

Article XXXIII.—THE DENTITION OF NOTHODECTES.

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PLATES XCIX–CII.

In 1915 I described under the name of *Nothodectes dubius*¹ part of a lower jaw from the Clark Fork beds at the base of the Wasatch in the Bighorn basin, Wyoming. The genus was referred to the Apatemyidæ, a small group of genera from the American Eocene, all of minute size, very imperfectly known and of very doubtful affinities.

In 1916 Mr. Granger investigated for the Museum a number of localities in the San Juan basin of New Mexico, among them one which Mr. J. W. Gidley had discovered some years earlier in reconnaissance work, and had invited us to explore as he was unable to look into it further himself. At this locality the beds were generally scantily fossiliferous but a number of specimens of fossil mammals were found, the fauna showing an admixture of Torrejon and Wasatch genera, and apparently corresponding to the similar admixture found by Mr. Granger in the Clark Fork beds of the Bighorn basin. These beds, provisionally called the Tiffany beds, were included in the 2275 feet ascribed by Gardner to the Wasatch.² Their stratigraphy is stated by Mr. Granger in a brief article which immediately precedes the present one.³ Like the Clark Fork, these beds appear to be at the top of the Paleocene rather than at the base of the Eocene.

The most important find in the Tiffany beds was a small fossiliferous pocket on the Spring Creek drainage, seven miles southeast of Ignacio, near to the Mason schoolhouse. This pocket, only a meter square, of dark gray shale very fine in texture, was full of bones and fragments mostly of small or minute mammals. The preparation of the material is in progress, in the hands of Miss Erna Kohlhaase whose skilful and careful work upon these delicate fossils is deserving of high commendation. The fauna shows considerable variety, and from the observed field conditions it was suspected that it might be a fissure filling, but apparently of approximately the same geologic age as the beds which enclose and surmount it.

An incomplete skull of a small chiropteran, *Zanycteris paleocenus*, has

¹ Bull. Amer. Mus. Nat. Hist., Vol. XXXIV, p. 482, fig. 52.

² Lee, W. T., "Stratigraphy of the Coal Fields of Northern Central New Mexico." Bull. Geol. Soc. Amer., Vol. 23, pp. 571–686, 1912. (Section by J. H. Gardner on p. 584.)

³ Granger, Walter, this Vol., pp. 821–830.

been briefly described in a preceding article.¹ A small plagiaulacid near *Ptilodus* and a small didelphid near *Peratherium* are well represented, and several other types, mostly of minute size are recognized.

To *Nothodectes* are referred, besides eight or ten lower jaws, three palates with well preserved dentition and more or less of the front of the skull. The species is clearly related to the Wyoming *N. dubius*, and these specimens show the complete upper and lower dentition of the genus. They confirm its reference to the "Apatemyidæ," and show further that this group is nearly related to *Plesiadapis* of the Cernaysian of Europe.

Nothodectes gidleyi² n. sp.

Type, No. 17170, upper and lower jaws. *Paratypes*, Nos. 17171, palate, 17172, lower jaws with fragments of skeleton. All from the same pocket in the Tiffany beds near the Mason schoolhouse, Col.

Specific Characters: Size about the same as *N. dubius*. P_2 present, minute. P_3 and p_4 smaller, somewhat less robust. Trigonid of m_1 somewhat smaller.

The type specimen of *N. dubius* shows doubtful indications of a minute vestigial tooth close behind the enlarged lower front tooth. This is probably not the vestigial p_2 of *N. gidleyi*, and no corresponding vestige appears on our specimens of that species. The diastema of *N. dubius* is more sharply crested than in the new species.

The separate incisor conjecturally associated with the type of *N. dubius* probably does not belong to it. If it does, it differs greatly from any tooth in the dentition of *N. gidleyi*.

