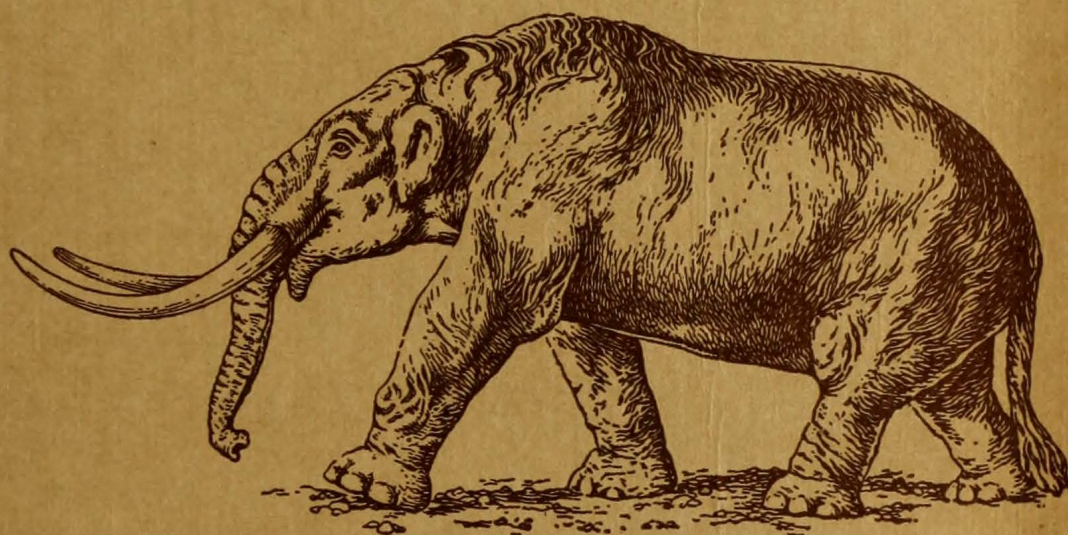


THE AMERICAN MUSEUM OF NATURAL HISTORY

# MASTODONS AND MAMMOTHS OF NORTH AMERICA



By HENRY FAIRFIELD OSBORN

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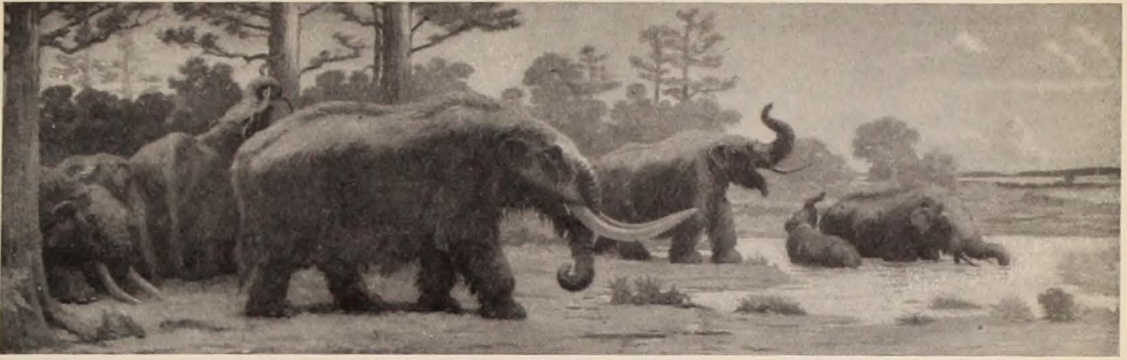
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Group of American mastodons (*Mastodon americanus*) along the banks of the Ohio River, where these animals were first discovered in 1739. After restoration by Osborn and Knight.

# The Elephants and Mastodons Arrive in America

By HENRY FAIRFIELD OSBORN

President of The American Museum of Natural History

FOREWORD.—Among the treasures of the American Museum is the unrivaled collection of skeletons and skulls of fossil proboscideans from Africa, the home of the race, from Asia, and from North and South America. Aided by the Morgan and Jesup funds, a large volume is being prepared describing the whole history of the elephant and mastodont families as far as known today. The present article is a sketch of these remarkable animals as they migrated, one race after another, into America, became naturalized and acclimated, enjoyed their lives here, and finally became extinct, the last survivor being the great mastodon of the eastern forests of North America.

THERE are few joys in life comparable with that which the naturalist experiences when one of his predictions or prophecies happens to be fulfilled. In 1900 I predicted that Africa would prove to be the cradle of the Proboscidea; in 1903 this prophecy was verified by British explorers in Egypt. Naturally eager to visit the scene of this discovery at once, I refrained until my British friends had fully described and published this and other discoveries and gained the world-wide reputation therefor to which they were richly entitled. I then asked President Theodore Roosevelt for an introduction to Lord Cromer, at the time Viceroy of Egypt, and through the generosity of President Jesup of the American Museum an expedition was fitted out, carrying as credentials a thoroughly

characteristic note from President Roosevelt to Lord Cromer. Unfortunately, I did not keep a copy of the note but, so far as I recall, it ran as follows:

January, 1907.

Dear Lord Cromer:

The bearer, Henry Fairfield Osborn, is a friend of mine keenly interested in palæontology who desires to enter the Fayûm district of Egypt. Any help which you may be able to extend to him or to his party will be greatly appreciated by

Yours sincerely,

THEODORE ROOSEVELT.

This brief and simple diplomatic message opened the doors of Egypt to the American Museum party. On our arrival at Shepheard's Hotel on the morning of January 23, a card was sent up announcing Captain H. G. Lyons, then director of the Geological Survey of Egypt, who thereupon as-



sured me that all the resources of the Survey would be placed at our disposal,—a camel caravan, a supply of the absolutely essential *fantasses* for carrying water, and, best of all, the guidance of a most intelligent and delightful member of the Survey staff, Mr. Hartley T. Ferrar. A personal caravan was also engaged. Thus, sixty camels strong, we wound our way past the pyramids of the eastern side of the Nile, skirted the fertile basin of the Fayûm, and struck southwest into the waterless desert until we reached the region that represented the ancient cradle of the elephant family. We at once set to work with a very superior force of Egyptian excavators from Kuft, under the direction of Mr. Walter Granger and Mr. George Olsen, two of the best fossil hunters of America, who stuck to their arduous post for nearly two months, until driven out by sandstorms and excessive heat. With their skilled aid, we soon discovered the burial sites of three of the early elephant dynasties; the MÆRITHERIUM, the abundant PHIOMIA, and finally the rare PALÆOMASTODON. The last-mentioned name is derived from the uncorrupted Greek words *παλαιός*, *μαστός*, and *ὀδόν*, signifying “the ancient nipple tooth.” This name, applied by the able British palæontologist, Charles W. Andrews, recently deceased, has proved to be of literal significance because we now have reason to believe that *Palæomastodon* may be the direct lineal ancestor of our true American mastodon (*Mastodon americanus*). Thus for the American Museum was disinterred a superb collection of small ancestral mastodonts, remote and humble relatives of three branches of the mastodont family—all of Upper

Oligocene time, estimated by some geologists as 3,000,000 years ago.

The Fayûm Expedition took place seventeen years ago. It aroused in the writer's mind the liveliest interest in these relatively small and primitive proboscideans, and a desire to compare them closely with the large proboscideans of France and South America, which were first described in 1806 by the famous Cuvier, also the wish to compare them with the proboscideans described and figured by the British explorers Falconer and Cautley in India between the years 1845 and 1847, and finally the hope to trace all these animals from their ancestral homes in Africa and Eurasia through their migrations to America.

#### TRAVELING INSTINCTS OF THE PROBOSCIDEANS

An insatiable *Wanderlust* has always possessed the souls of elephants as it has those of the tribes and races of man. Not only to overcome the changes and chances of this mortal life, but also to gratify their intelligent curiosity ever to explore afresh forests, pastures, fields, rivers, and streams, they have gone to the very ends of the earth and have far surpassed man in adapting their clothing and teeth to all possible conditions of life. Thus the romances of elephant migration and conquest are second only to the romances of human migration and conquest. Variety is the spice of elephant life, as it is of human life, and the very longing for a change of scene and of diet has been the indirect cause of what in scientific parlance we term *adaptive radiation*—the reaching out in every direction for every kind of food, every kind of habitat, in itself the *cause* of radiating or divergent evolution and adaptation. It is to this predisposition to local, con-



tinental or insular, and world-wide wanderings that we attribute the many branches and sub-branches which have been developed in this remarkable family. We may first enumerate all these branches and then signalize those that found their way to America and which form the chief subject of this article.

## PROBOSCIDEA

### *Races I-X of the Mastodont Family: Mastodontidæ*

I. THE MÆRITHERES, named from Lake Mæris of the Greeks. Small amphibious mastodonts of the North African rivers and lakes. See figure p. 9.<sup>1</sup>

II. THE DINOTHERES, implying proboscideans of terrifying size. Existed in Europe and Asia in Miocene and early Pliocene times.

III. THE TRUE MASTODONTS, arising from *Palæomastodon* of the Egyptian Oligocene. Sparsely represented in the forest and lignitic deposits of Europe; first appearing in America in Upper Miocene time, becoming the giant mastodons of the American forests at the close of the Ice Age. See figure p. 12.

IV. THE YOKE-TOOTHED MASTODONTS, OR ZYGLOPHODONTS. First known in the Miocene of Europe and leading into Borson's mastodon of the Upper Pliocene forests of Europe and Asia, close to the true mastodons.

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. See figures pp. 10 and 11.

VI. THE TETRALOPHODONTS, the name referring to the four ridge crests on the anterior molar teeth. First known from the Lower Pliocene of Eppelsheim, Germany, and of Pikermi, Greece; migrated across India, and entered America in late Pliocene time during the beginning of the Ice Age.

