Art. XXVI.—*New Camels in the Marsh Collection;* by Richard S. Lull.

[Contributions from the Othniel Charles Marsh Publication Fund, Peabody Museum, Yale University, New Haven, Conn.]

The Oligocene camels in the Marsh Collection consist of a number of skulls and other skeletal material. Those from the White River Oreodon beds are clearly referable to three of the known species of *Poëbrotherium* and add nothing to our knowledge of these forms. From the Protoceras beds, on the other hand, comes one apparently new species, while from the upper John Day are several specimens worthy of description.

Pseudolabis (Paralabis) matthewi, subgen. et sp. nov.

(Fig. 1.)

Holotype, Cat. No. 10167, Y. P. M. Upper Oligocene (Protoceras beds), Sturgis, South Dakota.

The type material consists of a poorly preserved skull with the third incisor and a complete series of cheek teeth.

Distinctive characters.—Size somewhat larger than *Poëbrotherium labiatum.* Skull mutilated so that few characters are observable. Auditory bullæ less rounded than are those of *Poëbrotherium,* although fully as large. Tympanohyal recess more widely open and inner posterior lobe thus narrower, more as in the later camels. Rear of orbit not preserved, but zygomatic arch and adjacent bones are rather heavy, so that its closure is probable. Infra-orbital foramen above P^4, palatal foramina opposite the posterior half of P^3.

Dental formula: $I^{3?}$, C^1, P^4, M^3. Alveoli of I^{1-2} not preserved, I^3 caniniform, recurved, probably equal to, if not exceeding, the canine in size. Canine lacking, alveolus elliptical, separated from I^3 by a short diastema. P^1 double-rooted, crown not preserved, larger than P^2, and separated from the adjacent teeth by diastemata, of which the anterior one is nearly two times the greater. P^2 to M^3 form a compact series, the crowns of medium height. Molars with prominent parastyle, mesostyle, and external ribs, no internal basal pillars present. P^3 with internal cingulum, and P^4 with an accessory internal crest connecting the crescent with the rear of the tooth, suggestive

of the double internal crescent described by Matthew in *Pseudolabis dakotensis,* although by no means so well developed.

Compared with its contemporary from the Protoceras beds, *Pseudolabis dakotensis,* the present species resembles the latter in the comparable cranial details, the relative spacing of the anterior teeth, the character of the third and fourth premolars, and in the actual size of M^3. It differs from Matthew's form in the smaller size, more attenuated muzzle, relatively larger C^1 and I^3, and rela-

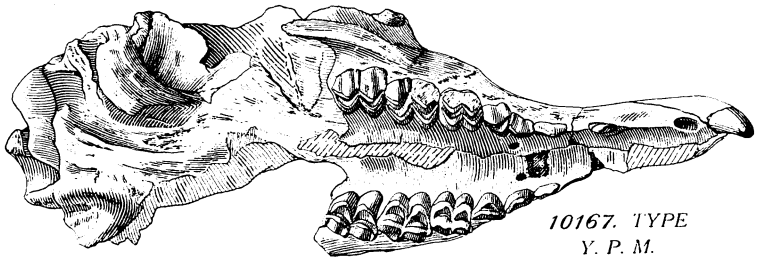

FIG. 1.—*Pseudolabis* (*Paralabis*) *matthewi,* subgen. et sp. nov. Holotype. Palatal aspect. A little less than one half nat. size.

tively much smaller premolars, as the table of measurements shows. The presence of the mesostyle, absent in the molars of *P. dakotensis,* is also very distinctive. Some of these distinctions, as, for instance, the relatively smaller canine and I^3 in *P. dakotensis,* might be sexual, were their possessor not a considerably larger animal. The presence of the mesostyle and the relatively more elongate muzzle and smaller premolars of the new form are both progressive characters which its contemporary lacks, showing the two to be divergent species, as the time and space limitations render the derivation of one from the other impossible. The gap so formed between them is certainly of subgeneric and possibly of generic rank.

The present form differs from *Poëbrotherium* in the larger size, the character of the auditory bullæ, the more prominent mesostyles, the relatively larger and more caniniform I^3, and the more attenuated muzzle, with, as a consequence, the longer diastemata, especially between the canine and P^1. Whether or not the rear of the orbit would prove a contrasting character can not be shown in the present specimen. In the type of *Pseudolabis dako-*

tensis the closure of the orbit is a notable distinction from *Poëbrotherium*. The present form is referred to the genus *Pseudolabis*, subgenus *Paralabis*, subgen. nov., and the specific name is given in recognition of the very high attainment of Doctor W. D. Matthew as a leader in paleontologic research.

