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A NEW DINOCEPHALIAN FROM THE CISURALIAN REGION (REPTILIA, THERAPSIDA; UPPER PERMIAN)

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ABSTRACT

A new genus and species of dinocephalian is described, based on a skull, teeth, and lower jaw fragment from the Upper Permian of south Cisuralian U.S.S.R. The new dinocephalian belongs to a group of carnivorous brithopodids which are widespread in the Cisuralian region. On the basis of morphological characteristics it is concluded that the new genus is closely related to *Syodon* and *Titanophoneus,* representatives of one of the late stages of development of the dinocephalian faunas of the U.S.S.R.

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Introduction

In the spring of 1963 A. K. Gusev, Senior Scientist at the University of Kazan, transmitted to the Paleontological Institute of the Academy of Sciences of the USSR the remains of vertebrates from three localities north-northwest of Aktyubinsk. In one of these localities was found the skull and teeth of a carnivorous dinocephalian. In addition to this, the author had at his disposal a lower jaw fragment, also of a large carnivorous dinocephalian, which had previously been sent to the Paleontological Institute from the University of Saratov by V. G. Ochev from the Permian deposits in the Orenburg oblast.

The skull and teeth from the Zhaksy-Karagala River bank near Aktyubinsk belong to a carnivorous dinocephalian of the Brithopodidae, representatives of which are fairly common in the more northern parts of the western Cisuralian region. Study of these remains has shown that they belong to a new genus closely related to the genus *Syodon,* which is well known in the dinocephalian fauna of the area of the village of Isheyevo (Middle Volga). Interestingly enough, some aspects of the skull structure (its large size, the borders of the temporal cavity, the massiveness of the zygomatic and the postorbital arches, the development of a parietal protuberance stronger than that of *Syodon,* and the development of a separate shoulder on the lingual sides of the precanine teeth) may be suggestive of specializations characteristic of a later geologic age. But in this instance the time interval between the faunas of these localities, if there was one, cannot have been very long. Thus, according to the preliminary data, the fauna of the Zhaksy-Karagala locality is a later grouping of the Isheyevo type and marks the southern limit of the geographic range of the Cisuralian dinocephalian fauna. (See section on Geology, below).

Study of the lower jaw fragment of the carnivorous dinocephalian from the Orenburg region has shown that it belongs to a late brithopodid fauna of the Isheyevo type, whose Early Tatarian age is accepted by most investigators. The morphological features of the lower jaw structure (its size, its general massiveness, and the small number of marginal teeth) indicate that it belongs to the same genus as the Aktyubinsk brithopodid from the Zhaksy-Karagala locality and that these two localities are of the same age. The discrepancy between the systematic position

of the remains from the Donguz locality and their stratigraphic position in the Upper Tatarian substage is due, in Ochev's opinion, to their redeposition after the erosion of the Lower Tatarian deposits. In my view, this discrepancy may be owing in equal measure to incorrect correlation of the local stratigraphic section with the Malyy Kinel' or the Northern Dvina suites, which are characterized by a Late Tatarian faunal assemblage.

The discovery of Permian vertebrates in the Orenburg-Aktyubinsk area of the Cisuralian region opens up new prospects for paleontological explorations and excavations and is of considerable interest for stratigraphy and correlation, since the localities in the Aktyubinsk area are evidently of the same age and together embrace a large interval of the Upper Permian section corresponding to the time during which the dinocephalian fauna was in existence. Efremov and V'yushkov (1955) also mention the discovery of vertebrates in the Lower Permian deposits of the Sogur-Say ravine (Tabantal River) south of Aktyubinsk. But these authors' conclusion regarding their age now seems doubtful, inasmuch as the finds were lost before they could be studied in detail, and the lithologically similar sandstone and conglomerate deposits with limestone gravels and algal nodules along the Tabantal River in the vicinity of the village of Kyzyl-Tu have been considered by Gusev to be part of the Blagodarnoye suite.

Description of New Genus

SUBORDER DINOCEPHALIA

Family Brithopodidae Efremov, 1954

Genus ***Notosyodon***, gen. n.

The generic name is derived from that of the existing genus *Syodon* and the Greek word *Notos*, "south wind."

TYPE SPECIES: *N. gusevi* sp. n.

SPECIES INCLUDED: The type species only.