The generic characters do not separate it satisfactorily from *Plesiadapis* as described and figured by Lemoine,³ but pending a revision of Lemoine's genus it seems better to retain *Nothodectes* provisionally, with the following generic characters:

Generic Characters: Dentition ^{2.1.3.3}/_{1.0.3-2.3}. Enlarged front teeth like those of *Plesiadapis* as figured by Stehlin, but with more elongate crown and an additional accessory cuspule on i^2 . I^3 and c^1 small, spaced. P^2 small, in series with molars, p_2 minute or absent, in series with molars when present. P^3-4 with large inner cusps, pa and me closely connate on p^3 , distinct on p^4 , pl distinct; p_3-4 of moderate size, short and robust with short wide heel cusps, distinct me^d on p_4 . Molars less quadrate than in some species of *Plesiadapis*, much less than in *Phenacolemur*. In *Plesiadapis remensis*

¹ Bull. Amer. Mus. Nat. Hist., Vol. XXXVII, Art. XX, pp. 569-571, Sept. 7, 1917.

² I take pleasure in naming this species in honor of my friend and former colleague J. W. Gidley, in recognition of his connection with the discovery of the Tiffany fauna.

³ Lemoine 1891, Bull. Soc. Geol. de France, Vol. XIX, p. 278, pl. x, figs. 49-70.

⁴ This formula ignores certain doubtful vestiges of i^1 noted on one specimen.

p^4 , auct. Stehlin,¹ has stronger pl and no me . In another species figured by Lemoine, both p^3 and p^4 have distinct metacones.

Family characters (Plesiadapidae): A pair of upper and lower front teeth much enlarged, soricoid in type, the upper (incisor 2?) with main cusp elongate, strongly recurved, pointed sub-spatulate with one or more accessory cuspules on outer border and with a strong posterior basal prong; the lower (incisor or canine) with long pointed simple crown, basal prong rudimentary or absent, the root elongate and extending under more or less of the molar series. Remaining incisors and canines reduced or absent, premolars reduced in varying degree. Form and pattern of premolars and molars much as in Eocene lemuroids. Molars primitive, low-crowned, bunodont, tritubercular or quadrate with hypocone, lower molars low-crowned with large basin heels, the heel of m_3 usually elongate. Posterior mental foramen beneath m_1 .

Key to genera of Plesiadapidae.

Front teeth moderately enlarged, jaw moderately deep.

Two functional lower premolars of rather small size.

Upper premolars, p^3 - p^4 sub-molariform.....*Nothodectes*; *Plesiadapis*.

Only one lower premolar, of large size.

Upper premolar, p^4 molariform.....*Phenacolemur*.

Front teeth much enlarged, jaw very short and deep anteriorly, root of lower front tooth extending under entire molar series.

Three functional lower premolars.....*Trogolemur*.

Two premolars, p_3 minute, p_4 small.....*Uintasorex*.

Only one small premolar in series with molars.....*Apatemys*.

Two premolars of moderate size.....*Chiromyoides*.

Of the above genera *Plesiadapis* and *Chiromyoides* are from the Upper Paleocene of Europe, the others are American, *Nothodectes* being Upper Paleocene, *Phenacolemur* Lower Eocene, the rest Middle Eocene.

A number of other very interesting European genera with "Chiromyoid dentition" are described and their affinities discussed by Dr. Stehlin in the monograph already cited. Of these genera *Heterochiromys* and *Amphichiromys* Stehlin have rootless gliriform front teeth and do not fall into this family; Stehlin does not refer them to it. Their cheek teeth are known only from the alveoli, and their affinities appear to me to be open to a wide latitude of interpretation. *Necrosorex* Filhol of the Phosphorites and *Heterohyus* Gervais from the Lutetian of Buchsweiler are also of doubtful affinities. (See Stehlin, *l. c.*, p. 1498.)

¹ Säugethiere des schw. Eocans, 7^{er} Teil, 2^e Half., Abh. schw. pal. Ges., Vol. XLI, p. 1476, fig. ccclv B.

Description of Teeth of Nothodectes gidleyi.

