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NEW UNGULATES FROM THE ARDYN OBO FORMATION OF MONGOLIA¹

WITH FAUNAL LIST AND REMARKS ON CORRELATION

By W. D. MATTHEW AND WALTER GRANGER

In a preceding article² we described two creodonts and three rodents from the Ardyn Obo formation, collected in 1923 by the Third Asiatic Expedition. The ungulate remains from this horizon include skulls of an amynodont rhinoceros already described by Professor Osborn and a complete titanotherium which he will describe in a forthcoming number of *Novitates*. The smaller and more fragmentary ungulate material, including four perissodactyls and three traguloid ruminants, is described in the following pages.

PERISSODACTYLA

Schizotherium avitum

Matthew and Granger, 1923

This species is based on a last lower molar. No. 20384, a poorly preserved piece of the lower jaw with p_2 and dp_3-m_1 , probably represents the same species. The second premolar is unworn and only partly emerged. It has a compressed protocone with sharp and prominent anterior and posterior ridges, the anterior curving around to the antero-internal corner of the tooth, the posterior extending back to become continuous with the sharp-crested, nearly median heel. There is a small, low-set, but quite sharply defined little cusp on the inner face of the tooth, a little above the base and posterior to the point of the protocone. It occupies about the position one would expect for a rudimentary metastylid, corresponding substantially in its relations to the base of the metastylid of the molars. We have not found this

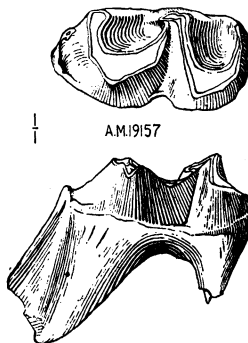


Fig. 1. *Schizotherium avitum*, last lower molar, superior and external views, natural size.

Type specimen, No. 19157, Ardyn Obo formation, Mongolia.

¹Publications of the Asiatic Expeditions of The American Museum of Natural History. Contribution No. 58.

²Amer. Museum Novitates, No. 193.

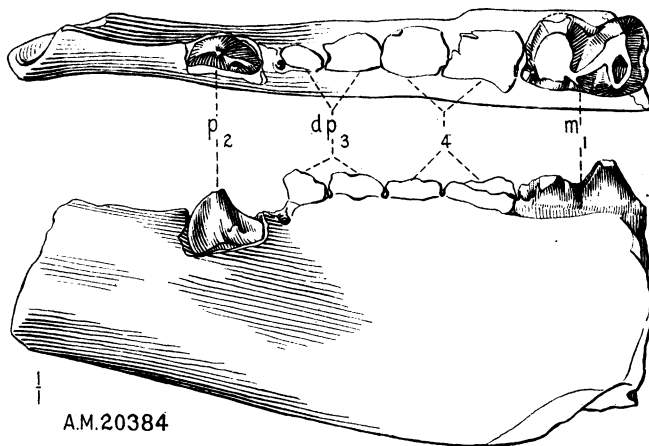


Fig. 2. *Schizotherium avitum*, part of lower jaw, immature, superior and internal views, natural size.

No. 20384, Ardyn Obo formation.

cuspid in p_2 of any other chalicothere, but it might be expected to occur in the family in view of the characteristic development of the metastylid in the molars. It is not present in p_2 of *Moropus*. The supposed milk teeth behind p_2 are so worn and shattered that nothing except the size and proportions of the teeth can be learned from them. The first molar is characteristically chalicothere in construction, although considerably worn. It compares rather closely with the type m_3 save that it is a little broader and lacks any trace of heel. It is a little larger in both dimensions than m_1 of *S. modicum*.

