59.92E(117:71.2)

Article XXV.—A MARSUPIAL FROM THE BELLY RIVER CRETACEOUS. WITH CRITICAL OBSERVATIONS UPON THE AFFINITIES OF THE CRETACEOUS MAMMALS.

By W. D. Matthew.

Plates II–VI.

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I. Review of Previous Knowledge of Upper Cretaceous Mammals.

Cretaceous mammals are exceedingly rare and extremely fragmentary. In the upper or true Cretaceous they are known only from Western North America. The earliest record dates back to forty years ago, in 1876, when Professor E. D. Cope [1] described under the name of *Paronychodon lacustris* a tooth from the Judith River formation of Montana, which he supposed to be reptilian but which has since been recognized (Osborn 1891) as the incisor tooth of a multituberculate mammal, probably related to *Ptilodus*.[2] The first discovery of recognized mammals is due to Dr. J. L. Wortman, who found in 1882 two teeth and a fragment of a humerus in the Lance formation of Wyoming, which were described by Professor Cope [3] under the name of *Meniscoëssus conquistus*. The type specimens of *Paronychodon* and *Meniscoëssus* are in the American Museum Cope Collection. The second tooth associated with the primary type of *M. conquistus* was described as a premolar. It is not mammalian, but is the tooth of an ankylosaurid dinosaur, either *Palæoscincus* or some near ally. The distal end of

[1] Cope, 1876. Descriptions of some Vertebrate Remains from the Fort Union Beds of Montana. Palæont. Bull. No. 22, Nov. 13, 1876, repub. in Proc. Acad. Nat. Sci. Phila., 1876, p. 256.

[2] Professor Osborn identifies it provisionally as *Meniscoëssus*.

[3] Cope, 1882. Mammalia in the Laramie Formation. American Naturalist, Vol. XVI, pp. 830–831.

the humerus is mammalian, and probably multituberculate, but appears too small to belong to *Meniscoëssus.*

Eighteen genera and thirty-one species were published by Marsh in 1889 [1] and 1892,[2] all of them based upon a collection of teeth and fragmentary jaws obtained by Hatcher, Beecher and Peterson from ant-hills and small washes and blowouts in the Lance formation of Niobrara County (formerly included in Converse Co.) Wyoming. This collection is chiefly in the Yale University Museum, partly in the National Museum at Washington. The localities and occurrence of these ant-hill fossils are briefly described in a very interesting article recently contributed by Professor Lull to Popular Science Monthly [3] and more fully discussed in an article in the American Journal of Science.[4]

The most complete specimen known from the Lance is the incomplete upper and lower jaw found by Doctor Wortman in South Dakota and described by Cope in 1892 [5] under the name of *Thlæodon padanicus.* This important specimen is also in the American Museum Cope Collection, and is redescribed and refigured in section III of this paper.

Osborn in 1891 [6] published a review of parts i and ii of Marsh's Discovery of Cretaceous Mammalia, in which the genera were revised and the various teeth provisionally correlated on the evidence then available. In 1893 [7] Osborn described in part a second ant-hill collection of fossil mammals from the Lance formation, obtained by Wortman and Peterson for the American Museum. He figured and correlated a series of multituberculate and trituberculate teeth, identifying certain types with the genera described by Cope and Marsh, and discussed the affinities of both groups and the faunal relations of the Cretaceous mammals. In 1898 [8] Osborn applied to three of the unnamed types of his 1893 paper the names *Synconodon sexicuspis, Ectoconodon petersoni* and *Protolambda hatcheri,* comparing them with the Periptychidæ and Pantolambdidæ of the Paleocene Amblypoda.

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[1] Marsh, 1889. Discovery of Cretaceous Mammalia, Part I, American Journal of Science, Vol. XXXVIII, pp. 81–92, pll. ii–v; Part II, *ibid.* pp. 177–180, pll. vii–viii.

[2] Marsh, 1892. Discovery of Cretaceous Mammalia, Part III, Amer. Journ. Sci., Vol. XLIII, pp. 249–262, pll. v–x.

[3] Lull, R. S., 1915. Ant-Hill Fossils. Pop. Sci. Monthly, Sept. 1915, pp. 236–243.

[4] Lull, R. S., 1915. The Mammals and Horned Dinosaurs of the Lance Formation of Niobrara County, Wyoming. Amer. Journ. Sci., Vol. XL, pp. 319–348.

[5] Cope, 1892. On a New Genus of Mammalia from the Laramie Formation. Amer. Nat., September, Vol. XXVI, p. 758, pl.

[6] Osborn, 1891. A Review of 'Discovery of the Cretaceous Mammalia.' Amer. Nat., Vol. XXV, pp. 595–611, 12 text figures.

[7] Osborn, 1893. Fossil Mammals of the Upper Cretaceous Beds. Bull. Amer. Mus. Nat. Hist., Vol. V, pp. 311–330, pll. vii–viii.

[8] Osborn, 1898. Evolution of the Amblypoda, Part I, Taligrada and Pantodonta. Bull. Amer. Mus. Nat. Hist., Vol. X, pp. 169–218. See pp. 170–172 and fig. 1.

Lambe in 1902 [1] described two mammals from the Belly River, *Ptilodus primævus* and *Boreodon matutinus*, the first record of fossil mammals from this formation. The former species was based upon a jaw fragment with two well preserved teeth, the latter upon a single imperfect premolar tooth.

Somewhat in contrast to the rapid advance of our knowledge of American Tertiary mammals, little or nothing has been done with the Cretaceous mammals during the last twenty-three years since Osborn's paper of 1893. No further systematic studies have been made [2] upon the material already collected, and until very recently no further collections have been made, save for the two types described by Lambe. Doctor Lull in his recent paper refers to the additional material obtained by his party from the Lance and it is to be hoped that this will lead to the revision of the fauna which is greatly needed. I have from time to time studied these mammals in a desultory way in connection with new discoveries or researches among the early Tertiary mammals. My conclusions were briefly outlined incidentally to a discussion of the correlation of the later Cretacic and early Tertiary formations.[3] They may now be more fully expressed, as follows:

1. *The Multituberculates.* More than half the material belongs to two or more genera of Multituberculata (*Meniscoëssus* and *Cimolomys,* perhaps other small forms) allied to *Polymastodon, Ptilodus* and other Paleocene genera. The position of the Multituberculata has been variously estimated, some authorities associating them with Monotremes, others with Marsupials. So long as they were known only from teeth and jaws their affinities were a rather speculative and doubtful problem, not to be taken too seriously. Within the last few years, however, skulls and skeletons have been discovered of the Paleocene genera, and it is now possible to arrive at a reasonably certain estimate of their approximate relationships. The first of these discoveries was a skull and jaws with important parts of the skeleton of *Ptilodus* from the Fort Union formation, described by J. W. Gidley.[4] Mr. Gidley concluded that it was most nearly allied to the diprotodont marsu-

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[1] Lambe, 1902. New Genera and Species of the Belly River Series (Mid-Cretaceous), p. 79, pl. xv, figs. 13–15, in Osborn and Lambe, Vertebrata of the Mid-Cretaceous of the North West Territory. Contrib. Can. Pal., Vol. XXX (Quarto), Geol. Sur. Canada, Sept. 1902.

[2] Gidley in 1906, Proc. Wash. Acad. Sci., Vol. VIII, pl. v, figured two teeth from the Lance formation in illustration of a discussion upon the origin of the tritubercular molar. Osborn, 1907, Evolution of the Mammalian molar teeth, pp. 95–97, fig. 47, and Gregory, 1910, The Orders of Mammals, p. 169, have discussed their evidence from the same viewpoint, but without adding anything to the evidence as to their affinities.

[3] Matthew, 1914. Evidence of the Paleocene Vertebrate Fauna on the Cretaceous-Tertiary Problem. Bull. Geol. Soc. Amer., Vol. XXV, pp. 381–402.

[4] Gidley, 1909. Notes on the Fossil Mammalian Genus Ptilodus with Descriptions of New Species. Proc. U. S. Nat. Mus., Vol. XXVI, pp. 611–626, pl. 70.

pials. In 1910, W. K. Gregory,[1] after critical consideration of the evidence afforded by Gidley's *Ptilodus* skeleton, concluded that while related to the Marsupials, the Multituberculates should be considered as a distinct order, paralleling the diprotodont Marsupials, but not closely related or ancestral. In 1914, a skull of *Polymastodon* from the Puerco formation found by Dr. W. J. Sinclair was described by Dr. R. Broom,[2] who maintained that the Multituberculates were more nearly allied to the Monotremes and probably ancestral to them. A more complete skeleton of a genus closely allied to *Ptilodus* was obtained from the Torrejon by Dr. Sinclair in 1913 and described by Mr. Walter Granger in 1915 and 1916. Mr. Granger [3] concludes that the multituberculates, while more nearly allied to the marsupials than to the monotremes, are fundamentally distinct from either, representing apparently a separate branch of the mammalian phylum, which parallels certain marsupials in many respects, and monotremes in a few others but is in fact only distantly related, and may even be regarded as a separate sub-class, coördinate with Prototheria, Metatheria and Eutheria, and equivalent in its stage of evolution to the Metatheria. To such a sub-class, if accepted, Marsh's term Allotheria would properly apply.

