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THE SHOVEL-TUSKERS, AMEBELODONTINÆ, OF CENTRAL ASIA[1]

BY H. F. OSBORN[2] AND W. GRANGER

Borissiak's most welcome description (April 6, 1928, pp. 105–120) of *Platybelodon danovi*, discovered in the summer of 1927 in the Chokrak beds (Middle Miocene?—*fide* Bor.) of the Kuban region, North Caucasus, anticipated by one year the Andrews-Granger discovery (July 28, 1928) of *Platybelodon grangeri* in the Pliocene **Tung Gur** horizon of Mongolia; in the same description Borissiak (*op. cit.*, p. 119) proposed the subfamily name PLATYBELODONTINÆ, signifying 'flat-tuskers.'

Both of these Asiatic discoveries were partly anticipated by Barbour's finding (April 4, 1927) of *Amebelodon fricki* in southwestern Nebraska, to which he applied (June, 1927) the family name Amebelodontidæ,[3] signifying the 'shovel-tuskers.' *Amebelodon* has extremely long and relatively narrow shovel-tusks, while *Platybelodon* has relatively short and extremely broad shovel-tusks; these animals consequently represent *two entirely distinct generic phyla.*

PLATYBELODON DANOVI BORISSIAK: GENERIC AND SPECIFIC CHARACTERS

Following the admirable papers (1928, 1929) of Dr. A. Borissiak, we may here give a brief synopsis of the characters of the genotypic species *Platybelodon danovi* Borissiak, of the Caucasus, also a characterization of the new form *Platybelodon grangeri* of eastern Mongolia.

The genotype, *Platybelodon danovi*, consists of the anterior portion of a cranium and nearly complete jaws (probably belonging to one individual), in the Leningrad Museum, having the following measurements, as compared with *P. grangeri* (Amer. Mus. 26200, type; Amer. Mus. 26202, paratype):

[1]Publications of the Asiatic Expeditions of The American Museum of Natural History. Contribution No. 108.

[2]This is the author's twenty-third communication on the evolution and classification of the Proboscidea since 1918, and the thirty-third in his total list of papers on the Proboscidea since 1907. See the author's chronologic and classified Bibliography to the end of the year 1929, namely, "Fifty-two Years of Research," pp. 3–54, 74–124.

[3]Modified by Barbour (1929. 1, p, 138) to Amebelodontinæ.

	Platybelodon danovi Type	*Platybelodon grangeri* Type Amer. Mus. 26200
MANDIBULAR MEASUREMENTS		
Mandible:		
Length, condyle to tip of incisor	?1240 mm.	1530e mm.
condyle to tip of median symphysis	1102e	1340e
Symphysis:		
Length, to tip of incisors	700	880
to symphysial border	518	670
Breadth (maximum)	245	380–388
Breadth (minimum)	130	165
Mandibular ramus:		
Breadth, maximum (thickness)	90	106
Depth, maximum (height)	120	178
DENTAL MEASUREMENTS		
Inferior incisive tusks:		
Breadth (width)	110	166
Thickness	15–30	ext. 25–33 med.
Third inferior molar. M_3		
Length	168–170	
Breadth (width)	67	
Height	30–25	
Second superior molar, M^2		
Length	98–100	
Breadth (width)	65	
Third superior molar, M^3		
Length	130–133	
Breadth (width)	65	
Height	41	

These comparative measurements show that all the dimensions, mandibular and dental, of *Platybelodon grangeri*, including the lower molars, exceed those of *P. danovi* in the ratio of 5 to 4, this ratio being established by eight measurements common to both species, namely, P. *grangeri* 5249 mm., *P. danovi* 4145 mm. This average increment of *P. grangeri* over *P. danovi* of 5 to 4, however, is exceeded in the anterior part of the symphysis and in the incisors of *P. grangeri;* the ratio in this pre-mandibular region is as 8 to 5, or, from the three measurements in common, as 873 to 575; the pre-mandibular numerical ratio rises as follows:

