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On the scientific names of mastodont taxa: nomenclature, Chinese translation, and taxonomic problems (Postprint)

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Abstract

Mastodonts represent a crucial stage in proboscidean evolution that established the fundamental framework for the diversification of proboscidean crown groups. With over 400 years of research history, mastodont classification and nomenclature have undergone numerous revisions, with the evolutionary trajectory of the group fully reflected in this nomenclatural history. This study examines the etymological origins of mastodont taxon names, compiling 175 Chinese translations (the vast majority being valid taxonomic names) encompassing 12 suprageneric taxa, 46 genera, and 117 species—covering nearly all mastodont species and genera. Based on this comprehensive compilation, we clarify the evolutionary lineage of mastodonts and identify several issues in their classification and nomenclature. The evolution of the skull and mandible in mastodonts demonstrates continuous, parallel trends across all lineages, while cheek tooth morphology, though not highly distinctive, remains relatively stable within each lineage. Choerolophodontidae represents the most robust monophyletic group within mastodonts, with Synconolophus potentially representing a valid genus. Within Mammutidae, both Miomastodon and Pliomastodon are likely valid taxa, though not necessarily direct ancestors of Mammut americanum. In Amebelodontidae, the phylogenetic relationships among Platybelodon danovi, P. grangeri, and Aphanobelodon zhaoi remain questionable, contingent upon whether the cross-section of P. danovi' s lower incisors truly exhibits a columnar dentine structure. Konobelodon britti from the Americas may be synonymous with Torynobelodon loomisi, while Asian species assigned to Konobelodon are not necessarily amebelodontids and may instead belong to Paratetralophodon. Within Gomphotheriidae, the genus Serridentinus may be valid, representing a zygodont-leaning group within gomphotheres that evolved toward the Cuvieroniinae. Cuvieroniinae likely includes only the genera Cuvieronius and Rhynchotherium, while among other short-jawed gomphotheres in the Americas, Stegomastodon may have evolved from a branch within Amebelodontidae,

and Notiomastodon may be related to Sinomastodon.

Full Text

Preamble

On the Scientific Names of Mastodont Taxa: Nomenclature, Chinese Translation, and Taxonomic Problems

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Abstract

Mastodont-grade proboscideans represent a crucial stage in the evolution of the order, establishing the fundamental evolutionary patterns for all crown proboscidean groups. Mastodont research spans more than 400 years, during which classification and nomenclature have undergone numerous revisions. The evolutionary history of mastodonts is fully reflected in their nomenclatural history. This paper presents a comprehensive bibliographic investigation into the nomenclature and etymology of various mastodont groups, reviewing 175 translated Chinese names of mastodont-grade proboscideans, including 12 taxa above the genus level, 46 genera, and 117 species—covering nearly all species of the mastodont radiation. Based on this foundation, we review the principal phylogenetic hypotheses of mastodont interrelationships and highlight persistent problems in mastodont classification and nomenclature. The evolution of mastodont skulls and mandibles is continuous across all clades, reflecting similar parallel evolutionary trends, while cheek tooth morphology, though not conspicuously distinct across lineages, remains relatively stable within each lineage.

Choerolophodontidae is the most robust monophyletic group within mastodonts, among which *Synconolophus* may represent a distinct, valid genus. Within Mammutidae, both *Miomastodon* and *Pliomastodon* are likely valid taxa, though not necessarily direct ancestors of *Mammut americanum*. The phylogenetic relationships among *Platybelodon danovi*, *P. grangeri*, and *Aphanobelodon zhaoi* within Amebelodontidae remain questionable, depending on whether the lower incisor cross-section of *P. danovi* exhibits a dentine rod structure. *Konobelodon britti* from America may be a synonym of *Torynobelodon loomisi*, while Asian species assigned to *Konobelodon* are probably not amebelodontids but rather attributable to *Paratetralophodon*. Within Gomphotheriidae, *Serridentinus* may be a valid taxon representing a trend toward zygodonty in gomphotheres that

terminated with the Cuvieroniinae. The Cuvieroniinae may include only *Cuvieronius* and *Rhynchotherium*, while other brevirostrine gomphotheres in America, such as *Stegomastodon*, may have evolved from an amebelodont lineage. *Notiomastodon* may be related to *Sinomastodon*, which itself may have originated from *Pliomastodon (?) zhupengensis* in southern China. The name *Mastodon intermedius* Teilhard de Chardin & Trassaert, 1937 (now *Sinomastodon intermedius*) has the senior primary homonym *Mastodon intermedius* Eichwald, 1831. We suggest that *Sinomastodon intermedius* should be replaced with its senior synonym *Sinomastodon sendaicus* (Matsumoto, 1924).