VII. THE SERRIDENTINES, named in allusion to the serrations on the outer and inner borders of the grinding teeth; medium-jawed. First known in the Miocene forest deposits of Europe; migrated to our southern states, Texas and Florida, and survived to the very close of Pliocene time. See figure p. 13.

VIII. THE BEAK-JAWED MASTODONTS, OR RHYNCHOSTRINES, readily distinguished by the downward curvature of the tusks, similar to that in the Dinotheres. Of unknown European origin; first discovered in Colorado and California, and traced down into Mexico.

IX. THE NOTOSTRINES, name signifying 'mastodons of the south' because the animals are found chiefly in California and South America. Short-jawed, the like true mastodons.

X. EXTREMELY SHORT-JAWED MASTODONTS, OR BREVIROSTRINES. First known species, the straight-tusked mastodont of Auvergne, Pliocene of France. The Brevirostrines migrated to India, reached western Nebraska in Middle Pliocene time, and survived in our southern states into the beginning of the Ice Age. See figures, p. 15.

### *Races XI-XVI of the Elephant Family: Elephantidæ*

XI. THE STEGODONTS, named because of the resemblance of the toothed ridges of the grinding teeth to a series of roof-gables are more primitive than the true elephants. The Stegodons have been traced from the Miocene of Europe into the forests of India and the East Indies to China.

XII. THE AFRICAN ELEPHANTS, OR LOXODONTS, distinguished by their lozenge-shaped grinders. See upper figure p. 18. Related forms attained gigantic size in southern Europe and in India, dwarfing into the diminutive species of the Mediterranean islands. See lower figure p. 6.

XIII. THE SOUTHERN MAMMOTHS (*Archidiskodon*, signifying ancient crested). First known in India, migrating westward into southern Europe, eastward by Bering Strait into America, where they arrived in early Glacial time, and gave rise to the imperial mammoth. See figure p. 20.

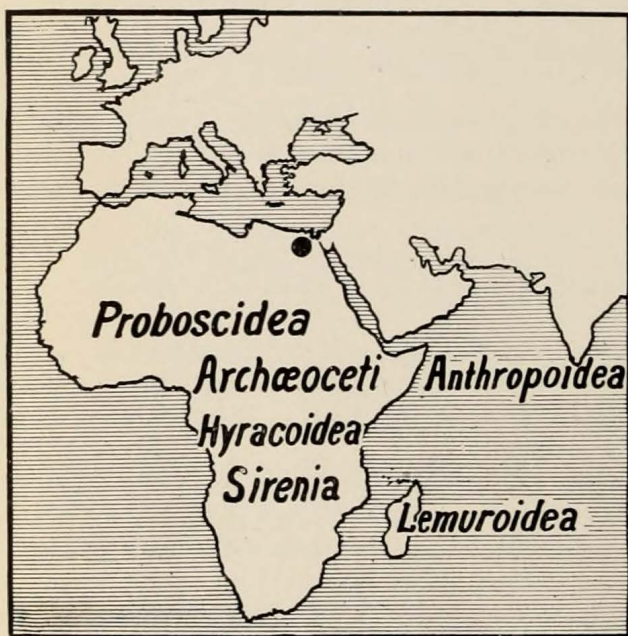
<sup>1</sup>The series of illustrations throughout the article are all to a uniform scale, with the exception of the head-piece and tail-piece.



XIV. PARELEPHAS, signifying a collateral to the true *Elephas*. Mammoths of the temperate zone. First known in Europe, traced into America, where they arrived in mid-Glacial time, and gave rise to the great Jeffersonian mammoth.

XV. THE WOOLLY MAMMOTH (the *Elephas primigenius* of Blumenbach). First discovered in northern Germany and in England. It crossed northern Asia, and arrived in America in late Glacial time. See figure p. 21.

XVI. THE TRUE ELEPHANTS (the *Elephas* of Linnæus), probably originating in northern Asia. First known in India early in the Age of Man, and giving rise to the recent species of India, Burma, and Ceylon. See lower figure p. 18.



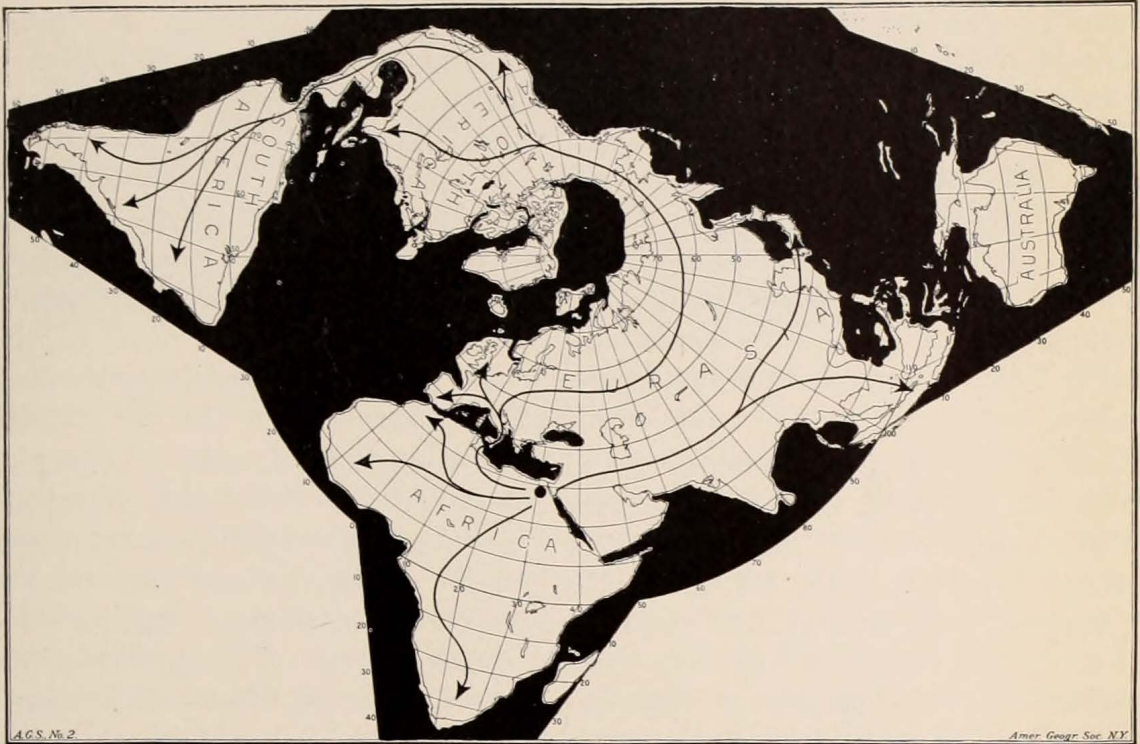
African home of the primitive mastodonts.—The word "Proboscidea" as printed 1900 and supplemented in the present map by the black dot (●) indicates the Fayûm Desert of Egypt, where these animals were discovered in 1903



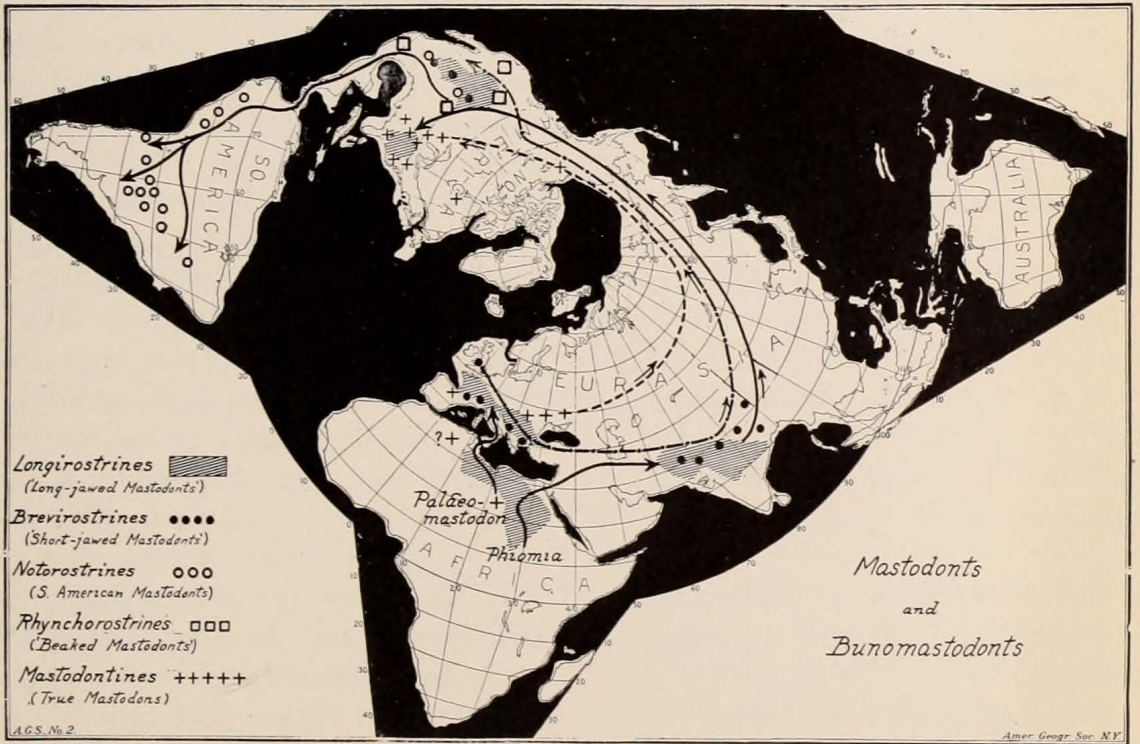
Pygmy elephants of Malta and of the other Mediterranean islands, as restored by Leith Adams in 1870, namely, 1, *Loxodonta (Pilgrimia) mnaidra*; 2, *L. (Pilgrimia) melitensis*; and 3, *L. (Pilgrimia) falconeri*, the smallest  $\frac{1}{50}$  natural size

