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## UPPER EOCENE AND LOWER OLIGOCENE TITANOTHERES OF MONGOLIA<sup>1</sup>

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The Eocene and Oligocene titanotheres of Mongolia, discovered by members of the Third Asiatic Expedition in the years 1922 and 1923, will be described and figured in detail by the author in Monograph 55 of the U. S. Geological Survey, now going to press. Subsequent and still more complete description will appear in "The Natural History of Central Asia," the series of volumes dealing with the Central Asiatic explorations of the American Museum. The object of the present issue is to name the various titanotheres discovered and to briefly designate the genera and species to which they belong as well as the geologic life zones in which they occur. Fortunately for purposes of correlation and bearing on zoögeographic relations in Upper Eocene and Lower Oligocene time, seven of the genera closely correspond in the two countries, namely, Mongolia and the Rocky Mountain region of North America. The geologic distribution of these genera and species in *descending* order is as follows:

### LOWER OLIGOCENE, ARDYN OBO FORMATION, BRONTOPS GOBIENSIS LIFE ZONE.

*Brontops gobiensis*, the broad-skulled 'thunder-eyed' titanotheres of the Gobi desert, in a similar stage of evolution to *Brontops brachycephalus* of the Chadron A formation, Lower Oligocene, South Dakota.

*Menodus mongoliensis*, the 'long-skulled' titanotheres of the Gobi desert, in a similar stage of evolution to *Menodus giganteus* of the Chadron B formation, Lower Oligocene, South Dakota.

### UPPERMOST EOCENE, SHARA MURUN FORMATION, PROTITANOTHERIUM MONGOLIENSE LIFE ZONE.

*Protitanotherium andrewsi*, named in honor of Roy Chapman Andrews, leader of the Third Asiatic Expedition; in a somewhat more advanced stage of evolution than *Protitanotherium superbum* of the Uinta C formation, northern Utah.

*Protitanotherium mongoliense*, the titanotheres first named from Mongolia, believed to be in a somewhat similar stage of evolution to the *Protitanotherium superbum* of the Uinta C formation, northern Utah.

*Dolichorhinus kaiseni*, named in honor of Peter Kaisen, a member of the Third Asiatic Expedition; believed to be in a more progressive stage of evolution

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<sup>1</sup>Publications of the Asiatic Expeditions of The American Museum of Natural History. Contribution No. 63.

than *Dolichorhinus (cornutus) hyognathus* of the Uinta B formation, northern Utah.

Genus?, species?, a long, slender-limbed titanotheriine, possibly ancestral to *Menodus mongoliensis*, represented by the fore limb bones (Amer. Mus. 20253).

UPPER EOCENE, IRDIN MANHA FORMATION, PROTITANOTHERIUM GRANGERI LIFE ZONE.

*Protitanotherium grangeri*, the first titanotheriine found in Mongolia, named in honor of Walter Granger, chief palæontologist of the expedition; believed to be in a stage of evolution similar to that of *Protitanotherium emarginatum*, lower levels of the Uinta C formation, northern Utah.

*Dolichorhinus olseni*, named in honor of George Olsen, a member of the Third Asiatic Expedition.

*Telmatherium berkeyi*, named in honor of Charles P. Berkey, chief geologist of the expedition, who collected the first titanotheriine jaw.

*Manteoceras? irdinensis*, of doubtful generic affinity to the *Manteoceras* of the Uinta B, Utah, named specifically in reference to its discovery in the Irдин Manha formation of Mongolia.

*Metarhinus? mongoliensis*, of doubtful generic reference to the fluviatile *Metarhinus* of the Uinta B of Utah, named specifically in reference to its discovery in Mongolia.

#### FIELD CATALOGUE AND NOTES BY WALTER GRANGER, 1922 and 1923

Of great importance is the precise geographic and geologic distribution of titanotheriine remains, skulls, jaws, and portions of the skeleton, collected from the three chief localities. Treated in geologic descending order, the records are as follows.