DIAGNOSIS: Medium-sized, carnivorous, possibly omnivorous, dinocephalian with a massive, heavy skull. The orbits are large, slightly oval in shape longitudinally, and almost vertical. The edge of the orbits are thickened. The preorbital area has a step-like bend between the dorsal and the lateral sides of the roof of the skull.

The temporal cavities are large and converge sharply in the dorsomedial area. The zygomatic arch is high. The roof of the skull is very thick in the interorbital and the parietal areas. The interorbital portion is flat and straight and lacks a median ridge. The frontals do not enter into the formation of the transverse crests which border the anterodorsal sections of the temporal cavities. The parietal foramen is large and slightly oval longitudinally and is not surrounded by a bony ridge. The parietal boss is high and unusually massive. The upper part of the occipital region is considerably inclined downward and rearward. The posterior branches of the pterygoid are long and narrow. The ventral and dorsal surfaces of the basisphenoid are thoroughly ossified, and its posterior portion is wide, high, and massive. The occipital condyle is very large. The lower jaw is high and has a massive symphysis and a small number of teeth. The dental formula of the lower jaw is I4 C1 PC6.

COMPARISON WITH RELATED GENERA: In its general overall configuration, the position of its orbits and its temporal cavities, the skull of *Notosyodon* very strongly resembles that of *Syodon,* from which it differs, however, in its considerably larger size and the much greater massiveness of its component elements. In addition, the new genus differs in the following: the interorbital part of the skull is wide and straight and lacks a sagittal crest; the edges of the orbits are wide and thickened along their whole perimeter; the parietal boss and the occipital condyle are unusually large; the occipital region is relatively narrow and the upper part of the occiput is strongly slanted upward and forward; the posterior rami of the pterygoids diverge at a small angle and the basisphenoid, whose posterior section is very high and wide, is well ossified.

These characteristics also distinguish the new genus from another similar and closely related genus, *Titanophoneus,* which despite its large size differs from *Notosyodon* in its elongated skull, its almost vertical temporal cavities, and the structure of the dorsal surface of the pterygoids. In the thick roof of its skull, the borders of its parietal boss, and the upper parts of its temporal cavities *Notosyodon* closely resembles the genus *Doliosauriscus,* which was described by Orlov (1958). It should be noted, however, that the range of the remaining differences between these two genera is much wider than between the new genus on the one hand and

Syodon and *Titanophoneus* on the other. In a number of characters (thickness of the parietal area, the massiveness of the skull, the structure of the precanine teeth and others) the new genus is close to an earlier representative of the same family, the genus *Archaeosyodon.* But here, too, the new genus shows significant differences in the hypertrophied parietal boss, the basisphenoid area and the occipital condyle.

Notosyodon, in contrast to the other known brithopodids, is also characterized by a smaller number of marginal teeth; this, like the general massiveness of the skull and its much greater degree of ossification, is probably a sign of its later geologic age.

The morphology of *Notosyodon* shows that the later brithopodids included not only light and highly mobile predators (like *Syodon* and *Titanophoneus*) and gigantic predators who represent the so-called titanosuchian adaptation *(Doliosauriscus, Admetophoneus),* but also moderate sized, heavily built and relatively non-mobile, possibly omnivorous dinocephalians such as *Notosyodon.*

Description of New Species

Notosyodon gusevi, sp. n.

HOLOTYPE: PIN No. 2505 1, Paleontological Institute collection, Academy of Sciences of the U.S.S.R., Moscow.

The preorbital part of the skull anterior to the transverse processes of the pterygoids are not preserved (fig. 1). The interorbital and a small part of the preorbital areas with a stepwise curvature between the dorsal and the lateral surfaces of the skull roof are represented by an internal mold with impressions of the frontals and the prefrontals. The base of the skull with the occipital condyle and the posterior rami of the pterygoids are well preserved. The skull is slightly deformed dorsoventrally and laterally in such a manner that the anterior part of the base of the skull is somewhat displaced to the right. The brain case is not fully preserved and lacks the sphenethmoid.