? *Schizotherium* species

No. 20385, a small jaw fragment, has an unworn molariform tooth, the alveolus of a larger two-rooted tooth behind it, and behind the alveolus a part of a pocket for a preformed tooth. This tooth may perhaps be dp_3 , although no exact comparison can be made with the shattered dp_3 of No. 20384, and the length and verticality of the roots suggest a permanent molar. The tooth has the construction of the *Schizotherium* molar, with a small transverse hypoconulid heel, not unlike the m_3 of *S. modicum*; but it is considerably smaller than the molars of *S. modicum* and *S. avitum*, and the alveoli behind it indicate a considerably larger tooth. If a permanent tooth, it would necessarily be m_1 , and the proportions of m_1 to m_2 would differ considerably from those of the known species.



AM.20385

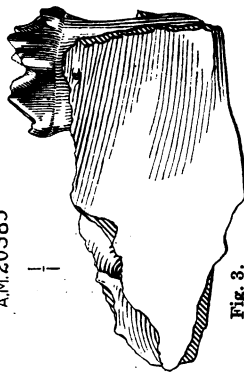


Fig. 3.

AM.20357

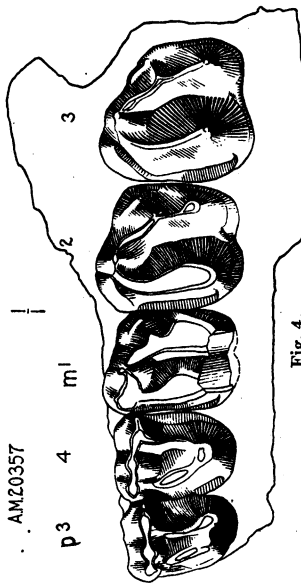


Fig. 4.

Fig. 3. *Schizotherium* species, fragment of lower jaw, superior and internal views, natural size.
No. 20385, Ardyn Obo formation.

Fig. 4. *Colodon inceptus*, new species, upper jaw, type specimen, No. 20357, crown view of teeth, natural size.
Ardyn Obo formation.

Fig. 5. *Paracolodon curtus*, new genus and species, part of upper jaw with premolar teeth, outer and crown views, natural size.
Type specimen, No. 20355.

Colodon inceptus, new species

TYPE.—No. 20357, upper jaw with p^2 - m^2 of the left side.

CHARACTERS.—Size of *C. occidentalis* (Leidy) (as represented by the palate figured by Osborn and Wortman), molars similar in construction, except that the posterior crest of m^2 runs nearly straight from paracone to hypocone, while in *C. occidentalis* it curves outward just behind the paracone. M^2 shows a similar difference but less marked. Inner cusp of p^4 single, on p^3 partly divided but still closely connate, as in p^3 and p^4 of *C. occidentalis*.

This species is a little more primitive than the *C. occidentalis* of the *Oreodon* beds. The type of Leidy's species is recorded as from the *Titanotherium* beds but is known only from the last lower molar. It might be equivalent to *C. inceptus*, although probably not conspecific.

Among the fragmentary lower jaws and teeth, there are two or three specimens that may belong to this or the following genus, but we cannot identify them with certainty.

Paracolodon curtus, new genus and species

TYPE.—No. 20355, upper jaw with p^2 - 4 and parts of alveoli of canine and first molar.

GENERIC CHARACTERS.—Premolar construction as in *Colodon* but the premolars progressively reduced forward, p^1 absent, postcanine diastema short and molars relatively large. P^2 is proportioned like p^1 of *Colodon*, but the construction is more as in p^2 , with two outer cusps, two inner cusps, the anterior one vestigial, the posterior connecting crest incomplete. P^3 constructed much as in *Colodon* but nearly quadrate, the anteroposterior and transverse diameters subequal. P^4 like that of *Colodon*. Narial notch extending far back, at least to a point above p^4 . Premaxilla extending backward to a point above p^2 , probably farther.

SPECIFIC CHARACTERS.—About the size of *C. inceptus* and p^4 of nearly identical size and proportions. A slight groove obscurely separates the inner cusps; the postero-external cusp less flattened than in *C. inceptus*, in which it has begun to resemble the corresponding part of the molars. Inner cusps of p^3 well separated, of subequal size and prominence, whereas in *C. inceptus* the posterior cusp is larger. Postcanine diastema less than the length of p^2 - 3 . Transverse diameter of molar roots fifteen per cent. greater than that of p^4 ; in *Colodon* they are nearly equal.