Ardyn Obo Formation, Lower Oligocene. Teeth, Jaws, and Skull collected on the Kalgan-Uliassutai Trail, southeastern Gobi, Mongolia

Amer. Mus. No.	Genus and Species	Material
20354	<i>Brontops gobiensis</i> , new species.	Crushed skull. July 2, 1923.
20353	" " referred.	Symphysis of jaw. June 30, 1923.
20351	<i>Menodus mongoliensis</i> , new species.	Lower grinding tooth. June 29, 1923.

Shara Murun Formation, uppermost Eocene. Remains of twenty-seven Titanotheriines collected on the Kalgan-Uliassutai Trail, southeastern Gobi, Mongolia, chiefly during the season of 1923. Type of *Protitanotherium mongoliense* collected in 1922

Amer. Mus. No.	Genus and Species	Material
20252	<i>Dolichorhinus kaiseni</i> , new species.	Male skull and jaws, nearly complete dentition.

Amer. Mus. No.	Genus and Species	Material
20257	<i>Dolichorhinus kaiseni</i> , paratype.	Palate and basicranium, complete dentition.
20255	<i>Dolichorhinus kaiseni</i> , referred.	Female skull and jaws, nearly complete dentition.
20260	<i>Dolichorhinus kaiseni</i> , referred.	Male skull and jaws, complete dentition.
18653	<i>Protitanotherium mongoliense</i> Osborn, type.	Right ramus, fragment, with six grinders. First titanothere to reach Museum from Mongolia.
20263	<i>Protitanotherium mongoliense</i> , neotype.	Palate and dentition complete.
20256	<i>Protitanotherium mongoliense</i> , referred.	Palate, canine, superior grinders, lower jaws.
20261	<i>Protitanotherium mongoliense</i> , referred.	Female skull complete (crushed), incisors, canine, grinders.
20270	<i>Protitanotherium mongoliense</i> , referred.	Right maxilla and zygoma, superior grinders.
20273	<i>Protitanotherium mongoliense</i> , referred.	Fine pair jaws, lacking symphysis, inferior grinders.
20271	<i>Protitanotherium andrewsi</i> , new species.	Complete male skull, dentition, nasals wanting.
20251	<i>Protitanotherium andrewsi</i> , paratype.	Male? Left ramus, inferior grinders.
20254	<i>Protitanotherium andrewsi</i> , referred.	Male skull, superior dentition.
20262	<i>Protitanotherium andrewsi</i> , referred.	Jaws, symphysis, upper incisors, grinders.
20269	<i>Protitanotherium andrewsi</i> , referred.	Symphysis of jaws, with canines.
20280	<i>Protitanotherium andrewsi</i> , referred.	Juvenile palate, deciduous premolars, first, second molars.
20272	<i>Protitanotherium andrewsi</i> , referred.	Fine jaw, male, inferior dentition.
20253	Genus? and species? not determined.	Premaxilla, incisor; ulna, femur, vertebræ, foot bones, pro- <i>Menodus</i> phylum?
20265	Genus? and species? not determined.	Maxilla fragment.
20268	Genus? and species? not determined.	Left ramus of lower jaws.
20258	Genus? and species? not determined.	<i>Protitanotherium?</i> Fore foot, with distal end ulna and radius.
20259	<i>Protitanotherium andrewsi?</i> , referred.	Part of fore foot (metapodials).
20267	Genus? and species? not determined, <i>Protitanotherium</i> .	Associated foot bones.
20274	<i>Protitanotherium mongoliense</i> , referred.	Incomplete hind foot.
20275-20276	Genus? and species? not determined, <i>Protitanotherium?</i>	Fore and hind foot bones.
20277	<i>Protitanotherium mongoliense</i> , referred.	Complete hind limb and foot.
20327	<i>Protitanotherium andrewsi</i> , referred.	Right humerus, 2 right tibiæ, left tibia, foot bones.