Upper teeth. A minute and doubtful vestige in front of the enlarged upper incisor may represent the first incisor, and, if so, it fixes the enlarged tooth as i^2 . The large tooth is of the same soricoid type as in *Plesiadapis* but differs in details.¹ The main cusp is less sharply recurved than in the shrews, heavier and longer, with a concave posterior face, sharply convex anterior face, a strong accessory cusp on the outer margin near the apex, as in *Plesiadapis*, a second accessory cusp on the inner margin and a weak cusplike lower down on the outer margin, not present in *Plesiadapis* as figured by Stehlin. The tooth is more elongate than in *Plesiadapis* and the crown less curved. At the base of the posterior face of the main cusp is a sharp prong-like cusp projecting backward and curving downward, much as in *Plesiadapis*, not so large or prominent as in Soricidæ. The arrangement of the enamel is normal, again as in *Plesiadapis*; it is not extended downward over the root in a thickened margin as in Soricidæ. The root shows, however, a certain degree of consolidation with its alveolus, as in Soricidæ, but by no means to so marked a degree.

The supposed third incisor is a tooth of moderate size, one-rooted, with simple oval, pointed crown, somewhat flattened and spatulate. Between its root and the root of the enlarged incisor is a sunken irregular area on the outer surface of the maxilla which may possibly indicate the location of the maxillo-premaxillary suture. If so, the tooth just described is the canine. But while the course of the suture cannot be positively traced on any of the specimens at hand it appears to be more probably indicated by certain parts of the fractured line that shows on the side of the muzzle in No. 17171 (Plate C) and lies behind this tooth.

The canine (possibly p^1) is smaller than the preceding tooth and somewhat less prominent on the buccal margin of the jaw, so that it has somewhat the appearance and relations of a first premolar.

Behind i^2 , i^3 and c^1 are short diastemata. The cheek teeth, p^2 - m^3 , are set close together but not crowded.

P^2 is a very small tooth with two connate outer roots, no inner root, and a triangular simple pointed crown.

P^3 is transversely extended with three roots, large protocone, well developed paracone, paracone external with rudimentary metacone in its posterior flank, slight parastyle, a posterior cingulum and obsolete

¹ Stehlin observes that this tooth has never been found in position but states the evidence for regarding it as the upper incisor of *Plesiadapis*. The *Nothodectes* dentition confirms his conclusion and removes any further doubt as to its correctness.

external cingulum. The cusps including the protocone are somewhat rounded, not crescentic, but with distinct crests on the anteroexternal and posterointernal faces of the protocone.

P⁴ has similar pattern but is larger, broader, the metacone strong, parastyle stronger than in p³, metastyle distinct though very small, paraconule prominent.

M¹ is between trigonal and quadrate in outline, broader than long, the principal cusps low and somewhat angulate, conules small and rather obscure, sharp cingula on external and anterior borders and a heavy curved cingulum in the position of the hypocone, rising anterointernally to meet the apex of the protocone, and curving around posteroexternally along the posterior margin of the tooth.

M² and m³ are similarly constructed save that in m³ the posterior external portion of the tooth, with the metacone, is reduced and low.

Lower teeth. The lower incisor is large with crown and root elongate, considerably compressed laterally, the inner face of the crown nearly flat, the anterior face strongly and the external face moderately convex. The posterior face is margined by a sharp external and an obscure internal crest, the surface between is concave from base to tip, and with a median convexity running longitudinally. At the base the outer and inner crests unite to an obscure posterior basal cusp corresponding to the prong of the upper incisor but quite rudimentary. The inner crest margining the posterior face fades out towards the tip and the tooth ends in an obliquely oval point.

P₂ is a simple minute one-rooted tooth.

P₃ is two-rooted, stout and short with wide transversely crested heel, the principal cusp with flat posterior face and convex external and internal faces and a somewhat marked anterior crest. No cingula.

P₄ is of similar pattern but somewhat larger size.

The molars have small trigonids and large deeply basined heels, the cusps low and rounded much like those of *Pelycodus*. They have obsolete external cingula.

M₁ has a distinct paraconid, internal in position, metaconid and protoconid about equal in height and size, hypoconid and entoconid a little lower, the hypoconid with a low crest that crosses to the metaconid, the entoconid with an external crest curving around the posterior border.

M₂ is similarly constructed but somewhat larger and broader, and without distinct paraconid; the metaconid is obscurely twinned, the posterior cusp having rather the relations of a metastylid.

