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New Archosaurs from the Jurassic of Siberia and Mongolia

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Abstract—New finds of crocodiles and dinosaurs from the Late Jurassic deposits of southwestern Mongolia (Shar-Teg locality) and Eastern Siberia (basin of the Vilyui River, Teete locality) are described. A new species of small-sized running crocodiles, *Nominosuchus arcanus*, characterized by a small number of teeth is described from the Shar-Teg locality on the basis of the anterior parts of the skull. A Jurassic assemblage of dinosaurs, including *Stegosaurus* sp., sauropods resembling *Camarasaurus*, and predatory theropods, including *Allosaurus* sp., is established for the first time on the basis of the material from the Teete locality in Siberia. This corroborates the presence of the zoogeographic relationship between the North American and Siberian faunas at that time.

INTRODUCTION

New material substantially enlarging our knowledge of a variety of higher archosaurs in the Jurassic faunas of Asia was collected during the field research of the expeditionary teams of the Palaeontological Institute of the Russian Academy of Sciences late in the 1980s in the Shar-Teg locality (Mongolia) and Teete locality (Yakutia).

Shar-Teg. The Late Jurassic Shar-Teg locality situated on the southern margin of the Mongolian Altai was discovered in 1984; subsequently, it was repeatedly excavated by teams of the Joint Soviet–Mongolian Paleontological Expedition. An extensive literature is devoted to it (Efimov, 1988, 1996; Efimov *et al.*, 2000; etc.); a detailed description of the section and analysis of the fauna was given by Gubin and Sinitza (1996). As regards the structure and faunal and floral diversity, this is one of the most important and interesting localities in Asia. The flora includes charophytes, thalli of bryophytes, ferns, bennettites, equisetoids, and ginkgoaceous plants; the fauna includes such invertebrate as limulids, conchostracans (two species), ostracodes *Darwinula* (four species), *Lycopterocypris* sp., *Mantelliana* sp., *Cypridea* sp., and *Timiasevia* sp., internal casts of pelecypods, and insects (almost 800 species of more than 22 families). Vertebrates are represented by dipnoans of the genus *Ceratodus* (three species); paleoniscoids; hybodont sharks; brachyopoid labyrinthodont *Gobiops desertus*; chelonia *Annemys levensis*, *A. latiens*, and *Shartegemys laticentralis* (see Sukhanov, 2000); dinosaurs, including theropods and sauropods similar to Chinese *Mamenchisaurus*; and mammals, including the docodont *Tegotherium gubini.*

An unusual feature of the Shar-Teg locality is the great diversity of crocodiles, including *Sunosuchus shartegensis, Shartegosuchus asperopalatum, Nominosuchus matutinus, Adzhosuchus fuscus*, and a new species, *Nominosuchus arcanus*, described below. This is apparently attributable to their sizes: almost all crocodiles (except three-meter-long *Sunosuchus*) do not exceed 60–70 cm in length. Such a pattern of assemblages was marked in a number of Jurassic localities that are rich in archosaurs (e.g., in Zolengofen and Chinese localities in Sichuan), where small-sized crocodiles could occupy different ecological niches. *Sunosuchus* was an ichthyophagous and mainly aquatic animal, whereas the others led a cursorial and terrestrial mode of life and fed on arthropods and small-sized juvenile vertebrates.

SYSTEMATIC PALEONTOLOGY

Order Crocodylia Gmelin, 1788

Suborder Mesosuchia Huxley, 1875

Family Shartegosuchidae Efimov, 1988

Genus *Nominosuchus* Efimov, 1996

***Nominosuchus arcanus* Efimov et Abramov sp. nov.**

Etymology. From the Latin *arcanus* (latent).

Holotype. PIN (Paleontological Institute of the Russia Academy of Sciences), no. 4174/6, anterior region of skull; Mongolia, Gobi-Altai District, Shar-Teg locality; Late Jurassic (? Tithonian), Ulanmalgait Beds.

