

Box 2: Description of *Stygivenator*

Linnaean hierarchy:

Paraclass Reptilia

Parasubclass Diapsida

Parainfraclass Archosauria

Parasuperorder Theropodomorpha

Paraorder Theropoda

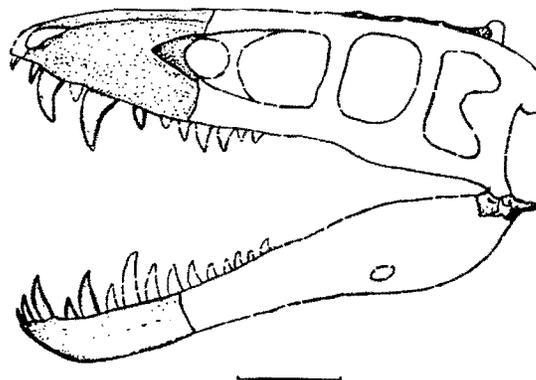
Suborder Tyrannosauria nov.

Family Tyrannosauridae

Subfamily Shanshanosaurinae nov.

Genus *Stygivenator* nov.

Type species *Stygivenator molnari* (Paul, 1988) n. comb.



Synonyms:

"Jordan theropod" of Molnar, 1978

Aublysodon molnaris Paul, 1988 [sic]

Aublysodon molnari Paul, 1989

Etymology: *Stygi-*, Latinized combining form of Styx, one of the three rivers of Hades, the underworld of Greek mythology, referring to the Hell Creek Formation, in which the type specimen was discovered; and *-venator*, combining form of *venator*, Latin for "hunter"; thus, "Hell Creek hunter"

Holotype specimen of type species: LACM 28471 (figure above by Tracy Lee Ford, view of left side of reconstructed skull; scale bar = 10 cm), associated skull material including the anterior portions of nasals and maxillae with teeth, a premaxillary tooth, incomplete left and right frontals and parietals, fragment of surangular including the jaw joint, and anterior portions of both dentaries with teeth. Presently at the Los Angeles County Museum of Natural History. The individual may have been subadult or even juvenile. An endocranial mold has been prepared from the specimen.

Type locality and horizon: Dark gray clay of the Hell Creek Formation on the Lester D. Engdahl ranch (not, as originally noted, the F. S. McKeever ranch) near Jordan, Garfield County, Montana, USA, near a large ceratopid skull (probably *Triceratops*). Discovered in the summer of 1966 by Harley Garbani, on a Los Angeles County Museum expedition to Jordan under the direction of J. Reed MacDonald.

Diagnosis: *Stygivenessator* is a shanshanosaurine genus characterized by several very long anterior maxillary and dentary teeth. The height of the largest anterior maxillary tooth equals or even surpasses the depth of the dentary at its location, so that were the jaws to close completely, the tips of the anterior maxillary teeth would extend slightly below the ventral margin of the snout. Anterior premaxillary tooth is considerably narrower in lateral view than the lectotype tooth of *Aublysodon mirandus* (see figure below) and somewhat smaller, precluding reference to that doubtful species.



The tooth row of the anterior portion of the dentary, including the first three dentary teeth, is elevated above the level of the remainder of the tooth row, and the anterior dentary teeth are procumbent.

Left: Premaxillary tooth of *Stygivenessator molnari*, from Molnar, 1978, left lateral and posterior views, about twice life size. **Right:** Lectotype tooth of *Aublysodon mirandus*, from Leidy, 1860, left lateral and posterior views, slightly smaller than life size.

Referred specimens: None

Referred species:

?*Stygivenator amplus* (Marsh, 1892) n. comb., formerly *Aublysodon amplus* Marsh, 1892 (= *Deinodon amplus*, *Manospondylus amplus*, and *Tyrannosaurus amplus*) and ?*Stygivenator cristatus* (Marsh, 1892) n. comb., formerly *Aublysodon cristatus* Marsh, 1892 (= *Deinodon cristatus*). See text for details.