Keywords: mastodonts, proboscidean, etymology, nomenclature, Chinese translation, taxonomy

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Introduction

Proboscideans became a "globally evolving" group during the Late Cenozoic. This term refers to their simultaneous evolution across multiple continents and their migration between them, making proboscideans index fossils for global stratigraphic correlation during the Late Cenozoic. Their broad environmental adaptability also makes them indicative of global environmental evolution during this period.

Proboscideans are among the most important and earliest studied groups of Late Cenozoic fossil mammals. According to Osborn (1936:2), the first scientific paper on proboscideans was published in 1602 (by Diego de Avalo y Figueroa), marking 419 years of research history. Over these centuries, the accumulated literature has become voluminous, with academic perspectives flourishing in a hundred competing schools of thought. This complex research history has created numerous challenges for researchers, particularly for those new to the field, who struggle most with mastering the nomenclatural history of proboscideans. Nomenclature is far more than merely assigning names—it places each name within a taxonomic system that requires morphological distinction from related groups while reflecting information about associated individuals, time periods, and other contextual details, all while avoiding homonymy and synonymy issues. Nomenclature demands profound understanding of a group' s evolutionary questions, and it is no exaggeration to say that a clear grasp of a taxon' s nomenclatural history provides the key to studying that group.

For Chinese researchers, additional difficulties arise from Western languages. Paleontological nomenclature must conform to Latin rules, while most proboscidean names derive from Greek—both languages presenting natural barriers for native Chinese speakers. This linguistic gap impedes understanding of these

names' meanings, let alone their frequent Western cultural contexts, thereby hindering comprehension of the research subjects themselves.

Furthermore, with China' s rapid economic, cultural, and scientific development, the general public has urgent needs for popular science, including paleontology. Numerous paleontology enthusiasts are active in society, some with considerable expertise, and proboscideans are a group of particular interest. Their primary concern is: what is this elephant called? Many Chinese translations proposed by enthusiasts have gained widespread acceptance and dissemination. However, enthusiasts lack comprehensive systematic knowledge of nomenclatural history, and some translations may be inappropriate. For example, the suffix *-belodon* commonly appears in shovel-tusker names, but *-bel* does not mean "shovel" —it derives from Greek words for "arrow" or "bolt," first used in *Tetrabelodon* and *Dibelodon* (Cope, 1884) to refer to the rod-like incisors of *Gomphotherium* and *Cuvieronius*. If lower incisors were present (four total incisors), it was *Tetrabelodon*; without lower incisors (two upper incisors), it was *Dibelodon*. These names were later applied to elephantids as *Stegotetrabelodon* and *Stegodibelodon* (see below). Therefore, translating *-belodon* as "shovel-tusked elephant" is inaccurate. In this paper, we translate most *-belodon* names as "incisor," such as *Amebelodon* as "shovel-incisored elephant," with few exceptions (*Platybelodon* retains the traditional "shovel-tusked elephant"). These blind spots in nomenclatural history are hidden within proboscidean research history and require professional researchers to comprehensively excavate and systematically organize.

Through our research, we have gradually recognized deficiencies in the proboscidean evolutionary framework. Western researchers have largely dominated studies of European, African, and South Asian proboscideans, but their understanding of East Asian fossils remains relatively generalized. However, East Asia sits at the crossroads of proboscidean migration from Africa via Eurasia to the Americas, where various proboscideans converged and flourished, leaving an extremely rich and complex fossil record. The absence of a particular record may interrupt evolutionary 线索, creating puzzles. For example, North American *Gnathabelodon* (jaw-incisored elephant) has long been considered an enigma in proboscidean evolution, with no scholar providing a reasonable taxonomic explanation until the first two authors of this paper discovered *Choerolophodon* (pig-ridged elephant) fossils in China, particularly complete mandibles, recognizing *Gnathabelodon* as a product of choerolophodontids entering America (Li et al., 2019).

Many such cases exist, yet limited time and energy prevent us from fully presenting new materials and discoveries to the scientific community in a short time. If our discoveries can revise the proboscidean evolutionary framework, more researchers must invest greater effort to systematically present these new findings to the world and produce convincing results.

Through our research, we deeply feel the lack of a Chinese-language proboscidean work that keeps pace with the times, making it difficult for new

researchers to quickly enter the field and comprehensively understand existing problems in proboscidean evolution, while enthusiasts struggle to communicate conveniently with scholars. Therefore, the authors of this paper attempt to address nomenclatural issues in a short article, hoping to provide some assistance with these problems.