MAXIMUM BREADTH OF ROSTRUM	*P. danovi*	*P. grangeri*
Symphysis	245	380
Single flattened incisor	110	166
Combined incisors at tip	220	327
	575	873

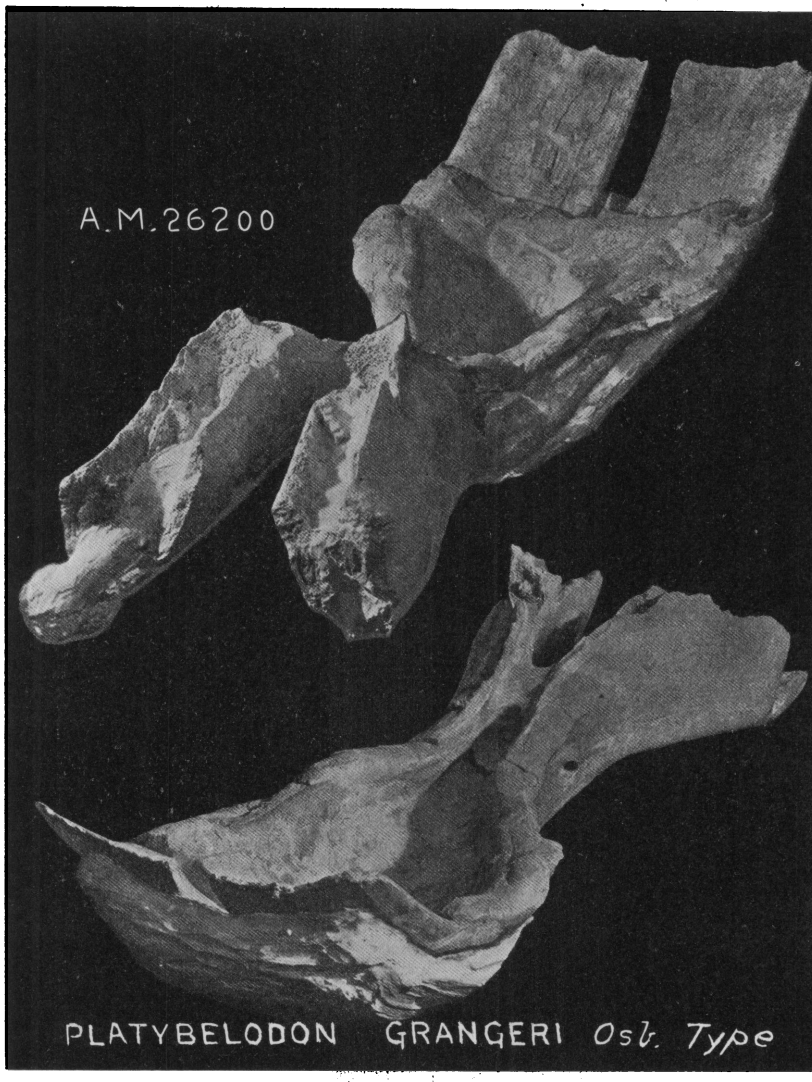

Fig. 1. Type mandible of *Platybelodon grangeri* Osb. (Amer. Mus. 26200), in oblique superior and anterior aspects. About one-eighth natural size.

Observe that the inferior incisors are accidentally separated; in the natural condition of the jaw (Fig. 3 A1) they are closely approximated, as indicated by dotted lines.

This establishes as a clearly distinctive specific character of *Platybelodon grangeri* its more progressive and highly specialized functional flat-tusk or platybelodont anterior region, namely, *the flat- or shovel-tusk region evolves most rapidly since it has become vitally important in the struggle for existence.*

Thus clearly establishing the progressive specific characters of *Platybelodon grangeri*, we may pass to a summary of all the extraordinary characters of this new species, a knowledge of which has been gained by a comparison of the twenty more or less complete specimens collected by Andrews and Granger in the **Tung Gur**, a relatively thin horizon, about 100+ feet in thickness, exposed in a radius of approximately ten miles. These type and referred materials apparently do not differ greatly in geologic age or specific progression; the variations in size lie rather in differences of age as between the referred immature cranium (Amer. Mus. 26201), and jaw of an estimated condylar-symphysial length of 980 mm., as compared with 1340e mm. in the type.