Discussion: Since *Stygivenator* is so strikingly different from other tyrannosaurids, it is first necessary to justify its inclusion in Tyrannosauridae. Naturally, *Stygivenator* differs strongly enough from the "orthodox" tyrannosaurids that at least subfamilial separation is warranted. But the smooth, constricted nasals; low, pointed maxillae; long frontals; unserrated D-sectioned premaxillary tooth; relatively slender dentary; and lateral buttress above the surangular foramen are a combination of characters present in *Stygivenator* that are diagnostic of the tyrannosaurid parasubfamily Shanshanosaurinae (= Aublysodontidae [*nomen dubium*] of authors). The surangular buttress and morphology of the articulation point of the dentary in particular are quite similar to that of *Shanshanosaurus huoyanshanensis*. *Stygivenator* is thus best viewed as a highly derived, late-occurring member of that taxon.

Most of the diagnostic characters may be found in the description of this genus (as the "Jordan theropod" and as *Aublysodon*) by Molnar (1978) and Molnar & Carpenter (1989). The specimen was personally examined by the author on a visit to the University of California at Berkeley Museum of Paleontology in the early 1980s, when the specimen was on loan to that institution.

Box 3: Description of *Dinotyrannus*

Linnaean hierarchy:

Paraclass Reptilia

Parasubclass Diapsida

Parainfraclass Archosauria

Parasuperorder Theropodomorpha

Paraorder Theropoda

Suborder Tyrannosauria nov.

Family Tyrannosauridae

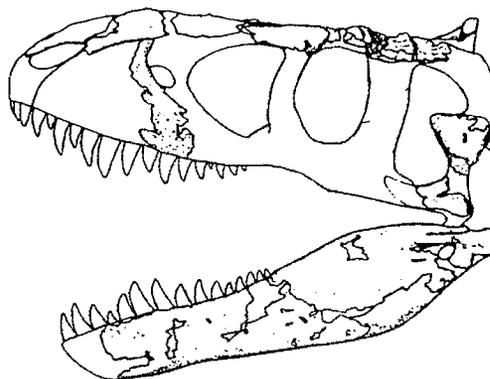
Subfamily Tyrannosaurinae

Tribe Tyrannosaurini nov.

Genus *Dinotyrannus* nov.

Type species *Dinotyrannus megagracilis*

(Paul, 1988) n. comb.



Synonyms of type species:

Albertosaurus megagracilis Paul, 1988

Etymology: *Dino-*, Latinized combining form of *deinos*, Greek for “terrible,” and *-tyrannus*, Latinized combining form of *tyrannos*, Greek for “tyrant,” “master,” or “despot”; thus, “terrible tyrant,” referring to its obvious carnivorous nature as well as to its close phyletic relationship to the genera *Nanotyrannus* and *Tyrannosaurus*.

Holotype specimen of type species: LACM 23845 (figure above by Tracy Lee Ford, view of right side of reconstructed skull, reversed), a partial skeleton including scattered skull and jaw elements (portions of nasals, maxillae, right lacrimal, prefrontals, frontals, partial parietal, supraoccipital, pterygoids, partial quadratojugals, partial right dentary, incomplete angulars and prearticulars, nearly complete right surangular, partial left surangular) and limb bones (left ulna, metacarpal II, manual ungual, partial left femur and tibia, complete right fibula, right astragalus, right metatarsals II and III, and 11 pedal phalanges), found in association and presumably belonging to the same individual. Presently at the Los Angeles County Museum of Natural History. The looseness of the articulations of the skull bones strongly suggest the holotype individual was subadult.

Type locality and horizon: Hell Creek Formation, on the Lester D. Engdahl ranch near Jordan, Garfield County, Montana, USA. Discovered in 1967 by a Los Angeles County Museum field party under the direction of J. Reed MacDonald.