JUGALS: The anterior portion of the zygomatic arch and its contact with the lacrimal and the maxillae have been lost, but on the internal surface, at the level of the anterior edge of the orbit, there is a small fragment of the lacrimal, which lies like a scale upon the jugal. Directly below the contact with the lacrimal, the jugal

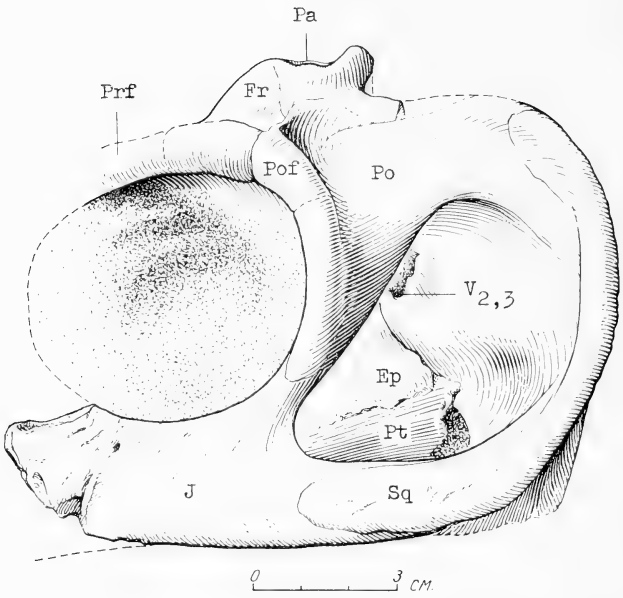

FIG. 1. *Notosyodon gusevi*, gen. et sp. n. PIN 2505/1 (holotype). Left side of skull.

gives rise to a anteriorly directed projection which fits behind the inner edge of the mandible. The jugal is high and has a thickened orbital edge. Its postorbital process is covered to a considerable extent on the outside by the postorbital. The jugal is completely covered laterally by the anterior process of the squamosal but, to judge from its length, reached as far back as in the typical brithopodids.

PREFRONTALS: Impressions on the internal mold show that these bones occupied the usual brithopodid position, but differed in their somewhat thicker orbital edges. At the boundary with the nasals they took part in the formation of the nasoturbinal crest.

FRONTALS: Their anterior portions are narrow and show the maximal thickness along the sagittal suture. The orbital edge is

wide but thinner. There is no median longitudinal crest on the dorsal side; the ventral side preserves the usual shallow groove bordered by ridges along its sides. They grade forward without any separation into the nasoturbinal ridge of the nasals; in the posterior portion they are less distinct and join the lateral wall of the brain case at the anterior edge of the sphenethmoid. The boundary between the braincase and the sphenethmoid is at the level of the dorsal suture of the prefrontals. The dorsal surfaces of the frontals along the suture with the postfrontals are smooth and, in contrast to *Syodon* and *Titanophoneus,* have no transverse ridges bordering the anterodorsal areas of the temporal cavities. From the level of the posterior edge of the orbit to the contact with the parietal, the frontal descends smoothly and steeply, becoming twice as thick, and contributes to the formation of the massive parietal boss.

POSTFRONTALS: These bones are small in size and fairly narrow, reaching their greatest width and thickness at the orbital rim. The postfrontal has a sharp transverse ridge which runs medially from the edge of the orbit and then bends smoothly to the rear, disappearing at the contact with the parietal bone. Posterior to this contact the postfrontal overlaps the parietal, forming part of the perpendicular wall of the parietal boss, and outlines the mediodorsal boundary of the temporal cavity.

PARIETALS: These small but very thick and massive bones make up the greater part of the high parietal boss. The anterior slope of the boss descends quite steeply and merges smoothly into the roof of the skull; the posterior slope is vertical above the posterior surface of the occiput. The parietal boss lacks the bony ridge that is possessed by the majority of representatives of this family. The parietal foramen is large and slightly oval longitudinally.

POSTORBITALS: These very massive and large bones overlap the postfrontals and the parietals in the upper part of the temporal cavity.

INTERPARIETAL: Not fully preserved. Its lateral parts are thin and plate-like; the upper lateral part overlaps the parietal bone and the lower part of the interparietal covers the edge of the supraoccipital. The interparietal was evidently not greatly thickened in the area of the sagittal crest. In any case, the formation of the

upper part of this crest on the occipital surface involves the posterior parts of the parietals, which are also wedged into the interparietal in the form of a crest; the lower part of this crest is to a considerable extent formed by the ascending process of the supraoccipital. A fracture in the bone has exposed the contact of the interparietal with the prootic along the lower parts of the sides of the sagittal crest.

TABULARS: These have been preserved in the area of the lateral occipital crest, where they partially cover the posterior surface of the lateral processes of the parietals and also the postorbitals. In the lower occipital area they combine wih the squamosals to form a continuation of the lateral occipital crest which commonly occurs in the brithopodids.