Cranial Measurements	*Platybelodon danovi* Type	*Platybelodon grangeri* Type Amer. Mus. 26200
Fragment preserved:		
Length, glenoid to tip of superior incisors	746 mm.	
occipital condyle to tip of premaxillaries (est.)	819	1120 mm.
Maxillo-premaxillæ:		
Length	310	
Breadth (maximum)	180	
Incisive tusk:		
Transverse breadth (thickness)	40	

Geno-specific Characters of P. danovi.—Maxillo-premaxillæ, flattened and broadened. Two superior grinding teeth functional in adult dentition, orbit above M^3; M^2 three crested, with typical bunolophodont intermediate conules, as in *Phiomia*; M^3 four crested, bunolophodont, with lophs and conelets of *Phiomia* type. Superior incisive tusks small, rounded, diameter 40 mm. *Mandible* with low and massive rami, greatly prolonged anteriorly and upcurved towards extremity of incisors; symphysis greatly elongated, gradually expanding from narrowest portion (130 mm.) to broadest terminal portion (245 mm.); inferior double tusks with flattened, slightly concave surface above, greatest breadth 110 mm., thickness along midline 30 mm., along thinner outer line 25 mm., taken anteriorly 15–20 mm., converging at tip, slightly separated at emergence from jaws; enamel absent on upper surface, with irregular longitudinal grooves, protected below by enamel longitudinally striated (1929, p. 22).

The above synopsis from Borissiak's admirable text and figures (Figs. 1–4, Pls. III–V) demonstrates the complete generic distinction of

COMPARATIVE MANDIBULAR AND DENTAL MEASUREMENTS OF TYPE, PARATYPE, AND JUVENILE PLATYBELODON GRANGERI

	Amer. Mus. 26200 Type	Amer. Mus. 26202 Adult Paratype	Amer. Mus. 26201 Juvenile
Mandibular Measurements			
Total length	1340e = 4 ft. 4¾ in.	1015+mm. = 3 ft. 4 in.	980 mm. = 3 ft. 2½ in.
Symphysis:			
Length to end of alveolus	655e = 2 1½		415 = 1 4¼
Breadth (maximum)	388 = 1 3¼		229 = 9
Breadth (minimum)	165 = 6½		122 = 4¾
Ramus:			
Depth below M 2	150 = 5⅞	129 = 5 1/16	106+ = 4⅛
Breadth opposite M 2	111 = 4⅜	91 = 3½+	101 = 4

Dental Measurements

	l.M_2	l.M_3	r.M_2	r.M_3	l.M_1	l.M_2	r.M_2	r.M_3
Anteroposterior	109	205	100	192	92e	123	125	?
Transverse	63	68	61	69	51	58	55	55+
Height	?	69	?	70	?	63	60	59e

Platybelodon Borissiak (1928, 1929) from *Amebelodon* Barbour (1927); it also shows that the easterly Mongolian form discovered by Andrews and Granger in July, 1928, belongs to an entirely distinct species, to which Osborn in 1929 assigned the name '*Amebelodon grangeri*,' in honor of the discoverer of the type and referred specimens, and which may now be redescribed as *Platybelodon grangeri*.

Platybelodon grangeri Osborn, 1929

Collection, 1928. Tairum Nor Basin, Mongolia. **Tung Gur** Pliocene.

TYPE.—Amer. Mus. 26200 (Field No. 812). Lower jaw, back part weathered out; grinding teeth missing. A large fully adult individual.