Diagnosis: The genus *Dinotyrannus*, with an adult body length estimated at 11–12 meters, differs from all albertosaurinids (members of the paratribe Albertosaurini), such as *Albertosaurus*, in lacking a lacrimal “horn”; that is, the lacrimal dorsal margin is more or less level with the dorsal surface of the skull. This character bars it from Albertosaurini and strongly supports inclusion in the tribe Tyrannosaurini (or paratribe Tarbosaurini). Nasals markedly downturned in front (giving a convex dorsal profile to the muzzle reminiscent of AMNH 5336 and USNM 12814, skulls perhaps wrongly referred to *Gorgosaurus*, and some specimens of *Tarbosaurus efremovi*). Nasals less constricted at junction with frontals than in either *Nanotyrannus* or *Tyrannosaurus*, precluding reference to either of those genera. Contact between frontal and prefrontal less angular in dorsal aspect than in *Tyrannosaurus*. Broadened posterior region of frontals suggests the occiput was expanded and the eyes somewhat forwardly directed, though not to the extent seen in *Nanotyrannus* and *Tyrannosaurus*. As noted by Molnar (1980), the frontal has a distinctly different shape from that of *Tyrannosaurus*. Dorsal orbital margin with wide gap between lacrimal and postorbital for frontal, but this may be due to juvenility of the specimen. Medial shelf on ventral margin of posteroventral process of dentary absent (unlike in *Tyrannosaurus*).

Ulna straight and untapered, without strong olecranon process; it differs in these characters from those of other North American tyrannosaurids. Manual ungual phalanx without proximal tendon tubercle and with angular rather than arcuate articular surface, differing from all other tyrannosaurids in this combination of characters. Forelimb quite short relative to hind limb, perhaps due more to relative elongation of hind limb than to forelimb reduction.

General hind-limb proportions large but relatively slenderer than in an albertosaurinid of comparable size. Hind limb relatively longer than in any albertosaurinids or *Tyrannosaurus*. Tibia triangular in proximal view, unlike that of albertosaurinids, which is quadrangular in proximal view. Cnemial crest of tibia prominent and extends more laterally than in other tyrannosaurids except *Maleevosaurus novojilovi*, which otherwise does not seem closely related to this form. The slenderness and length of the hind limb suggest that *Dinotyrannus* had a lighter weight and more gracile body proportions for its size than albertosaurinids or *Tyrannosaurus*, hence the trivial name *megagracilis* given to the type species by Paul.

Referred specimens: None.

Referred species: None.

Discussion: Though clearly different from the other two Lance tyrannosaurids, *Dinotyrannus* remains difficult to diagnose because of the scantiness of the holotype material and the lack of any referred specimens. The limb bones and other material at the Smithsonian Institution (USNM 2110, 6183, and 8064: see Gilmore [1920]) from the Lance Formation presently referred to *Tyrannosaurus rex* should be reexamined and compared with the holotype limb elements to see whether they might be better referred to *Dinotyrannus*. It is also difficult to classify *Dinotyrannus* at the level of tribe; it could be either a derived tarbosaurinid or a primitive tyrannosaurinid. It is more plausible to find a tyrannosaurinid in the Lance of western North America than a tarbosaurinid, so *Dinotyrannus* is considered a primitive member of the tribe Tyrannosaurini. Inasmuch as the only other evidence for an *Albertosaurus*-size tyrannosaurid in the latest Maastrichtian of North America, besides the *Dinotyrannus* type material, lies in isolated teeth and indeterminate skeletal elements, such material should more properly be referred to the genus *Dinotyrannus* as *Dinotyrannus* sp. or *Dinotyrannus* cf. *D. megagracilis* instead of to *Albertosaurus*. As far as is known, no member of paratribe Albertosaurini survived in that epoch in North America.

Most of the diagnosis was distilled from the published descriptions of the holotype specimen by Ralph E. Molnar (1980) and Paul (1988). Molnar also provided unpublished drawings of some *Dinotyrannus* skull elements for this review, and his contribution is most gratefully acknowledged.