AFFINITIES OF *Colodon* AND *Paracolodon*

The relationship of the Mongolian and of Borissiak's species to the American genus appears to be beyond reasonable doubt. *Colodon* in turn appears to be rather nearly related to "*Desmatotherium*" *mongoliense*, which is certainly near to *D. guyotii* of the ? Washakie,¹

¹Recorded as Bridger, but it may have come from the Washakie. It has not been recognized in any of the subsequent collections from the Bridger and appears to be decidedly later in type than the Bridger Iophiodonts.

although congeneric only in a broadly inclusive sense. We are unable to agree with Peterson that *Desmatotherium* should be removed from the Helaletidæ to the Hyracodontidæ, but a general discussion of the affinities of this group of lophiodonts may better be postponed until the Irdin Manha material is more fully described. Among the European genera, *Chasmothorium* comes nearest in molar structure, but the premolars and anterior teeth differ widely. *Lophiodon* differs in the molar construction, as pointed out by Stehlin and Depéret, and is decidedly

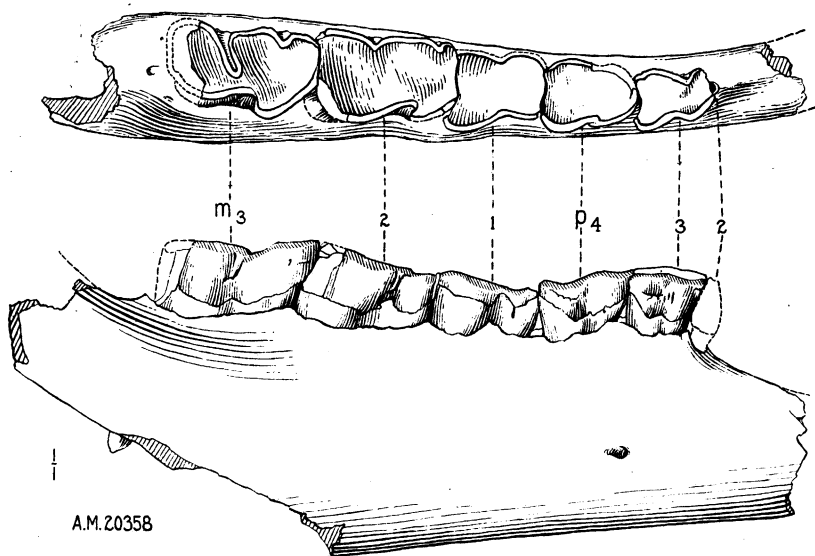


Fig. 6. *Ardynia præcox* Matthew and Granger, lower jaw with premolar and molar dentition, crown and outer views, natural size.

No. 20358, Ardyn Obo formation.

more primitive in its premolars. Both *Desmatotherium mongolicum* and *Paracolodon curtus* had apparently the same peculiar recession of the nasal notch that is seen in skulls of *Helalestes* collected by one of us in 1904, and has been observed by Peterson, 1919, and Troxell, 1922, in the type of this genus. The character is not known in the remaining species of this group, but may well have been distinctive of all of them, and would separate them from *Lophiodon*, *Chasmothorium* and *Hyrachyus*, as well as from *Systemodon* and *Isectolophus*. The beginnings of this recession are doubtfully seen in *Heptodon*.