Irdin Manha Formation, Upper Eocene. Remains of twenty-six Titanotheres collected north and south of the Kalgan-Urga Telegraph Line, southeastern Gobi, Mongolia. Chiefly collected during the season of 1923. First specimen found in 1922

Amer. Mus. No.	Genus and Species	Material
20111	<i>Manteoceras? irдинensis</i> , new species.	A right lower jaw.
20117	(Misplaced.) Field label, "titanotheres lower jaw."	
20167	<i>Metarhinus? mongoliensis</i> , new species.	Small lower jaw, two grinders, milk superior grinders.
20103	<i>Protitanotherium grangeri</i> Osborn, type.	Female skull, jaws, incisors, canines, fragmentary molars.
19179	<i>Protitanotherium grangeri</i> , referred.	Left jaw and symphysis, with six grinders. First titanotheres found in Mongolia.
20120	<i>Protitanotherium grangeri</i> , referred.	Perfect portion of right maxilla.
20122	<i>Protitanotherium grangeri</i> , referred.	Juvenile palate and grinding teeth.
20123	<i>Protitanotherium grangeri</i> , referred.	Fragment of left maxilla and grinding teeth.
20126	<i>Protitanotherium grangeri</i> , referred.	Fragment of left ramus with grinding teeth.
20105	<i>Protitanotherium grangeri</i> , referred.	Large adult male jaw with teeth.
20108	<i>Protitanotherium grangeri</i> , referred.	Small female right maxilla and grinding teeth.
20113	<i>Protitanotherium grangeri</i> , referred.	Facial portion of female cranium, anterior grinders.
20114	<i>Protitanotherium grangeri</i> , referred.	Anterior portion female cranium with dentition.
20119	<i>Protitanotherium grangeri</i> , referred.	Left jaw fragment with four grinding teeth.
20112	<i>Protitanotherium grangeri</i> , referred.	Young male right ramus of jaw with six grinders.
20104	<i>Protitanotherium grangeri</i> , referred.	Very large male jaw with nearly complete dentition.
20110	<i>Protitanotherium grangeri?</i> , referred.	Large male jaws with complete dentition.
20106	<i>Telmatherium berkeyi</i> , new species.	Adult female lower jaws, right maxilla, canines, grinders.
20107	<i>Telmatherium berkeyi</i> , paratype.	Anterior half of jaw, canine, inferior grinders.
20121	<i>Telmatherium berkeyi</i> , referred.	Perfect left maxilla and grinding teeth.
20127	<i>Telmatherium berkeyi</i> , referred.	Palate and superior grinders.
20115	<i>Telmatherium berkeyi</i> , referred.	Juvenile lower jaw with incisors and grinder.
20125	<i>Telmatherium berkeyi</i> , referred.	Left maxilla with premolar teeth.
20124	<i>Telmatherium berkeyi</i> , referred.	Right jaw with well-preserved grinders.
20109	<i>Dolichorhinus olseni</i> , new species.	Fine pair of jaws.
20171	<i>Protitanotherium grangeri</i> , referred.	Right humerus, 2 right ulnæ, left ulna and radius, axis, right tibia.

**BRONTOTHERIIDÆ****Brontopinæ*****Brontops gobiensis*, new species**

In the Ardyn Obo formation were found remains of three titanotheres in a distinctly Oligocene stage of evolution. The type skull (Amer. Mus. 20354), named herewith *Brontops gobiensis*, contains three superior incisors with distinct tetartocones in the three molars, no hypocone in M<sup>3</sup>. The massive symphysis (Amer. Mus. 20353) is referred to the same species.

The type of *Brontops gobiensis* (Amer. Mus. 20354) consists of the cranium reconstructed after comparison with that of *Brontops brachycephalus*. The horns partake of the short, broad character of the cranium; they are obtusely prominent. The nasals are elongated, broad, and shovel-shaped as in *Protitanotherium* and *Menodus* (= *Titanotherium*). The symphysis of a referred jaw (Amer. Mus. 20353) is extremely massive like that of *Brontops*. The dental formula  $I \frac{3}{3} - \frac{3}{3} \quad C \frac{1}{1} - \frac{1}{1} \quad P \frac{4}{4} - \frac{4}{4} \quad M \frac{3}{3} - \frac{3}{3}$  agrees with that of *Teleodus* Marsh in the presence of three superior incisors, and differs from that of *Brontops brachycephalus* Osborn, in which the incisive formula is  $I \frac{2}{2} - \frac{2}{2}$ . The cranium is as brachycephalic as that of *B. brachycephalus*. The strong, well-developed tetartocones of the premolars or double internal premolar cones mark the chief progression beyond *Protitanotherium*.