So strong was the migratory impulse that only six out of these sixteen races of mastodonts and elephants failed to reach America. The Stegodonts (Race XI), one of these six groups of 'stay-at-homes,' were confined, according to the writer's theory, to the warm southern forests of India, to China, Japan, and the East Indies, when these islands were connected with the mainland. The true African elephants, or Loxodonts (Race XII), never left the African continent, although the somewhat closely related pygmy elephants of the Mediterranean islands (see lower figure on this page) and the giant straight-tusked elephants of India and southern Europe were great travelers. The true Indian elephant (Race XVI) never went beyond the confines of Asia, and its Asiatic ancestors still await discovery; their probable home land was in the great northern plateaus and forests. The amphibious Mœritheres (Race I) were closely bound by their river habitat to Africa and thus far have not been recognized elsewhere. The Dinotheres (Race II), notwithstanding their long limbs and gigantic size, wandered only east and west in their European and Asiatic homelands. The 'yoke-toothed





Theoretic migration routes of the mastodont family from their center (●) in Africa to all of the continents excepting Australia. The cradle of the elephant family is still unknown



Actual migration routes of the long-jawed mastodonts (*Longirostrinæ*) and of the true mastodon (*Mastodontine*) from their actual center of origin in north Africa as indicated by their respective symbols. Note also the migration routes of the *Brevirostrines*, *Notorostrines*, and *Rhynchorostrines*

mastodonts,' or *Zygalophodonts* (Race IV), never reached America and are not treated fully in this article.

The successive times of departure and arrival of the ten wandering races as contrasted with the 'stay-at-homes



cannot be fixed exactly. En route from Asia to North America, they were all forced to come by way of the northern Bering Strait, then an isthmus. Some races, like the 'beak-jawed mastodonts,' are very rare and are as yet known only by a few specimens, which are of highly characteristic and easily distinguishable form and associated habit. All the arrivals were naturally subsequent to the early evolution of the sixteen races of proboscideans in the African and Eurasiatic continents. In some cases the migrations appear to have been gradual; for example, the 'long-jawed mastodonts' (Race V), as represented by *Phiomia*, appear in the Oligocene of Egypt; they spread all over Europe in Miocene time, and were fairly abundant in Nebraska and Colorado in Pliocene time. At the other extreme are such instances of rapid traveling as that represented by the southern mammoth, which appears in the Upper Pliocene of Europe and in the advancing Ice Age of North America. Next in point of interest is the evidence of strong climatic preferences; it would appear that the south temperate and north temperate races of elephants sought corresponding and congenial life zones for their prevailing habitat, as do the Italians, the Germans, and the Scandinavians in the human migrations of our day.

Thus three kinds of mammoths are distributed on different isotherms, as indicated in the table herewith.

Proboscideans have always been fastidious in their feeding habits. Con-

sistent with their choice of similar isotherms conditioning the flora and fauna of their times, these clever animals coming from the Old World also sought out similar habitats in America, whether of northern or southern forests, savannas, stream borders, or more or less arid and desert zones. For example, we have proof of the arrival of Race X (the Brevirostrines, genus *Stegomastodon*) in the rapidly desiccating areas of western Texas and western Arizona, where they competed for food with other desert-loving forms, like the horses, the camels, and the armored glyptodonts (*Glyptotherium*) of South America. Superb adaptations to these different degrees of temperature, different kinds of food, and more or less moist or arid atmosphere appear not only in the tusks and in the grinding teeth (which are beautifully preserved in the fossil condition), but also doubtless in the unique shaping of the upper lip into the organ known as the proboscis, which gives these animals their ordinal name Proboscidea.

#### RACE I, THE MÆRITHERES, AND RACE II, THE DINOTHERES

THE MÆRITHERES (RACE I).—These are the oldest proboscideans known at present, the most primitive and diminutive. Their remains occur in the estuarine and fluvial sands of the primordial river Nile, which the German geologist, Blanckenhorn, named 'Ur-Nile.' The pair of enlarged upper and lower tusks abrade each other as in the hippopotami; were it not for the fact that these teeth are comparable to the pair of incisors

#### CLIMATIC TABLE

KINDS OF MAMMOTHS	EURASIA	AMERICA
XV. WOOLLY MAMMOTH	Boreal and circumpolar habitat	Boreal habitat and borders of glacial ice sheet
XIV. TROGONThERIAN MAMMOTH ( <i>Parelephas</i> )	Mid-temperate regions	Mid-temperate regions
XIII. SOUTHERN MAMMOTHS	South temperate: <i>Elephas meridionalis</i>	South temperate: imperial mammoth ( <i>Elephas imperator</i> )





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*Mærittherium* on the borders of the primitive river Nile, now the Fayûm of Egypt. After restoration (1907) by Osborn and Knight;  $\frac{1}{50}$  natural size

enlarged into tusks in all other proboscideans, and that the grinding teeth are also comparable to the grinders of all the higher mastodonts, we might question the relationship of these animals to the higher proboscideans, because their amphibious habits separate them so markedly from the other members of their order. They disported abundantly in the Ur-Nile but are not known to have migrated into Europe or to have left descendants.

THE DINOTHERES (RACE II).—Teeth, jaw fragments, and an astragalus of the *Dinotheres* had been found and described between the years 1715 and 1758, but it was not until 1828 that the famous lower jaw, named by Kaup in 1829 *Dinotherium giganteum*, was discovered at Eppelsheim, Germany. The *Dinotheres* appear abundantly in the Miocene of Europe and we are inclined to believe that they sprang from African ancestors, because one of these ancestors has recently been discovered.<sup>1</sup> As they are distinguished by sharply crested teeth and by a pair of huge down-turned lower incise tusks, it was long supposed that, like the *Mærittheres*, they too were amphibious in habit, but this hypothesis has been weakened by the discovery of a complete skeleton, which shows that these proboscideans had very tall

limbs, with high body proportions altogether different from those of the *Mærittheres* and of the existing hippopotami; in fact, all amphibious mammals have either short limbs or no limbs at all. Whatever their habits and special habitat, the *Dinotheres* attained gigantic size, as evidenced by the *Dinotherium gigantissimum* of Roumania. They reached India, but thus far there is no evidence of their having penetrated as far as China and still less of their having approached the American continent.

#### RACES V AND III. THE LONG-JAWED MASTODONTS AND THE TRUE MASTODONS

THE LONG-JAWED MASTODONTS (RACE V).—These animals derive their scientific name 'Longirostrines' from their extremely long and slender jaws, which far surpass in length those of any other land mammal thus far discovered. At the extremity of the lower jaw is a pair of shovel-shaped lower tusks, and there is no doubt that these tusks were used, after the manner of a trowel or spade, in the digging out and uprooting of plants. That this unique function gave these animals very great advantage over their rivals is demonstrated by the rapid spread of the Longirostrines eastward into India, thence northward into China and America, and all the while they were increasing in size and power until as a culmination the massive animal known as *Tri-*

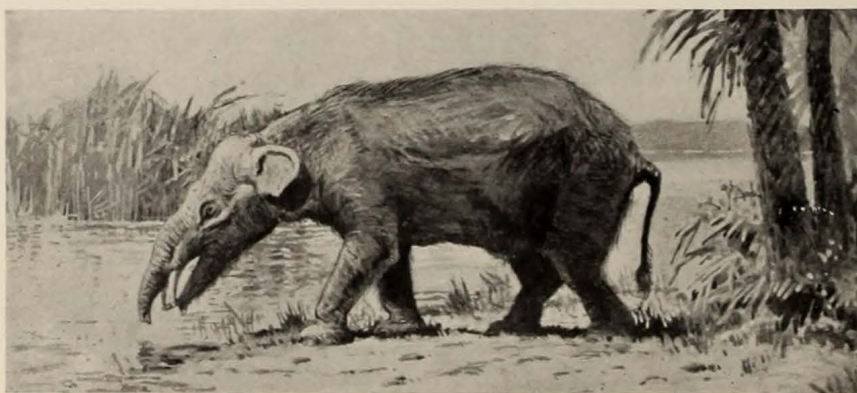
<sup>1</sup>This is *Dinotherium hobleyi* from the east side of Victoria Nyanza, described in 1911 by the late Charles W. Andrews, of the British Museum, found in beds attributed to Lower or Middle Miocene age.



*lophodon giganteus*, discovered by Mr. Troxell in South Dakota, attains a height nearly equaling that of our giant American mastodon. It is difficult to believe that this giant springs from the relatively slender North African Longirostrine, to which the name *Phiomia* has been given in reference to the proximity of its former habitat to the Fayûm of Egypt, the *Phiomia* of the Greeks; yet when we examine minutely the horizontally placed upper and lower tusks of *Phiomia*, the long narrow grinding teeth harmonic with the long jaw, and the three crests of the intermediate grinding teeth, there can be little doubt that *Phiomia osborni* is a progenitor of the race that gave rise to the *Trilophodon angustidens* of Europe, to the *Trilophodon palæindicus* of India, and to the numerous long-jawed species recently discovered in South Dakota, Nebraska, and Colorado by

condition, hardly more complex than those of the Egyptian *Phiomia*, in which the jaw measures two feet six inches. To our mind, the Longirostrine relied very largely upon their superior and inferior tusks for the gathering in of food, which was rapidly masticated and readily swallowed because of its relatively succulent nature.