Description (Figs. 1a, 1b). The reconstructed skull is about 3.5 cm long, and the animal is approximately 40 cm long. The snout is short, wide, and slightly flattened. The external nares are paired. The posterior surface of the lachrymal and the anterolateral surface of the prefrontal lack sculpturing, they form facets for the articulation with a bony eyelid. The preorbital fenestrae are shaped into wide and deep depressions lowering to the jaw edge posterior to the caniniform teeth. Each depression is pierced medially by two narrow foramina of the canals extending toward the

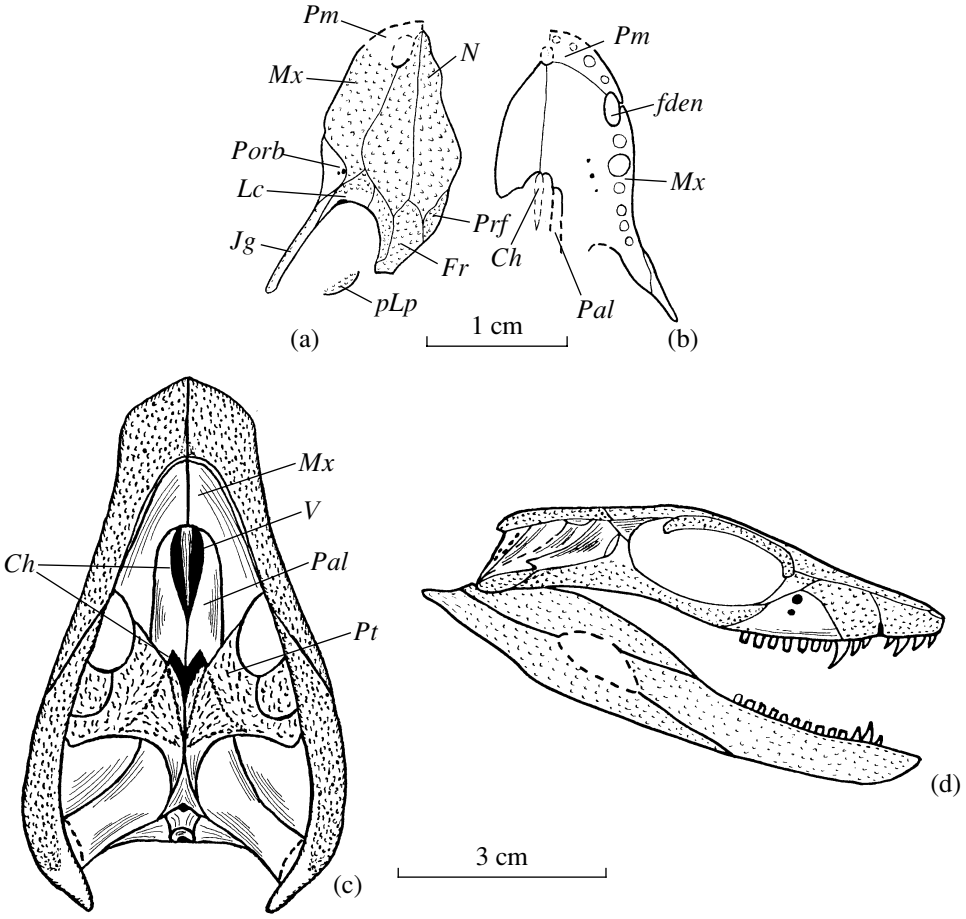

Fig. 1. *Nominosuchus*: (a, b) *N. arcanus* sp. nov., holotype PIN, no. 4174/6, anterior part of the skull: (a) dorsal and (b) ventral views; (c, d) *N. matutinus* Efimov, 1996, holotype PIN, no. 4174/4, skull with the lower jaw: (c) ventral and (d) right lateral views; Mongolia, Gobi-Altai District, Shar-Teg locality. Designations: (*Ch*) choana, (*fden*) dental fossa, (*Fr*) frontal, (*Jg*) jugal, (*Lc*) lachrymal, (*Mx*) maxilla, (*N*) nasal, (*Pal*) palatine, (*pLp*) hard palate, (*Pm*) premaxilla, (*Porb*) postorbital, (*Prf*) prefrontal, (*Pt*) pterygoid, and (*V*) vomer.

nasolachrymal duct. At this point, there was probably a reservoir–distributor, like a lachrymal sac, throwing the secretion of the salt excretory glands in the nasal cavity or directly externally at the corner of the mouth. The posterior edge of the preorbital depression is formed by the lachrymal and the anterior process of the jugal.

The anterior part of the secondary hard palate is formed by the maxilla. The choana is longitudinally extended and divided by the medially fused vomers. The lateral edges of the choana are formed by the palatines. Apparently, as in *N. matutinus* (Fig. 1c), the palatines are closed caudally to form the extention of the nasal passage and the second posterior opening of the choana. The similar structure of the palate is unknown in protosuchians and exceptionally occurs in mesosuchians of various taxonomic position, for example, *Notosuchus*, *Fruitachampsa*, and *Eutretauranosuchus* (Mook, 1967).