**Menodontinæ*****Menodus mongoliensis*, new species**

The type of *Menodus mongoliensis* (Amer. Mus. 20351), from the Ardyn Obo formation, is a second right inferior molar tooth in which the second lobe is perfect, the first lobe is broken in front. The generic and specific characters, as compared with the *Brontops gobiensis* type, are:

An animal equal in size to the large male individuals of *Menodus giganteus* (= *ingens* Marsh) of South Dakota; length of two lobes of second inferior molar estimated at 93 mm., actual breadth of anterior lobe 40 mm., height of relatively unworn second lobe 53 mm.; prominent postero-external cingulum; prominent posterior crests on metaconid and hypoconid; internal valleys of trigonid and talonid widely open; inferior molar proportions similar to those of *Menodus*, wholly dissimilar to those of *Brontops*, indicating that *M. mongoliensis* was a long-headed rather than a broad-headed animal.

**Manteoceratinæ (Brontopinæ)*****Protitanotherium andrewsi*, new species**

The seven specimens, including the type of *Protitanotherium andrewsi* (Amer. Mus. 20271), the paratype (Amer. Mus. 20251), and the referred skulls and jaws of this species, as listed above, while recorded from the same formation as *Protitanotherium mongoliense*, exhibit decidedly progressive mutations and rectigradations warranting a specific separation. This advance is indicated not only by the greater measurements of the cranium and jaws throughout, but by several progressive characters more or less clearly observed in the grinding teeth, although the grinders do not greatly exceed in length those of *Protitanotherium grangeri*.

The specific distinctions are as follows: (1) Tetartocones prominent in  $P^2-3$ ; (2) rudiments of a hypocone in  $M^3$ ; (3) grinders otherwise similar to those of *P. mongoliense*; (4) male canines larger and more robust; (5) relative reduction of lateral superior incisors; (6) bluntly rounded summits of the second superior incisors.

The comparative measurements in three of the species of *Protitanotherium* are as follows:

Chief Comparative Measurements	Basilar length of skull	Superior grinding teeth, $P^2-M^3$	Inferior grinding teeth, $P_2-M_3$
<i>Protitanotherium andrewsi</i>	757	283	308
Type (Amer. Mus. 20271), paratype (Amer. Mus. 20251)			
<i>Protitanotherium mongoliense</i>	677	269	289
Type (Amer. Mus. 18653), neotype (Amer. Mus. 20263), referred (Amer. Mus. 20261)			
<i>Protitanotherium grangeri</i>	695	242	174
Type (Amer. Mus. 20103)			

***Protitanotherium mongoliense* Osborn, 1923**

ORIGINAL REFERENCE.—Osborn, H. F., 1923, Titanotheres and Lophiodonts in Mongolia. Amer. Mus. Novitates, No. 91, October 17, p. 3.

Supplementing the type of *Protitanotherium mongoliense* (Amer. Mus. 18653), a right ramus with a well-preserved series of grinding teeth, discovered in 1922, is a very fine series of specimens, fully listed above, discovered in 1923. Although recorded from the same Shara Murun formation as the more progressive species *Protitanotherium andrewsi*, all the above specimens agree in their relatively less advanced stage of

evolution, as shown chiefly in the rectigradations of the grinding teeth and in the inferior dimensions throughout. As pointed out in the original description (Osborn, 1923, p. 3), *P. mongoliense* is intermediate in its actual measurements and dental indices between *Protitanotherium emarginatum* and *P. superbum* of the Uinta C formation, Utah.