SQUAMOSALS: These large bones are markedly thickened along the posterior edge of the temporal cavity. This posterior edge repeats the line of the curvature of the posterior wall of the orbit. In the upper portion, along the lateral occipital crest, they overlap the postorbitals for a considerable distance. The jugal process of the squamosal, which is equal in height to the squamosal process on the jugal, almost completely overlaps the latter and terminates at the level of the inner edge of the posterior wall of the orbit. From the lower posterior angle of the temporal cavity the squamosal, which here becomes much thicker, grades smoothly into the occipital surface, where it is bordered at the contact with the tabular by the lateral occipital crest. The boundary of the squamosal in the temporal cavity and its contacts with the quadrate complex are unclear. The occipital surface of the squamosal along the edge of the temporal cavity has rough corrugations.

PTERYGOIDS: The massive flanks of the transverse processes reach their greatest height laterally and are oriented mainly perpendicular to the axial line of the skull (fig. 2). The lower lateral parts of the transverse processes are slightly curved downward and backward. The medial part of the pterygoids directly behind the transverse processes give rise to posteriorly projecting, converging crests which form a double ventral keel on the ventral surface in front of the basisphenoid (fig. 2b). On the dorsal side (fig. 2a) lateral to the sagittal axis, the pterygoid forms two thin longitudinal septa which have wide bases and are inclined forward and upward.

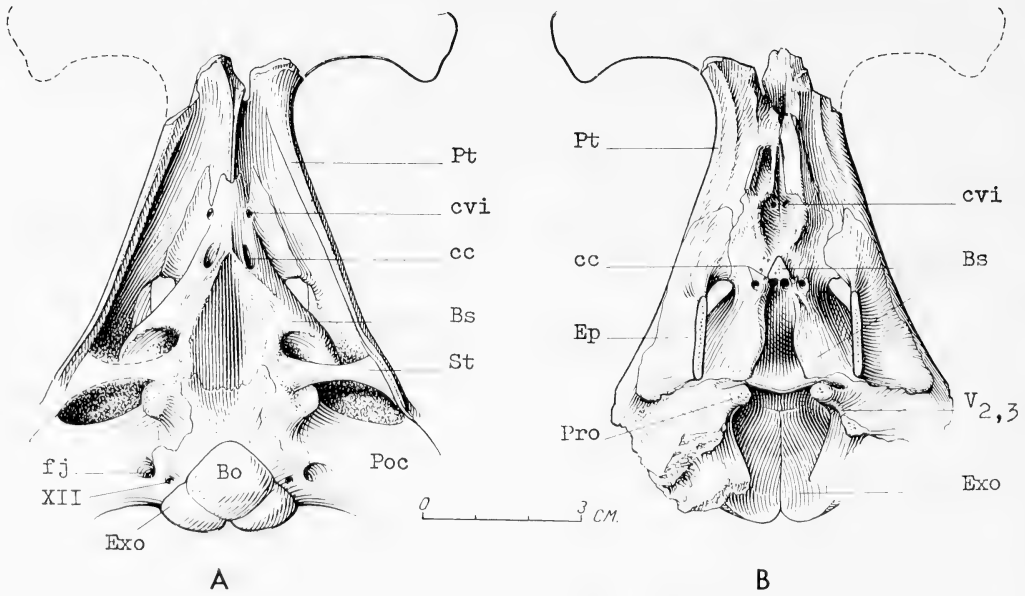

FIG. 2. *Notosyodon gusevi*, gen. et sp. n. PIN 2505/1 (holotype). Base of skull: A) ventral view; B) dorsal view.

Further to the rear the septa diverge somewhat, taking on the outline of a compressed figure X in dorsal view. The anterior parts of the septal bases are thickened by accumulations of bony tissue separated laterally from the corpus of the bone by the appearance of a suture. The posterior halves of the bases of these septa also give rise to similar but much wider bony growths separated from the medial parts of the bones by small and evidently fully enclosed cavities. These cavities have a length of 10 mm, a width at the front of 1 mm and at the rear of 3 mm, and an overall height of 2 mm. The bottoms of these cavities are inclined downward and forward; their posterior walls at the contact with the basisphenoid are very thin and only slightly ossified. A similar structure in the dorsal portion of the pterygoids, and which has not previously been noted in the Brithopodidae, is also characteristic of *Titanophoneus* and appears to be typical of the later representatives of this family. (Of the existing skulls of *Syodon, Titanophoneus* and *Doliosauriscus,* the dorsal part of the pterygoid is preserved only in the second of these genera.) It is quite likely that these bony growths and their accompanying enclosed cavities in the central portions of the pterygoids originated independently and represent an ossification of the anterior processes of the cartilaginous palatoquadrate.