2. Translation Principles and Writing Conventions

This paper discusses mastodonts (*mastodonts*), the most diverse and widely distributed clade within Proboscidea. All post-Late Oligocene groups except deinotheres and advanced members of stegodontids and elephantids are considered mastodonts. From an evolutionary level perspective, mastodont evolution can be divided into paleomastodont, trilophodont, and tetralophodont groups. Paleomastodont groups retain vertical tooth replacement; trilophodont and tetralophodont groups have three and four transverse ridges on intermediate cheek teeth (DP4/dp4–M2/m2), respectively. Evolutionary stages beyond tetralophodonty exceed mastodont limits, entering stegodont and elephantid stages. However, from a phylogenetic perspective, mastodonts constitute a paraphyletic group. Early stem groups are collectively termed paleomastodonts in this paper, while crown groups (if the reference time extends to the Pleistocene) include the monophyletic families Choerolophodontidae, Platybelodontidae, and Mammutidae; the paraphyletic family Gomphotheriidae; and the most primitive representatives of the monophyletic families Stegodontidae and Elephantidae. Recent studies suggest that previously established phylogenetic frameworks may contain deep inconsistencies. For example, ancient protein sequence comparisons support *Notiomastodon* (southern mastodon) belonging to Mammutidae rather than the traditionally recognized Gomphotheriidae (Buckley et al., 2019). Whether this results from methodological problems, insufficient understanding of *Notiomastodon* and Mammutidae, or inherent defects in phylogenetic worldview and methodology deserves careful consideration.

The number of mastodont taxa is enormous. As understanding deepens, new taxa continue to be established while old ones gradually fade from use. Some previously abandoned names have been revived by new research as valuable. The authors cannot introduce all historical taxa but discuss those currently widely recognized in academia. Family-level classification primarily follows Gheerbrant and Tassy (2009), who treat choerolophodontids, platybelodontids, and gomphotheriids as family-level taxa. Additionally, for cladistic considerations, Gheerbrant and Tassy (2009) separately treat *Palaeomastodon* and *Phiomia* as families, but for brevity, these family-level taxa are not listed here. Genus-level taxa selection references Shoshani and Tassy (2005), while species-level selection references Shoshani and Tassy (1996: Appendix III), supplemented by recently established taxa, with particular attention to Chinese taxa. The vast majority of discussed taxa are valid, though some controversial taxa and historically significant but now considered junior synonyms (e.g., *Mastodon* Cuvier, 1806) are included, marked with "¶" after the name.

When introducing translations, genus-level and above translations are presented first, following the sequence: paleomastodont groups, trilophodont groups, and tetralophodont groups. Subsequently, main species translations are introduced following the same order. Within each genus, the type species is generally introduced first, with other species arranged as convenient.

Translation principles are as follows:

Translations should employ meaning-based translation whenever possible, primarily referencing Brown (1954). Phonetic translation is reserved for non-Chinese personal and place names. An exception is *Mammut*, phonetically translated as (Mammut elephant) rather than the original meaning "digger" (Osborn, 1936:6), a word unrelated to elephants that is difficult to translate meaningfully.

Phonetic translations of personal and place names should follow official recommended standards. Place name translations follow *The Manual of World Place Names* (Encyclopedia of China Publishing House, Xiao Derong et al., 1984 edition). Personal name translations follow *English Name Translation Manual* (The Commercial Press, 1988 edition) and *French Name Translation Manual* (Xin Hua, 1970 edition). Information about individuals (birth/death years, contributions) and geographical locations is investigated whenever possible.

When translating place names, complete translations are listed. When translating personal names: if the name is a genus name, it is fully translated; if it is a species name with two or fewer Chinese characters, the full name is translated; if it exceeds three characters, only the first character is used, followed by "氏" (meaning "clan" or "family") to represent the full name. For example, *Morrillia* Osborn, 1924a, as a genus name, is translated as (Morrill elephant), while *Eubelodon morrilli* Barbour, 1914, as a species name, becomes (Morrill' s true-incisored elephant). Western personal names in species epithets generally use only surnames, though occasionally full names appear, such as *Platybelodon barnombrowni* (Barbour, 1931), translated as (Barney Brown shovel-tusked elephant).

Meaning-based translation should correctly and accurately reflect all information expressed in the original name. For example, *Stegomastodon* Pohlig, 1912, where *stego-* means "roof" and *mastodon* means "nipple-tooth," is thus translated as (ridged mastodon, omitting "roof"). We need not preserve controversial translations simply because previous scholars rendered it as (saber-toothed mastodon). Similar translation applies to *Stegolophodon* (ridged-ridge-tooth elephant).