So far as the Upper Cretaceous and Paleocene multituberculates are concerned the evidence in favor of Mr. Granger's conclusions appears to me to be fairly conclusive. I am somewhat less certain about the affinities of *Plagiaulax* and its allies, and decidedly doubtful about the real position of *Tritylodon.*

The teeth of multituberculates are so highly characteristic and peculiar that there can be no doubt as to the near relationship of the Cretaceous genera to those of the Paleocene. It is also clear, as Osborn pointed out in 1891 and 1893, that the eight genera described by Marsh represent not more than two clearly defined generic types, *Meniscoëssus* Cope [4] and *Cimolomys* Marsh, the latter representing probably several closely allied genera of the *Ptilodus* group, which cannot be differentiated until better known.

2. *The Trituberculates.* The remainder of the Cretaceous mammals have tritubercular molars, but their affinities are uncertain. Teeth of similar type are found among polyprotodont marsupials, Insectivora, Chiroptera and creodonts and the earliest known stages in the evolution of

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[1] Gregory, 1910. The Orders of Mammals. Bull. Amer. Mus. Nat. Hist., Vol. XXVII, pp. 166–170.

[2] Broom, 1914. On the Structure and Affinities of the Multituberculata. Bull. Amer. Mus. Nat. Hist., Vol. XXXIII, pp. 115–134.

[3] Granger, 1915. New Evidence of the Affinities of the Multituberculata (Abstract). Bull. Geol. Soc. Amer., Vol. XXVI, p. 152. Granger, 1916, in Amer. Mus. Bull., not yet published.

[4] *Meniscoëssus* is said to be related to *Polymastodon* (*Tæniolabis*); its affinities may perhaps be somewhat closer with *Catopsalis*, a related but smaller genus from the same horizon as *Polymastodon.*

artiodactyls, perissodactyls, condylarths, taligrades, tæniodonts, rodents, lemuroid primates etc. are either typically tritubercular, or clearly derivable from a tritubercular ancestry. These isolated teeth might represent marsupials or they might include ancestors of almost any or all of the placental orders. Marsh (1892, p. 257) regarded them as chiefly marsupials and compared them with *Didelphis* in particular, but intimated that others might be allied to the Insectivora. Osborn (1893, pp. 326, 329, 330) regarded them as representing doubtfully both marsupials and early ancestral placental types, while referring the multituberculates to the monotremes in accord with current views at that date.

No additional collections or better specimens of trituberculates have since been obtained from the Lance, and the evidence is still in the same unsatisfactory condition as in 1893. Some specimens show or indicate the characteristic marsupial angle of the jaw, but this was never shown to be associated with any particular type of teeth, except in *Thlæodon,* and Cope's description of this genus is erroneous and misleading in several important points. The dental formula was unknown in any of them, and while for various reasons it seemed probable that most or all of these Cretaceous trituberculates were marsupials, there was no conclusive proof of it. On the other hand there was not and is not any valid evidence for placing any of them in the placental group.

The Cretaceous age of the Lance formation has likewise been challenged. This problem I have elsewhere discussed,[1] and will merely observe now that my conclusions as to the relations of the vertebrate faunas from the Belly River Cretaceous to the Wasatch Eocene are confirmed on various points by subsequent discoveries and that I have seen no occasion to modify the opinions therein expressed. The specimen here described adds materially to the evidence that the Lance mammalian fauna was essentially Cretaceous, nearly related to that of the Belly River, sharply distinct from that of the Paleocene in that it consisted exclusively of multituberculates and marsupials, with no placental element, while that of the Paleocene is dominantly placental with a few surviving multituberculates and no recognized marsupials although a few of these may have been present.

Paronychodon of the Judith River is probably a multituberculate but not further determinable at present.

Of the two specimens described by Lambe from the Belly River one is certainly related to *Çimolomys* (*Cimolodon*) of the Lance and apparently not generically separable. The second (*Boreodon*) has been compared with *Thlæodon* but is practically indeterminate. The jaw here described is

[1] Matthew, 1914, *l. c.*

related to the Cimolestidæ of the Lance. Its marsupial affinities appear to be unquestionable, and afford evidence that the Cimolestidæ are nearly related to the Didelphidæ and at present cannot be separated from them by any distinctions of family value. The opossums appear therefore to have survived since the Cretaceous with comparatively little change.

The bearing of this upon the antiquity of the marsupial type of skull and dentition is obvious. Some authorities have held that the marsupial dentition is derived from that of the placentals through the partial suppression of the premolar replacement and that their inflected jaw is likewise a secondary feature. If this be true, we must at least suppose that the differentiation of the two phyla took place far back in the Mesozoic. The marsupials are certainly not derivable from early Tertiary Creodonta as Lydekker has suggested for the specimen here described shows that the modern didelphid type of marsupial long antedates the Tertiary. We cannot on the other hand suppose that the Tertiary placentals are derived from late Mesozoic marsupials, for there is no approach in any Paleocene placentals to the marsupial type.

II. Eodelphis browni, New Genus and Species.

Plates II–VI and Text-Figs. 1–4.

Diagnosis. Order Marsupialia. Family Cimolestidæ = ?Didelphidæ.

Eodelphis browni gen. et sp. nov.

Type, No. 14169, left ramus of lower jaw nearly complete, symphyseal portion of right ramus; right zygomatic arch and temporal region of skull.

Horizon, Cretacic (Montana group) Belly River formation.

Locality, Sand Creek, 15 miles below Steveville, Red Deer River, Alberta.

Collector, Barnum Brown, American Museum Expedition of 1915.

Ordinal Characters.

(1) Three premolars, four true molars.

(2) Angle of jaw inflected in the usual marsupial style.

(3) Posterior end of jugal extending backward to take part in glenoid articulation.

(4) Occipital exposure of mastoid extensive.

Family characters.

(1) Incisors small, canine large, laniary, premolars trenchant, simple, molars tritubercular with large basin heels (as in Didelphidæ).

(2) Glenoid articulation transverse, deeply excavated, postglenoid process prominent (as in Didelphidæ).

(3) Incisors reduced in number (apparently more or less reduction in all the Cretaceous genera, but this is a character of doubtful family value).

Generic characters.

(1) Three lower incisors, the second somewhat enlarged, others minute, crowded, vestigial.
(2) No diastemata behind canine (cf. *Chironectes*).
(3) Symphysis compact, anterior portion of jaw rather deep and short, massive.
(4) Trigonids of molars moderately high, wider than long, protoconid not overtopping paraconid and metaconid, the paraconid not extended forward but equalling or slightly overtopping the metaconid in height.
(5) Angular process similar to *Didelphis* but broader.
(6) Coronoid process high, broad, condyles little above level of tooth row.
(7) Lower border of zygomatic arch compressed, thin.
(8) Occiput wide; mastoid exposure broad (cf. *Sarcophilus*); post-tympanic process a prominent plate.

Circumstances of Discovery. The specimen was discovered by Mr. Brown while engaged in undermining a Ceratopsian skull beneath which it lay. Being thus accidentally found during work with a heavy pick, it was badly shattered, and only by careful and thorough search was it possible to recover most of the fragments, while some were irrecoverably lost or destroyed. The specimen was entrusted to Mr. A. E. Anderson, and under his skilful ministrations the fragments were all accurately pieced together, the matrix removed and the specimen photographed and mounted. Considering the circumstances of discovery and the delicate fragile character of the fossil, both Mr. Brown and Mr. Anderson are to be congratulated upon the remarkably successful results of their labors. The jaw has suffered no important loss save for the condyle and part of the coronoid process; there may have been originally more of the skull than is now preserved, but from the absence of any fragments of other portions it is probable that very little has been destroyed.

Horizon, locality and accompanying fauna. It is most fortunate that this specimen is from a formation whose Cretaceous age cannot be questioned. The section along the Red Deer River [1] is an undisturbed one and shows the Belly River non-marine sandstones and shales lying between an upper and a lower member of the marine Cretaceous Fort Pierre formation equivalent to the Upper Senonian of Europe. The locality is a richly fossiliferous pocket from which Mr. Brown has secured for the American Museum a fine series of skulls and skeletons of dinosaurs. The genera are identical with or equivalent to the Judith River dinosaurs of Montana, and represent throughout earlier stages of the same phyla of dinosaurs as are

[1] Brown, 1914, Bull. Geol. Soc. Amer., Vol. XXV, p. 359.

found in the Lance formation and its equivalents in Montana, Wyoming and Colorado. The same relations hold true in other groups of reptiles, and, so far as the rarity of material permits comparison, in the mammals as well.

Partial List of Associated Fauna.[1]

Mammalia.
- *'Ptilodus' primævus* Lambe, cf. *Cimolodon* Marsh.
- *Boreodon matutinus* Lambe, cf. *Stagodon* Marsh.
- *Eodelphis browni* nom. nov., cf. *Cimolestes* Marsh (partim).

Dinosauria.
- *Kritosaurus notabilis* (Lambe).
- *Trachodon marginatus* Lambe.
- " *selwyni* Lambe.
- " *altidens* Lambe.
- "*Stephanosaurus marginatus*" Lambe.
- *Hypacrosaurus altispinus* Brown.
- *Corythosaurus casuarius* Brown.
- *Monoclonius dawsoni* (Lambe).
- " *flexus* Brown.
- *Ceratops belli* (Lambe).
- " *canadensis* (Lambe).
- *Styracosaurus albertensis* Lambe.
- *Ankylosauridæ* sp. div.
- *Palæoscincus* sp.
- *Deinodon* sp. div.
- *Gorgosaurus libratus* Lambe.
- *Ornithomimus altus* Lambe.
- Gen. indesc. (Theropoda).
- *Stegoceras validus* Lambe (incertæ sedis).
- *Troödon formosus* Leidy (incertæ sedis).