Measurements.

	Y. P. M. 10167 *P. matthewi* mm.	Ratio	A. M. N. H. 9807 *P. dakotensis* mm.
Length, I^3 to condyle	219.0		
I^3 to M^3	122.0	0.88	138.5
C^1 to M^3	108.5		
P^2 to M^3	69.5	0.83	83.7
I^3, ant.-post. diameter	7.7		
I^3, length of crown	14.5		
Diastema, I^3 to C^1	5.5		
C^1, length of alveolus	7.7		
Diastema, C^1 to P^1	15.5		
Diastema, P^1 to P^2	10.0		
Length, P^2	8.0		
P^3	9.5		
P^4	9.5		
M^1 to M^3	43.5	0.906	48.0
M^1	12.5		
M^3	17.0		

John Day Camels.

Of the four species of camels which have been described from Oregon, two, *Paratylopus (Gomphotherium) sternbergi* (Cope) and *P. (G.) cameloides* (Wortman), come from the John Day horizon, while the two others, *Miolabis transmontanus* (Cope) and *Procamelus altus* Marsh, are from newer rocks. The Yale collection includes the type of the last-named species, while of John Day material there are at least six specimens, some of which pertain to *Paratylopus cameloides*, the others being evidently new. *P. (G.) sternbergi*, which comes from an older horizon, is apparently not represented at Yale.

Paratylopus (Gomphotherium) cameloides (Wortman).

(Figs. 2-4.)

Type material contained in the American Museum of Natural History, as follows: Cat. No. 8179, holotype,

mandibular ramus; Cat. No. 7915, paratype, upper dentition; Cat. No. 7912, paratype, almost complete fore limb, as well as several other fragments. Type locality, the Cove, John Day basin, Oregon. Type level, upper John Day (Promerycochœrus beds), uppermost levels, several hundred feet above that of *P. (G.) sternbergi.*

The association of this material under one species is open to question. The mandible, No. 8179, which is the first mentioned type, and therefore the holotype, is distinguished by increased size over that of *P. sternbergi,* as well as by the absence of diastema between the lower canine and outer incisor. The Yale specimen, Cat. No. 10921, comes from the type locality, and in so far as it is preserved, agrees in detail with the type. It consists of a muzzle, both upper and lower incisors, still embedded in the matrix, together with the lower canines, P_1 of the right side, and a detached fragment of the right ramus containing P_4, M_{1-2}. Fragments of the superior molars, premolars and canine are also present. There is no difference in size, except that in the type, P_1 is somewhat smaller and P_4 of the latter bears a small posterior cusp on the external face which is lacking in the Yale specimen. The teeth of the upper series (No. 7915, A. M. N. H.) are too large, especially the premolars and first molar. The ratios of Wortman's own measurements show the discrepancy at once, thus:

	P. sternbergi	Ratio	*P. cameloides*
	mm.		mm.
Length of upper molars and P^{2-4}	60	0.72	83
Length of lower molars and P_{2-4}	65	0.67	97

as the two series of *sternbergi* belong to the same individual.

Thus, the upper dentition of No. 7915, A. M. N. H., paratype, pertains to a somewhat larger and more conservative, although contemporaneous, specimen (see below).

Cat. No. 10090, Y. P. M., is also probably to be referred to *Paratylopus cameloides,* although an immature individual. This specimen, consisting of a skull and jaws collected by L. S. Davis in 1876 in the John Day valley, Oregon, is from the same horizon as the type. It consists of the skull from the middle of the orbits forward, the hinder part not being preserved. The milk dentition is present except for the upper median incisors. M_2 is not

erupted, M^2 was not in use although fully visible in the jaw, and both upper and lower third molars are not formed.

Distinctive characters.—Skull small, very slender, muzzle elongated. Facial vacuity apparently present. Deep depression on either side of face in maxillary, the pre-orbital pit, preceded by a slight swelling, the infra-orbital foramen over P^4. Premaxillaries very delicate, extending back to above P^2 and forming an extensive union with the nasals.