The posterior rami of the pterygoids are high. Their ventral edges are thickened for one third of their length, are massive and relatively low; the middle and posterior parts are thinner and higher and descend ventrally with ridges that curve inward slightly. Highly characteristic of *Notosyodon* is the small angle of divergence of the posterior rami of the pterygoids — not more than 36°. In *Titanophoneus* and *Syodon* these angles are 70° and 80° respectively.

EPIPTERYGOIDS: From the side these have the appearance of plates that are wide at the bottom and narrow toward the top, their bases overlying the mediodorsal parts of the posterior rami of the pterygoids. The anterior parts of the bases give rise to inward curving medial projections which contact the dorsal surface of the basipterygoid processes by distinct sutures. The anterior edges of the epipterygoid are thickened and rounded along their entire length. The lower halves of the epipterygoids, a fraction of a millimeter in thickness and the posterior edges were evidently not

ossified at all. The upper rod-like parts have wedge-shaped cross sections with anterior edges thickened to 1 mm. Above their bases the epipterygoids converge smoothly and their dorsal edges fit into small longitudinal depressions along the ventral edges of the parietal and just barely outside the crests which mark the lateral walls of the brain case.

The occipital region of *Notosyodon's* skull is wide and high. Its maximum width at the level of the occipital condyle amounts to about 150 mm. The upper part of the occipital area from the level of the upper edge of the occipital foramen is concave and strongly inclined posteroventrally. The angle between the oblique upper occipital crests, which separate the occiput from the temporal depressions, is 90°. The occipital condyle, which lies in the zone of curvature of the occipital surface, projects sharply posteroventrally. Its lower segment, which makes up the greater part of the condyle, is bounded by an arc of 120° and its spherical articulating surface has an anteroventral orientation. The lateral segments of the condyle are more highly developed than in *Syodon* and *Titanophoneus* and are bordered by arcs of 60°. The articular surfaces of the lateral segments are quite distinct and well ossified. But the three segments as a whole do not form a single spherical surface: the lateral segments are elongated dorsolaterally, while the ventral segment is displaced slightly forward relative to the lateral segments.

BASIOCCIPITAL: This has a normal brithopodid position and structure, but differs in its very large size. Together with the exoccipitals, the basioccipital forms the massive occipital condyle which in *Notosyodon* is twice as large as in *Syodon* and is only a little smaller than the occipital condyle of the much larger skull of *Titanophoneus*. The sagittal suture between the exoccipitals on the surface of the occipital condyle is not crested. The processes for the proatlas, which are located at about the middle of the height of the occipital foramen magnum, rise dorsoposteriorly in the form of short rods with rounded articular facets. The pair of foramina for the twelfth nerve occupy the usual positions in the base of the lateral parts of the exoccipitals, whence they continue upward medially and emerge into the cranial cavity near the occipital foramen in a large canal about 1.5 mm in diameter. The jugular foramen which is about 2.5 mm across, is located below

the lateral processes of the exoccipital at the contact with the opisthotic and passes into the brain case almost parallel to the canal for the twelfth nerve.

SUPRAOCCIPITAL: These are not completely preserved. Their boundaries with the tabular, the opisthotic and the exoccipital on the occipital surface are not distinct. The anterodorsal sections of the supraoccipital are separated by a deep sagittal incisure that opens posteriorly, while the thin lower lateral parts are inserted like scales between the prootic and parietal. At the boundary with the parietal the anterodorsal parts of the supraoccipital have small, slightly ossified areas directed toward the apices of the epipterygoids.

OPISTHOTIC: Their anterior, upper and lateral outlines are indistinct; the boundaries with the exoccipital, the basioocipital, the stapes and the basisphenoid on the ventral side of the skull for the most part are the same as in *Syodon* and *Titanophoneus*. The anteromedial parts of the opisthotic in the area of the basiooccipital and the basisphenoid are thickened and widened anteroposteriorly. The area of the contact with the stapes and the basisphenoid is indistinct because of its slight ossification. The contact of the opisthotic with the basisphenoid evidently lies not at the level of the anterior edge of the proximal end of the stapes as in *Syodon* and *Titanophoneus,* but at the level of its posterior edge—that is, it occupies a smaller area.