M₃ is like m₂ except for the heel which is extended backward as a broad shelf, rising postero-internally to the level of the trigonid cusps and margined internally by a prominent curving crest that sweeps around the

posterior end of the tooth in a broad curve. The surface of this shelf is somewhat rugose and the hypoconid is broken up into two or three marginal cuspsules.

The zygomatic arch is deep anteriorly, the distance of the lower border of the orbit above the jaw is considerable. The orbital margin is well defined posteriorly. The lachrymal foramen lies within or upon it, clearly not external.

The lower jaw is moderately deep, somewhat shallower beneath m_3 than beneath the premolars. The mental foramina are beneath the anterior ends of p_3 and m_1 . The masseteric fossa is rather deep and sharply defined above by an antero-superior crest, more obscurely beneath; the fossa reaches forward about to the posterior end of m_3 . The condyle is transverse, but not extended into a wide scroll as in creodonts and Carnivora; the angle is extended in a prominent flattened process curving downward and backward, similar to the angle of many Insectivora. It is narrower than in *Lepilemur*, and contrasts with the usual broad flat angle of the Primates.

The above skull characters, while indecisive, point toward primate affinities. A number of skeleton bones probably referable here have already been extracted from the matrix — a humerus that might be either insectivore or very primitive primate, a femur with a singularly prominent lesser trochanter, a tibia with its distal articulation of primate type, unlike Insectivora, an astragalus that suggests a very early stage of primate evolution, a calcaneum, several vertebræ, sacrum, etc., of indecisive characters, and certain metapodials and phalanges strongly suggesting the primate type. Description of these is reserved until all the material has been extracted from the matrix. The indications are however that the *Plesiadapidae* are not specialized Lemuroidea nor are they specialized Soricoidea but a very primitive group in some respects intermediate, although nearer to Primates than to Insectivora. Their relations to the Menotyphla (*Tupaia* and *Macroscelididae*) require further consideration.

Affinities of Nothodectes.

Stehlin's admirable figures and description of *Plesiadapis* (l. c., pp. 1474, 1489, figs. cccclv-ccclix) show clearly that *Nothodectes* resembles it closely in a number of specialized features. The molars are much alike, but in *Plesiadapis* sp. a little more quadrate, with heavier hypocone flange and broader external cingula; they are intermediate in most respects between *Nothodectes* and *Phenacolemur* (an apatemyid from the Wasatch described by Matthew in 1915). The fourth upper premolar of *Plesiadapis remensis*

as figured by Stehlin has the outer cusps more closely connate and the protoconule more prominent than in *Nothodectes*. On the other hand, Lemoine figures (Bull. Soc. Geol. Fr., 1890, Vol. XIX, pl. x, fig. 58) an upper jaw in which the metacone appears to be more distinct than in *Nothodectes gidleyi*. The lower premolars and molars figured by Stehlin are also much like those of *Nothodectes*, with the same heavy transversely crested heel on p_4 , paraconid more distinct on the molars, m_3 with the same elongated and squared heel but the entoconid shelf narrower and more of the normal crested type — again like other genera of Apatemyidæ, especially *Phenacolemur*. The enlarged upper and lower incisors of *Plesiadapis* are of identical type with those of *Nothodectes*, differing only in being relatively smaller and less elongate and the upper tooth having only one lateral accessory cusp in addition to the basal prong. The diastema in front of the cheek teeth in *Plesiadapis* is somewhat longer.

I do not think anyone will question that the two genera are nearly related if not identical and belong certainly to the same family.

Phenacolemur of the Wasatch, known from the lower jaws and upper cheek teeth, is certainly related to *Nothodectes* and *Plesiadapis* but has more reduced and specialized premolars, more quadrate upper molars, and more enlarged lower incisor.

Apatemys, *Uintasorex* and *Trogolemur* are provisionally referable to the same group, but are too incompletely known for positive reference, as I have already observed (Matthew, *l. c.*, p. 478).