Upper deciduous incisors small, somewhat spatulate, and spaced. Deciduous canine isolated by long diastemata. The small, apparently permanent first premolar is

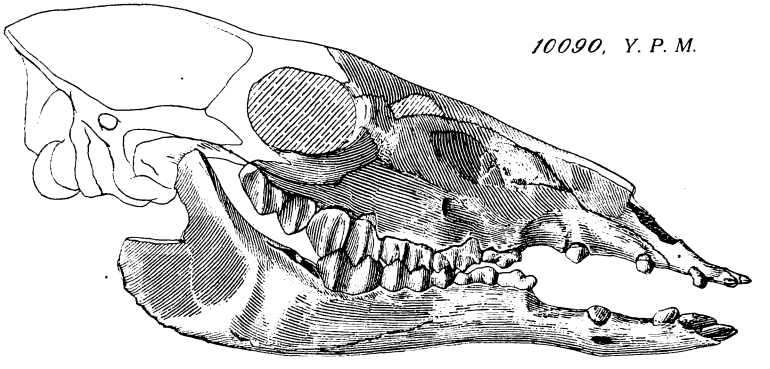

FIG. 2.—*Paratylopus cameloides* (Wortman). Juvenile. Skull and jaws, right aspect. × 3/5.

also isolated, its crown not fully erupted; it is triangular, trenchant, and apparently double-rooted. Dp^2 to M^2 form a continuous series with prominent external styles and buttresses, especially upon the molars. Dp^2 simple, laterally compressed, with one prominent cusp, flanked anteriorly by a lesser one, externally supported by a buttress. Dp^3 elongate, irregularly triangular, with one anterior and two posterior crescents. Dp^4 molariform, with a small internal pillar and prominent mesostyle. Molars tending toward hypsodonty, M^1 with small internal pillar and strong parastyle, mesostyle, and external buttresses.

The apparently deciduous inferior incisors and canine form a continuous series without diastema, are spatulate and procumbent. Canine incisiform, somewhat smaller

than incisors. P_1 apparently permanent, partly erupted, but unused, compressed, trenchant. Dp_{2-4} present. Dp_4 three-lobed, otherwise molariform. M_1 the only erupted molar.

Ramus very slender, gracefully curved, symphysis long. Mental foramen of left side just below anterior margin of P_1. This form differs from *Poëbrotherium* chiefly in the great elongation and attenuation of the muzzle, giving an actually greater antero-posterior dimension to the premaxillaries and a relatively slenderer jaw and longer symphysis. The lack of caniniform teeth is evidently due, in part at least, to the permanent ones not having erupted, and the diastemata are relatively much greater. While the nasals are not preserved throughout their entire length, it is doubtful whether they ever extended

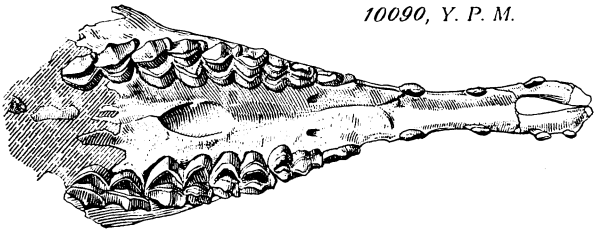

FIG. 3.—*Paratylopus cameloides* (Wortman). Juvenile. Palatal aspect of skull. × 3/5.

so near the tip of the muzzle as in *Poëbrotherium,* although their relative extent, as compared with the maxillaries, was similar.

The lower jaw, on the other hand, has very much the contour of the type of *Paratylopus cameloides,* with which it also agrees in the lack of diastemata between the lower incisor and canine teeth. The position of the mental foramen also is in practical agreement, although it varies in the two rami of the jaw, extending further back on the right side. The size of the permanent molars approximately corresponds.

Two other specimens may be referred to *Paratylopus cameloides.* These are, first, Cat. No. 10917, Y. P. M., collected by William Day in 1875 from the upper John Day beds at the Cove, John Day River, Oregon, and consisting of the superior maxillary, containing the dentition from the canine back, except that the crowns of P^{2-3} are broken away. This is an old animal, with M^1 worn almost

to the roots. The proximal portion of a left metatarsal is also present. There is, however, no direct evidence that the two bones pertain to the same individual.

The second specimen is Cat. No. 10922, Y. P. M., collected in 1875 by L. S. Davis from the same level in Haystack valley 10 miles below the Cove on the John Day River. It consists of a right mandible, dorsal centra, astragalus, and both femora and tibiæ, all four incomplete as to their shaft.