The premaxilla contains four teeth, the third tooth is the largest; the maxilla contains six teeth, two anterior maxillary teeth are caniniform. A noticeable diastema is present between the first and second cheek teeth. At the level of the suture between the premaxilla and maxilla, there is a deep oval fossa containing fragmentary crowns of two large lower caniniform teeth entering this fossa during the occlusion of jaws. The fossa opens laterally as a narrow vertical slit in the lower part of the premaxilla–maxilla contact.

C o m p a r i s o n. The new species differs from *N. matutinus* (Fig. 1d) (from the same locality) by its smaller size, flattened muzzle, and a smaller number of the maxillary teeth.

M a t e r i a l. Holotype.

Teete Locality. In 1960, the geologist V.F. Filatov discovered a locality containing dinosaurs at the Teete Creek (tributary of the Botomooiu River in the middle course of the Vilyui River, Yakutia). This locality is approximately 90 km southwest of the village of Nyurba and is one of the northernmost dinosaurian localities in Russia, only finds on the Kakanaut River of the Koryak Plateau occurred 0.5° further north (Nessov, 1995). The specimens (fragmentary humerus, scapula,

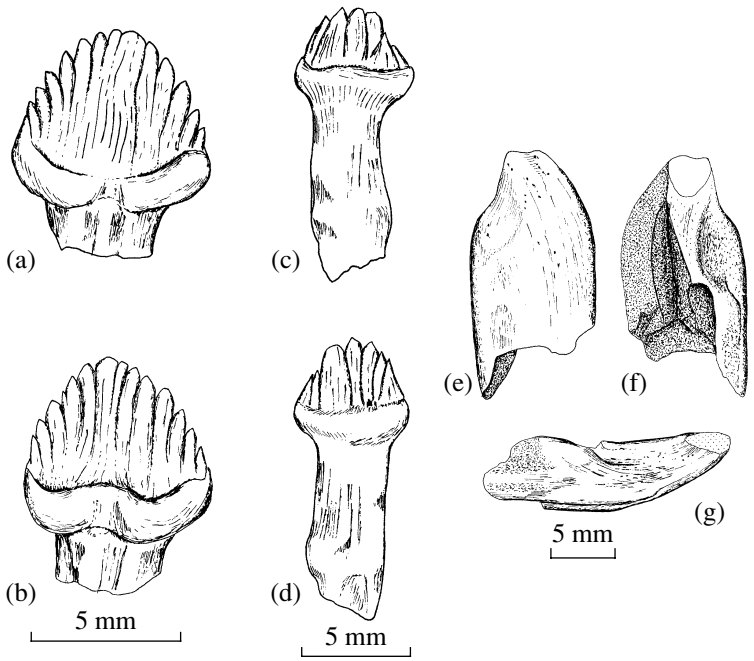

Fig. 2. Teeth of dinosaurs: (a–d) *Stegosaurus* sp., specimen PIN, nos. 4874/5 and 6; (e–g) cf. *Camarasaurus*, specimen PIN, no. 4874/7; (a, c, e) lingual surface; (b, d, f) labial surface; and (g) anterior view.

ribs, and vertebrae) from the sandy limestones referred to as the Sangarian Group were dated to the Neocomian, and a preliminary study showed that the bones probably belong to ankylosaurs (Rozhdestvenskii, 1973).

A joint expedition of the PIN (Moscow) and the Institute of Geology (Yakutsk) worked at this locality in 1988. The specimens were collected in two outcrops of the bone beds exposed as isolated spots along the entire extent of the Botomooiu River and its tribytary, the Teete Creek over about 1000 km^2. The collected bone specimens allowed us to draw new conclusions concerning the taxonomic composition of dinosaurs and the age of the host rocks. The inaccuracy of the previous determinations is accounted for by poor preservation and the small number of bones collected by geologists.

All finds come from two small outcrops (up to 15 m long) on the right bank of the Teete Creek approximately 1.8 km upstream of its mouth. The locality is composed of sand and calcareous sandstones more than 10 m thick of the lacustrine alluvial genesis (Kurzanov *et al.*, 2000).

Specimens of excellent preservation occur in the upper part of the section. The teeth of theropods, sauropods, and stegosaurs; fragmentary vertebrae and ribs; and remains of small-sized reptiles were collected there.