Testudines.
- *Aspideretes foveatus* (Leidy).
- *Basilemys variolosa* (Cope).
- *Baëna antiqua* Lambe.
- *Boremys pulchra* Lambe.
- *Neurankylus eximius* Lambe.

Plesiosauria.
- *Cimoliasaurus* sp.

Rhynchocephalia.
- *Champsosaurus profundus* Cope.
- " *annectens* Cope.
- " *brevicollis* Cope.

Crocodilia.
- *Crocodilus humilis* Leidy.
- *Leidyosuchus canadensis* Lambe.

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[1] B. Brown, 1914, Bull. Geol. Soc. Am., Vol. XXV, p. 378.

Batrachia.
    ?*Scapherpeton tectum* Cope.
Pisces.
    Myledaphus bipartitus Cope.
    Accipenser albertensis Lambe.
    Lepisosteus occidentalis Leidy.
    Rhineastes cruciferus (Cope).
    Diphyodus longirostris Lambe.
Invertebrates.
    Unio danæ Meek & Hayden.
    " cf. *supenawensis* Stanton.
    Anodonta propatorius White.
    " sp.
Plants.
    Cunninghamites ?elegans Endlicher.
    Dammara sp.
    Castalia stantoni Knowlton.
    " sp. indesc.
    Aspidium sp.

Dammara acicularis Knowlton.[1]
Cunninghamites pulchellus Knowlton.
Populus cretacea Knowlton.
Castalia stantoni Knowlton.
Carpites judithæ Knowlton.

Description and Comparisons. The left ramus is complete except for the condyle and part of the coronoid process. The posterior molars are well preserved, the anterior ones damaged by corrosion and shattering; the premolars, canine and incisors are badly corroded, so that the enamel and more or less of the dentinal surface has disappeared and the original outlines must be inferred from the character of the corroded surfaces. The jaw has not been seriously damaged. A second fragment consists of the symphysis of the right ramus with the incisors and canine also badly corroded on the crowns. A third fragment consists of the anterior part of the zygoma, with most of the jugal and part of the zygomatic process of the maxillary. The posterior end of the jugal and its superior branch have been completely destroyed by corrosion, but the infra-orbital portion is well preserved, and most of the squamosal suture. The fourth fragment consists of most of the squamosal with the mastoid portion of the periotic bone. The glenoid and postglenoid regions are complete and well preserved, but the end of the zygomatic process is broken off, part of the cranial plate of the squamosal missing and the petrous portion of the periotic is broken off.

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[1] The following are also reported by W. J. Wilson in the Annual Report for 1915, Can. Geol. Sur., p. 205, as identified by Dr. Knowlton from collections made by Mr. C. H. Sternberg for the Canadian Survey.

Teeth: The *first incisor* is minute, its alveolus postero-internal to i_2. The *second incisor* is of moderate size, much smaller than the canine, not notably procumbent, the root rounded, the crown destroyed by corrosion. The *third incisor* is also minute its alveolus external to that of i_2, the crown corroded down to the roots. The *canine* is somewhat larger than in *Didelphis,* proportioned much as in that genus but apparently somewhat less curved and more ridged posteriorly. Its root is flat, oval in cross section and the crown has also lost heavily by corrosion. The premolars are not spaced. The *first premolar* is small, one-rooted, and had apparently a simple pointed compressed-oval crown, mostly corroded away. The *second premolar* is larger, two-rooted, with flattened-oval pointed trenchant crown

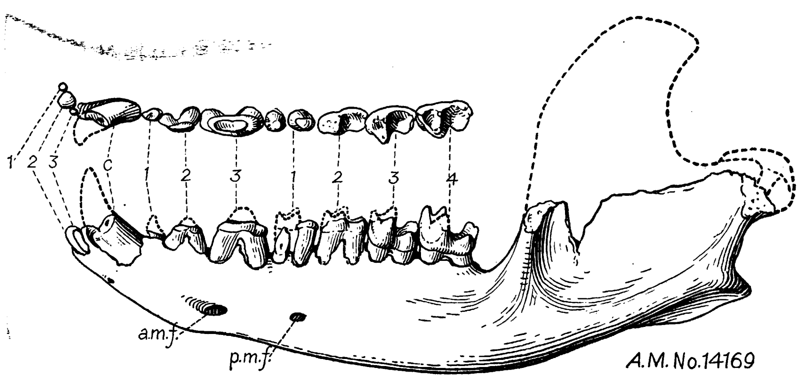

Fig. 1. ***Eodelphis browni,*** **lower jaw of type, external view, and crown view of teeth, three halves natural size, No. 14169 *a.m.f.*, anterior mental foramen; *p.m.f.*, posterior mental foramen.**

and a small heel, so far as one can judge from what remains. The *third premolar* is larger than p_2, intermediate in characters between the second and third premolars of *Didelphis,* but the crown is considerably damaged by corrosion, and the tip broken off.

Of the *first molar* little remains but the roots, the crown being corroded and most of it lost. Its position in the jaw, more fully emerged than either p_3 or m_2 indicates it as belonging to the primary series (milk-molars and molars) and in view of the evident maturity of the animal, as shown by the wear of the molars, it is clearly not a deciduous tooth. It must therefore be assigned to the true molars as in the marsupials, and is not a milk-molar followed by a successional or premolar tooth as is the corresponding tooth of the placental mammals.[1]

[1] Note on the Marsupial and Placental tooth formulas:— It is commonly stated that the marsupials have three premolars and four molars, the placentals four premolars and three molars. Although the premolars are usually simpler than the molars the essential difference lies not in the form of the teeth but in their replacement. The four anterior cheek teeth (milk molars) of the placental

The *second molar* is much worn although not badly corroded, and except that it is similar in size and general proportions to m_3 deserves no especial comment.

The *third molar* has a short moderately high trigonid and long deeply basined heel. The paraconid and metaconid are broken off, but were apparently of nearly equal height, much closer together than in *Didelphis* and the protoconid is somewhat lower and stands well apart from the inner cusps; entoconid and hypoconulid are high, distinct, close together at the postero-internal side of the basin, the hypoconid external and lower. There is a strong anteroexternal cingular ledge on the trigonid, similar to that in *Didelphis* but rising up sharply towards the much higher paraconid.

The *fourth molar* has the same construction as the third, save that the

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mammal are succeeded by a second or successional series, the true premolars. In the marsupial the third cheek tooth has a milk predecessor, the others do not, except that in certain South American Tertiary polyprotodonts the canines and anterior premolars are said to have milk predecessors.

The most probable interpretation of the difference in dental formula I take to be this; that in the marsupials the first dentition has been suppressed save for dp$\frac{3}{3}$ and the true molars, while the second dentition is not developed behind p$\frac{3}{3}$; in the placentals the first dentition is complete, except for dp$\frac{1}{1}$, the second developed as far back as p$\frac{4}{4}$. The dental formulæ would then be:

Marsupials:

incisors canine premolars molars
1.2.3....1.....1.2.3.... (Second Series)
3....1.2.3.4 (First Series)
———————————————
3....1.2.3.4 (First Series)
1.2.3....1.....1.2.3.... (Second Series)

Placentals:

incisors canine premolars molars
1.2.3....1.....1.2.3.4 (Second Series)
1.2.3....1.......2.3.4....1.2.3 (First Series)
———————————————
1.2.3....1.......2.3.4....1.2.3 (First Series)
1.2.3....1.......2.3.4.... (Second Series)

It is quite possible that the additional incisors in some marsupials may have been originally characteristic of the group instead of being a secondary result of intercalation of one dentition with the other, or of reduplication. Parallel instances may be cited among the placentals for either method of increasing the number of the teeth; but reduction from an original number of four or five is suggested by the fact that some of the Jurassic mammals display this number. But as the relations of these mammals are very doubtful and the oldest known marsupials show three or less, and the primary placental formula is certainly three, it appears simpler to assume an identical formula as above for the common ancestral stock of marsupials and placentals, the subsequent differences arising through the evolution of the second or replacing series of teeth and the partial suppression of the first series, additional incisors being acquired in some marsupials through reduplication.

However this may be, the fossil specimens allow of the recognition of molar and premolar teeth through their relative emergence. The first true molar is erupted with or shortly after the preceding milk molar, but before the successional premolar. The posterior molars are successively erupted after the first true molar. In consequence, the first true molar whether of a marsupial or a placental, is more completely emerged, and the base of the crown stands higher above the alveolar border than the premolar in front of it or the second true molar behind it. If the jaw were immature, and the last molar not yet or only partly erupted, one might suspect that the tooth occupying this position was a milk molar, but in the present instance the maturity and considerable wear of the teeth precludes this view. It appears to me beyond reasonable doubt therefore that the tooth formula in *Eodelphis* is as stated above.

hypoconulid is somewhat more separated from the entoconid. It is less damaged by corrosion than any of the other teeth, the enamel being nearly all preserved, and the points of the cusps intact except for the protoconid, which has lost the tip. The characteristic features are the short wide trigonid with paraconid and metaconid internal, distinct, but much closer together than in *Didelphis,* the paraconid somewhat higher than the metaconid, the protoconid external, anteroposteriorly compressed, somewhat lower apparently than the metaconid, certainly lower than paraconid, the large deeply basined heel with external hypoconid and posterointernal angle extended upward into a double cusp (entoconid-hypoconulid) decidedly higher than the hypoconid; the strong basal cingulum on the anteroexternal face of the trigonid rising sharply towards the high paraconid.