PARATYPE.—Amer. Mus. 26202 (Field Nos. 791, 792). Middle portion of right and left adult lower jaws, containing finely preserved second and third inferior molars of both sides, M_2, M_3. All measurements agree precisely with those of the type, consequently used in the restoration.

TYPE DESCRIPTION.—(Osborn, 1929.769, pp. 13–16): "A new species of mastodont named *Amebelodon grangeri*, a descendant of the primitive long-jawed mastodont (*Phiomia*) of northern Africa. Adapted to uprooting bulbous plants, it frequented the shallow lake waters of ancient Gobi. . . . This unique type of mastodont was first described by Prof. Erwin H. Barbour from a fossil jaw which he found in western Nebraska and to which he applied the highly appropriate generic name *Amebelodon* (derived from two Greek words signifying 'shovel' and 'end-tooth'). The Gobi discovery, which may be named *Amebelodon grangeri* confirms in the most surprising manner the adaptation so aptly named by Professor Barbour, and it demonstrates, as in the case of all the other quadrupeds, that the Gobi climate and environment were even more favorable than that of the Nebraska plains in Pliocene time, because in the Gobi shovel-tusker the dimensions are nearly double those of the Nebraska shovel-tusker."

SPECIFIC CHARACTERS.—Type exceeding *Platybelodon danovi* in size, mandibular dimensions in ratio of 5 to 4; in pre-mandibular dimensions in ratio of 8 to 5. Anterior portion of mandible greatly broadened; second inferior incisors correspondingly broadened, flattened, and relatively shortened; post-mandibular proportions as in *P. danovi*.

MATERIALS.—Besides the type and paratype fully adult jaws there are four individuals represented by referred crania and jaws, several individuals represented by isolated fragments of inferior grinding teeth, six individuals represented by inferior incisive tusks, two individuals by superior tusks; five individuals represented by unassociated foot bones, which enable us to estimate approximately the height and bodily proportions of *Platybelodon grangeri*. In detail the materials are as follows:

REFERRED CRANIA AND JAWS

Amer. Mus. 26201 (Field No. 793). Juvenile cranium and lower jaws, vertically crushed, containing superior incisive tusks, r. and l. I^2, and M^1, M^2, also M_1, M_2, M_3; inferior flattened tusks wanting.

Amer. Mus. 26203 (Field No. 791A). Left lower jaw fragment, containing second and third inferior molars, M_2, M_3. Adult, exceeding type and paratype in size.

Amer. Mus. 26204 (Field No. 794). Fragment of left lower jaw with perfect l.M_2, slightly exceeding type in size.

Amer. Mus. 26210 (Field No. 806). Fragment of ?M^3.

Amer. Mus. 26243 (Field Nos. 795 A, B, C, D, E). Fragments of five grinding teeth.

Amer. Mus. 26212 (Field No. 806 D, E, F, G). Jaw fragment and portions of inferior grinding teeth.

INFERIOR INCISIVE TUSKS:

TYPE (Amer. Mus. 26200). A perfect pair (see Figs. 1 and 3).

Amer. Mus. 26205 (Field No. 795). Fractured portion of an r.I_2 (sectioned).

Amer. Mus. 26206 (Field No. 795). Outer fractured portion of r.I_2.

Amer. Mus. 26207 (Field No. 795). Median portion of r.I_2 (sectioned). See figure 2.

Amer. Mus. 26208 (Field No. 795). Left incisor fragment (sectioned).

Amer. Mus. 26209. Anterior fragment of an l.I_2, showing sharpened edge.

Amer. Mus. 26211 (Field No. 806). Median portion of an l.I_2, displaying dentine.

SUPERIOR INCISIVE TUSKS:

Amer. Mus. 26201 (Field No. 793). Right and left rounded tusks, juvenile, female.

Amer. Mus. 26212 (Field No. 806A). Right superior tusk, r.I^2.

Amer. Mus. 26212 (Field No. 806B). Core, male superior tusk.

FOOT BONES:

Amer. Mus. 26212 (Field No. 806F). Unassociated posterior and anterior foot bones.