For some established translations that have become deeply ingrained despite inaccurate meaning, we retain them. For example, *Stegodon* Falconer, 1857, should literally be translated as (roof-ridge-tooth elephant), but (saber-toothed elephant) has become so deeply rooted (possibly via Japanese translation) that it cannot be changed.

The origins of name roots should be traced whenever possible. For example, *Serbelodon* Frick, 1933: *ser-* from Latin *serra* (saw); *bel-* from Greek meaning arrow or bolt; *odon* from Greek meaning tooth. This name is one of the few heterologous terms in mastodont nomenclature, with roots from different languages —a practice to be avoided in nomenclature. As the authors are not linguistics experts, only Latin forms are listed; for non-Latin alphabets such as Greek, Russian, or Japanese, forms are not listed.

For a few errors arising from inconsistent gender endings in original names, we correct them according to international nomenclatural rules without preserving original errors. For example, *Gomphotherium shensiensis* becomes *Gomphotherium shensiense*, and *Gomphotherium rongrensis* becomes *Gomphotherium rongrense*. Both use neuter ending *-ense* to replace masculine *-ensis*. However, original spelling errors (generally of place names) are not altered, such as *Gomphotherium yongrense*, where removing the ending yields *yongr*, inconsistent with the original place name Yongren, but the *yongr* spelling is retained.

For names with ambiguous meanings, we investigate original authors' descriptions to express their intended meaning. For expressive names, translations should be elegant, particularly drawing from classical Chinese literature. For example, *Stegotetrabelodon syrticus* Petrocchi, 1943, is translated as (vast sea saber-ridge-tooth elephant). The species name derives from *syrtis*, originally referring to the flowing sand landforms of North African coastal regions. The translation borrows from *Records of the Grand Historian*' s description of the "Han Sea," originally referring to a great northern lake (Lake Baikal?) later becoming a term for the Gobi Desert, which is very appropriate here.

For taxa above genus level, only translations are listed without explanation, as family and subfamily names derive from genus names.

For each name entry, information is presented in the following order, using *Mastodon* as an example:

[**Scientific Name**] *Mastodon* Cuvier, 1806¶ (¶ indicates discarded or controversial)
[**Translation**] (mastodon)
[**Gender**] (masculine)
[**Etymology**] *mast-*, from Greek, breast; *odon*, from Greek *odontus*, tooth.
[**Name Meaning**] Here referring to the mammillated structures on cheek teeth.
[**Remarks, i.e., Nomenclatural History and Taxonomic Interpretation**] Note: Cuvier (1806) did not formally name using Linnaean binomial nomenclature. He published five mastodont species, the first written as *Mastodonte de l' Ohio* (i.e., *Mammut americanum*), meaning "Ohio mastodon." Until Cuvier (1817) adopted binomial nomenclature, writing it as *Mastodon giganteum*, this was the formal use of *Mastodon*. However, *Mastodon* Cuvier, 1806 is actually a junior synonym of *Mammut* Blumenbach, 1799. Blumenbach (1799) recorded the American mastodon in binomial form as *Mammut ohioticum*. Osborn (1936)

consistently denied the priority of *Mammut* Blumenbach, 1799, partly due to Cuvier' s lofty status in paleontological history, and possibly because *Mammut* means "digger" (Osborn, 1936:6), a name Osborn (1936:169) described as "barbaric" with limited scientific value. Osborn' s opinion was adopted by most subsequent scholars until Simpson (1945) pointed out that personal preferences cannot override rules, restoring *Mammut* to its proper status.

However, Cuvier' s (1806) *Mastodonte* did not refer solely to the American mastodon. The other four species were *petit Mastodonte* (small mastodon, i.e., *Mastodon tapiroides*, later not strictly distinguished from *Zygolophodon turicensis*); *Mastodonte à dents étroites* (narrow-toothed mastodon, i.e., later *Gomphotherium angustidens*); *Mastodonte des Cordilières* (Cordilleran mastodon, i.e., later *Cuvieronius hyodon*); and *Mastodonte humboldien* (Humboldt' s mastodon, i.e., later *Notiomastodon platensis*). These covered the main evolutionary stages of gomphotheres and mammutids, making "mastodon" a representative name for this evolutionary stage of proboscideans. Although *Mastodon* as a genus name is a junior synonym of *Mammut*, and as a higher taxonomic unit it has been eliminated due to cladistic developments, the term "mastodon" as a general name (Western *mastodont*) for this important stage in proboscidean evolutionary history retains practical utility. Therefore, we recommend retaining "mastodont" as a general term referring to the groups included in classic works by Osborn (1936), Tobien (1973, 1975, 1978), and others—the scope discussed in this paper.