***Ardynia præcox*, Matthew and Granger, 1923**

This small rhinocerotoid is represented by a number of fragmentary jaws and teeth. No. 20358, a lower jaw with p_3 - m_3 and alveolus of p_2 , shows the marked reduction in the lower premolars corresponding to that in the upper premolars of the type. The combined length of the three premolars was about half that of the three molars. A small round alveolus indicates that p_2 was reduced to a vestigial tooth. P_3 is reduced

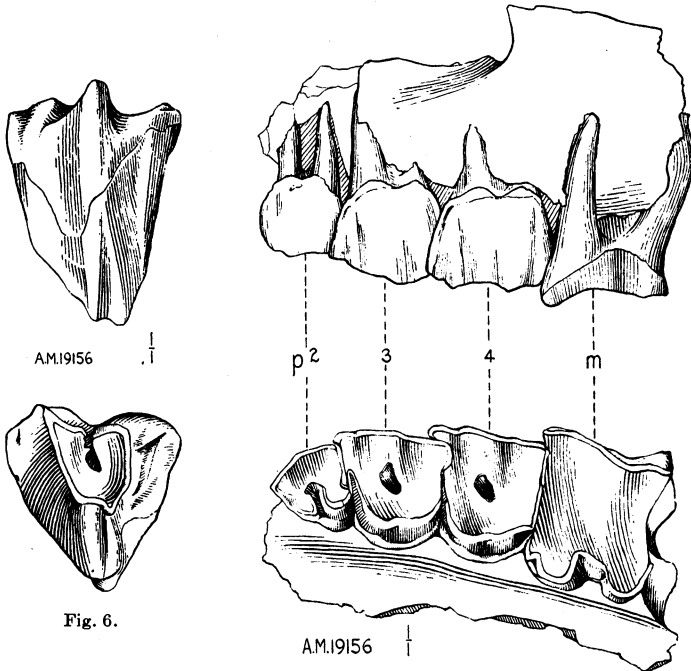


Fig. 6.

Fig. 7. *Ardynia præcox* Matthew and Granger, last upper molar, external and crown views, natural size.

Paratype, No. 19156.

Fig. 8. *Ardynia præcox* Matthew and Granger, part of upper jaw, outer and crown views of premolars and first true molar, natural size.

Type specimen, No. 19156.

anteriorly somewhat as in p_2 of *Hyracodon*. The second and third molars are subequal, the first considerably smaller and about equal in size to p_4 . No. 20386, lower jaw fragment with p_3 - 4 , has alveoli of p_2 , c_1 , and part of an incisor alveolus. The front teeth correspond in size and arrangement to *Hyracodon*.

"*Prothyracodon*" *uintense* Peterson resembles *Ardynia* to some extent, but appears to be more brachydont, and the premolars, so far as one may judge from the milk teeth, are not reduced. Peterson's species can hardly be congeneric with *P. obliquidens* (Scott and Osborn), in which m^3 retains the free posterior flange of the ectoloph, but may be comparable with *Prothyracodon* Koch of the Eocene of Hungary.

ARTIODACTYLA

LOPHIOMERYX Pomel

TYPE.—*L. chalaniati* from the Oligocene of France.

CHARACTERS.—Distal end of fibula separate from tibia. Navicular and cuboid united, median pair of metacarpals and metatarsals separate, not closely appressed, lateral metacarpals (and probably metatarsals) complete with slender shafts, distal

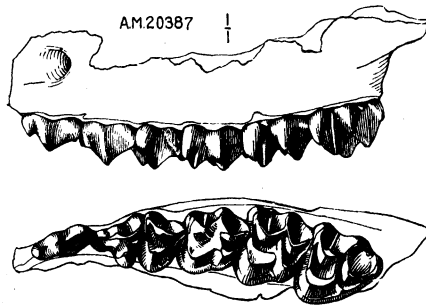


Fig. 9. *Lophiomeryx angarex*, new species, upper jaw, outer and crown views, natural size.

No. 20387. Last molar reversed from opposite side of jaw. Ardyn Obo formation.

keels very sharp posteriorly but not extended in any degree over anterior face of metapodials. Molars brachydont, with mostly crescentic cusps, hypocone of m^3 reduced or vestigial. Upper molar crescents in obliquely set pairs, outer styles prominent, anterior rib sharp and prominent, no trace of posterior rib. Fourth upper molar of two crescents, third non-crescentic, composed of three outer cusps in a row and a median internal cusp, the outer cusps partly united into a crest but more or less clearly distinguishable, middle cusp the highest. Third upper molar similar but no inner crests and anterior and posterior outer crests weaker.