THE TRUE MASTODONS (RACE III).—The true mastodons of our American forests appear to have arisen from the diminutive *Palæomastodon* of the primordial river Nile. The reason these animals have left no trace of their 10,000-mile and 2,000,000-year journey from the Nile region to the forests bordering the Ohio and the Hudson rivers is that fossilization of forest-living fauna has always been rare. The ancestral *Palæomastodon* of the Nile region is itself very rare; in the American Museum collection there are



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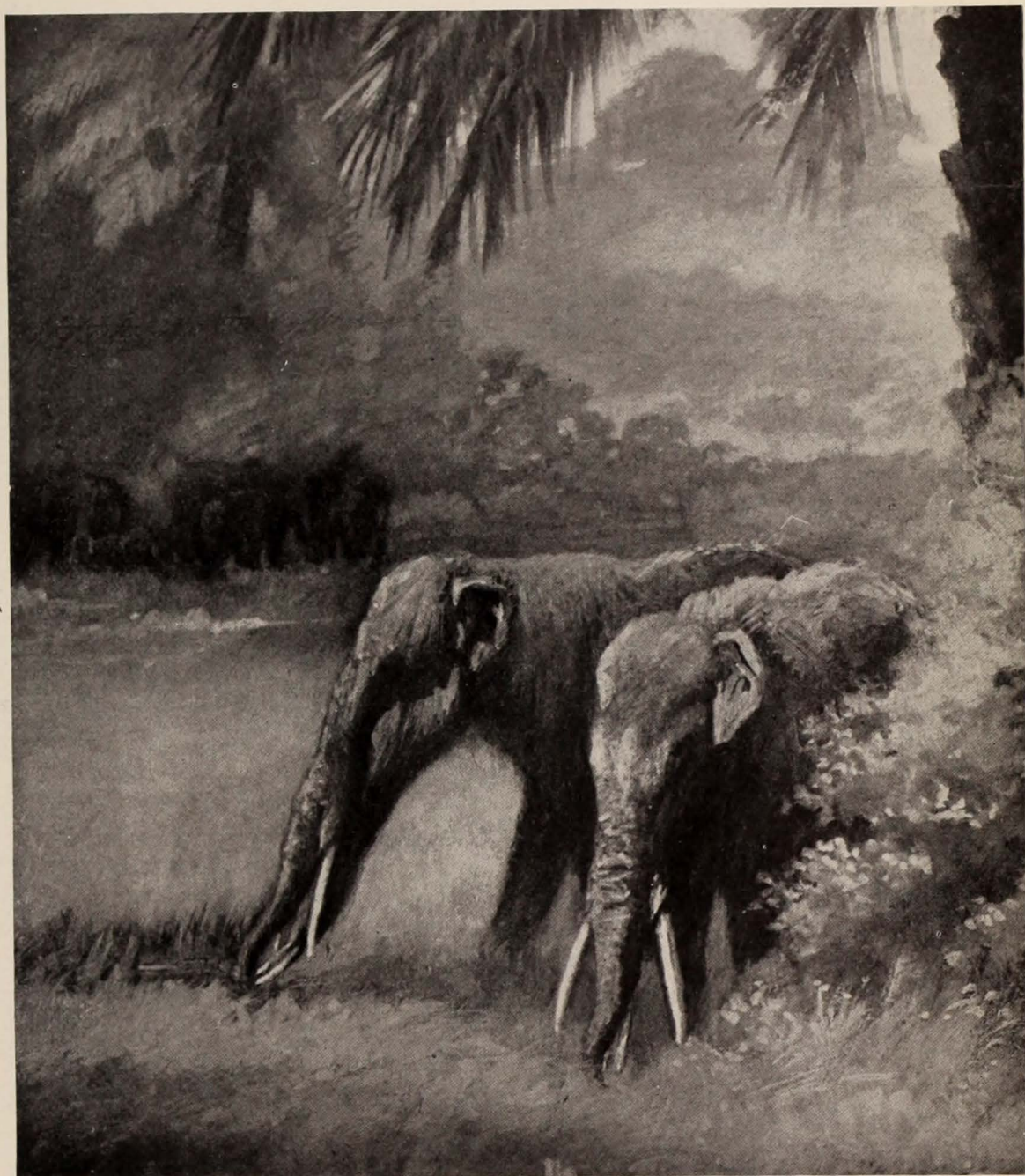
Long-jawed mastodont (*Phiomia osborni*) on the borders of the primitive river Nile, now the Fayûm of Egypt. After restoration by Osborn and Knight;  $\frac{1}{50}$  natural size

Prof. Erwin H. Barbour of the University of Nebraska, by Mr. Harold Cook of western Nebraska, and by Mr. E. L. Troxell mentioned above.

In these American Longirostrines the elongation of the lower jaw and tusks reaches the incredible extreme of six feet, seven inches in the species *Trilophodon lulli*. Jealous of her endowments, nature kept the grinding teeth of these animals in very simple

forty-eight specimens of the long-jawed *Phiomia* to seven specimens of *Palæomastodon*; not even fossilized teeth of this race were scattered in Europe to show the route. Thus, while the woolly mammoth left an overwhelming number of fossilized remains which were discovered in western Europe from the end of the eighteenth century onward, the true mastodon was first found on the banks of the Hud-





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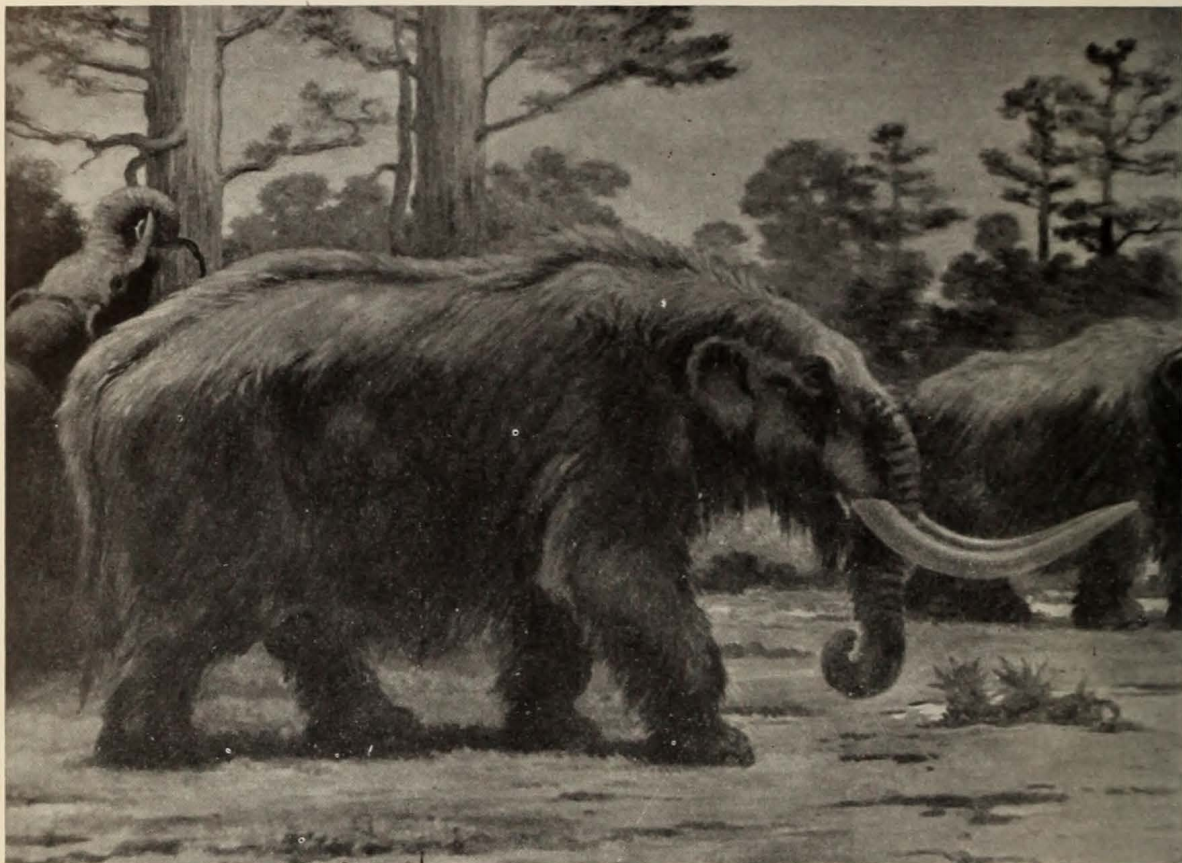
Long-jawed mastodons (*Trilophodon giganteus*) from the Lower Pliocene beds of South Dakota. After restoration by Osborn and Knight;  $\frac{1}{50}$  natural size

son (1705) and the Ohio (1739). The Ohio fossils were fully characterized by the great French naturalist Buffon as a distinct species belonging to the epoch of the elephants although Buffon did not give the animal a name. Johann Friedrich Blumenbach, who named the woolly mammoth *Elephas primigenius* in 1799, in the same communication placed the name OHIO-INCOGNITUM beneath the figure of the tooth of

the American mastodon. These animals now rival the mammoth, as the best-known of all the extinct proboscideans; thousands of teeth and jaws, as well as more or less complete skeletons have been found, chiefly in the Fourth Glacial swamps and marshes of our Middle and Eastern States.

In contrast with the long-jawed mastodons, the true mastodons are short-jawed. Their lower tusks are





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True mastodon (*Mastodon americanus*) from the Pleistocene beds of New York. After restoration by Osborn and Knight;  $\frac{1}{50}$  natural size

variable; the upper tusks curve upwards and inwards, like those of the elephants, and served for uprooting plants and for defensive and offensive purposes, while the proboscis was the main 'food getter' for the huge bodily frame.