The maxillary teeth of *Stegosaurus* sp. (PIN, nos. 4874/5, 6; Figs. 2a–2d) have a slightly asymmetric spatular triangular crown and cylindrical root. The crown is slightly concave lingually and is convex labially. In the basal part, the crown forms a well-developed convex protrusion (cingulum); the anterior and posterior segments of the cingulum are rectangular; on the lingual side, the cingulum is thicker than on the labial side. Either side of the crown is covered by ribs. The marginal ribs are relatively large and reach the cingulum, as do the narrow medial ribs. The upper edge of the crown is denticulated (12–13 denticles). Similar to the ribs, the marginal denticles are larger than the central denticles. Almost all ribs bear a complex network of secondary ribs. It should be noted that the majority of teeth are strongly worn.

A neural spine (collected in 1960) probably belonging to a middle thoracic vertebra of *Stegosaurus* sp. is characterized by a wide spinous process and the parapophyses positioned high at the base of the transverse processes. The anterior articular processes are almost horizontal. The caudal vertebra of a stegosaur is most likely from the middle region of the tail. Its centrum is subsquare, with a clearly oblique posteroventral edge marking the attachment area for the chevron. The teeth and vertebrae are similar to those of *Stegosaurus* from the Morrison Formation, Kimmeridgian–Tithonian (Gilmore, 1914; Galton, 1990).

In the humerus and scapula collected by Filatov, the epiphyses are not preserved; they could belong to either ankylosaurs or a stegosaurs.

Two maxillary teeth of a sauropod, cf. *Camarasaurus* (PIN, no. 4874/7; Figs. 2e–2g) found in the locality are characterized by an asymmetric spoon-shaped crown with a concave posterior edge in their upper third. Lingually, the upper half of the crown is concave

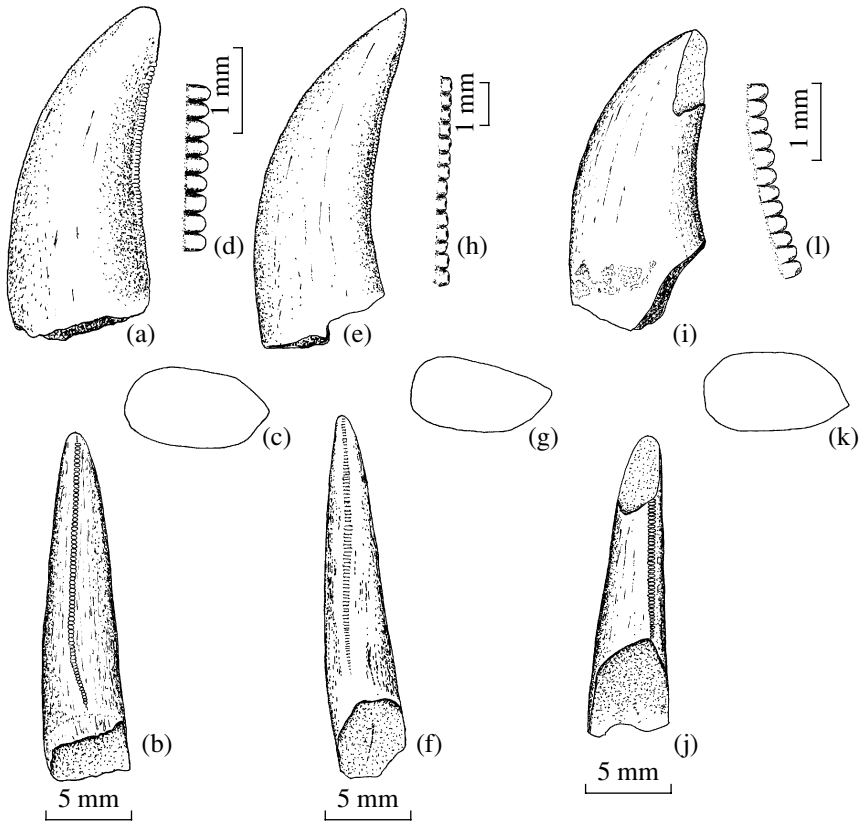

Fig. 3. Teeth of theropods: (a–h) Coelurosauria fam. indet., specimen PIN, nos. 4874/3 and 4; (i–l) *Allosaurus* sp., specimen PIN, no. 4874/2; (a, e, i) labial surface; (b, f, j) posterior view; (c, g, k) cross section at the basis; and (d, h, l) serration on the posterior edge.

and projects in the central part. The crown is convex labially. The teeth are similar in these features to the teeth of *Camarosaurus* from the Morrison Formation of North America (McIntosh, 1990) and differ by the absence of serration. A more precise identification of the teeth is impossible because of poor preservation.