Lower molars with imperfect inner crescents, the anterior flange of metaconid and posterior flange of entoconid in varying degree imperfect or absent. Heel of m_3 with two subparallel crests running forward from apex, the inner one imperfect, no inner cusp on heel.

Premolar composition of anterior, median, and posterior inner transverse crests, the last cingular (distinction from *Prodremotherium*) in position and imperfect, so that no closed pocket is formed between it and the median crest (distinction from *Eumeryx*); the anterior crest also little developed.

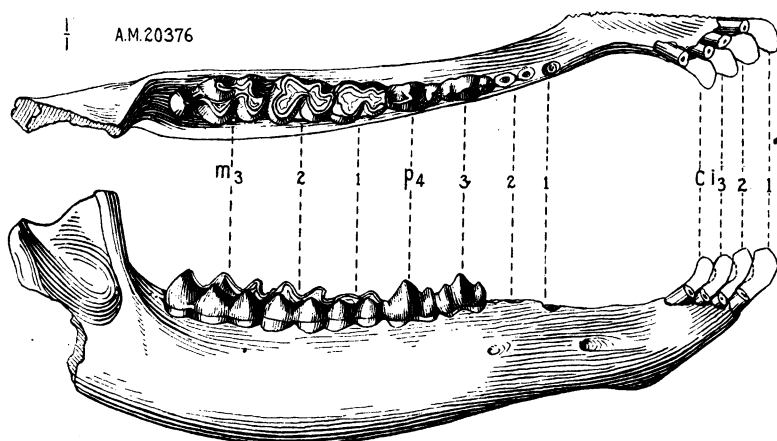


Fig. 10. *Lophiomeryx angaræ*, new species, lower jaw, outer and crown views, natural size.

Type specimen, No. 20376; the front teeth supplied from No. 20387.

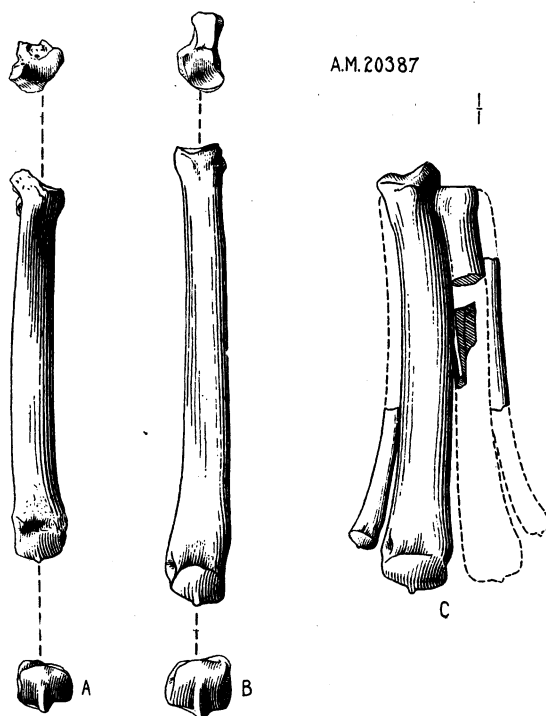


Fig. 11. *Lophiomeryx angaræ*, new species, foot bones associated with upper and lower jaws.

A, metacarpal iii, proximal, dorsal, and distal views. B, corresponding views of metatarsal iv. C, metacarpals articulated, incomplete, showing completeness and relative size of lateral digits. All natural size. No. 20387.

The characters specified above show, first, that we are dealing with a member of the pecoran-traguline division of the Selenodontia; second, that it is a traguloid, not one of the higher groups; third, that its affinities lie with *Prodremotherium*, *Gelocus*, *Leptomeryx*, and other early Oligocene genera of that group, but that it is more primitive than any of them in the complete separation of both metacarpals and metatarsals, as well as in the imperfection of the inner crescents of the molars, and various other details of composition of the teeth.