PROOTICS: These bones are short anteroposteriorly, high and massive. They are connected anteriorly by a distinct transverse suture with the basisphenoid, and in their upper lateral parts with the supraoccipital, whose anterior double lobes at the top overlie the medial portions of the prootics. The suture connecting them with the opisthotics is apparently overgrown. The prootics, which are connected to the basisphenoid at the end of its deep longitudinal groove, form high and wide medial tabular processes which converge in the sagittal suture. In their location these processes correspond to the false spine of the sella turcica described by Tatarinov (1965) in the tapinocephalian *Moschops*. The upper anterior parts of the prootic have the usual brithopodid semi-oval incisure for the exit of the vein and the trigeminal nerve.

BASISPHENOID: The basisphenoid of *Notosyodon* is distinguished for its massiveness and the great width of its posterior portion. Its contact with the basioccipital on the ventral side is quite distinct, although it shows some signs of incomplete ossification. The contact with the opisthotic lies in a slightly ossified zone which also extends to the posterolateral angles of the basisphenoid. On the ventral side the basisphenoid has a deep and wide longitudinal groove. This begins directly behind the short ventral crest which separates the foramina for the carotid arteries at the level of their anterior edges, then widens and becomes deeper toward the rear, continuing into the anterior part of the basioccipital. The corpus of the basisphenoid, which is divided by a medial groove, forms two massive, diverging and rearward extending rounded crests, each of which has a posterior unossified area facing the fenestra ovalis. The basisphenoid is connected anteriorly with the medial parts of the pterygoids by a deep stepwise suture in whose posteromedial part, along the inner sides of the basipterygoid processes, are the vidian canals. On the dorsal side the basisphenoid is divided into two sections: an anterior section which is comparatively narrow and solid, and a posterior section that is divided by a long, deep groove beginning just behind the canals for the carotid arteries and terminates in the anteromedial portions of the prootic. The anterior part of the basisphenoid is divided by a short and shallow but wide groove which originates behind the elevated and widened bases of the pterygoidal septa and runs back, narrowing and finally terminating at the base of the dorsal process of the basisphenoid. The vidian canals, which are separated by a very thin bony partition, open into the anterior part of this groove. The base of the basipterygoidal rostrum lies in front of the hypophyseal pit and the medial canals of the carotid arteries. In plane view it has a cross section shaped like an isosceles triangle with its vertex forward. The basisphenoidal rostrum itself is a thin plate which, as seen from the side, has the form of a scalene triangle with its obtuse angle at the base of the rostrum. From the base to the apex, the more elongated anterior edge of the rostrum rises in a straight line upward and forward at an angle of about 60° to the base of the skull. The upper point of its anterior wedge-shaped end projects far forward of the vidian canals between the anterior ends of the pterygoidal septa. The posterior edge of the rostrum is also straight and runs back above the hypophyseal pit

and upward parallel to the ridge of the posterior part of the basisphenoid; its uppermost point projects above the basisphenoid somewhat forward of the prootic. The dorsal edge of the rostrum was convex and may have been incompletely ossified. The canals for the carotid arteries, which emerge on the ventral side through two large and widely separated foramina, pass through the body of the basisphenoid, converging upward and to the rear and emerge dorsally in two quite large foramina separated by a thin bony partition. Besides these basic canals, the two arterial branches continuing dorsally give rise to five smaller foramina. The first of these emerges to the side of the principal foramina; the other four, which are still smaller, emerge forward along the sides of the base of the rostrum. The lateral sides of the posterior part of the basisphenoid have a steep lateral inclination, and their lower parts are slightly concave. The posterior part of the basisphenoid at the contact with the prootic is very high, and its lateral ridges at the rear almost reach the height of the false spine of the sella turcica. The posterior surface cannot be seen, but the dorsal contact of the basisphenoid with the prootic and the basioccipital shows a slight degree of ossification. In general, the basisphenoid in *Notosyodon* is much more fully ossified than in *Syodon* and *Titanophoneus*.