Eleven isolated teeth of theropods probably belonging to two genera were found. The first type (five specimens, PIN, nos. 4874/1, 3, 4; Figs. 3a–3h), determined as Coelurosauria fam. indet. comprises small-sized and laterally compressed teeth oval in cross section and considerably curved posteriorly. The anterior edge of their crown is rounded, the posterior edge is sharpened. Small-sized and almost triangular denticles (approximately 4–5 per 1 mm) are well developed along the posterior edge and displaced labially to the ventral end. A characteristic feature of the teeth investigated is the presence of denticles on the anterior edge of the crown as well. They are approximately half as large as the denticles at the posterior edge and developed only in the upper third of the crown. This type is closely similar to isolated teeth from the Kimmeridgian–Tithonian deposits of the Tendaguru Formation of Tanzania. Janensch (1925) proposed that these teeth could belong to *Elaphrosaurus*, postcranial remains of which were previously described from this area; however, skull has not yet been found. Therefore, according to Barsbold and Osmólska (1990), the assignment of the teeth from Tanzanian to this genus is doubtful. Anyway, independently of the generic attribution of the teeth, the similarity between specimens from Yakutia and Tanzania is obvious.

The teeth of the second type identified as *Allosaurus* sp., (six specimens; PIN, no. 4874/2; Figs. 3i, 3j) are of the same size class (1–1.5 cm) and approximately the same shape; however, they are rounder in cross section and serration is developed only in the posterior edge of the crown. Teeth of similar structure from the Upper Jurassic Kirkwood Formation of South Africa were identified as Theropoda indet. (Rich *et al.*, 1983) and those from the Morrison and Tendaguru formations were assigned to *Labrosaurus sulcatus* and *L. stechowi*, respectively (Janench, 1925; Marsh, 1879, 1896). At present, the generic name *Labrosaurus* is usually considered to be a junior synonym of *Allosaurus* (Norman, 1990).

The above data enable one to evaluate the taxonomic diversity of the Yakutian Dinosaur Assemblage and its geological age. The presence of ankylosaurs in this assemblage has not been corroborated, although it is impossible to exclude this with certainty. Despite the somewhat different proportions of the species involved,

the Teete Faunal Assemblage, including Jurassic sauropods and theropods and, especially, the genus *Stegosaurus*, could be considered to be similar to the dinosaur assemblage from the Morrison Formation of North America and dated as the Upper Jurassic rather that the Lower Cretaceous. Taking into account the fact that the Sangarian Series is dated as the Neocomian, one can propose that the section of the Teete locality is lower and should be referred to as the Djaskoian Formation (Lower Callovian–Oxfordian). The new assemblage is similar to the Upper Jurassic Fauna from the Tendaguru Formation (East Africa) Norman, in the presence of teeth determined here as Coelurosauria fam. indet.; at the same time, it is distinguished from the latter fauna (as well as from the Upper Jurassic fauna of China [Dong, 1995]) by the presence of the genus *Stegosaurus*.

The most numerous elements of the Teete Dinosaurian Fauna are medium-sized theropods and stegosaurs. This is rather surprising, since in similar faunas from North America and East and South Africa, they, (especially, stegosaurs) are extremely scarce, whereas the dominant position is occupied by large sauropods. In the Teete locality, sauropods are represented by only two teeth of poor preservation. Apparently, this is associated with the conditions of the oryctogenesis. The bones from the localities investigated are disarticulated and isolated. A significant part of them is damaged; however, they are only slightly rounded. Probably, the burial occurred in a small and quiet backwater where the bones were accumulated after a long transport rather than in the riverbed alluvium. According to paleogeographic data, the region under study in the Late Jurassic Time was located on the lake–alluvial plain on the western coast of the Lena Sea, which occupied a large part of Eastern Siberia (Ivanov, 1988).

The bones of crocodiles (Shar-Teg locality) and dinosaurs (Teete locality, collected in 1988) described above are housed at the Palaeontological Institute of the Russian Academy of Sciences (collection nos. 4174 and 4874, respectively). The place of storage of specimens collected by Filatov (Teete, 1960) is currently unknown.

ACKNOWLEDGMENTS

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REFERENCES

Barsbold, R. and Osmólska, H., Ornithomimosauria, *The Dinosauria*, Weishampel, D.B., Dodson, P., and Osmólska, H., Eds., Berkeley: Univ. California Press, 1990, pp. 280–305.