Gelocus retains a more primitive construction in the simple heel of m_3 and the simple trenchant premolars of traguloid type, but is much more progressive in reduction of lateral digits, union of metatarsals into a cannon bone, and compression of metacarpals, and in the transverse set of the upper molar crescent pairs. *Prodremotherium* has the molars of more distinctly cervid construction, premolars more progressive, metatarsals united and metacarpals compressed.

The above diagnosis is based upon the Ardyn Obo species, chiefly upon *L. angaræ*, of which we have numerous parts of jaws and skeleton bones, some of the foot bones partly articulated, found at two or three localities along the Chinese Post-road near Ardyn Obo. As there is no admixture of other artiodactyl remains, the association is reasonably certain. These specimens agree closely in dentition with *Lophiomeryx* from the Phosphorites received from the Munich Museum in 1896 and identified by Doctor Schlosser. As to the foot-construction, Schlosser remarks in the last edition of Zittel's Grundzüge that the "metapodials are separate," and places the genus in the traguline group, but we have failed to find any more detailed description or figures of the foot bones which might verify the generic reference of these Asiatic species. The close correspondence in teeth, however, renders it a highly probable one.

Lophiomeryx is typical from the Cournon (Stampian) but our comparisons are with the Phosphorites species referred to it. We have not personally verified the accuracy of this reference, but it rests upon the high authority of Schlosser and Stehlin.

***Lophiomeryx angaræ*, new species**

TYPE.—No. 20376, lower jaw, associated with No. 20387, a series of jaws and skeleton bones found together.

SPECIES DISTINCTION.— $P_1-m_3=60$; $m_1-3=32$. M^3 with vestigial hypocone; $p^2-m^2=49$; $m^1-3=29$. P_1 single-rooted, a short diastema behind it, a long one in front of it.

Lophiomeryx gobiæ, new species

TYPE.—No. 20381, lower jaw, associated with various fragmentary lower and upper jaws found together; Nos. 20379-80, upper jaws.

SPECIES DISTINCTIONS.— $M^1-3=24$ mm. Hypocone of m^2 well developed, although smaller than protocone. Three lower premolars. Metaconids of lower molars crescentic, the anterior crest complete. Premolar and molar construction otherwise resembling that of the larger species.

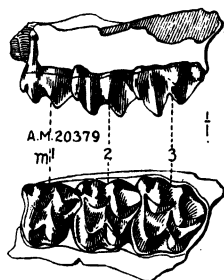


Fig. 12.

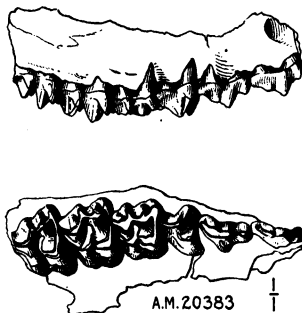


Fig. 13.

Fig. 12. *Lophiomeryx gobiæ*, new species, upper jaw, outer and crown views, natural size. No. 20379.

Fig. 13. *Miomeryx altaicus*, new genus and species, upper jaw, outer and crown views, natural size.

Type specimen, No. 20383.

There is some doubt about the reference of this species to *Lophiomeryx*, as it lacks p_1 and also one characteristic feature of the genus, the imperfect antero-internal crescent of the molars.

Miomeryx altaicus, new genus and species

TYPE.—An upper jaw, No. 20383, with p^2-m^3 .

Nearly related to *Lophiomeryx*, but distinguished by more brachydont molars, less development of inner cusps of premolars, stronger external ribs on anterior halves of molars, an external rib on p^4 , more rugose enamel. Size smaller than *L. gobiæ*; the length of $p^2-m^3=34$ mm.

P^2 has neither internal root nor cusp. Dimensions of p^3 are tr., $4.0 \times a-p.$, 7.5; of p^4 , tr., $6.4 \times a-p.$, 5.2, with medial anteroposterior width of 3.5. Corresponding dimensions of p^3 in *L. angaræ* are 6.0×8.5 ; of p^4 , 7.6×6.1 , with medial width of 4.9.