3. Translations of Genus-Level and Above Taxonomic Names

(1) **Suborder:** Elephantiformes Tassy, 1988 —(Elephantiform suborder)

(2) **palaeomastodonts** —(Paleomastodont group, paraphyletic)

(3) *Palaeomastodon* Andrews, 1901 —(Paleomastodon, masculine). *palae-*, from Greek, ancient or old. Indicates this genus is older or more primitive than *Mastodon*.

(4) *Phiomia* Andrews & Beadnell, 1902 —(Phiomia, feminine). *Phiom*, from ancient Greek, an ancient city name, now Fayum (Egypt), the first discovery location of this genus. Note: Previously translated as (primitive mastodon), this translation is not recommended here.

(5) *Hemimastodon* Pilgrim, 1912 —(Hemimastodon, masculine). *hemi-*, Greek prefix, half. Indicates this genus' s evolutionary level is halfway between *Palaeomastodon* and *Gomphotherium*. Note: Some scholars (Osborn, 1936; Pickford, 1987) considered this genus should belong to suiforms (Suidae or Anthracotheriidae), but most scholars consider it a proboscidean.

(6) *Eritreum* Shoshani et al., 2006 —(Eritreum, neuter). Derived from ancient Greek *Eritrea*, Red Sea, here referring to Eritrea on the Red Sea coast of northeast Africa, indicating the fossil' s discovery location.

(7) **Superfamily:** Elephantimorpha Tassy & Shoshani, 1997 in Shoshani et al., 1998 —(Elephantimorph superfamily, monophyletic)

(8) **trilophodonts** —(Trilophodont group, informal taxonomic unit)

(9) **Choerolophodontidae** Gaziry, 1976 —(Choerolophodontid family, monophyletic). Choerolophodontidae is the most undisputed monophyletic group within mastodonts, supported by numerous synapomorphies. Choerolophodontidae has no tetralophodont-level taxa.

(10) *Choerolophodon* Schlesinger, 1917 —(Choerolophodon, masculine). *choero-*, from Greek *choiros*, pig; *lopho-*, from Greek meaning "ridge," usually translated as "脊" but commonly as "棱" in proboscideans to avoid confusion with *stego-*. This name indicates this genus' s teeth are highly folded, similar to pig teeth. Note: Wang and Deng (2011) previously translated this as (pig-ridge-tooth elephant), but we recommend (pig-ridge-tooth elephant) to unify the translation of *loph* in proboscideans.

(11) *Synconolophus* Osborn, 1929a —(Synconolophus, masculine). *syn-*, Greek prefix, together; *con-*, Greek prefix, cone, here referring to cuspules. This name means the cuspules on tooth ridges are superimposed, showing patterns of both bunodont and folded teeth. Note: Zhou Mingzhen and Zhang Yuping (1974) translated this as (thick-tooth elephant), but since the original lacks the tooth root (*odontus*) and only contains ridge (*loph*), we recommend (thick-ridge elephant). Recent literature mostly treats *Synconolophus* as a synonym of *Choerolophodon* (Tassy, 1983a), but considering the type species *S. corrugatus* has a very elevated skull and downward-curved mandibular symphysis, clearly different from *Choerolophodon* type species *C. pentelici* with its flat skull and forward-projecting mandible, it may be considered a separate genus.

(12) *Gnathabelodon* Barbour & Sternberg, 1935 —(Gnathabelodon, masculine). *gnatha-*, from Greek, jawed. This genus name roughly means using a lower jaw without lower incisors to replace the forward-projecting lower incisors. Note: Only recently confirmed as belonging to Choerolophodontidae by Li et al. (2019), characterized by an elongated, trough-like mandible lacking lower incisors.

(13) *Afrochoerodon* Pickford, 2001 —(Afrochoerodon, masculine). *Afro-*, Africa; *choerodon*, abbreviated from *choerolophodon*. Indicates this genus was first named from Africa. The validity of this genus is discussed below.

(14) **Mammutidae** Hay, 1922 —(Mammutid family, monophyletic?). Monophyly is uncertain due to the possible *Sinomastodon–Notiomastodon* lineage, often considered gomphotheres. Mammutidae has no tetralophodont-level taxa.

(15) *Mammut* Blumenbach, 1799 —(Mammut, neuter). *mammut*, meaning digging animal (Osborn, 1936:6), difficult to translate meaningfully, hence phonetic translation is used. Issues regarding *Mammut* are discussed below at the species level.

(16) *Zygolophodon* Vacek, 1877 —(Zygolophodon, masculine). *zygo-*, Greek root, yoke; in this translation, the customary "棱" (*loph*) is omitted. Issues regarding *Zygolophodon* are discussed below at the species level.