Compared with *Didelphis,* the paraconid is much higher, the trigonid shorter anteroposteriorly, the protoconid lower, the talonid of the last molar much larger and more like those of the preceding molars, all having the posterointernal angle more projecting and its cusps much higher.

The basal cingulum in *Didelphis* does not rise up so sharply towards the internal side. In general the trigonid of *Didelphis* comes much nearer to the carnivorous type, with high protoconid, paraconid projecting far forward, basin lower on the inner side, reduced and wedge-shaped talonid on m_3.

The characters of the lower molars in *Eodelphis* indicate that m^4 was not transverse as in *Didelphis* and that the metastyles of m^{1-3} were not extended into shearing crests.

The lower molar figured by Marsh as *Cimolestes curtus* is somewhat similar to the posterior molars of *Eodelphis* but the metaconid is more reduced, heel wider and shorter, its marginal cusps less differentiated and the posterointernal cusps not so high or backwardly prominent. The tooth is considerably larger, agreeing more nearly with *Thlæodon* in size.

Among modern polyprotodonts the exaggerated height of the inner cusps and reduction of the external row is carried much further in *Myrmecobius* in which the outer cusps of the lower molars have become vestigial, and correlatively the inner cusps of the upper teeth have almost wholly disappeared.

I do not find any near parallel among placental mammals to the molar construction of *Eodelphis.*

The *lower jaw* is shorter and more robust than in *Didelphis,* the anterior portion rising more abruptly to a stouter symphysis, the symphyseal suture about twice as long as wide. There is no trace of a meckelian groove. The posterior mental foramen is beneath m_1; the anterior mental foramen is larger, and situated beneath the anterior root of p_2. The dental foramen is larger than in *Didelphis* and considerably further forward, situated about half way between the last molar and the posterior border of the angle and slightly below the level of the alveolar line. The angle is much as in the opossum so far as preserved except that it is considerably broader, but the point of the angular process is broken off. The masseteric fossa is deeply excavated, more sharply defined anteriorly than in *Didelphis*, with prominent inferior border as in that genus.

The *jugal* is thin and of moderate width, the lower border comes to a thin edge with no trace of the broad flattened surface so characteristic of the opossum and many of its relatives.

The glenoid fossa is deep, broad, transversely extended more than in the opossum, and the postglenoid process about the same. The preglenoid

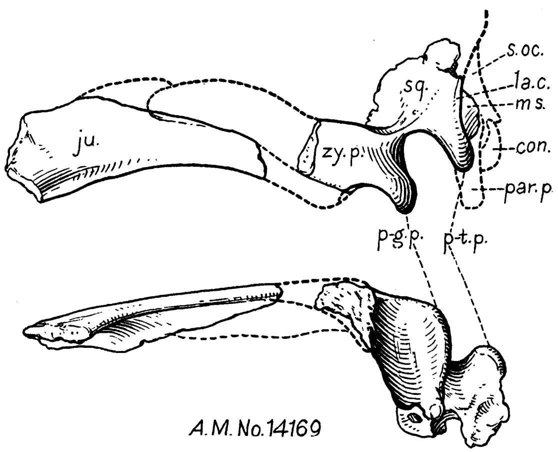

Fig. 2. *Eodelphis browni*, fragments of skull of type, side and under views, three halves natural size. The missing portions of the zygomatic arch and occipital region are partly restored in dotted outlines. Lettering as follows: *con.*, occipital condyle; *la.c.*, lambdoidal crest; *ju.*, jugal; *ms.*, mastoid portion of periotic; *par.p.*, paroccipital process; *p.-g.p.*, postglenoid process; *p.-t.p.*, posttympanic process; *s.oc.*, supraoccipital; *sq.*, squamosal; *zy.p.*, zygomatic process of squamosal.

process of the jugal is lost, but its broad triangular sutural union shows upon the surface of the squamosal, exactly as in the opossum. The anterior end of the jugal is broken off, but enough is preserved to show that the floor of the orbit was defined by a low ridge, partly on the posterior end of the maxillary and partly on the inner face of the jugal, somewhat better defined than in the opossum; the squamous suture of the maxillary with the jugal seems to be much the same save that the maxilla ends posteriorly in a broader plate. The posterior branch of the jugal is deeper than in the opossum although not so thick; its upper border in advance of the squamosal suture is defective, but apparently the zygomatic process of the squamosal did not extend so far forward, nor was the superior border of the jugal as high or as much extended over the inner face and superior border of the squamosal process.

Most of the *squamosal* bone is preserved. The glenoid fossa is somewhat wider than in *Didelphis;* the alisphenoid does not extend outwards along its anterior margin as in that genus, but ends abruptly at its inner border; a large diploë lies apparently between the alisphenoid and the glenoid portion of the squamosal, excavated in the latter bone above the inner end of the glenoid fossa.

The posttympanic process has the same general construction as in *Didelphis* but is more prominent and set further outward, its external margin nearly as far out as the middle of the glenoid fossa. This with the much wider mastoid exposure, the failure of the alisphenoid to extend out on the anterior border of the glenoid fossa, and the greater transverse width of the latter, all agree in indicating a decidedly wider occiput.

The postglenoid foramen is in the same relative position as in *Didelphis,* but somewhat smaller. There is no trace of the sub-squamosal foramen characteristic of most modern marsupials, but there is a minute postzygomatic foramen. The postglenoid foramen leads into an extensive series of canals and diploës whose relations cannot be wholly distinguished owing to the breaking away of the bone which has exposed them.

The *mastoid* portion of the periotic is nearly complete but the petrosal portion is almost wholly broken away. The occipital exposure of the mastoid is remarkably wide and compares well with *Sarcophilus;* in *Didelphis* and most other polyprotodonts it is only about half this width. The mastoid foramen is conspicuous, opening downward and forward into the system of canals and sinuses between the squamosal and periotic. The anterior surface of the mastoid directly mediad to the posttympanic crest is grooved by the stylomastoid foramen, and mediad to this is a rather large fossa excavated in the anterior face of the mastoid, apparently the posterior end of the mesotympanic pit. A third fossa larger and deeper than the preceding lies above the broken off petrosal and agrees fairly well in size and relations with the corresponding diploë in *Phascologale;* in the carnivorous marsupials this diploë appears to be filled up with cancellous tissue.

Comparisons. The only Belly River mammals as yet described are *Ptilodus primævus* Lambe and *Boreodon matutinus* Lambe. The first is known from a fragment of a lower jaw with two well preserved teeth, and is clearly a plagiaulacid. *Boreodon* is known only from an imperfect premolar tooth, and although described by Lambe under Plagiaulacidæ the figure agrees rather with the Trituberculata. It is practically an indeterminate type, and Mr. Lambe has wisely made no attempt to estimate its affinities.

The tooth may well be a lower premolar of a relative of *Thlæodon;* but it does not agree at all closely with the premolars of the new genus so far as comparison can be made and is larger and more robust. Mr. Lambe notes a concavity on the posteroexternal and posterointernal faces of the tooth, separated by a median posterior crest; and no such form is indicated in our specimen.

Among the various lower molars of tritubercular type figured by Marsh, those referred to *Didelphops* and *Cimolestes* agree most nearly with the present genus in the comparatively low protoconid, short wide trigonid and large talonid. In other figured types the protoconid is higher, paraconid more extended anteriorly, talonid smaller. Most of these are referred specimens of very questionable correlation. The type of *Didelphops vorax* is an upper molar. The type of *D. ferox* is a lower molar of which Marsh states that "its crown has the same general composition as that of the lower molars of the modern *Didelphys* but the anterior portion is more elevated." His figure whether intended as an inner or an outer view does not at all agree with this description; nor do either figure or description accord with the lower molars of *Eodelphis*. The type of *D. comptus* is a lower molar whose "structure is well shown in the cuts mentioned. There is a characteristic ridge on the outer surface but not on the inner." If Marsh's figure is correct this tooth pertains to an animal certainly not congeneric with the preceding species, nor with *Eodelphis*.

The type of *Cimolestes, C. curtus,* is also based upon an isolated lower molar which agrees more nearly with *Eodelphis,* the principal difference being the smaller metaconid, shorter and wider heel with no distinct marginal cusps and lower internal and higher external border. The type of *Cimolestes incisus* on the other hand is a molar of quite different proportions, much more like those of *Didelphis*.

Why Marsh associated such widely different types of teeth in the same genus, or what he could possibly have supposed to be the distinctive generic characters of the two genera cited I do not know. At all events the jaw here described differs so much from any of the types figured that it cannot be referred to *Didelphops* or *Cimolestes,* and is still more distinct from *Stagodon.*

The type of *Pediomys* is another upper molar, probably a last molar, and incommensurable.

The type of *Telacodon* is the anterior part of a lower jaw, slender anteriorly and with small front teeth, of quite different type from *Eodelphis.*

III. Re-description of Thlæodon padanicus Cope.

The type is a lower jaw with part of the upper jaw, No. 3013, Amer. Museum Cope Coll., found by J. L. Wortman in the Lance beds of South Dakota. It is the only one of the trituberculates from the Lance that is based on an adequate type. Some, but not all, of the teeth and fragments included by Marsh under *Stagodon* are probably congeneric with Cope's type; and the upper molar on which *Didelphops* was founded, *D. vorax* Marsh, is very like the upper molars of *Thlæodon* and may also be congeneric; while the lower molar on which *Cimolestes* rests accords equally well with the lower molar of *Thlæodon.* But most of the referred species of each of Marsh's three genera are certainly not congeneric with the genus here described.