#### RACES VI, VII, AND VIII. TETRALOPHODONTS, SERRIDENTINES, AND BEAK-JAWED MASTODONTS

THE FOUR-CRESTED MASTODONTS (RACE VI).—In 1832 Europe was greatly stirred by the discovery in the Lower Pliocene of Eppelsheim, Germany, of a mastodont with *four* instead of *three* ridge crests on its intermediate grinding teeth. Hugh Falconer based upon this character the appropriate name *Tetralophodon* (i.e. four-crested teeth) as distinguished from *Trilophodon*, the designation of the mastodonts with three ridge crests. In

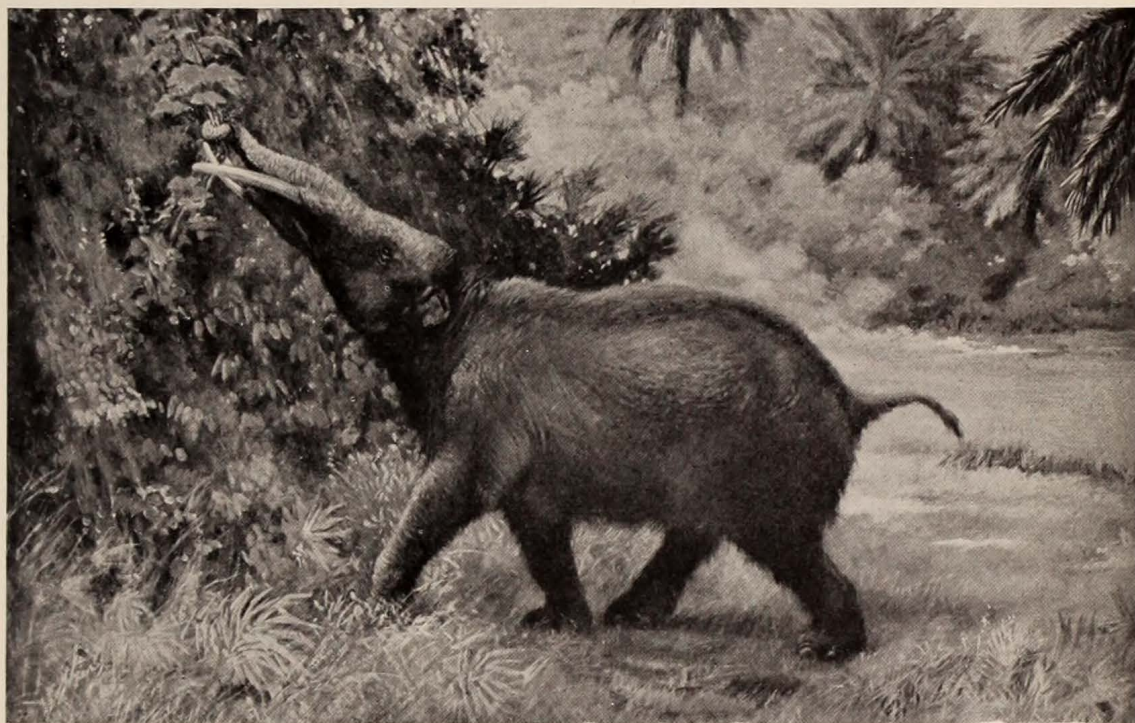
these animals with four-crested teeth the jaws are not so extremely elongated for shovel and spade work as in the long-jawed mastodonts (Race V), but by way of compensation, the grinding teeth became much more complex because they had to do far more work. While the back grinders of the long-jawed mastodonts remain very simple and never exceed four and a half ridge crests, the back grinders of the Tetralophodonts rise to seven and a half ridge crests and become adapted to their very long and arduous life work, culminating in the stage which the writer has named *Tetralophodon* (*Morillia*) *barboursi*, after Dr. Erwin H. Barbour, the geologist and explorer, and the Honorable Charles H. Morrill, patron and benefactor of the exploration of the extinct life of Nebraska. The Tetralophodonts are in all coun-



tries very rare, yet we can trace their long migration through eastern Europe into India and China, until finally they arrive in Kansas and Nebraska. The jaws remain of medium length, the lower tusk is not as yet known; the upper tusk curves downwards and outwards.

THE SERRIDENTINES (RACE VII).—The Serridentines, or 'serrate-toothed mastodons,' have only recently, as a result of investigations of the writer, become distinguished from the long-jawed mastodons, on the basis of the structure of the relatively few teeth found in ancient forest or lignitic

one member of this race succumbed and left his jaw to become a fossil on one of the ancient rivers of Mongolia, and here it was unearthed by the Third Asiatic Expedition in 1922 and subsequently christened *Serridentinus mongoliensis*. Eight thousand miles eastward and southward of this spot, which is in the desert of Gobi, the Americanized descendants are found in the marls near Santa Fé, New Mexico, and in the ancient river sands near Clarendon, Texas, in a formation of Lower Pliocene age. A beautiful restoration, made under the direction of the writer, from a nearly complete



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Serrate-toothed mastodont (*Serridentinus productus*) tree-browsing; as found fossil near Clarendon in northern Texas. After restoration by Osborn and Knight; natural size

deposits of France, Switzerland, and Austria. Yet these few teeth afford indubitable proof that these Serridentines are not to be confused either with the long-jawed mastodons (= *Trilophodon*) or with the medium-jawed mastodons (= *Tetralophodon*). They form a race of their own, to which the generic name *Serridentinus* has been given. En route to America

skeleton of a Serridentine of northern Texas is reproduced above. It shows the animal reaching for foliage with its proboscis, aided by a lower jaw with tusks of medium length, a jaw more elongate than in the true mastodons but less elongate than in the extremely long-jawed forms.

THE BEAK-JAWED MASTODONTS (RACE VIII).—The 'beak-jawed mas-



todonts,' technically known as Rhynchorostrines, are readily distinguished from all other mastodonts by the sharp downward curvature of the anterior portion of the jaw into a beaklike prolongation, in which are inserted two downwardly pointed tusks flattened on the sides. It was due to this unique adaptation of the jaw and tusks for uprooting plants and roots that Falconer in 1856-68 applied the name *Rhynchotherium* to the animal under the following circumstances: "At Genoa I saw a cast of a large lower jaw of a Mastodon from Mexico, with an enormous *bec* abruptly deflected downwards and containing one very large lower incisor. The beak is much thicker than in *M. (Trilophodon) angustidens* and larger than in *M. (Tetralophodon) longirostris*. You know that every one (Laurillard, Gervais, etc.) has insisted on the absence of the lower incisors from both of the South American species. The outline of the jaw resembles very much the figure in Alcide D'Orbigny's Voyage, described by Laurillard as *M. Andium*. The specimen is unpublished material and I was therefore only allowed to examine it very cursorily. The Genoese palæontologists had provisionally named it *Rhynchotherium*, from the enormous development of the beak, approaching *Dinotherium*."

Very few remains of this 'beak-jawed mastodont' have been discovered, and it has required long study to work out the peculiar adaptations of the dentition which consists of downturned upper and lower tusks and of very broad and simple upper and lower grinding teeth. Traces of the 'beak-jawed mastodonts' occur in Oregon in Montana, in Colorado, and in California, but thus far the best-preserved jaws are those from Mexico, the region from which came the specimen that

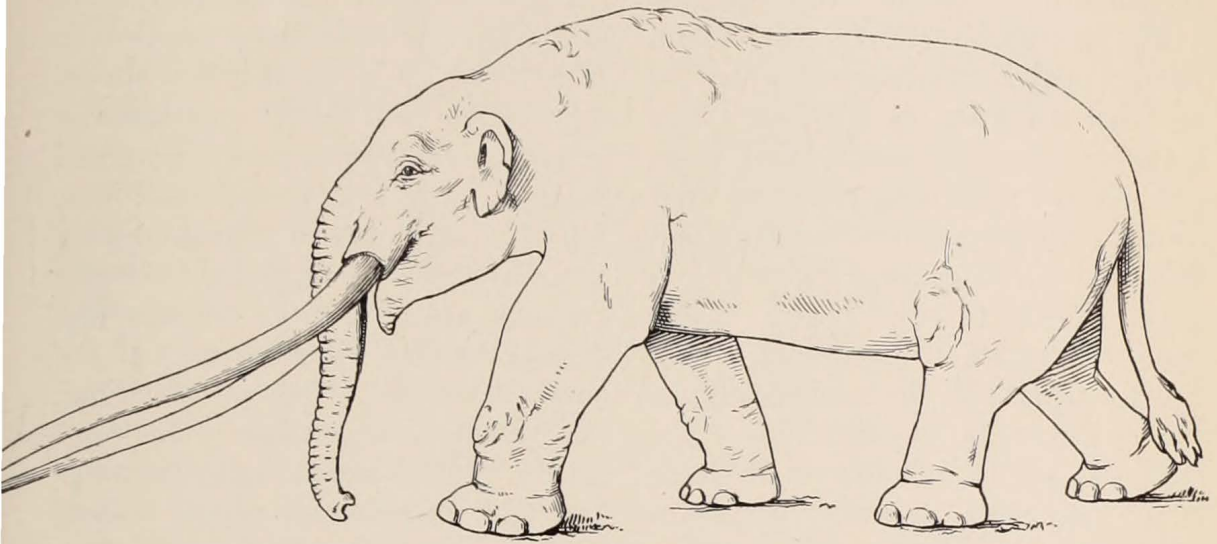
the keen eye of Falconer first recognized as a beak-jawed animal quite distinct from the 'long-jawed mastodont' of western Europe.