(17) *Miomastodon* Osborn, 1922 —(Miomastodon, masculine). *mio-*, from Greek *meion*, meaning less, here referring to Miocene. Means Miocene mastodon. Note: This genus was once considered a synonym of *Zygolophodon*, but Wang et al. (2020) further explained and considered it valid.

(18) *Pliomastodon* Osborn, 1926 —(Pliomastodon, masculine). *plio-*, from Greek *pleion*, meaning more, here referring to Pliocene. Means Pliocene mastodon. Note: This genus was once considered a synonym of *Mammut*. The authors believe this genus may be valid. In fact, based on incisor and mandibular morphology, *Pliomastodon* is closer to *Mammut borsoni* and *M. obliquelophus*. Since the latter two have long been considered separate genera from *Mammut americanum*, they might instead be assigned to *Pliomastodon* (Simpson, 1945; Makov, 2008).

(19) *Eozygodon* Tassy & Pickford, 1983 —(Eozygodon, masculine). *eo-*, Greek prefix, dawn, beginning; *zygodon*, abbreviated from *zygolophodon*. Indicates this genus is earlier or more primitive than *Zygolophodon*.

(20) *Losodokodon* Rasmussen & Gutierrez, 2009 —(Losodokodon, masculine). *Losodok*, a locality in Kenya' s Turkana Basin. This site yielded a Late Oligocene fauna including this taxon.

(21) *Sinomammut* Mothé et al., 2016a —(Sinomammut, masculine). *Sin-*, from Latin *Sina*, referring to China. Means a mammutid discovered in China. Note: The holotype of *Sinomammut* has mostly been lost, with characteristics based on photographs taken before specimen restoration. The important feature is a relatively long mandibular symphysis but missing lower incisors (which are actually difficult to confirm from photographs). In true American *Mammut* species, *Mammut pacificus* lacks lower incisors, and *M. americanum* only occasionally has them. A

relatively long mandibular symphysis is merely a plesiomorphic feature of *Sinomammut*, so *Sinomammut* may be an ancestral type of the two narrowly defined American *Mammut* species.

(22) **Amebelodontidae** Barbour, 1927 —(Amebelodontid family, monophyletic?). The monophyly of Amebelodontidae is relatively weakly supported (Wang et al., 2017a). Uncertainty arises because Asian species of *Konobelodon* and *Archaeobelodon* may belong to Gomphotheriidae, and *Stegomastodon* may have evolved from a *Megabelodon–Eubelodon* lineage that gradually lost lower incisors and shortened the mandible.

(23) *Amebelodon* Barbour, 1927 —(Amebelodon, masculine). *ame-*, from ancient Greek, meaning shovel. Here referring to this genus' s shovel-shaped mandible. Note: The translation "shovel-tusked elephant" has long been occupied by *Platybelodon*, leaving no suitable translation for *Amebelodon*. In Zhou Mingzhen et al.' s (1976) translation of Colbert (1969), it was rendered as (changed-tooth elephant), possibly treating *ameb-* as a root meaning "change," but *bel* is an integral unit that cannot be split. Here we translate *bel*' s original meaning as "incisor," distinguishing it from shovel-tusked elephants.

(24) *Platybelodon* Borissiak, 1928 —(Platybelodon, masculine). *platy-*, from Greek, meaning wide or broad. Indicates this genus' s mandible and lower incisors are very wide and flat. Note: Translating *Platybelodon* as "broad-toothed elephant" or "flat-toothed elephant" would be more reasonable, but in Osborn and Granger' s (1932:pl. 8, fig. 6) study of *Platybelodon grangeri* from Tung Gur, they juxtaposed its mandible with a large iron shovel, making "shovel-tusked elephant" a long-standing and deeply rooted translation that we retain here.

(25) *Serbelodon* Frick, 1933 —(Serbelodon, masculine). *ser-*, from Latin root *serr-*, serrated; *belodon* commonly used for amebelodontids. This name indicates this genus' s cheek teeth have a combined structure of serrated anterior and posterior lophs and central conules, with flat lower incisors.

(26) *Protanancus* Arambourg, 1945 —(Protanancus, masculine). *prot-*, Greek prefix, first, usually translated as "原" (primitive); *a(n)-*, negative prefix; *ancus*, possibly from Proto-Indo-European meaning curved; *anancus* originally means "not curved," i.e., straight-toothed. This name stems from Arambourg (1945) believing *Protanancus* had some features of alternating main and subsidiary columns, making it an ancestor of *Anancus* (*Anancus* alone is translated as (mutually-ridged elephant), see below; since *Protanancus* and *Anancus* have no direct phylogenetic relationship, we do not adopt the (primitive mutually-ridged elephant) translation used in some previous literature). Note: Tassy (1983b) demonstrated *Protanancus* belongs to Amebelodontidae, distributed in

Africa and South Asia, and also believed American *Amebelodon* originated from *Protanancus*. Wang et al. (2015a) reported *Protanancus* from East Asia, establishing the connection; East Asian *Protanancus* is indeed morphologically more similar to *Amebelodon*.