**SPECIFIC CHARACTERS.**—The skull, the two palates, the right maxilla, and the two pairs of jaws agree sufficiently with the type jaw in size and in progressive evolution of the incisors, canines, and grinding teeth to clearly demarcate this species of the Shara Murun from the more primitive *Protitanotherium grangeri* of the Irдин Manha formation. At the same time they indicate a phase of *Protitanotherium* evolution somewhat more ancient geologically than *P. andrewsi*, the giant species of this genus. Unlike *P. grangeri*, the inferior premolars (type Amer. Mus. 18653, referred Amer. Mus. 20256, 20273) exhibit very distinct entoconids in  $P_{2-4}$ , with distinct entoconid shelf and deep talonid basin partly closed internally by the metastylid. Similarly the superior premolars (skull Amer. Mus. 20261 referred, palate Amer. Mus. 20256 referred, neotype palate Amer. Mus. 20263, right maxilla Amer. Mus. 20270 referred) all exhibit progressive tetartocones in the second and third premolars,  $P^{2-3}$ , and a more or less well-developed tetartocone rudiment in the fourth premolar,  $P^4$ . The several maxillæ and premolar grinding series show progressive steps in the development of this tetartocone of  $P^4$ ; in fact, the palatal series (Amer. Mus. 20263) exhibits the tetartocones of  $P^{3-4}$  in their most rudimentary stage, whereas the tetartocones in the skull (Amer. Mus. 20261) are in their most progressive stage.

***Protitanotherium grangeri*, new species**

Occurring in the more ancient geologic formation of the Irдин Manha, the type female skull and jaw of *Protitanotherium grangeri* (Amer. Mus. 20103) and the numerous referred specimens listed above, found north and south of the Kalgan-Urga telegraph line, exhibit very uniform cranial and dental characters supplemented by the remains of fore and hind limbs of both the right and left sides (Amer. Mus. 20171, belonging to several individuals).

**SPECIFIC CHARACTERS.**—The exceptional features of the type cranium (Amer. Mus. 20103), such as (a) the horseshoe-shaped concavity bordering the posterior nares and (b) the deep pits on either side of the presphenoid, characters observed also in specimens of (a) *Dolichorhinus* and of (b) *Sphenocælus*, led us at first to regard this type as related to the above genera.

The real propinquity of the species *grangeri* to *Protitanotherium* is, however, firmly established by: (1) The elongate horns, the broad, shovel-shaped nasals, (2) the broad sweep of the zygomatic arches, and (3) the saddle-shaped cranial top; also (4), in the dentition, by (5) the sharply incurved canines, (6) the enlarged lateral superior and inferior third incisors,  $I \frac{3}{3}$ , (7) the diminishing second and first incisors, which in this species retain their pointed, posteingulate form.

DENTITION.—The ancestral or primitive character of the grinding teeth of *Protitanotherium grangeri*, as compared with the more progressive grinders of *P. mongoliense* and of *P. andrewsi*, is seen in the absolutely simple internal deutocones without even a rudiment of the tetartocones. The ancestral character is observed also in the absence of any trace of a hypocone in  $M^3$  (compare type Amer. Mus. 20103, also referred Amer. Mus. 20114, 20108, and 20120). These non-progressive superior grinders indicate that *P. grangeri* is geologically far more ancient than the *P. mongoliense* and the *P. andrewsi* of the Shara Murun.

### Telmatheriinae

#### *Telmatherium berkeyi*, new species

Remains of this very large and deep-jawed titanother were discovered in the Irдин Manha formation in two localities intermingled with those of *Protitanotherium grangeri* and in one locality intermingled with those of *P. grangeri* and of *Dolichorhinus olseni*.

