – exoccipital, F – frontal, Ls – laterosphenoid, P – parietal, Po – postorbital, Qj – quadratojugal, So – supraoccipital, Sq – squamosal.

Fig. 4. *Alioramus remotus* Kurzanov, sp. nov.

Specimen No. 3141/1, PIN; upper jaw, external view; southern Mongolia, Ingenii-Khobur; Upper Cretaceous.

Fig. 5. *Alioramus remotus* Kurzanov, sp. nov.

Specimen No. 3141/1, PIN; lateral view of the skull. Mongolia, Ingenii-Khobur; Upper Cretaceous. L – lacrimal, Par – paroccipital process, Pt – pterygoid, Q – quadrate. For remaining designations, see Fig. 3.

Fig. 6. *Alioramus remotus* Kurzanov, sp. nov.

Specimen No. 3141/1, PIN; skull in posterior view; Mongolia, Ingenii-Khobur; Upper Cretaceous. Bs – basisphenoid, Fq – quadrate foramen, X – foramen for cranial nerve X. Other abbreviations as in Figs. 3 and 5.

Fig. 7. *Alioramus remotus* Kurzanov, sp. nov.

Specimen No. 3141/1, PIN; left alisphenoid in external view; Mongolia, Ingenii-Khobur; Upper Cretaceous.

Fig. 8. *Alioramus remotus* Kurzanov, sp. nov.

Specimen No. 3141/1, PIN; left lower jaw in lateral view; Ang – angular, D – dentary, Fsa – anterior surangular foramen, Fsp – posterior surangular foramen, Lb – labial foramina, Sang – surangular.

Fig. 9. *Alioramus remotus* Kurzanov, sp. nov.

Specimen No. 3141/1, PIN; left metatarsus, anterior view; Mongolia, Ingenii-Khobur; Upper Cretaceous.