The type represented by this genus is a very peculiar one. Marsh compares it (*Stagodon*) with the modern *Sarcophilus,* and there is in fact a certain degree of resemblance in the stout robust proportions of the jaw. But in *Sarcophilus* the molars are large powerful shearing teeth, and the premolars greatly reduced, while in the *Thlæodon* group the premolars are greatly enlarged robust crushing teeth, the molars reduced, 'insectivorous' in type. The relations between *Thlæodon* and *Eodelphis* are in some respects parallel to the relations between *Sarcophilus* and *Dasyurus,* although the diversity is less between the two Cretaceous than between the two modern genera. But the specialization of *Thlæodon* is in a wholly diverse adaptive direction from *Sarcophilus.*

The type of *T. padanicus* has never been photographed, and Cope's figure of it is very crude. His description is an extended one, but requires amendment in several important particulars, as it is based upon an incorrect interpretation of the specimen.

Cope states that the upper and lower jaw were found (by Doctor Wortman, 1888–1890?) about 100 feet apart but correspond so closely in character and wear that they may be referred safely to the same species and probably to the same individual. Unfortunately no details have been preserved of the exact circumstances of the discovery. So far as the preservation, wear and fit of the jaws are concerned they have every appearance of belonging to the same individual. Cope gives the tooth formula of the lower jaw as $\overline{?.1.4.\ ?3.}$ I think it more probably interpreted as $\overline{?.1.3.\ ?4.}$ There is a large canine alveolus and behind it two long slender divergent alveoli, one posterointernal the other posteroexternal to the canine alveolus, probably for two-rooted p_1. Following are two transversely wide roots crowded together, which Cope considers as roots of p_2 and p_3, the crowns being completely worn off. Each of these roots corresponds in position and form to the double root of p_1 and may be similarly divided into two distinct roots below the alveolar border, although certainly not so divergent. I think it most probable that these are the anterior and posterior roots or pairs of roots of a single robust premolar of similar type to the one that follows, but wider and shorter. The last premolar is a very robust 'inflated' tooth, the bulbous crown simple save for indications of a rudimentary heel, and worn flat at the top. Marsh's figure of '*Stagodon*' *validus,* which seems to be allied to *Thlæodon* although

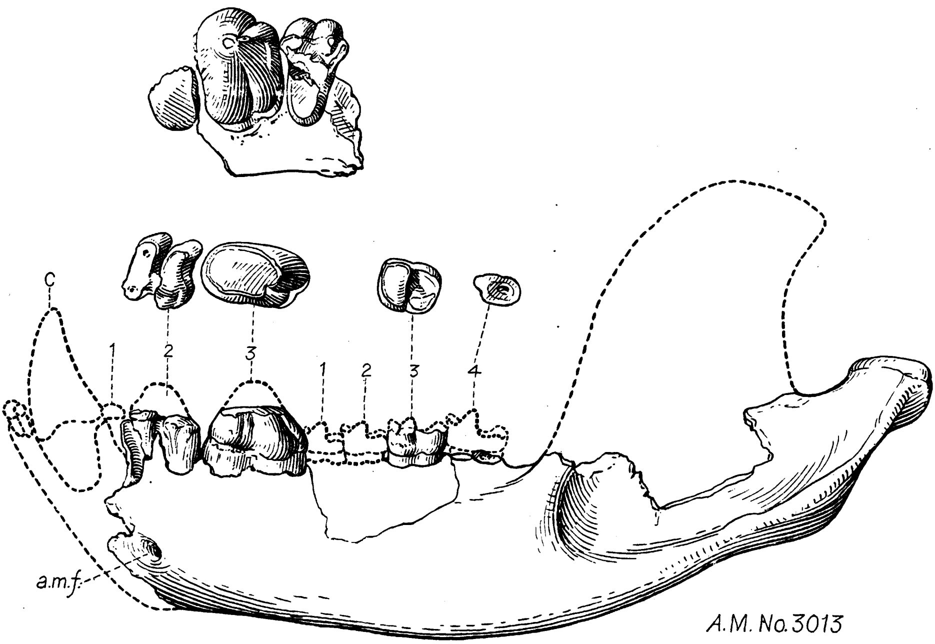

Fig. 3. ***Thlæodon padanicus*, upper jaw fragment, lower jaw and crown view of lower teeth, type specimen, No. 3013, three halves natural size: *a.m.f.*, anterior mental foramen.**

not identical with *T. padanicus,* shows three premolars behind the stout canine, the first very small, the second large, robust, and, although incomplete, apparently corresponding to the two roots or pairs of roots of *Thlæodon padanicus,* and the third evidently corresponding with the last premolar of Cope's type although differing in proportions. This is the natural derivative of the primitive proportions of the premolars observed in *Eodelphis,* and more or less characteristic of all polyprotodont marsupials; the first premolar is small and short, often one-rooted, the second and third much larger, two-rooted and subequal. The broadening of the premolars would result in giving p_1 a transversely broadened root or pair of roots internal and external, and p_2 and p_3 would each have two transversely broadened roots or pairs of roots. Cope's interpretation would involve very anomalous proportions in the premolars, comparable indeed to some of the Epanorthidæ, but not to any of its near allies *Stagodon, Eodelphis* etc., nor to the didelphids.

The alveolar borders of the jaw are missing behind the last premolar, as far as the posterior root of the last molar, which is round oval and of moderate size. The crown of an intermediate molar is preserved nearly complete, but cannot be certainly placed in the jaw so that the number of molars is uncertain. The pattern of the tooth is very like that figured by Marsh as the type of *Cimolestes curtus,* but it is much more worn. The space appears to me adequate for accommodation of four molars, of which the first would be somewhat smaller than the others, and this I regard as the probable arrangement in view of the obvious marsupial characters of the jaw.

The back of the jaw including the condyle is largely present and accords very well with marsupial jaws of similar robust proportions, although not so specialized as in *Sarcophilus.* It has apparently the usual inflected angle, but the inflected border is mostly broken off; on the outer side the masseteric fossa is deep and bounded inferiorly by a strong crest. Cope's statement that the jaw has no angular process is due apparently to his failure to observe that the inner angular border is a broken edge. There is in fact no reason to believe that the angle differed in any way from the normal polyprotodont type. The condyle is wide transversely, and strongly rolled. The anterior part of the jaw is of moderate depth but very short and robust; the symphysis is not preserved, nor anything in advance of the posterior side of the canine alveolus. The mental foramen is large, situated under the first and second premolars.

The upper jaw fragment and teeth I interpret differently from Professor Cope. It appears to be a fragment of the left, not of the right maxilla. A portion of the floor of the orbit is present, and the relations and slope of this, its continuance with the external surface of the maxilla, seem to show clearly that Professor Cope mistook the anterior for the posterior end of the maxilla. The single complete tooth I agree with him in identifying as p^4, but the inner halves of the teeth adjoining it on each side will, according to this arrangement, be p^3 and m^1, instead of m^1 and p^3; and the outer half of an unmistakable molar tooth which clearly does not conform to the tooth identified by him as m^1, and was hence identified as m^2, conforms very well to the missing outer half of the tooth supposed by Cope to be p^3 but which must be m^1 with the jaw reversed. I can find no actual contact between this tooth and the main portion of the jaw; possibly it is not m^1 but m^2 or m^3, but the amount of wear, size and proportions, lead me to conclude that it probably belongs as here placed.

This arrangement is not only more in conformity with the details of construction, proportions and wear in the upper teeth, but it is also more in accord with the probabilities of preservation and discovery in the field. It is reasonably certain that both the lower jaw and the maxillary fragment are from the left side, and as thus placed the maxilla conforms so well in position and wear of the teeth with the lower jaw as to make it almost certain that they are from the same individual. It is more probable that the external half molar lying beside the upper jaw fragment should be the missing outer half of the molar whose inner half is still in place than that it should be part of another molar entirely beyond the limits of the portion of the maxilla preserved; and if, as is not unlikely, the maxilla was originally in place on the mandible, the process of erosion which removed the front of the maxilla and mandible, the upper and lower molars, would spare until the last the posterior premolar and anterior molar teeth. Subsequently, one may suppose, the maxillary fragment became separated and rolled down a slope perhaps, to the considerable distance where it was found.

The penultimate premolar, as here understood, is represented by the much worn inner half, and was presumably a wide bulbous tooth, subquadrate, wider than long, moderately large, but much smaller than its neighbor. The last premolar is much larger than its neighbors, bulbous, globular, rounded, quadrate in outline, divided by transverse radial furrows into a larger anterior and much smaller posterior segment, each again obscurely divided into inner and outer quadrants. It has three stout roots, posterior, internal and anteroexternal in position.

The first molar is a transversely extended tooth roughly trilateral in outline, nearly as wide transversely as the preceding tooth but shorter anteroposteriorly. The construction of the tooth seems, so far as it is preserved, to be much as in *Didelphops* Marsh or *Ectoconodon* Osborn, but wider transversely than Osborn's type. The styles are developed into a pair of robust powerful cusps strongly convex externally; a sharp short cingular crest runs inwardly from the posteroexternal angle, and internal to these lies a worn transverse ridge apparently the remains of paracone and metacone. The protocone is also worn down almost to the base of the crown, and no indications remain of internal cingula; the middle portion of the tooth is missing and the conules if they existed are not shown. The constructional resemblances in the outer part of the tooth to *Didelphops* are sufficient to make it highly probable that the whole tooth was similarly constructed. It has one internal and two external roots, subequal, moderately compressed anteroposteriorly, the outer pair parallel and moderately divergent from the inner root.