The specific characters are derived solely from the gigantic type jaw and maxilla (Amer. Mus. 20106) and from six other specimens of superior and inferior maxillæ, none of which yields a knowledge of the cranium, yet we may be confident that the skull was relatively high and deep as well as elongate, that the bony horns were somewhat rudimentary, while the canine tusks were sharp and powerful. The jaws contrast widely with those of the Mongolian *Dolichorhinus* and *Protitanotherium*, not only in their prodigious size but in the great depth of the mandibular rami, of the chin processes, and of the lower borders. The incisors are the largest known among the titanotheres, the second pair being greatly enlarged. The canines are very large, pointed, subanceolate. The premolars have prominent crowns and highly sculptured internal cingula. The posterior molars are exceptionally long and relatively narrow, the breadth-length index being 82 as compared with 98 in *Dolichorhinus* and 115 in *Brontops brachycephalus*. The elongate jaw of *Telmatherium berkeyi*, measuring 30 inches from condyle to symphysis, nearly 9 inches



in its deepest portion below  $M_2$ ,  $M_3$ , and  $7\frac{1}{2}$  inches at the symphysis, is quite unique; it betokens a long deep cranium of prodigious size. Unlike its contemporaries, the coronoid is very broad, the condyle is only moderately elevated above the line of the molar teeth, the angle is small, not prominent; the lower border is deeply depressed below the grinding series, then rises slightly below the premolars and sinks into the deep, powerful symphysis which rises like the inclined straight prow of a ship to the elevated border of the cutting teeth.

The cutting teeth are all extremely prominent. The prominent superior canines resemble those of *Telmatherium* and of *Menodus* (= *Titanotherium*). The lateral incisors are smaller than the second incisors, although  $I^{1-3}$  are very prominent, flattened anteroposteriorly, not deeply cupped behind. High, laterally compressed inferior premolars with sculptured crowns; superior premolars with prominent sculptured ectolophs. Molars elongate, compressed, with prominent ectolophs, fairly prominent protocones and hypocones. In  $M^3$  a very prominent hypocone; this tooth is extremely long and narrow.

### **Dolichorhininae**

#### ***Dolichorhinus kaiseni*, new species**

This species is based upon the type male skull and jaws (Amer. Mus. 20252) and the paratype palate and basicranium (Amer. Mus. 20257) from the Shara Murun formation, of uppermost Eocene age, which also yields *Protitanotherium mongoliense* and *P. andrewsi*. Strikingly uniform in character and measurements are the type, paratype, and referred specimens, as fully listed above.

**SPECIFIC CHARACTERS.**—As shown in a comparative series of measurements, *Dolichorhinus kaiseni* is superior in length of jaw and in all its dental measurements to *Dolichorhinus olseni*; the breadth-length indices of the fourth inferior premolar,  $P_4$ , and of the third inferior molar,  $M_3$ , are approximately the same in the two species. These relatively long, narrow indices are harmonic with the extremely dolichocephalic, elongate cranium and jaws. As in several of the Wyoming and Utah species of this genus, the small canines, even in the males, are in compensation for the precociously developed horn swellings; these bony horns are relatively much more prominent than in *Dolichorhinus hyognathus* (= *cornutus*) of the Washakie and Uinta formations. Although the canines are relatively small as compared with the robust canines of *Protitanotherium*, we judge that the four crania (Amer. Mus.

20252, 20257, 20260, 20255) belong to male individuals because of the uniform size of the canines and of the uniform development of the protuberant bony horns. These horns project outward rather than upward; the fore-and-aft diameter of the horn-base is short as compared with the elongate horns of *Protitanotherium*. Below them are the flaring sides of the premaxillo-nasal junction, which are extended forward into the hooded nasals that resemble the inverted, rounded prow of a boat; this exaggerated evolution of the long and narrow nasals suggested the name *Dolichorhinus cornutus* for the 'horned-long-nosed' titanother of Wyoming and Utah. Back of this extension is the long tubular cranium, which in section is quite hollow, including the large tubular air chambers which completely conceal the small brain-case below.

The cranial proportions are correspondingly elongate, laterally compressed, arched superiorly, with slender, flattened zygomatic arches correlated with relatively feeble powers of mastication; the breadth-length index, length 695 mm., breadth 330 mm., index 47, contrasts with an index of 69 in a skull of *Protitanotherium grangeri* of the same basilar length, namely, 695 mm. The horns do not partake of this elongated character but are rounded, short, obtuse, and much more prominent than in any known American species.