RATIOS	<i>M. altaicus</i>	<i>L. angaræ</i>
P^3 a-p	100	100
P^3 tr.	53%	71%
P^4 a-p	100	100
P^4 tr.	123%	124%
P^4 med. width	67%	80%

The molars of this genus compare nearly with specimens from the Phosphorites identified by Doctor Schlosser as *Bachitherium*. We have no premolars for comparison, and Filhol's figures of the upper dentition of the type species *B. insigne* do not agree well in the molars and have obviously a distinct type of premolars, the inner crescents well developed on both p^3 and p^4 . Filhol's figures are obviously not very accurate and represent referred specimens which may well belong to another genus; but we have not found any published redescription of the genus or any accurate figures. Pending an adequate revision of the Phosphorite artiodactyls, it appears better to record the Gobi genus as new. It is, however, nearly related to certain material from the Phosphorites, whatever name properly applies to that material.

Leptomeryx, the nearest American genus, differs in the better development of inner cusps on the premolars, in higher crowned molars with weaker anteroexternal rib and less rugose enamel.

LIST OF ARDYN OBO FAUNA AS IDENTIFIED MARCH 1, 1925

CARNIVORA

Oxyænidæ

Ardynictis furunculus, n. g., n. sp. front of skull and lower jaws

Hyænodontidæ

Hyænodon eminus, n. sp. lower jaws, upper molar

? Canidæ

? *Cynodictis*. front of lower jaw

RODENTIA

? Ischyromyidæ

Ardynomys olseni, n. g., n. sp. lower jaws

Ardynomys chihi, n. sp. lower jaws

Ochotonidæ

Desmatolagus robustus M. and G. lower jaws

PERISSODACTYLA

Titanotheriidæ

Brontops gobi Osborn. skull and jaws, etc.

Chalicotheriidæ

Schizotherium avitum M. and G. m₃; part of lower jaw

Helæletidæ

Colodon inceptus, n. sp. upper jaw

Paracolodon curtus, n. g., n. sp. part of upper jaw

? Hyracodontidæ

Ardynia præcox M. and G. parts of upper and lower jaws

Amynodontidæ

Cadurcotherium mongoliense Osborn. skulls, jaws, part of skeleton

? AMBLYPODA

Gen. indet. fragment of skull with horn

ARTIODACTYLA

? Anthracotheriidae

Gen. indet. lower molar

Hypertragulidae

Lophiomeryx angaræ, n. sp. numerous jaws, parts of feet*Lophiomeryx gobiæ*, n. sp. upper and lower jaws*Miomeryx altaicus*, n. g., n. sp. upper jaw

CHELONIA

Testudo insolitus M. and G. parts of carapace and plastron;
lower jaw.

CORRELATION OF THE ARDYN OBO

Present evidence indicates that this fauna is older than the Hsanda Gol, approximately equivalent to the *Titanotherium* zone in the American succession and probably to the Sannoisian or Ludian faunas of Europe. There is, however, little or nothing on which to base any exact correlation with the European succession. The absence of any higher types of Artiodactyla, of true rhinoceroses, of higher Carnivora, with one doubtful exception, and of any Oligocene rodents, gives the fauna a broadly Eocene aspect, while the specialized stages reached in the various Eocene phyla point to its being at least at the end of the Eocene. It appears distinctly older than the Hsanda Gol in the survival of titanotheres and perhaps of amblypods, absence of the Rhinocerotidae, of the higher Carnivora and more specialized rodents of that fauna, and especially in the tragulid ruminants in contrast to the cervid *Eumeryx* of the Hsanda Gol. The creodonts are more primitive stages in the same phyla. It is decidedly more advanced than the Irdin Manha and Shara Murun faunas as shown by the more progressive titanotheres, tragulids, lophiodonts and hyænodonts.