SUPERIOR INCISORS.—The superior tusk-like incisors are relatively short and slightly out-turned; subcylindrical to cylindrical in section; slightly down-turned, worn sharply at extremities (806A). In the juvenile specimen (Amer. Mus. 26201), a female tusk not fully emerged presents at a point about 200 mm. from the tip a transverse measurement of 47 mm., and a vertical measurement of 48 mm. Whereas a supposed male tusk (806A) presents at a point 204 mm. from the tip a transverse measurement of 47 mm., and a vertical measurement of 56 mm. The core of a still larger male tusk (806B) presents a transverse measurement of 63 mm., and a vertical measurement of 70 mm., taken at the same distance.

INFERIOR INCISORS AND DENTINAL TUBULES

In the type (Fig. 3A—Amer. Mus. 26200) the lower incisors, on excavation, were rightly estimated at 14 in. (360 mm.) in total length, of which the exposed portion measures exactly 8¾ in. (225 mm.); width 6½ in. (166 mm.); median thickness at point of exposure 1¼ in. (33 mm.); thickness along outer border 1 in. (25 mm.).

Portions of five more or less fractured lower incisors reveal a very new and important character, also observed in the *Amebelodon fricki* of Barbour, namely, the presence of very numerous and closely compacted dentinal tubules within the inferior incisive tusks. Figure 2A1, representing a partly fractured crown of Amer. Mus. 26207, shows a

portion of this tubular area and a mass of these dentinal tubules; in transsection these tubules are seen in Fig. 2A, each of which has a small lumen. This discovery led to the examination of a portion of a left lower incisor of *Amebelodon* from Texas (Fig. 2B—Colo. Mus. 1319), in which similar dentinal tubules are displayed, although the fossilization is much less clear and distinct.

The dentinal tubules are somewhat smaller and more closely compacted in *Platybelodon* (Fig. 2A) and more numerous, namely, of an estimated total of 250 separate tubules. In *Amebelodon* (Fig. 2B) they are larger, and much less numerous, namely, of an estimated total of 100–150. The function of these tubules is probably to strengthen the inferior tusks and to resist the results of abrasion of the beveled edges, as shown in figure 3 A1. The microscopic structure will be given further study.

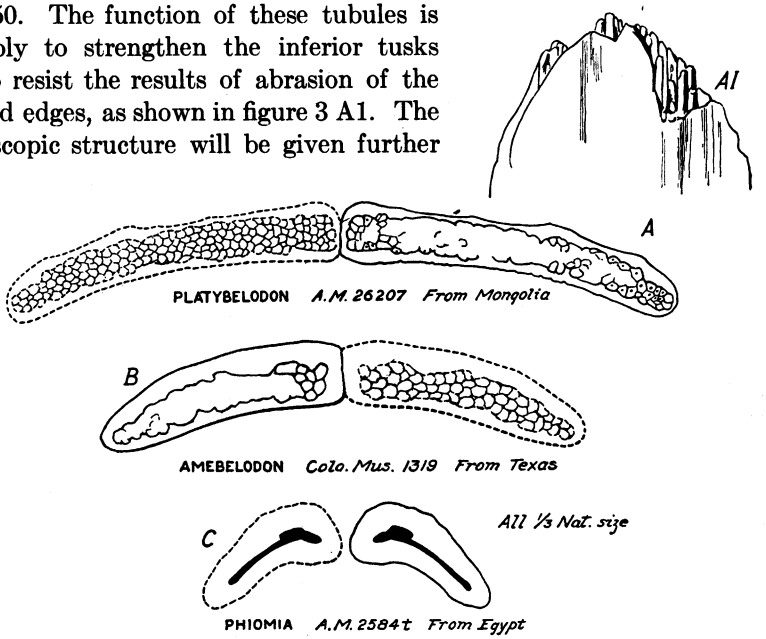

Fig. 2. Comparison of Platybelodon, Amebelodon, and Phiomia Incisors
All one-third natural size

A, Diagrammatic transsection of the right lower second incisor of *Platybelodon grangeri* (Amer. Mus. 26207). The left lower incisor is restored.