Distinctive characters.—Canine caniniform, sharply recurved, the section ovate. P^1 two-rooted, separated from the preceding and following teeth by extensive

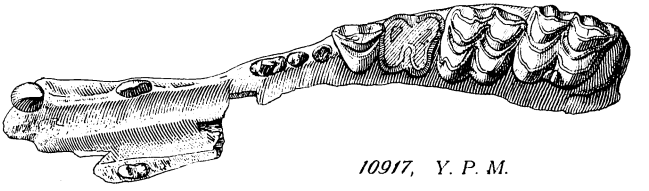

FIG. 4.—*Paratylopus cameloides* (Wortman). Crown view. × 3/5.

diastemata, of which the posterior one is somewhat the longer. Crown compressed, rounded by wear, with a distinct posterior cutting edge. P^4 sub-triangular, external buttress inconspicuous. M^1 characterless through wear, markedly smaller than the succeeding molars. M^2 and M^3 with well developed mesostyles, external buttresses, and rather pronounced internal basal pillars. On M^1 the internal style may have been present, but if so, has been worn away. Enamel of teeth rugose. Muzzle rather slender. Marked depression above and behind P^1. Infra-orbital foramen above posterior margin of P^4. Palatine foramina not preserved.

Compared with the type lower jaw of *P. cameloides*, there is a close agreement, as the molar teeth fit accurately. There is in the type, however, no trace of external basal pillar corresponding to the internal basal pillars in the present specimen, but this has been shown to be an inconstant feature within a species.[1] The teeth in the type also appear more hypsodont, but the Yale specimen shows a much greater degree of wear. With the referred superior dentition (No. 7915, A. M. N. H.), however, there

[1] See R. S. Lull, this Journal (4), 50, 104, 1920.

is more discrepancy, as the first molar and premolars are relatively markedly smaller, as compared with molars 2 and 3 of the upper series, thus indicating a greater degree of evolutionary advance.

Measurements.

	mm.
Length, P_2 to M_3	78.5
Diastema, C to P^1	16.0
Diastema, P^1 to P^2	20.0
P^4, ant-post. diameter	11.0
P^4, transverse diameter	10.0
M^1, ant.-post. diameter	13.0
M^2, ant.-post. diameter	17.3
M^2, transverse diameter	16.5
M^3, ant.-post. diameter	20.0
M^3, transverse diameter	17.4

The proximal third of a left metatarsal is associated with the jaw and is coössified by the plantar (palmar of Peterson) processes. It corresponds in every way with the jaw, but may not pertain to the same individual, as the same lot contained non-camel material as well. The component elements are very closely applied, so much so that were it not for a film of matrix between their approximated surfaces, they would appear to be coössified throughout. This very close approximation, together with the final fusion of the plantar processes,[2] is probably due to the age of the individual. It is in agreement with *Oxydactylus* (see below).

Measurements of cannon-bone.

	mm.
Proximal width	25.9
Ant.-post. diameter over plantar processes	24.4
Width of shaft, 50 mm. below summit	15.6

Specimen No. 10922, Y. P. M., consists of a right mandible, the teeth of which show fair correspondence with those of the upper jaw. One abnormal peculiarity, however, is a supernumerary P_1, the presence of which prevents an accurate fit with an upper jaw, No. 10917, as the smaller forward tooth interferes with P^1. Both first lower premolars are double-rooted, with trenchant

[2] In the type of *Paratylopus sternbergi* (Cope) in the American Museum the plantar processes are entirely separated throughout.

crowns, and are preceded and followed by diastemata of less extent than in the upper jaw. No other peculiarities are to be noted, except that there is a low basal pillar between the two outer crescents of M_1 corresponding to those between the inner crescents of M^2 and M^3. The character of the enamel corresponds to that of the upper dentition. The jaw is slender, with a nearly straight inferior margin, except toward the symphysis, where it is deflected downward. The mental foramen lies beneath the anterior P_1. The preserved portions of the limb bones and dorsal centra show nothing distinctive.