#### RACE X, THE SHORT-JAWED BREVI-ROSTRINES, AND RACE IX, THE NOTOROSTRINES

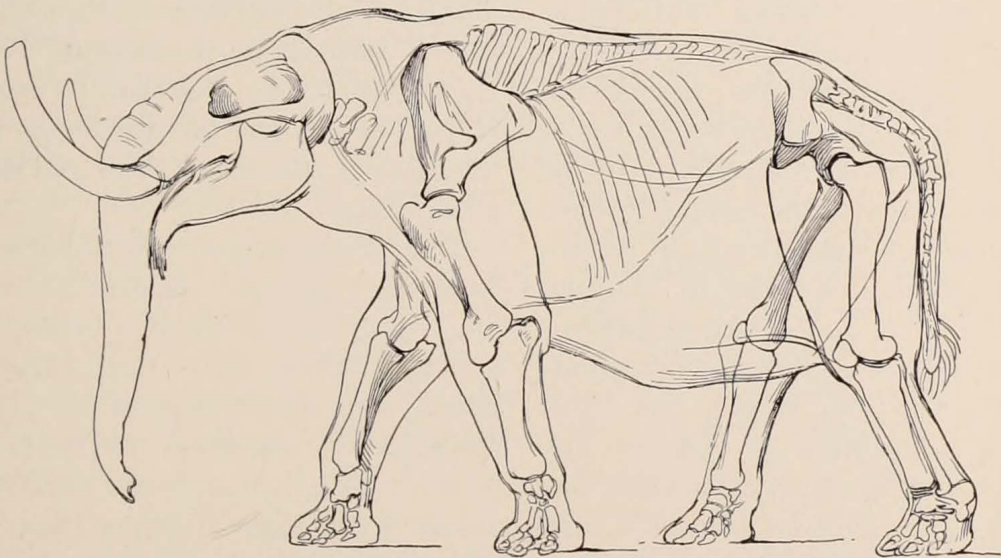
Races X and IX present a marked contrast to all the races preceding, in the shortening of the lower jaw and the disappearance of the lower tusks, which transfer to the upper tusks, the proboscis, and the upper and lower grinding teeth the whole function of collecting the food and of masticating it before it enters the long process of digestion and assimilation whereby the relatively feeble energy of plant life is transformed into the commanding energy of these proboscideans.

The back grinders, or third upper and lower molars, are, on the whole, the most characteristic part of the entire anatomy of these and other proboscideans, even more distinctive than the tusks. Many proboscideans resemble each other in the general shape of the superior tusks, which may display substantially the same curvature and shape in nine of the sixteen races which are here considered; this tendency is due to the fact that in all these races the upper tusks perform the same functions of offense and defense and are tools of great value in the uprooting of plants and small trees. It is true that there are in the tusks distinct differences of curvature and of diameter which become increasingly apparent as the animals attain old age, but the tusks of the young of the Indian elephants, of the woolly mammoth, of the Jeffersonian and of the imperial mammoths, of the African elephants, and of the Stegodonts are not readily distinguishable from the upper tusks of the true mastodonts nor from the two tusks of the short-jawed





Short-jawed mastodont of southern Arizona (*Stegomastodon arizonæ* Gidley), as discovered by J. W. Gidley in the San Pedro beds. After restoration by Knight;  $\frac{1}{50}$  natural size



Short-jawed mastodont of Auvergne, France, (*Ananceus arvernensis*), highly characteristic of the Upper Pliocene of Italy, southern France, and Great Britain. After restoration by Osborn and Knight;  $\frac{1}{50}$  natural size



racés we are now considering, namely, the Brevirostrines, the European and American genera of which are illustrated on p. 15, and the Notorostrines.

To distinguish clearly the sixteen races of proboscideans from one another we must study the back grinders with extreme care, and observe that these grinders are constantly changing their form to compensate for the gains and losses in the anterior grinders and in the upper and lower tusks. Thus, while the external appearance of the Brevirostrines and Notorostrines is not wholly dissimilar, the structure of the back grinders is radically at variance in the two races, and a very tyro in odontography could not fail to distinguish these grinders.

THE BREVIROSTRINES (RACE X).—Very early in their history the Brevirostrines began to lose their lower tusks with the rapid shortening of the lower jaws; in recognition of these changes, one of the first of these fossils found in France was termed '*Mastodon brevirostris*,' or 'short-jawed mastodont.' As in all other proboscideans, the two compensations were, first, a great increase in size of the upper tusks, which became excessively long and straight in the mastodont of Auvergne, France, and short and massive in the mastodont of Arizona (see figures, p. 15), and, second, a novel and complex mechanism which developed in the back grinders. The first step in this new food-grinding adaptation is seen in the Brevirostrine of Auvergne (*Anancus arvernensis*) and in its distant cousin of India (*Pentalophodon sivalensis*), namely, a twisting of the outer and inner grinding-tooth cones so that they *alternate on the inner and outer sides of the teeth*. Meanwhile in the Indian *Pentalophodon* five ridge crests are added to the teeth in front of the back grinders, and the crowns of the back

grinders are heightened. These two new devices in grinding-tooth construction were so successful that these animals increased in numbers in Eurasia and achieved their long journey to North America, where they first appear in western Nebraska, subsequently spreading southward into Texas and Arizona. The veteran palæontologist, Joseph Leidy, was so impressed with the complexity of these Brevirostrine grinding teeth that he thought the animal that bore them worthy of the name *Mastodon mirificus*, signifying the 'wonderful mastodon.' This complexity went on increasing by the addition and complication of the enamel foldings until the crown became a veritable labyrinth of dental tissue, well adapted to the hard grasses and tough woody fiber of the plants then becoming characteristic of the great American desert. It is by this condition of the teeth, ever growing more and more complex, that we trace these animals southward through the species *Stegomastodon* (*Mastodon*) *mirificus* of Nebraska into the *S. texanus* of Texas, thence into the *S. arizonæ* of the ancient playa lakes of Arizona, and finally into the giant *S. aftonix* of the First Interglacial epoch of Iowa.

Thus, this long and eventful journey from the Auvergne region of France, and the Norfolk region of England, through India, into the American desert, was rendered possible only by the constant evolution and improvement of the grinding teeth until they attained the highest degree of perfection of their kind.

THE NOTOROSTRINES (RACE IX).—These animals take their name from the Latinized Greek word *Nōtus*, signifying the south wind, that blew upon them as they left southern California, where their remains have recently been discovered by Mr. Childs Frick, and



journeyed southward along the Andes to the region now known as the Argentine. As discovered in Neogæa, or South America, it was appropriate that Cuvier should name one of these species *Mastodon humboldtii*, in reference to the travels of Alexander von Humboldt, and the other, *Mastodon andium*, commemorating the discovery of remains of this species on the slopes of the Andes.

In these Notorostrines the lower jaws are in process of abbreviation with corresponding loss of the lower incisive tusks, an abbreviation which does not go so fast or so far as in the extremely short-jawed Brevirostrines just described. The superior tusks contain a long ribbon of enamel on the outer side, and as the tusk rotates on its own axis, this enamel ribbon is carried around to the inner side in a corkscrew spiral form, a peculiarity not observed in any other proboscidean. This powerful tusk was so effective that, again following her principle of economy, nature kept the back grinders in a relatively simple condition in the species now known as *Dibelodon* (*Mastodon*) *andium*. In its sister form, *Cuvieronius* (*Mastodon*) *humboldtii*, named in honor of both Cuvier and von Humboldt, the upper tusks are of simpler upturned form, without the enamel ribbon, and the grinding teeth at once become more complex by means of the enamel foldings known as double trefoils.

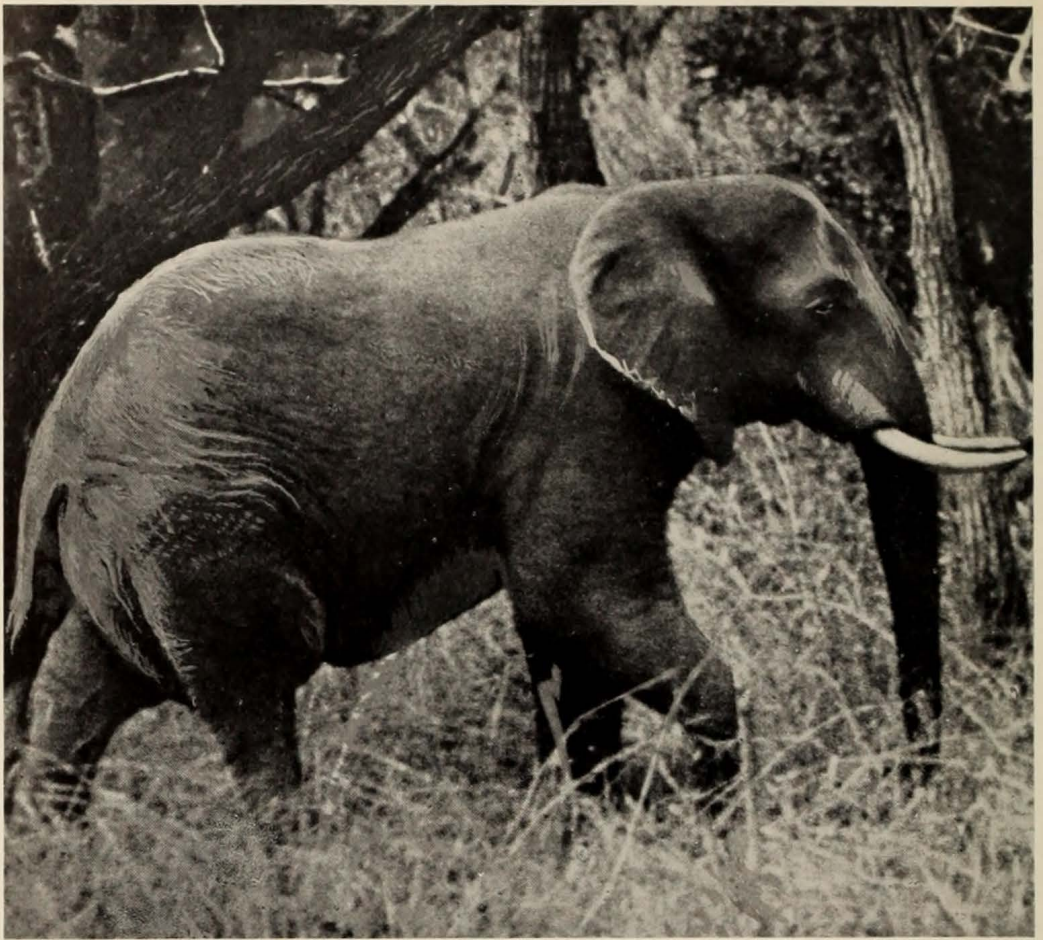
#### RACES XII AND XVI, THE LIVING ELEPHANTS, AND RACE XI, THE STEGODONTS

THE LIVING ELEPHANTS (RACES XII AND XVI).—We now turn to the history of the elephant family, Elephantidæ, the second great division of the proboscideans, the two living examples of which are the true elephants of India belonging to the genus *Elephas*