There are no traces of roots or alveoli of molars behind m^1 but the specimen is broken in such a way that if present they would be wholly destroyed, and the number and size of the lower molars make it safe to infer three or four upper molars of moderate size.

It is not at all improbable that *Didelphops ferox, D. comptus, Cimolestes curtus,* and perhaps others of Marsh's Lance mammal species may be based on isolated teeth of *Thlæodon. Stagodon validus* is based on the anterior portion of the jaw of a related species, possibly congeneric. But it would be a waste of time to attempt detailed comparisons on the present data; Marsh's genera are arbitrary assemblages of teeth which evidently were not carefully studied or compared by the describer, the descriptions, when there are any, are of no value and so discrepant from the illustrations as to throw doubt on their accuracy.

Affinities of the Cretaceous trituberculates. It is possible — I do not think it probable — that a prolonged and exhaustive research upon the three Lance collections — one at Yale University, one at the American Museum, the third at the National Museum — might result in a really sound and reliable placing of the teeth and classification of all the alleged genera of Cretaceous trituberculates. At present two genuine and determinate types emerge from the miscellaneous ruck of odd teeth and jaw fragments. These are *Thlæodon* of the Lance and *Eodelphis* of the Belly River. So far as one may judge from the fragmentary material, *Thlæodon* is an extreme of a type characterized by large size, short jaws, enlarged robust premolars, low tritubercular molars. *Eodelphis* is a somewhat central type, with various intermediates between it and the *Thlæodon* specialization, while on the other side there are several small slender-jawed genera with insectivorous molars either paralleling the smaller Didelphids or perhaps approaching the Epanorthid specializations. All these may be grouped in one family Cimolestidæ provisionally, and there are really no wholly conclusive reasons at present for separating them from the Didelphidæ. Apparently there is more or less reduction and differentiation of the incisors in most or all of the genera; but this by itself is a slender basis for family distinction. The difference in character of teeth between *Thlæodon* and the small insectivorous types is not greater than between the sea-otter and the weasels or between *Dasyurus* and *Sarcophilus* if a marsupial comparison be demanded; the number of premolars is a character whose taxonomic value in Cretaceous marsupials is unknown, and the evidence for more than three in any of them is a matter of very doubtful interpretation of alveoli — too shaky a foundation to build permanent systematic results upon it.[1] The alveoli which Marsh identified as canines in *Batodon* and *Telacodon* may quite as well be enlarged incisors. If this be the case these genera were analogous, or possibly related, to the Epanorthidæ and may not have been so closely related to *Eodelphis* and its allies.

The tendency to reduction and specialization of the incisors observed in *Eodelphis,* and perhaps carried further and accompanied by a reduction

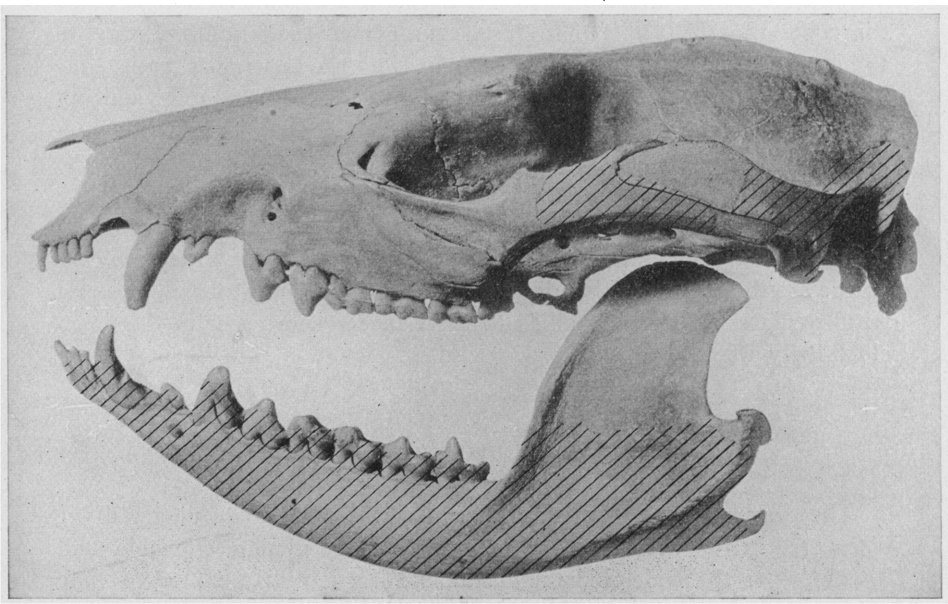

Fig. 4. *Didelphis virginiana*, skull and lower jaw, three-halves natural size, the cross-hatching showing the parts preserved in *Eodelphis browni* type.

of the canine in such types as *Telacodon* and *Batodon,* is suggestive of the conditions found in the diprotodont marsupials, and especially in the pseudo-diprotodonts of South America. This cannot be assigned much weight as evidence of relationship until it is shown to be correlated with a tendency towards the peculiar specialization of the posterior premolars characteristic of the cænolestid group (Epanorthidæ), and of this there is at present no

[1] It has of course an important bearing upon the evolution of mammalian dentition. For that reason if no other it seems necessary to insist that the supposed four or five premolars in some of these Cretaceous mammals is not a proven fact like the marsupial characters of their jaws and teeth, but a doubtful interpretation. Theoretical discussions of evolution in this as in other subjects are very apt to confuse between certainties and probabilities. One may build safely upon the former, but not upon the latter; their relative value in controversial questions is very different.

evidence. (The quadrate molars of the cænolestids might well be a later adaptation, hardly to be expected in the Lance). One may likewise observe among the isolated molars of the Lance, types which appear to be tending towards the shearing specializations of the Borhyænidæ, Dasyures and Thylacines. But until a sound and positive correlation of these isolated teeth can be made, it is idle to discuss any special affinities of this sort.

In his very valuable detailed study of the stratigraphic position of the mammal localities in the Lance formation, Professor Lull [1] has observed that while the Multituberculates range throughout the formation from top to bottom, the Trituberculates are absent from the lowermost levels. He appears to attach considerable importance to this circumstance, and observes "This seems to be significant, for Multituberculates are known from the Jurassic and become extinct in the Paleocene, while descendants of the Trituberculates may still exist." Whatever views may be held as to the relationship of the Lance trituberculates to Tertiary and modern mammals, it is evident that their absence from the lowest levels of the formation cannot be ascribed to other than local conditions, since multituberculates and trituberculates both nearly allied to the Lance genera occur in the much older Belly River formation.

IV. Conclusions.

The specimen here described is the most complete fossil mammal yet discovered in the Cretaceous. Its Cretaceous age is unquestionable, and its affinity to the Didelphidæ unmistakable. It is nearly related to some of the trituberculate mammals of the Lance formation and is considered to be a new genus and species of Cimolestidæ, a family not clearly separable from Didelphidæ. It agrees in the number and characters of the premolar and molar teeth, the construction of the angle of the jaw, zygomatic arch and temporal region of the skull, and differs only in the reduction and specialization of the incisor teeth.

A re-examination of *Thlæodon padanicus* Cope from the Lance formation shows that serious errors in the description and interpretation of this type have been made. Although peculiarly specialized in the premolars it is quite nearly related to *Eodelphis* and derivable from a similar type. It agrees with *Eodelphis* in the characters of the angular region of the jaw, and probably in the premolar and molar formula, but the incisors may be further

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[1] Lull, 1915. The Mammals and Horned Dinosaurs of the Lance Formation of Niobrara County, Wyoming. Amer. Journ. Sci., Vol. XL, p. 316.

reduced, and the premolars are enlarged and much inflated and the jaw more robust throughout.

Eodelphis, Thlæodon, and all the more fragmentary trituberculates of the Cretaceous may well belong to a single family Cimolestidæ, of which the Didelphidæ represent the little-altered descendants. The Epanorthidæ and Borhyænidæ of the South American Tertiary may be considered as divergent specializations from the same stock, evolved in the New World but probably chiefly in South America, while the Diprotodonts, Phalangers, Dasyures and Thylacines whose relations to the Cimolestidæ are more distant may represent parallel Old World specializations, probably evolved chiefly in Australia, and ultimately derived from Palæarctic Cretaceous marsupials very similar to the American Cimolestidæ and probably to be included, when found, in the same family.

As thus interpreted, the marsupials, more or less cosmopolitan in the Cretaceous, were displaced from the northern world by the placentals at the great diastrophic epoch that closed that period, and found a refuge in the two great southern continents, Australasia and South America. During the Tertiary while the placentals were evolving and dispersing from Holarctica, the marsupials underwent a corresponding adaptive radiation and dispersal from the two isolated southern centres towards the tropical regions. The remnants of those dispersals we find in the later Tertiary and Pleistocene and modern faunas of the southern and tropical regions; in each, the most primitive surviving types are found in the tropics, the most specialized types far to the southward, since the dispersal movement was conditioned by the progressively cold polar climates. The parallelism between the specializations of the two isolated southern dispersal centers is rather striking, diprotodonts and thylacines evolving from phalangers in the one, pseudo-diprotodonts and pseudo-thylacines evolving from opossums in the other. It is only by the more careful anatomical studies of recent years that the superficial and purely adaptive character of these resemblances has been perceived. Much more work in this line will be needed in order to demonstrate conclusively their exact affinities; the foregoing conclusions must be regarded merely as a tentative interpretation of the evidence at hand.