Measurements of lower jaw No. 10922.

	mm.
Length, P_2 to M_3	85.0
First P_1, ant.-post. length	5.8
Second P_1, ant.-post. length	7.7
Diastema, P_1 to P_2	12.3
P_2, length	9.2
P_3, length	11.3
M_2, length, ant.-post.	15.5
M_2, transverse diameter	10.6
M_3, ant.-post. diameter	21.6
M_3, transverse diameter	10.0
Depth of jaw at P_{1-2} diastema	14.4
Depth of jaw outside beneath ant. part M_3	24.5
Thickness of jaw beneath ant. part M_3	13.0

Paratylopus wortmani, sp. nov.

(Fig. 5.)

Holotype, Cat. No. 10884, Y. P. M. Upper Oligocene (upper John Day), Haystack valley, John Day River, Oregon.

The material upon which this new species is based consists of the anterior part of the upper jaws, four cervical vertebræ, humeri, ulno-radius, carpalia, metacarpalia, distal ends of both femora, proximal end of a tibia, and portions of both metatarsals. The premaxillaries are preserved, together with the maxillaries back as far as the root of the left P^2.

Distinctive characters.—The incisors were all present, I^3 being the largest, caniniform, and separated by a long diastema from the true canine tooth. In *P. cameloides*, this diastema must have been very short, as there is none

between inferior I_3 and C_1. The caniniform I^3 of the present form would seem to imply such an inferior diastema as in *Oxydactylus*. The canine is a well developed recurved cone. P^1 is two-rooted, compressed laterally, crown not preserved, but apparently less caniniform, separated from the adjacent teeth by diastemata of somewhat similar extent. The premaxillaries are prolonged backward, forming a premaxillo-nasal contact of considerable extent.

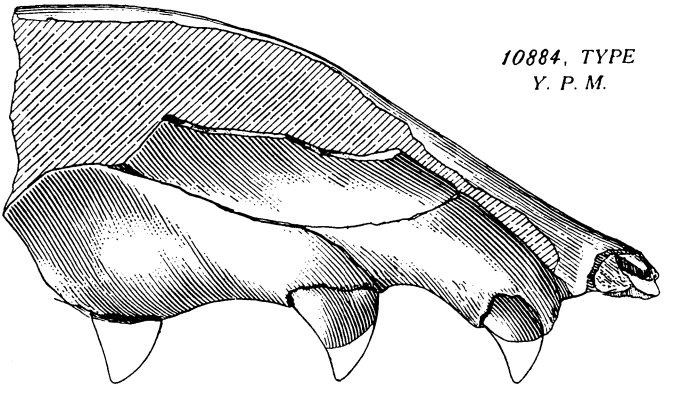

FIG. 5.—*Paratylopus wortmani*, sp. nov. Holotype. Right lateral aspect of muzzle. Nat. size.

Measurements.

	mm.
I^3, ant.-post. diameter	7.5
I^3, transverse diameter	5.0
C, ant.-post. diameter at base	9.3
C, transverse diameter	6.8
P^1, ant.-post. diameter of roots	8.7
P^1, transverse diameter of roots	3.5
Diastema I-C	12.0
Diastema C-P^1	17.4
Diastema P^1-P^2	22.4

Of cervical vertebræ, there are present the atlas, and an entire cervical V, to which are articulated nearly half each of cervicals IV and VI. These bones, while somewhat more primitive, resemble those of *Oxydactylus longipes* Peterson, although differing in dimensions, as the comparative measurements show.

Measurements.

	Cat. No. 10884 Y. P. M.	Ratio	*O. longipes*
	mm.		mm.
Greatest length of atlas	64.5	0.806	80
Greatest breadth of atlas	58	0.773	75
Greatest length, cervical V	114	0.674	169
Length of centrum, cervical V	97	0.647	150

The ratios show somewhat slenderer bones in No. 10884, together with a relatively long atlas.

The humerus differs from that of *O. longipes* in the form of the trochlea, which shows a greater obliquity in the latter. The proximal end is not preserved, and herein our John Day form resembles Wortman's figure of *P. cameloides* paratype, No. 7912, A. M. N. H. (see above). In some respects the trochlea suggests the one, in others, the other. Judging from the figure, there is a close agreement with *cameloides* in size.

The right ulno-radius is essentially complete, lacking only a very small portion of the distal articulation, which is supplied by its mate. The fusion between the two bones is so complete that the line of demarcation between them is practically obsolete except at the distal end. The element resembles very closely that figured by Wortman for *P. cameloides,* from which it differs chiefly in apparent dimensions as taken from the figure. From *Oxydactylus,* it differs in the greater distinctness of the distal end of the fibula and in certain minor details of the proximal end.