A1, Superior aspect of the right lower second incisor of same specimen (Amer. Mus. 26207) showing the partly exposed dentinal tubules.

B, Transsection of the left lower second incisor of *Amebelodon fricki* (?) ref. (Colo. Mus. 1319) from the Pliocene of Texas. The right lower incisor is restored.

C, Section of the right lower second incisor of *Phiomia osborni* (Amer. Mus. 2584t) from the Oligocene of the Fayûm, Egypt, exhibiting open dental pulp cavity. The left lower incisor is restored.

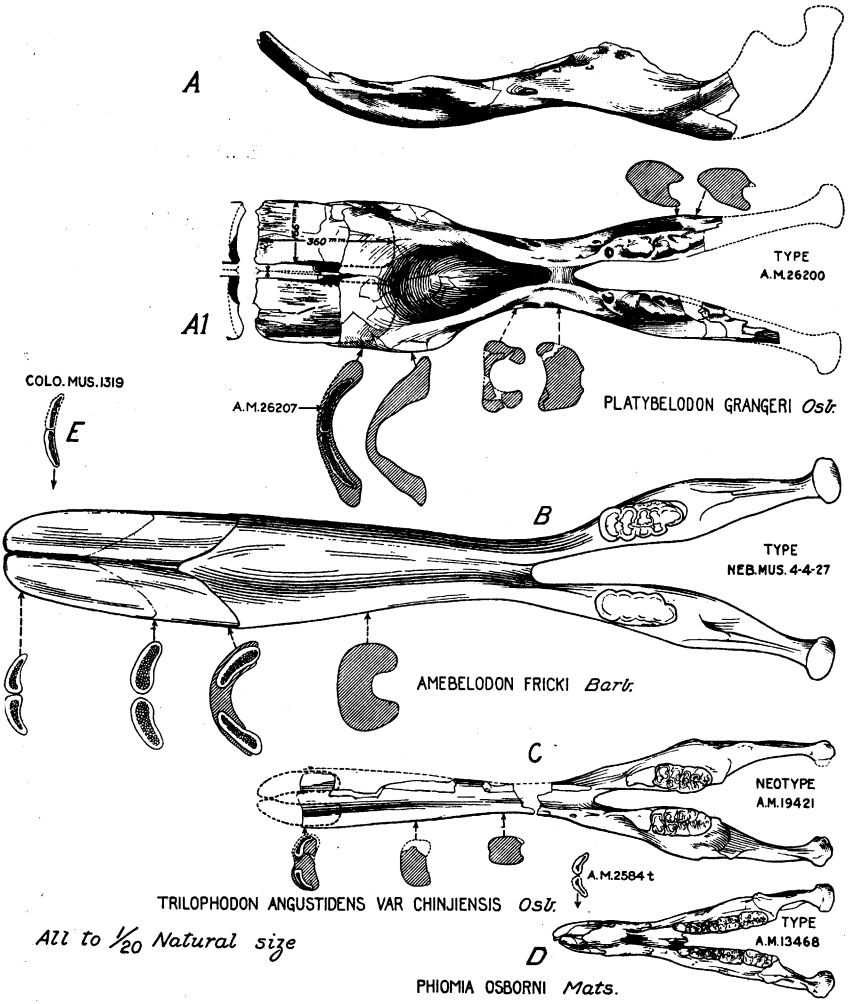

Fig. 3. COMPARISON OF PLATYBELODON, AMEBELODON, TRILOPHODON, AND PHIOMIA
All one-twentieth natural size

A, *Platybelodon grangeri* type (Amer. Mus. 26200). Lateral aspect.

A1, The same, superior aspect, with sections of the rostrum and mandible at six points indicated.