As to the ordinal reference of the Plesiadapidæ I am, as previously, disposed to reserve final decision until the skull and skeleton characters are more fully known. Stehlin (*l. c.*, p. 1489) speaks quite positively upon it, stating that "*Plesiadapis* is a primate," and resting his conclusion upon the undoubtedly strong evidence afforded by the primate-like character of the cheek teeth, and upon the 'Chiromyoid' specialization of the front teeth. Unquestionably the resemblance in the cheek teeth to Eocene primates is very marked. The peculiar heel of m_3 is very suggestive of that in the Notharctidæ; the characters of the premolars are considerably like those of some Eocene Tarsiidæ; and the general molar construction is very much like the Eocene Lemuroidea. The last is not a strong argument, however, for various other Eocene mammals which are certainly or probably not primates equally resemble them in molar construction. The artiodactyls *Diacoderis* and the Leptchoeridæ, the condylarthran Hypsodontidæ and Miocænidæ, the creodont Oxycænidæ, the insectivore Pantolestidæ and the Mixodectidæ and Microsyopidæ of more doubtful affinities have all been referred, some or all of their genera, to the Primates, upon this evidence of the resemblance of their cheek teeth to those of

Eocene and modern Lemuroidea. The characters of the skull and feet have shown conclusively when found that they belonged to other orders.

As for the resemblance in the front teeth to the modern *Chiromys*, it is not close enough to be at all convincing. The enlarged front teeth occur in many different phyla of Tertiary mammals, and the upper incisors of *Chiromys* show little if any trace of the very peculiar construction seen in the Plesiadapidae, which is far more nearly paralleled in the Soricidae. The European Eocene chiromyoids which Stehlin regards as in various ways intermediate and serving to connect *Chiromys* with *Plesiadapis* are too imperfectly known to afford convincing evidence. They may pertain to two or more quite distinct groups of mammals. Like the Bridger Apatemyidae they are known only from incomplete lower jaws, and would seem to include greater diversity of form than the three Bridger genera.

Chiromys itself in the construction of its cheek teeth affords no very conclusive evidence as to its origin. They are four in number, rather featureless, small, round flat-topped, peg-like teeth with the coronal pattern obscurely quadrate. They might be derived by further specialization from the Plesiadapidae — or from some relative of *Necrolemur*, or from some true lemurid allied to *Archæolemur*. So far as I can see the problem is not soluble by tooth characters; it will be necessary to weigh and evaluate the characters of the skull and skeleton to determine whether *Chiromys* is

- (1) especially related to the Malagasy lemuroids, or
- (2) derived from the Eocene tarsioids independently from the Malagasy lemuroids, or
- (3) derived from the Plesiadapidae or some other family already specialized and distinct in the Paleocene.

It is not unlikely that more complete skull and skeleton parts of *Nothodectes gidleyi* may be found in the material from the Mason pocket, most of it still buried in the matrix. It seems better therefore to reserve opinion at present as to its ordinal affinities, although, as I have intimated above, the evidence thus far obtained suggests that it is a very primitive Primate.

EXPLANATION OF PLATES.

Nothodectes gidleyi, palates and lower jaws enlarged to three diameters ($\frac{3}{1}$). From the Mason pocket in the Tiffany beds, 7 miles southeast of Ignacio, Colorado. Upper Paleocene or base of Wasatch formation, Lower Eocene.

PLATE XCIX.

No. 17170, upper and lower jaws, type specimen: fig. 1, right side view; fig. 2, inferior view of left upper jaw; fig. 3, upper incisors, front view, 3a, posterior view, 3b, outside view of right upper incisor, 3c, inner view of left upper incisor, basal prong broken off.

PLATE C.