The jaws are of elongate, slender, angulate character, with slender coronoid processes. The dentition harmonizes with the relatively feeble masticating and offensive powers, the canines being relatively small, incisors of medium size with posterior cingula, second lower incisors slightly enlarged. As in the American species, the premolars are simple with large median internal deuterococones and rudimentary tetartocones.

It is this intermingling of the characters observed in the American specimens with those discovered in this Mongolian species of *Dolichorhinus* that gives these animals such exceptional interest.

#### ***Dolichorhinus olseni*, new species**

The type of *Dolichorhinus olseni* is a fine pair of jaws (Amer. Mus. 20109) found one-half mile north of the Kalgan-Urga telegraph line. This is the only specimen referable to *Dolichorhinus* discovered in the Irdin Manha formation, whereas the more progressive species *Dolichorhinus kaiseni* is very abundant in the overlying Shara Murun formation.

The type jaw of *Dolichorhinus olseni* is inferior in size throughout to the referred jaw of *D. kaiseni* (Amer. Mus. 20260). Besides its smaller size we observe the following less progressive characters: (1) Canines narrow and sharply pointed; (2) lateral first and second incisors more

pointed, less broadly cupped or cingulate posteriorly; (3) first premolars small, single-fanged, pointed; second and third premolars,  $P_{2-3}$ , lacking cup-shaped concavity of talonid which is present only in  $P_4$ ; that is, all rudiments of entoconid and all evidence of broadening of talonid are lacking in *D. olseni* in  $P_{2-3}$ ; these teeth are far more primitive than the corresponding teeth of *D. kaiseni*; (4) the fourth inferior premolar still very primitive, exhibiting a shallow concavity of the trigonid, a relatively broad, slightly concave talon.

### **Manteoceratinae (Brontopinae)**

#### **Manteoceras? irdinensis, new species**

The type of *Manteoceras? irdinensis* (Amer. Mus. 20111) is a right mandibular ramus with symphysis, containing  $M_{1-3}$  and alveoli of the premolar and cutting teeth. The locality is the Irdin Manha formation, Upper Eocene, two miles north of the Kalgan-Urga telegraph line. The generic reference to *Manteoceras* is doubtful and provisional, because the dentition does not agree with that of any known American species of this genus.

The distinctive characters are: (1) Lower canines enlarged, approximated, and strongly procumbent; (2) incisive border of alveoli correspondingly narrow and laterally compressed; (3) apparently three premolars, anterior alveolus of  $P_2$ ? seemingly double; entire premolar alveolar border short (80 mm.); molar border relatively elongate (190 mm.); molars typically titanotheroid; anteroposterior measurement of  $M_1=42$  mm., of  $M_2=60$  mm., of  $M_3=83$  mm., transverse measurement of  $M_3=33$  mm.; (4) symphysis broad, extremely shallow, flattened on inferior surface.

On further knowledge, this may represent a new genus of titanotheres.

### **Dolichorhininae?**

#### **Metarhinus? mongoliensis, new species**

The type of *Metarhinus? mongoliensis*, consisting of the anterior portion of a right mandible (Amer. Mus. 20167), is also from the Upper Eocene Irdin Manha formation, the exact locality being unrecorded. This jaw fragment, containing  $P_4$ ,  $M_1$ , is inferior in size both to *Manteoceras? irdinensis* and to the smallest individuals of *Protitanotherium grangeri*.

The distinctive characters of this species are: (1) Linear measurement of  $P_4$ ,  $M_1=43$  mm., anteroposterior measurement of  $M_1=24$  mm., transverse measurement 14 mm.; anteroposterior measurement of  $P_4=19$  mm., transverse measurement 11 mm.; (2) in *Protitanotherium gran-geri* the linear measurement of  $P_4$ ,  $M_1=45$  mm., anteroposterior measurement of  $M_1=24$  mm., transverse measurement 17 mm.; (3) valleys of metalophid cupped or deeply concave; (4) valleys of protolophid open with prominent paraconids.

While the resemblances of the type teeth to those of both *Metarhinus* and *Mesatirhinus* of Utah are fairly close, the generic reference of this species is decidedly doubtful.