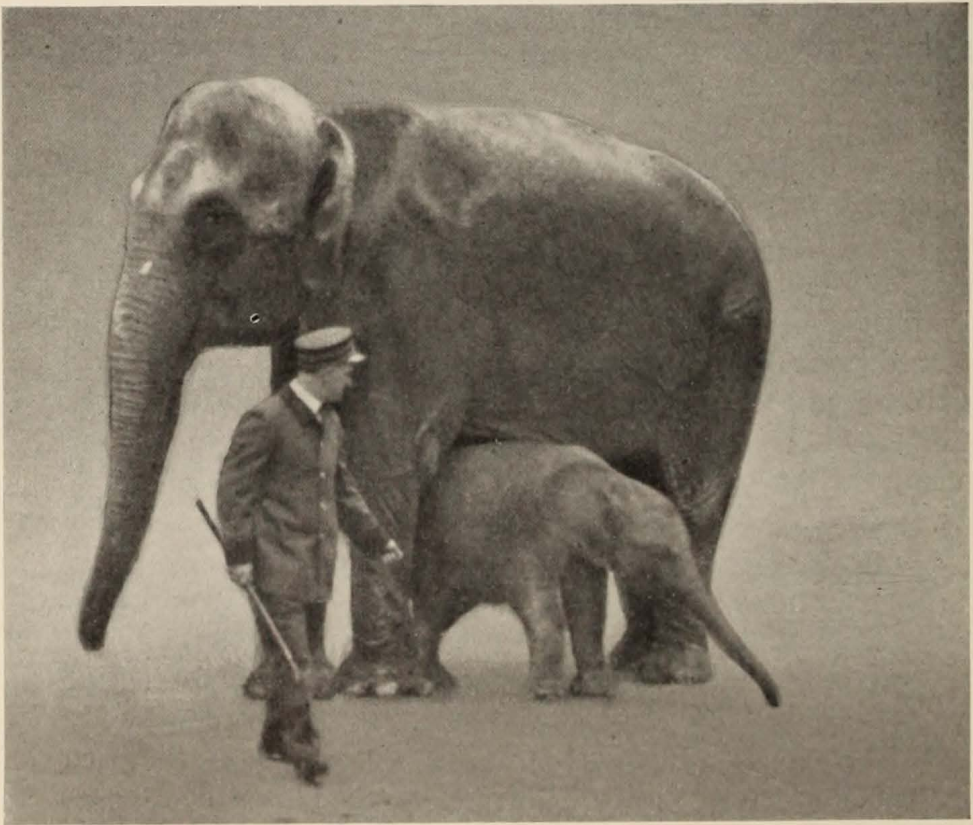
of Linnæus, and the elephants of Africa belonging to the genus *Loxodonta* of Cuvier. We know nothing of the direct ancestral history, or of the immediate ancestors, of either *Elephas* or *Loxodonta*; this history still lies buried in the rocks of the great Eurasian continent north of India and in the vast unexplored strata of central Africa, but we look forward confidently to the filling in of these missing chapters in proboscidean history. As our knowledge stands at present, the Indian elephant suddenly appears fully formed during the Age of Man and the same is true of the African elephant. Attempts to establish the descent of the Indian or African races either from Race XI (the Stegodonts) or from Races XIII–XV (the Mammoths) will not stand the test of the higher criticism of palæontologists. Yet it appears certain that all the elephants sprang from ancestors like the Stegodonts.

THE STEGODONTS (RACE XI).—From Miocene to Pleistocene time, these very primitive elephants known as Stegodonts were dwellers in the tropical forests, extending from India and the East Indies to China. Differing from the mastodont family, the Stegodonts have a new kind of grinding tooth with multiple ridge crests, from which the grinding teeth of all the higher elephant races may have been derived, and it is not improbable that a certain branch of the Stegodont family wandered into northern Asia and was there transformed into some of the primitive members of the elephant family; such transformation certainly did not occur in southern Asia, where the Stegodonts have their own independent history that culminated in the prodigious and widespread Stegodontines, which left their fossil remains in the same deposits with the earliest of the mammoths. The best-known among these giant Stego-





Living African elephant (*Loxodonta africana*) in the forests of Central Africa  
After photograph by Carl E. Akeley;  $\frac{1}{50}$  natural size



*Courtesy of New York Zoological Society*

Living Indian elephant (*Elephas indicus*) and living dwarf Congo elephant (*Loxodonta africana pumilio*) in the New York Zoological Park. After photograph by Elwin R. Sanborn;  $\frac{1}{50}$  natural size



donts is the species *Stegodon ganesa*, named after one of the legendary deities of India. It is contemporary with a giant true elephant related to the African.

#### THE THREE RACES OF MAMMOTHS (XIII, XIV, XV) WHICH REACHED AMERICA

The name *Mammut*, probably derived from the Tartar *mama*, signifying earth, in allusion to the discovery of fossilized bones buried in the earth, properly belongs to the northern or woolly mammoth, *Elephas primigenius*, the primordial elephant. The term mammoth is used in the present article in a much broader significance to embrace three great branches of the elephant family. Two of them—the imperial mammoth and the Jeffersonian mammoth,—resemble the woolly mammoth in the architecture of the cranium and in the strong incurvature of the superior tusks, as greatly as they differ from this boreal elephant in the structure of the grinding teeth. The cranium rises into a high acute peak and the forehead is concave instead of being plane and flattened as in the African elephant, or prominent and dome like as in the Indian elephant (see upper and lower figures respectively, p. 18). There are many other features which unite the three races of mammoths among themselves and which separate them from the African and Indian elephants, but the one of paramount interest to us is that these animals were greater wanderers than either the Indian or African elephants and successively entered the American continent as follows:

The imperial mammoth (Race XIII), late in the Age of Mammals, early in the Age of Man.

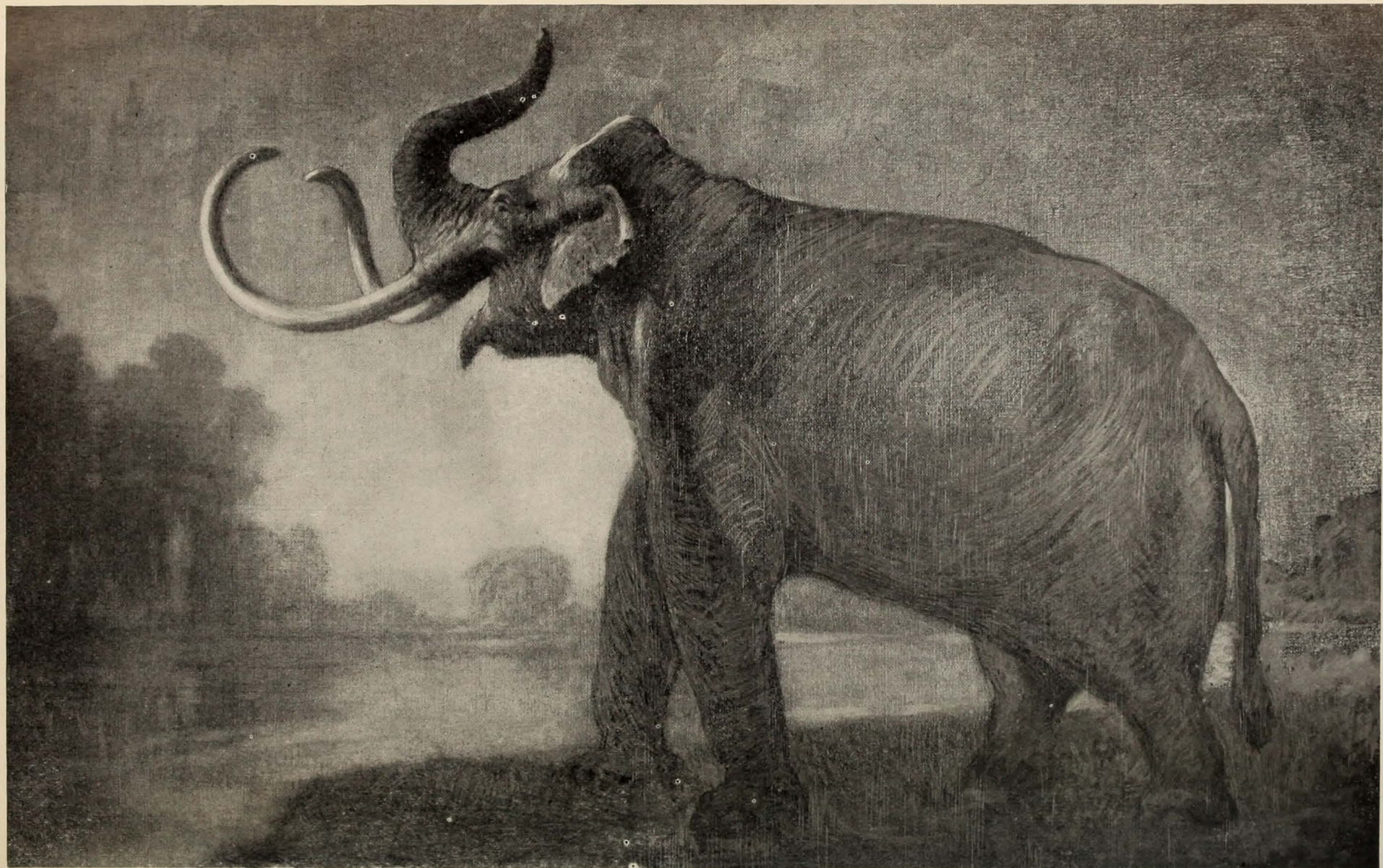
The Jeffersonian mammoth (Race XIV) during the Age of Man.