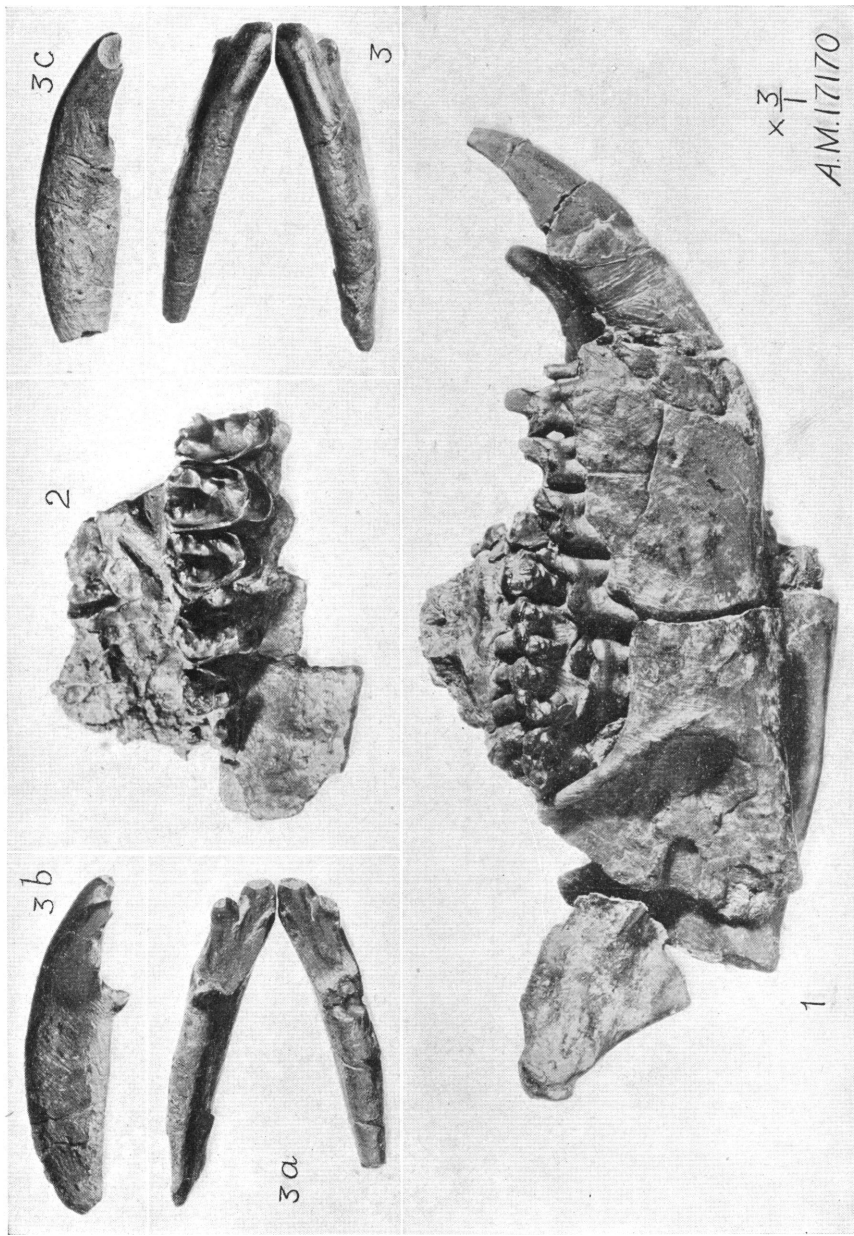
No. 17171, palate, paratype.

PLATE CI.