STAPES: The left stapes, which has the form of a massive bony column with widened ends, has been preserved in its natural articulation. Its proximal end, which has a round cross section and is slightly ossified, has no distinct contacts in the area of the fenestra ovalis. The corpus of the bone is inclined posteroventrally, is widened dorsoventrally and has an oval cross section. The distal end is wide, cut off at an angle and well ossified in the present specimen; its articular areas are turned toward the posterior rami of the pterygoid. The posterior section of the distal end of the stapes lies like a broad lead on the anterolateral edge of the opisthotic. The contact with the quadrate is not clear. Quite characteristically, the stapes in *Notosyodon*, as in the other brithopodids, has no stapedial foramen.

TEETH

Along with the skull fragment were found two isolated teeth (fig. 3) which appear to have belonged to the same skull. One of these (PIN 2505/3) is the fourth or fifth upper left postcanine;

the other (PIN 2505 2) is probably the crown of the third incisor tooth on the right side of the lower jaw.

The upper tooth has a longitudinally oval cross section; its crown is low, only half as long as the root. The outer side of the crown is markedly convex and the lingual side slightly so. The apex of the crown is somewhat displaced posteriorly relative to the axis of the tooth; its anterior and posterior edges are sharp and have serrated notches. The base of the crown where it merges with the root has a slight annular neck. The surface of the root has a concentric annular sculptured pattern which is especially marked at the base.

The crown of the third lower incisor is quite large, with an apex that curves posteriorly. The convex outer side bears traces of two weak facets. The inner side is slightly concave and at the base has a small oblique cingulum formed by shoulders which descend along the inner side to the sharp posterior edge of the crown. From the base of the collar a few well marked ribs ascend and converge toward the apex.

These teeth differ little from the corresponding teeth in *Archaeosyodon* or *Titanophoneus*. It is noteworthy that the large and massive teeth are consistent with the general massiveness of the skull.

TYPE LOCALITY: 20 km north-northwest of the city of Aktyubinsk and 7.8 km south of the village of Turazhol, in the lower part of

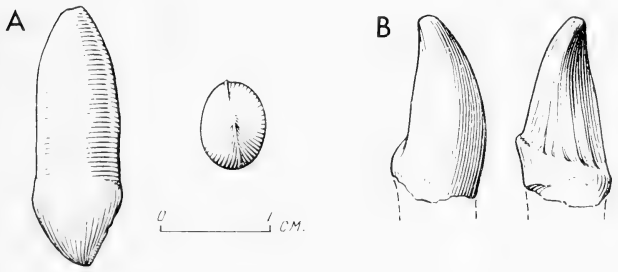

FIG. 3. *Notosyodon gusevi*, gen. et sp. n. A. Fourth or fifth upper left postcanine. PIN 2505/3. Left) lateral view; right) crown view. B. Crown of third precanine tooth on right side of lower jaw. PIN 2505/2. Left) lateral view; right) lingual view.

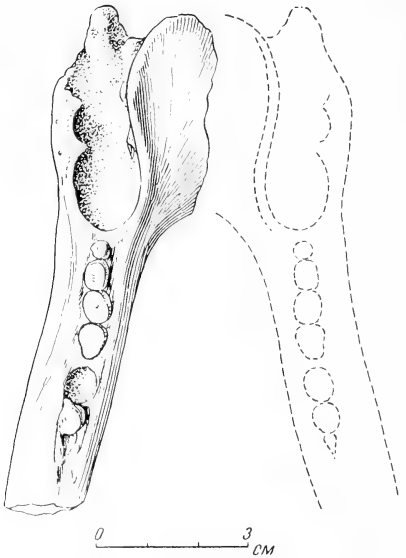

FIG. 4. *Notosyodon* sp. PIN 2608. Fragment of lower jaw, dorsal view.

the right bank of the Zhaksy-Karagala River. Kazakhstan, U.S.S.R.

GEOLOGIC AGE AND GEOGRAPHIC RANGE: Upper Permian, Lower Tatarian beds. Southern Cisurals region. (See also Geologic Data, below).

REMARKS: This species is named in honor of the geologist A. K. Gusev.