Dong, Z., The Dinosaur Complexes of China and Their Biochronology, *Sixth Symposium Mesozoic Terrestrial Ecosystems and Biota, Short Papers*, China: Ocean Press, 1995, pp. 91–96.

Efimov, M.B., Fossil Crocodiles and Champsosaurs from Mongolia and USSR, *Tr. Sovm. Sov.–Mongol. Paleontol. Eksped.* (Moscow), 1988, vol. 36, pp. 1–112.

Efimov, M.B., The Jurassic Crocodylomorphs of Inner Asia, *Bull. Mus. N. Arizona*, 1996, vol. 60 (The Continental Jurassic, Morales, M., Ed.), pp. 305–310.

Efimov, M.B., Gubin, Yu.M., and Kurzanov, S.M., New Primitive Crocodile (Crocodylomorpha: Shartegosuchidae) from the Jurassic of Mongolia, *Paleontol. Zh.*, 2000, vol. 34, suppl. 2, pp. 238–241.

Galton, P.M., Stegosauria, *The Dinosauria*, Weishampel, D.B., Dodson, P., and Osmólska, H., Eds., Berkeley: Univ. California Press, 1990, pp. 435–455.

Gilmore, C., Osteology of the Armored Dinosauria in the United States National Museum, with Special Reference to the Genus *Stegosaurus*, *Bull. US Nat. Mus.*, 1914, vol. 89, pp. 1–136.

Gubin, Y.M. and Sinitza, S.M., Shar Teg: A Unique Mesozoic Locality of Asia, *Bull. Mus. N. Arizona*, 1996, vol. 60 (The Continental Jurassic, Morales, M., Ed.), pp. 311–318.

Ivanov, N.V., Mesozoic Lakes in the North of Eastern Siberia, in *Istoriya ozer pozdnego mezozoya i kainozoya* (History of Lakes in the Late Mesozoic and Cenozoic), Martinson, G.G., Ed., Leningrad: Nauka, 1988, pp. 90–97.

Janensch, W., Die Coelurosaurier und Theropoden der Tendaguru-Schichten Deutsch-Ostafrikas, *Palaeontographica*, 1925, suppl. 7, pp. 1–99.

Kurzanov, S.M., Efimov, M.B., and Gubin, Yu.M., Dinosaurs from Yakutia, *Materialy regional'noi konferentsii geologov Sibiri, Dal'nego Vostoka i Severo-Vostoka Rossii* (Mat. of Regional Conf. of Geologists of Siberia, Far East, and Northeast of Russia), Tomsk, 2000, vol. 2, pp. 356–357.

Marsh, O.C., Principal Characters of American Jurassic Dinosaurs, *Am. J. Sci. Arts*, 1879, vol. 17, no. 97, pp. 86–92.

Marsh, O.C., The Dinosaurs of North America, *16th Ann. Rep. US Geol. Surv.*, 1896, pp. 133–244.

McIntoch, J., Sauropoda, *The Dinosauria*, Weishampel, D.B., Dodson, P., and Osmólska, H., Eds., Berkeley: Univ. California Press, 1990, pp. 345–401.

Mook, C.C., Preliminary Description of a New Goniopholid Crocodilian, *Kirtlandia*, 1967, no. 2, pp. 1–10.

Nessov, L.A., *Dinozavry Severnoi Evrazii: Novye dannye o sostave kompleksov, ekologii i paleobiogeografii* (Dinosaurs of Northern Eurasia: New Data on the Composition of Assemblages, Ecology, and Paleobiogeography), St. Petersburg: Sankt-Peterb. Gos. Univ., 1995.

Norman, D.B., Problematic Theropoda *"Coelurosaurus"*, *The Dinosauria*, Weishampel, D.B., Dodson, P., and Osmólska, H., Eds., Berkeley: Univ. California Press, 1990, pp. 280–305.

Rich, T., Molnar, R., and Rich, P.V., Fossil Vertebrates from the Late Jurassic or Early Cretaceous Kirkwood Formation, Algoa Basin, Southern Africa, *Trans. Geol. Soc. S. Afr.*, 1983, vol. 86, pp. 281–291.

Rozhdestvenskii, A.A., The Study of Cretaceous Reptiles in Russia, *Paleontol. Zh.*, 1973, no. 2, pp. 90–99.

Sukhanov, V.B., Mesozoic Turtles of Middle and Central Asia, *The Age of Dinosaurs in Russia and Mongolia*, Benton, M. *et al.*, Eds., Cambridge: Univ. Press, 2000, pp. 309–367.