(27) *Archaeobelodon* Tassy, 1984 —(Archaeobelodon, masculine). *archae-*, Greek prefix, ancient. This name indicates this genus is relatively primitive within Amebelodontidae (due to weakly flattened lower incisors). Note: As mentioned above, support for Amebelodontidae monophyly is weak. *Archaeobelodon*' s lower incisors are only slightly flattened, a degree of flattening not much different from *Phiomia*, representing a plesiomorphic feature. Some specimens assigned to *Gomphotherium* have more or less flattened lower incisors, making them difficult to distinguish from *Archaeobelodon*. *Archaeobelodon*' s cheek teeth also lack clear amebelodontid apomorphies. Therefore, although *Archaeobelodon* is geologically younger, it may represent a remnant of the common ancestor type of both amebelodontids and gomphotheres.

(28) *Eurybelodon* Lambert, 2016 —(Eurybelodon, masculine). *eury-*, Greek prefix, wide. This name indicates this genus has relatively wide lower incisors. Note: This genus is unique among proboscideans in having enamel covering both upper and lower incisors. Other features, including incisors and cheek teeth, show no clear differences from some *Amebelodon* species.

(29) *Aphanobelodon* Wang et al., 2017b —(Aphanobelodon, masculine). *aphan-*, from Greek, invisible. This name indicates this genus completely lacks upper incisors. Note: *Aphanobelodon* completely lacks upper incisors, with lower incisor cross-section showing concentric layer structure. *Platybelodon danovi* already shows obvious upper incisor reduction, but its lower incisor structure is unknown. If *P. danovi*' s lower incisor cross-section also shows concentric layer structure, then *Aphanobelodon* may be a synonym of *Platybelodon*.

(30) **Gomphotheriidae** Hay, 1922 —(Gomphotheriid family, paraphyletic). Stegodontidae and Elephantidae likely both originated from Gomphotheriidae.

(31) *Gomphotherium* Burmeister, 1837 —(Gomphotherium, neuter). *gomph-*, from Greek, referring to a nail-like object with a large head; *-therium*, from Greek, beast, translated as "elephant" in proboscideans. This name describes the morphology of the skull and mandible with incisors in gomphotheres. Note: The Chinese translation (embedded-tooth elephant) further describes the morphology where upper and lower incisors interlock when jaws close. Similar to *Mammut*, Osborn consistently used the later name *Trilophodon* for this genus, influencing contemporary scholars until

Simpson (1945) restored its proper status.

(32) *Trilophodon* Falconer, 1857¶ —(Trilophodon, masculine). *tri-*, Greek, three. This name means intermediate cheek teeth have three ridges. Note: As a genus name, *Trilophodon* has become a synonym of *Gomphotherium*, but as a general term for a mastodont evolutionary stage (*trilophodont*), this name remains convenient.

(33) *Tetrabelodon* Cope, 1884¶ —(Tetrabelodon, masculine). *tetra-*, Greek, four. This name means four rod-like incisors project forward in gomphotheres. Note: This genus is now considered a synonym of *Gomphotherium*.

(34) *Serridentinus* Osborn, 1923 —(Serridentinus, masculine). *serr-*, Latin root, serrated; *dentinus*, tooth. Like *Serbelodon*, this name indicates this genus' s cheek teeth have a combined structure of serrated anterior and posterior lophs and central conules. Note: This genus was established with American gomphothere *Mastodon productus* as type species, but later underwent inappropriate expansion to include some mammutid taxa (showing the boundary between Mammutidae and Gomphotheriidae is inherently blurred), creating much confusion about this group' s morphology. Tobien (1972) abolished this genus as a synonym of *Gomphotherium*. Wang et al. (2017c) demonstrated that *Serridentinus* can indeed exist as an independent branch within gomphotheres (though still possibly paraphyletic, as rhynchotheres likely originated from this group).

(35) *Progomphotherium* Pickford, 2003 —(Progomphotherium, neuter). *pro-*, general prefix meaning before (in time or space). This name indicates this genus is earlier than *Gomphotherium*. Note: This genus differs from *Gomphotherium* in having simultaneously used p3–m3 tooth rows, showing a lower level of cheek tooth replacement evolution, a plesiomorphic feature.