DESCRIPTIONS OF PLATES II–VI.

Plate II.

Eodelphis browni, type. Figs. 1–3, lower jaw, twice natural size, external, superior and internal views. Fig. 4, 4a, stereoscopic view of front of lower jaw, four times natural size.

Plate III.

See description under Plate IV.

Plates III and IV.

Eodelphis browni, type, zygomatic and temporal portions of skull, twice natural size, with corresponding views of the temporal region of *Didelphis virginiana* introduced for comparison.

Fig. 1. *Eodelphis*, internal view of jugal showing small portion of maxillary attached.

Figs. 2, 3, 4. *Eodelphis*, jugal and temporal regions, superior external and inferior views; 2a, 3a, 4a, corresponding views of temporal region of *Didelphis*.

Fig. 5. *Eodelphis;* 5a, *Didelphis*, posterior views of temporal showing relative extent of mastoid exposure.

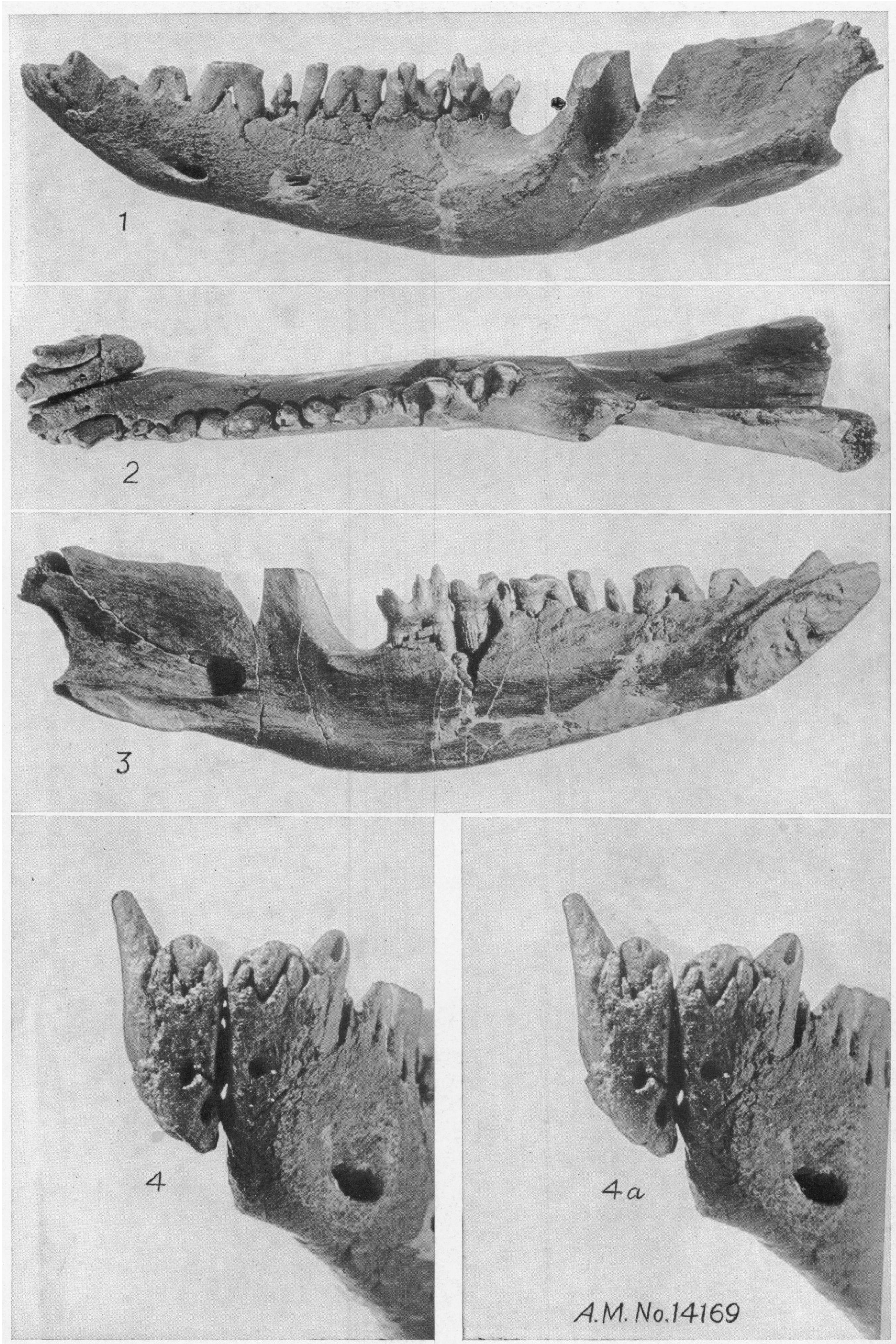
Fig. 6. *Eodelphis*, lower jaw of type, posterior view, showing inflection of angle.

Plate V.

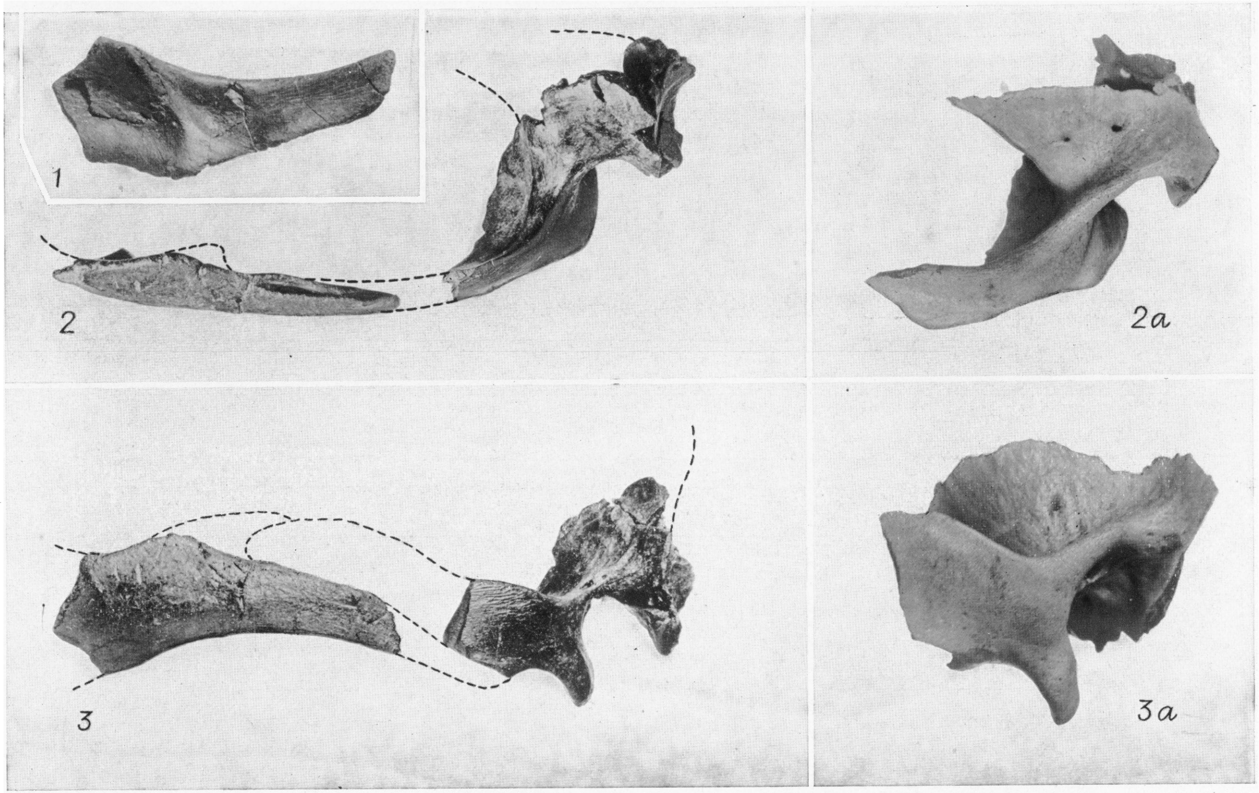
See description under Plate VI.

Plates V and VI.

Thlæodon padanicus, type, lower jaw and upper jaw fragment, twice natural size. Figs. 1, 2, 3, superior internal and external views of lower jaw; Figs. 4, 5, 6, external palatal and internal views of fragment of upper jaw.



Eodelphis browni. Type.