OTHER MATERIAL

The lower jaw, specimen PIN 2608, (which is tentatively considered as part of the type species) is known only from a fragment of the left dentary which has lost its incisors and canine (fig. 4). The symphysial portion of the dentary is high and thick. The rami of the mandible diverge at a small angle toward the proximal end. The height of the jaw at the anterior end of

the tooth row is smaller than at the posterior end. The lower edge of the mandible has no projection below the chin. The outer side in the area of the symphysis has a network of grooves and minute apertures for the superficial blood vessels and nerves. Judging from the size of the alveoli, the first incisor was small, the second larger and the last or fourth incisor about equal in size to the first. The canine was somewhat larger than the third incisor. The crowns of the teeth are damaged. The first tooth, which is the smallest, has a very low and sharp crown and on the lingual side is separated from the root by a slight cingulum. The second tooth is twice the size of the first. The preserved lower portion of its crown has a small cingulum. The third and fourth teeth are again larger than the second and equal to each other in size. The fifth has not been preserved. The sixth tooth, which is the last in the series, is equal in size to the third. The preserved lingual portion of its crown is separated from the root by a slight cingulum and barely extends above the edge of the jaw. On the lingual side of the tooth there is a small alveolus with a replacing tooth whose serrated apex is inclined forward. All the teeth have longitudinally oval sections.

TYPE LOCALITY AND GEOLOGIC AGE: Specimen PIN 2608 was found on the right bank of the Donguz River, opposite the Dolmatovskiy farm, in the Sol-Iletsk district of the Orenburg oblast, U.S.S.R.

It was in a stratum of light brown shales which in the local stratigraphic section are correlated by Ochev with the base of the Malyy Kinel' suite. In a recent summary by Ignat'yev (1962) of the Tatarian stage and in earlier publications by Rachitskiy (1956, 1957) and other investigators, the Malyy Kinel' suite is considered parallel with the lower part of the Upper Tatarian substage or the Northern Dvina horizon in the unified scheme adopted by the Interdepartmental Stratigraphic Committee.

Geologic Data

Specimens 2505/1, 2505/2, and 2505/3 were contained in a sandstone lens broken open by old rock fractures. On the basis of observations by A. K. Gusev and the present writer, who visited the site in 1964, the following description of the fossiliferous sandstone lens can be given. The sandstone is light gray in color,

fine-grained aud polymictic in composition with a calcareous cement, cross-bedded and made up of thin sandstone layers which contain a fine shaly gravel. In the upper part are interbedded gray shales with a multitude of impressions of stems and leaves of large plants (?gingkos, calamites and conifers). The cross-bedded inclined layers in the upper part of the lens contain frequent oval and cylindrical stromatolite formations up to 6 cm across. The fossil bones (part of the skull, and some teeth and vertebrae) were found in the upper portion of the lens, in a clayey-calcareous concretion. The upper part of the fossiliferous sandstone grades along the trend into a greenish-brown cross-bedded sandstone. The visible thickness of the fossiliferous lens is 6 m. The gray fossiliferous sandstone is overlain by a half-meter-thick stratum of reddish-brown sandstones and shales, separated by an interlayer (20-30 cm) of stromatolitic limestone bioherms.

The following stratigraphic subdivision (top to bottom) has been adopted for the Permian deposits of the Aktyubinsk region by the geologists of the University of Kazan:

Rodnikovo suite $P_2^{tat}2^{rd}$
Aktyubinsk suite $P_2^{tat}1^{ak}$
Tuketsk suite $P_2^{tat}1^{tk}$
Blagodarnoye suite $P_2^{kz\ bd}$
Akshat suite $P_2^{uf\ as}$

In the local stratigraphic section, the lens containing the fossil bones belongs, in Gusev's opinion, to the upper portion of the Lower Aktyubinsk subsuite, which on the basis of its bivalve molluscs correlates fully with the strata of the P suite in the Ciskazanian area — that is, with the strata which contain the dinocephalian fauna of Isheyevo.

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Preparation of the skull was done by M. F. Luk'yanova, the drawings are by N. A. Yan'shinov and K. P. Meshkov and the photographs by N. P. Finogenov.

The Russian manuscript was translated into English by Paul T. Broneer, Senior Geologist, Scripta Technica, Inc., New York.

Key to Abbreviations

Bo — basioccipital
Bs — basisphenoid
cc — canal for carotid artery
cvi — vidian canal
Ep — epipterygoid
Exo — exoccipital
fj — jugular foramen
Fr — frontal
J — jugal
Pa — parietal
Po — postorbital
Poc — paroccipital (opisthotic)
Pof — postfrontal
Prf — prefrontal
Pro — prootic
Pt — pterygoid
Sq — squamosal
St — stapes
V_2 V_3 — n. trigeminus
XII — aperture for suborbital nerve

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