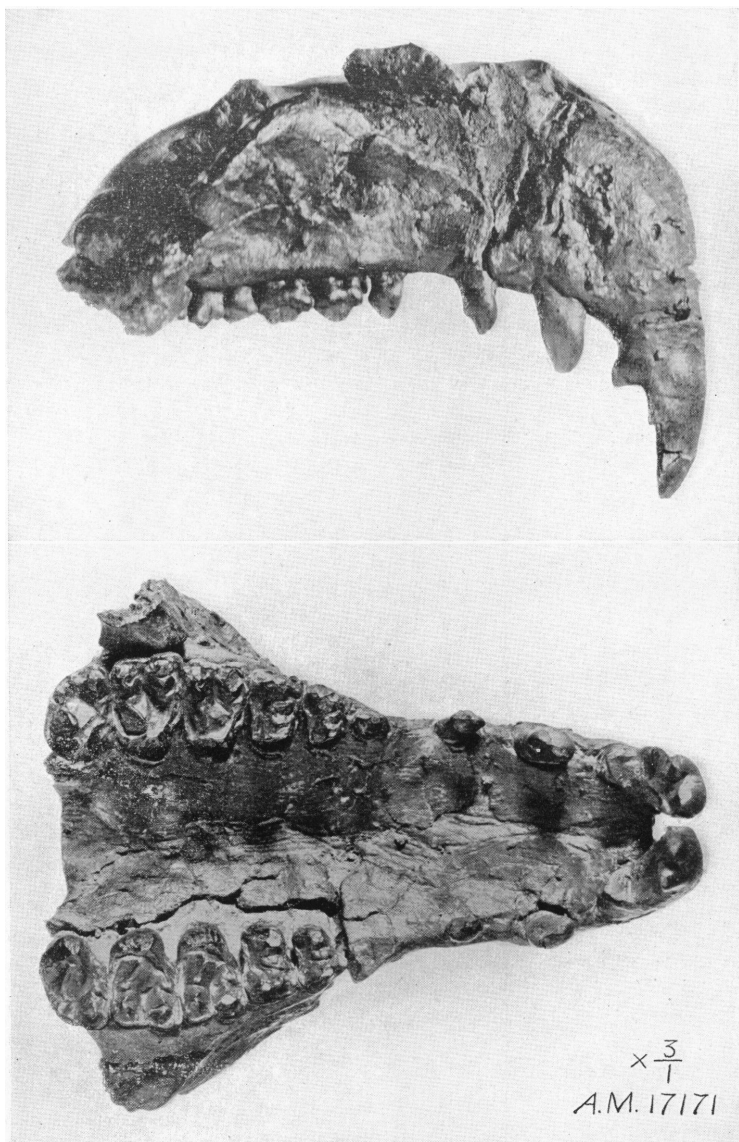
No. 17172, lower jaws, paratype. With this specimen were found parts of upper jaws of more than one individual, and a number of skeleton fragments which are not described or figured as they may not all belong to *Nothodectes*.

PLATE CII.

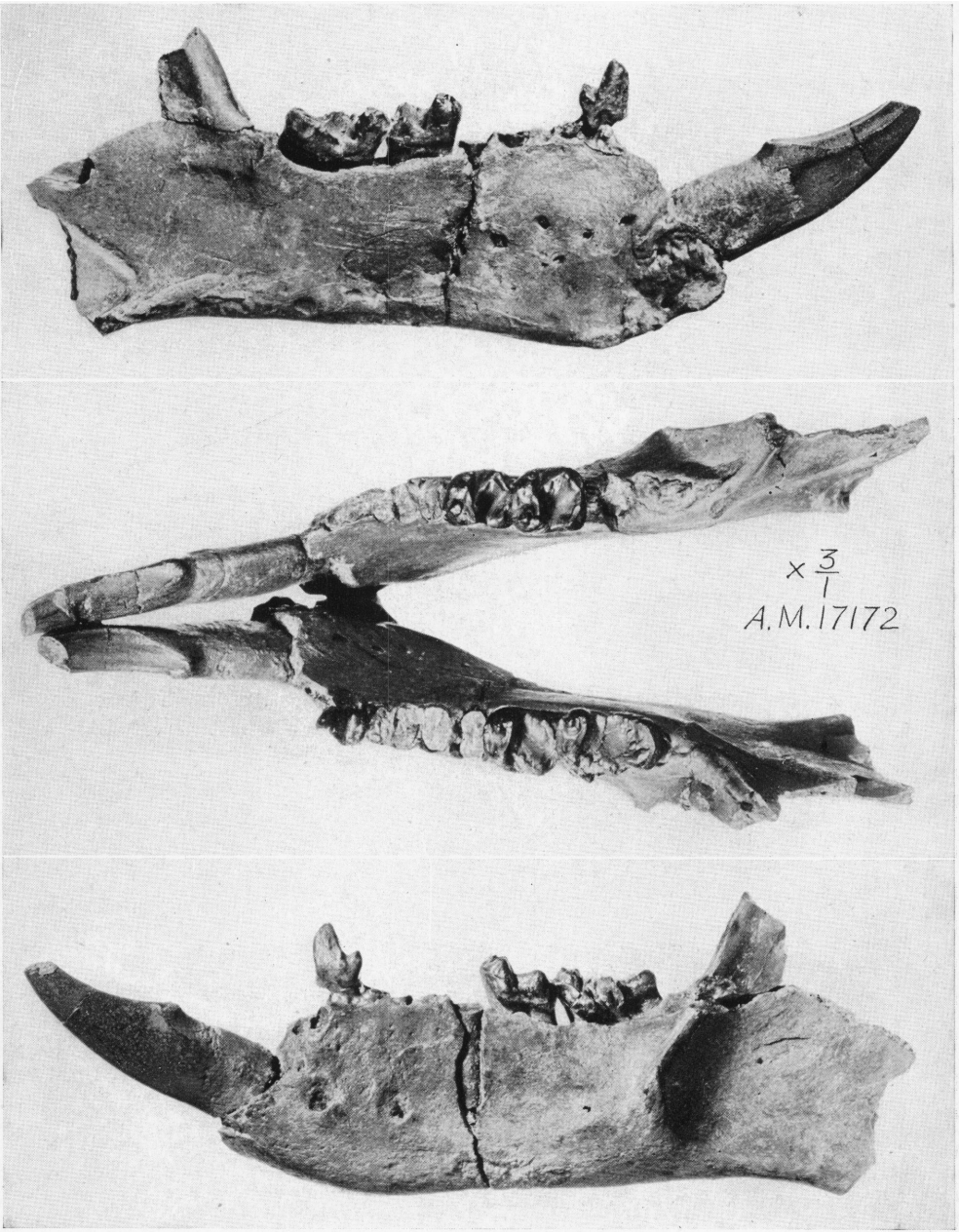
Nos. 17173, crushed palate, and 17174, lower jaw, showing unworn teeth.