Measurements.

	P. cameloides	Ratio	No. 10884 Y. P. M.	Ratio	*Oxydactylus longipes*
	mm.		mm.		mm.
Humerus, length	192*	1.12	215†	0.68	315
transverse diameter, mid-shaft			17		
transverse diameter, distal end			38		
Ulno-radius, length	285*	1.07	305	0.69	440
width, prox. end			34	0.72	47
width, dist. end			35.5		
width, mid-shaft			23	0.66	35

* From Wortman's figure.
† Estimated.

The metacarpus resembles that of *Oxydactylus,* except in the apparent degree of development of the vestigial metacarpals II and V, which Peterson speaks of as small,

flat, rugose ossicles, on the sides of the functional third and fourth metacarpals. Metacarpal II was apparently free, as there is a distinct facet on the outer posterior corner of metacarpal III contiguous to, but beneath, the trapezoid facet. Metacarpal V, on the other hand, is represented by a small rugose knob thoroughly coalesced with metacarpal IV. Herein, as with the cervicals, the form under consideration is simply more primitive than is *Oxydactylus*. No mention of these details is made by Wortman, who merely figures the anterior metapodials and records their length. There is no trace of coössification of the metacarpals, but their flat, somewhat rugose surfaces were closely applied.

Measurements.

	P. camel-oides mm.	Ratio	No. 10884 Y. P. M. mm.	Ratio	*O. lon-gipes* mm.
Metacarpals:					
Length	228	0.964	220	0.638	345
Breadth, combined, at mid-shaft	21*	1.00	21	0.637	33*
Breadth, prox. end	28.8*	1.02	29.5	0.638	46.2*
Breadth, dist. end, mcp. III	16.8*	0.905	15.2	0.660	23
Breadth, dist. end, mcp. IV	16.2*	0.969	15.7	0.683	23
Average		0.972		0.651	
Femur:					
Trans. diameter, dist. end			44.6	0.666	67
Diameter, mid-shaft			22	0.733	30
Tibia:					
Max. ant.-post. diameter, prox. end			61	0.726	84
Transverse diameter, prox. end.			48.3	0.690	70

* From the illustrations.

The phalanges again are comparable to those of *Oxydactylus,* the ungual being compressed and deer-like.

Measurements.

	Cat. No 10885 Y. P. M. mm.	Ratio	*O. longipes* mm.
Length of prox. phalanx	46	0.836	55
Length of median phalanx	22.2	0.793	28
Length of ungual	18.5	0.740	25

Specimen No. 10884, Y. P. M., is distinct from either *Paratylopus sternbergi* or *cameloides,* chiefly by its larger size, the robustness of the caniniform teeth, and the length of diastema between I^3 and C^1. It is not clear, however,

that it is distinct from the paratypes of the *cameloides* description, especially the upper dentition (No. 7915, A. M. N. H.). It seems fitting, therefore, to name it in honor of Doctor Jacob L. Wortman, the describer of *P. cameloides,* who for a time rendered so eminent a service to the science of vertebrate paleontology.

Peterson,[3] speaking of *Oxydactylus,* says this phylum appears to be divergent from that of the true camels and that we are at present able to trace it with some certainty to the genus *Protomeryx* of the Upper Oligocene. Matthew,[4] however, restricts the use of the term *Protomeryx* to the two species *P. halli* Leidy and *P. campester* Matthew, and uses the new subgeneric term *Paratylopus* to include what were originally described as *Gomphotherium sternbergi* (Cope) and *G. cameloides* Wortman, together with his new species *primævus,* which he makes the type of *Paratylopus.* His derivation of *Oxydactylus* is from *Paratylopus* through *Miolabis,* the restricted *Protomeryx* being in the direct line of camel evolution and leading to *Protolabis* and *Procamelus.* As Peterson considers *Protomeryx* to be a synonym for *Gomphoides* (preoccupied), it is probable that he and Matthew are referring to the same group under different names, and hence their statements agree. The Yale material thus briefly described certainly bears this out, as it differs from the later *Oxydactylus* mainly in its greater primitiveness.

[3] O. A. Peterson, Ann. Carnegie Mus., 2, 472, 1904.
[4] W. D. Matthew, Bull. Amer. Mus. Nat. Hist., vol. 20, 211-215, 1904.