(36) *Afromastodon* Pickford, 2003 —(Afromastodon, masculine). Indicates this genus was discovered in Africa. Note: This genus has rod-like lower incisors and subsidiary columns with three lobes, a feature seen in amebelodontids but not excluded in gomphotheres.

Trilophodont Groups of Uncertain Family Affiliation

Groups Possibly Related to Mammutidae

(37) *Sinomastodon* Tobien et al., 1986 —(Sinomastodon, masculine). *Sin-*, from Latin *Sina*, referring to China. This name indicates the first naming location of this genus. Note: The earliest included species was *Mastodon intermedius* from northern China (the validity of this species is discussed below). This species was once assigned to Mammutidae, while other included materials from southern China belonged to Gom-

photheriidae. Tobien et al. (1986) considered this genus a product of American *Notiomastodon* migrating back to East Asia. However, *Notiomastodon* is now considered found only in South America, with a first appearance far later than *Sinomastodon intermedius*, and similar in age and morphology to Chinese *Sinomastodon*. Therefore, *Notiomastodon* may instead be a product of Chinese *Sinomastodon* migrating to America in the Pliocene-Pleistocene. Wang et al. (2019) believed *Sinomastodon* could find ancestral types in southern China' s Late Miocene, namely *Pliomastodon (?) zhupengensis* discussed here. Therefore, *Sinomastodon* may indeed have originated from Mammutidae, and *Notiomastodon*' s ancient protein sequences are indeed closer to *Mammut* (Buckley et al., 2019).

(38) *Notiomastodon* Cabrera, 1929 —(Notiomastodon, masculine). *notio-*, from Greek, meaning southern, generally referring to South American mammals. This name indicates this genus was discovered in South America.

(39) *Haplomastodon* Hoffstetter, 1950¶ —(Haplomastodon, masculine). *hapl-*, Greek prefix, simple, single. This name indicates this genus has simple cheek tooth structure. Note: *Haplomastodon* is considered a synonym of *Notiomastodon* (Mothé and Avilla, 2015).

Groups Possibly Related to Amebelodontidae

(40) *Megabelodon* Barbour, 1914 —(Megabelodon, masculine). *meg(a)-*, Greek prefix, meaning huge. Indicates this genus is larger than known long-jawed mastodonts at the time. Note: This genus has a narrow, elongated mandible lacking lower incisors, with flattened traces at the missing alveoli. Its cheek tooth morphology is not very typical but similar to *Protanancus* (especially East Asian species) of Amebelodontidae. Therefore, this genus may have evolved from Amebelodontidae but represents a branch that lost lower incisors.

(41) *Eubelodon* Barbour, 1914 —(Eubelodon, masculine). *eu-*, Greek prefix, meaning good, complete, commonly translated as "true" . This prefix here indicates that from the perspective of incisor development, this genus is related to both four-incisored *Tetrabelodon* (generally referring to *Gomphotherium*) and two-incisored *Dibelodon* (referring to brevirostrine elephants) because its lower incisors are reduced but the mandible is long. Note: This genus' s mandibular morphology is similar to *Megabelodon* but significantly shortened, with cheek teeth also similar to *Megabelodon* but with more strongly developed subsidiary column trilobation, similar to amebelodontids. This feature also supports the possibility that this genus originated from Amebelodontidae.

(42) *Stegomastodon* Pohlig, 1912 —(Stegomastodon, masculine). *stego-*, from

Greek, meaning roof, here referring to *Stegodon* (saber-toothed elephant). This name means this genus is similar to *Stegodon* due to abundant cementum in tooth valleys, but cheek teeth have "Mastodon" characteristics. Note: This genus is also translated as (saber-toothed mastodon, Colbert, 1969; Zhou Mingzhen et al., 1976 translation), but *stego-* itself has no meaning of sword, and "saber-toothed mastodon" has not been widely circulated. Here we follow the translation scheme for *Stegolophodon* as (ridged-ridge-tooth elephant), translating it as (ridged mastodon). This genus is completely brevirostrine, but its well-developed subsidiary column trilobation and folded teeth suggest possible origin from the *Megabelodon–Eubelodon* lineage, with different origins from other Cuvieroniinae.

Groups Possibly Related to Gomphotheriidae

(43) **Subfamily Cuvieroniinae** Cabrera, 1929 —(Cuvieroniine subfamily)

(44) *Rhynchotherium* Lucas & Morgen, 2008a —(Rhynchotherium, masculine). *rhynch-*, from Greek, referring to the snout. Falconer (186

Note: Figure translations are in progress. See original paper for figures.

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