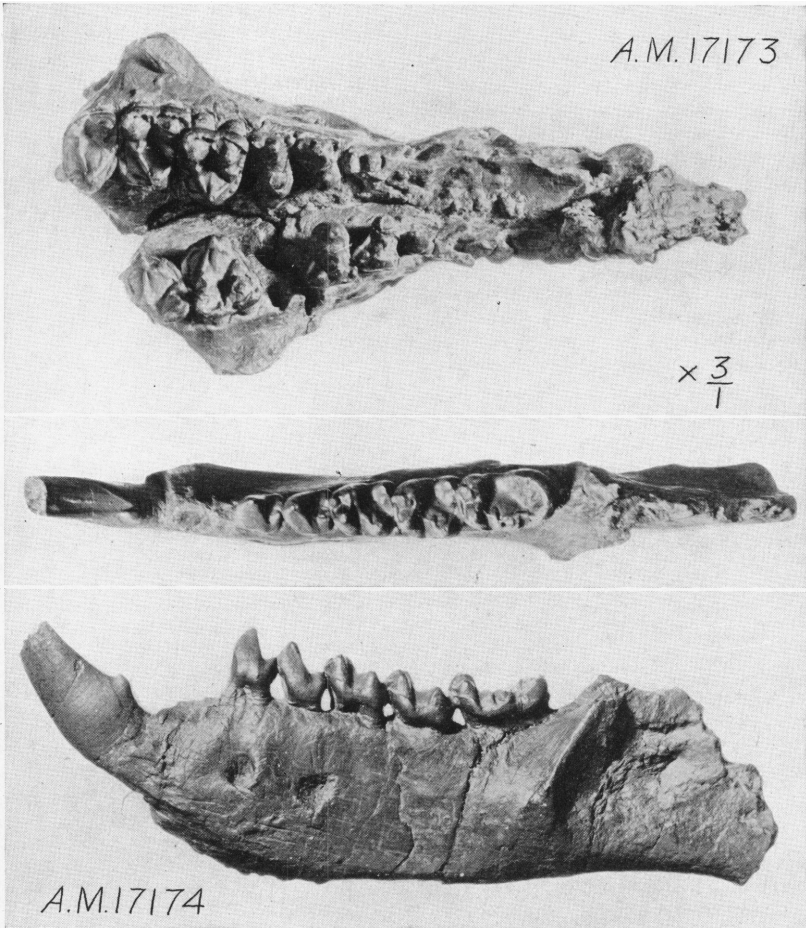
NOTIODECTES GIDLEYI.



NOTHODECTES GIDLEYI.



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