B, *Amebelodon fricki* Barb. type (Neb. Mus. 4–4–27), with *theoretic* section of the lower incisors and jaw at four points indicated.

E, Actual section of terminal region of incisive tusk of *Amebelodon fricki* ref. (Colo. Mus. 1319).

C, *Trilophodon angustidens* var. *chinjiensis* Pilg.-Osb. Neotype (Amer. Mus. 19421), Chinji horizon, Middle to Upper Miocene, with sections of hollow lower incisors at three points indicated.

D, *Phiomia osborni* Mats. type (Amer. Mus. 13468), Lower Oligocene Fluviomarine of the Fayûm, Egypt.

The presence of these dentinal tubules appears to unite *Platybelodon* and *Amebelodon* into a single subfamily, the AMEBELODONTINÆ of Barbour, 1929, embracing two phyla:

Amebelodon Barb., with relatively long and slender rostrum and incisors (Fig. 3B).

Platybelodon Bor., with short and extremely broadened rostrum and incisors (Fig. 3A, A1).

The comparative diagram (Fig. 3 A–D) of *Platybelodon*, *Amebelodon*, *Trilophodon*, and *Phiomia* seems to demonstrate that *Trilophodon* and *Phiomia* should remain in the subfamily Longirostrinæ, as they resemble each other in the presence of large hollow pulp cavities in the lower incisor teeth, as shown in the sections (Fig. 3 C, D). This is a somewhat surprising result, because in the superior aspect of the jaw, *Phiomia*, *Trilophodon*, and *Amebelodon* appear to form a natural ascending evolutionary series. The *transsections* of the incisive teeth prove that in its hollow incisors *Phiomia* resembles *Trilophodon*, while it differs widely from *Amebelodon* and *Platybelodon*.

Finally, this remarkable comparative diagram (Fig. 3) demonstrates that the postsymphysial portions of the jaw and grinding teeth undergo little progressive evolution except in size; it is the anterior symphysial and rostral region of the shovel-tuskers or Amebelodontinæ that undergo such an extraordinary specialization, while the grinding teeth remain substantially the same.

The unusual adaptations in the anterior portion of the jaw do not prevent the theoretic derivation of all the longirostrines from varied specific stages of *Phiomia*, as suggested by Osborn in the years 1921–1925.

In 1921 Osborn (1921.526, p. 331) wrote as follows: "*Phiomia* is certainly ancestral to the Bunomastodontidæ only, in fact, barely separable generically from *Trilophodon angustidens*, the typical longirostrine." In 1922 (Osborn, 1922.566, p. 454): "6. Longirostrinæ, typical long-jawed bunomastodonts arising in North Africa (*Phiomia*), spreading all over southern Europe, Asia, and North America." In 1925 (Osborn, 1925.637, p. 5): "V. THE LONG-JAWED MASTODONTS, OR LONGIROSTRINES, springing from the long-jawed *Phiomia* of the Egyptian Oligocene and becoming the *Trilophodon* of Europe, migrating through Europe and Asia in the Miocene and spreading over Nebraska, Kansas, South Dakota, and Colorado in Pliocene time."

TYPE DESCRIPTION OF THE NEW GENUS AND SPECIES *TORYNOBELODON LOOMISI* BARBOUR, 1929

After the manuscript of the above number of Novitates was written and approved, and actually sent to the press for publication (March 6, 1931), the present authors received (March 9, 1931) Prof. Erwin H. Barbour's most interesting Bulletin No. 16, of December, 1929, which will be fully abstracted and illustrated in Osborn's forthcoming Proboscidea Monograph. Unfortunately the original copies of Barbour's Bulletin 16 (issued in December, 1929) miscarried and the first copy received came in response to a letter from the senior author to Professor Barbour, dated February 25, 1931, to which Professor Barbour most kindly replied, immediately mailing another copy of Bulletin 16.

We therefore desire to give Professor Barbour the fullest credit for prior description of the remarkable dentinal tubules of which the tusks of *Torynobelodon loomisi* are composed.

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