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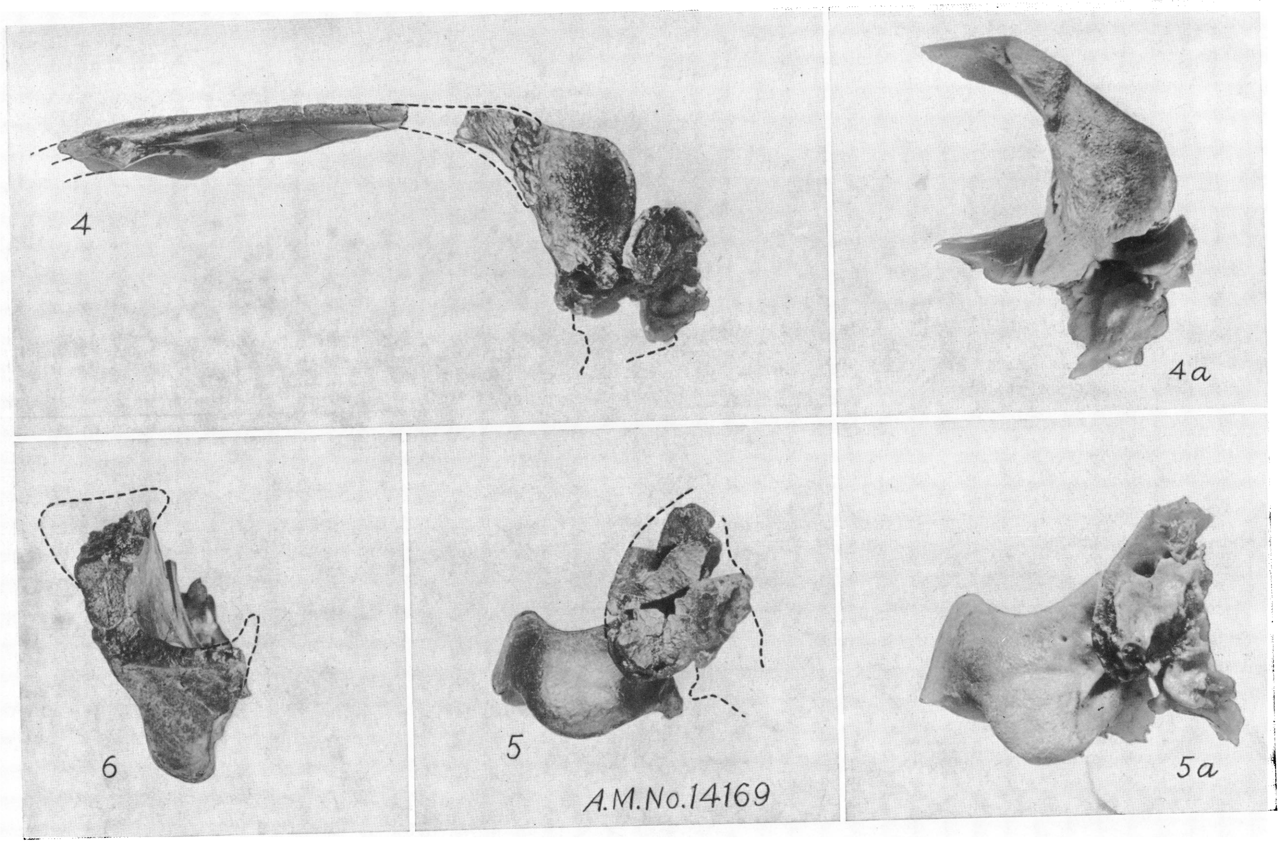
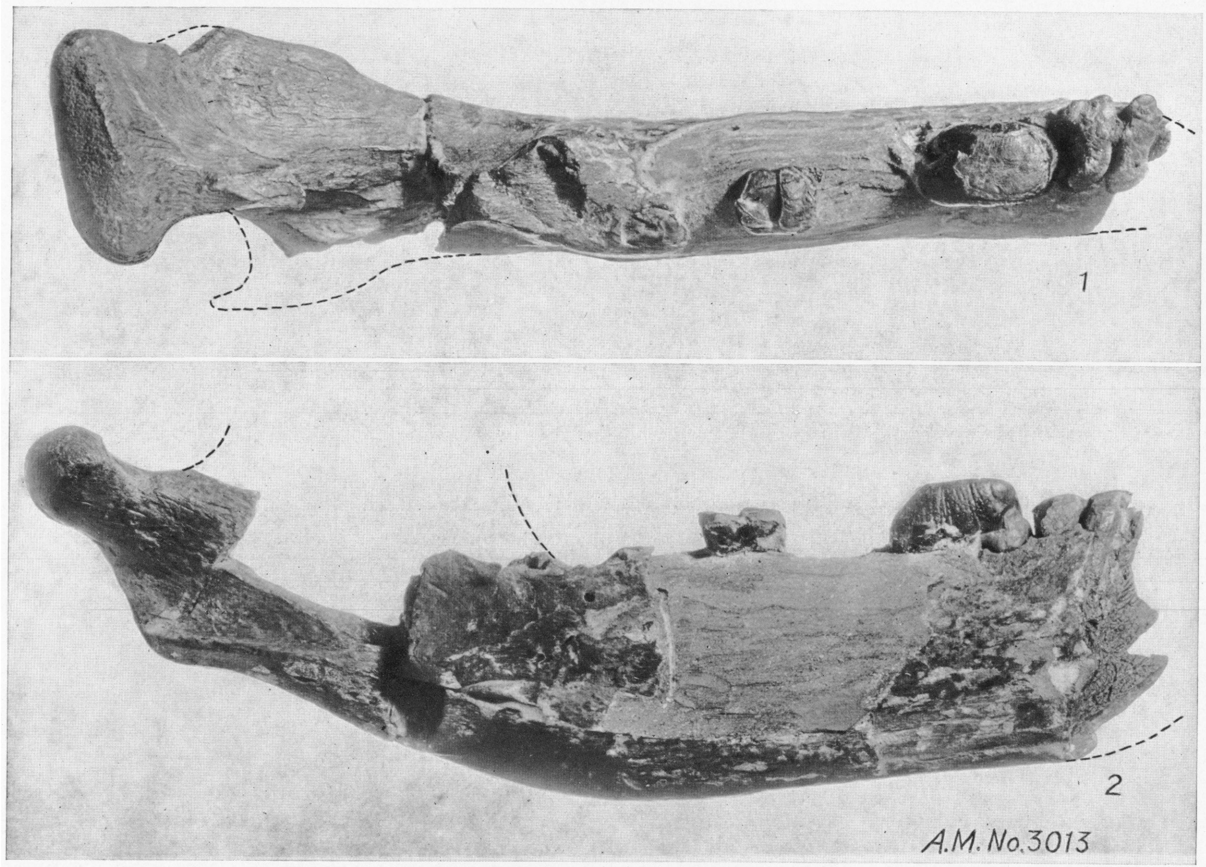
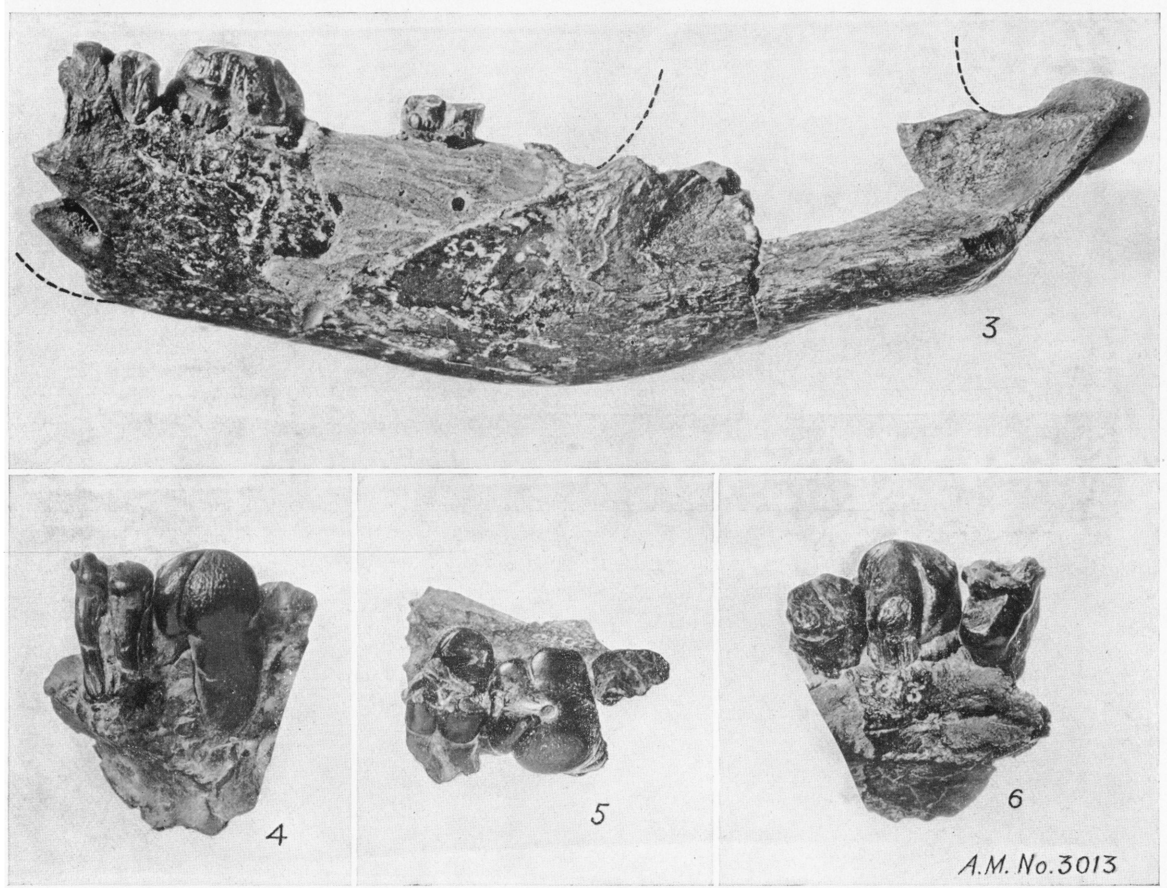


EODELPHIS BROWNI. Type.



THLÆODON PADANICUS. Type.



THLÆODON PADANICUS. Type.