The woolly mammoth (Race XV), late in the Age of Man, during the period of the last great glaciation.

THE IMPERIAL MAMMOTH (RACE XIII).—This majestic animal was discovered by Ferdinand Hayden, the exploring geologist, in Nebraska, and described by Joseph Leidy in 1858 as *Elephas imperator*, signifying the 'imperial elephant' in reference to the surpassing size of the grinding teeth and the impressive height of the animal. This designation has been more than justified by subsequent discoveries of remains of this gigantic animal in Nebraska, Kansas, Iowa, Texas, California, and Mexico, consisting of portions of teeth, skulls, and skeletons sufficient to establish the fact that the full-grown animals attained a height of 13½ to 14 feet, exceeding by 2½ feet the tallest of the existing African elephants and rivaled only by the gigantic straight-tusked elephant of India and western Europe known as *Loxodonta antiqua*.

The grinding teeth are readily distinguished by their surpassing size and by the relative paucity of the enamel ridge plates, which never exceed twenty in number; the ridge plates are very far apart and the enamel bands are broad, whereas in the woolly mammoth the enamel of the ridge plates is excessively fine, the grinding teeth are relatively small, and the number of ridge plates amounts to twenty-seven. It is in reference to this massive but primitive structure of the grinding teeth that Prof. Pohlig has named these animals *Archidiskodon*, signifying primitive ridge plates. The adaptation of these huge, coarse grinders was to tree- and shrub-browsing and the crushing of great masses of leaves and twigs; these imperial mammoths were therefore probably browsers, and with the reduction and disappearance of the western forests, they diminished in numbers and became extinct—the last of a noble line which traces its lineage





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IMPERIAL MAMMOTH (*ARCHIDISKODON IMPERATOR*) OF NEBRASKA AND TEXAS. AFTER RESTORATION BY OSBORN AND KNIGHT:  $\frac{1}{50}$  NATURAL SIZE





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WOOLLY MAMMOTH (*MAMMONTEUS PRIMIGENIUS*) OF THE RIVER SOMME, FRANCE, IN LATE GLACIAL TIME. AFTER RESTORATION  
BY OSBORN AND KNIGHT;  $\frac{1}{50}$  NATURAL SIZE



back to *Archidiskodon planifrons* in the Upper Pliocene of India and is related to the giant *Archidiskodon meridionalis* of the Pliocene and Lower Pleistocene forests of Italy, France, and Great Britain. In America *Archidiskodon* attained by far its greatest size, as majestically represented in our restoration (p. 20).

THE JEFFERSONIAN MAMMOTH (RACE XIV).—It has taken many years of study to disentangle the lineage of this great immigrant from that of the imperial mammoth on the one hand and that of the woolly mammoth on the other. With the aid of Prof. Hans Pohlig of Bonn and of Prof. Charles Depéret of the University of Lyons this lineage has been traced back to Germany, to southern France, and to Great Britain, and it is now a well established fact that the Jeffersonian mammoth came from smaller and more primitive ancestors which wandered in the forests and meadows of western Europe during the first half of the Age of Man. These European forebears replaced the ancestors of the imperial mammoth and were in turn replaced by great herds of the woolly mammoth that entered Europe in the closing period of the Age of Man. These animals are so distinct from either the imperial or the woolly mammoth stock that we give them the separate generic designation of *Parelephas*, in allusion to their development parallel with the true elephants of India. Whereas the European branch of *Parelephas* became extinct, the American branch flourished exceedingly in the temperate regions of the United States, and its fossil remains are far more numerous than those of either the imperial or the woolly mammoth; *Parelephas* also endured for a long period of time and underwent a considerable evolution in

respect to its grinding teeth, from an earlier stage which we have named *Parelephas jeffersonii* in honor of President Jefferson, to a final stage in which the third upper molar possessed as many as thirty plates and the third lower molar twenty-six.

Second only in size to the imperial mammoth, the Jeffersonian mammoth succeeded its imperial forerunner and survived the severe climate of the Fourth Glaciation, at the close of which it became extinct.

THE WOOLLY MAMMOTH (RACE XV).—Late in the Age of Man arrived the woolly mammoth (p. 21), closely related to the *Elephas primigenius* of the ancient steppes and tundras of western Europe. The first to make very close comparison between the west European and the American varieties of this boreal race was Dr. Hugh Falconer, who declared that while the same number of enamel ridge plates was present in the forms of both regions, namely, twenty-four in the last molar of each jaw, the American animals were in general characterized by still finer and more compressed ridge plates than those of western Europe. Thus we may distinguish one of our own forms as *Mammonteus primigenius americanus*, while in Indiana and in Alaska we find a type of mammoth with close-fitting enamel ridge plates to the number of twenty-seven and of such exceeding fineness that we have named it *Mammonteus primigenius compressus*. This adaptation of the grinding teeth for grazing habits was to enable the animal to feed upon the hard grasses which covered the tundras and steppes of the north during the summer season. Thus the woolly mammoth was chiefly a grazer, as proved by the stomach contents of frozen carcasses recovered from the ice in Siberia.

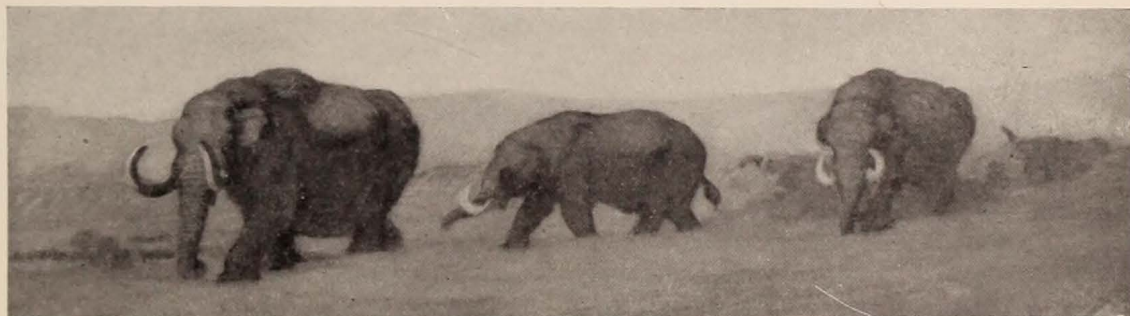


TABLE OF COMPARATIVE HEIGHTS OF CERTAIN  
ELEPHANTS AND MASTODONTS

COMMON NAME	SCIENTIFIC NAME	HEIGHT
Imperial Mammoth	<i>Archidiskodon imperator</i>	13 feet 6 inches
African Elephant	<i>Loxodonta africana</i>	11 feet 4 inches
Jeffersonian Mammoth	<i>Parelephas jeffersonii</i>	10 feet 6 inches
Indian Elephant	<i>Elephas indicus</i>	10 feet
American Mastodon	<i>Mastodon americanus</i>	9 feet 6 inches
Woolly Mammoth	<i>Mammonteus primigenius</i>	9 feet 3 inches
Giant Longirostrine	<i>Trilophodon giganteus</i>	7 feet 9 inches
Small Mediterranean Elephant	<i>Loxodonta (Pilgrimia) mnaidrae</i>	7 feet
Texas Serridentine	<i>Serridentinus productus</i>	5 feet 8 inches
Small Elephant of Malta	<i>Loxodonta (Pilgrimia) meliensesis</i>	5 feet
Fayûm Longirostrine	<i>Phiomia osborni</i>	4 feet 5 inches
Young Congo Elephant	<i>Loxodonta africana pumilio</i>	4 feet 5 inches
Smallest Elephant of Malta	<i>Loxodonta (Pilgrimia) falconeri</i>	3 feet
Fayûm Mœritheres	<i>Mœritherium andrewsi</i>	2 feet 1 inch

The woolly mammoth is relatively diminutive in size, not much exceeding nine feet and, despite the grazing adaptation in its grinding teeth, it shows its relationship both to the imperial and the Jeffersonian mammoths in two outstanding characters, namely, the extreme acuteness of the apex of the skull and the strong incurvature of the tusks, which completely cross each other in old age and no longer serve either for purposes of combat or for the gathering of food. Remains of the woolly mammoth are relatively rare in the United States but a few fine skulls have been recovered from Indiana and from Alaska, in which the acute apex, the concave forehead, the extreme flattening and deepening of the cranium and the tooth sockets may be observed.

We know little of the external appearance of the imperial mammoth; it was probably nearly hairless like the Indian and the African elephants. The Jeffersonian mammoth, we believe, was partly hairy, for it is characteristic of the north temperate region both of Europe and the United States. The northern mammoth of the Ice Age was both hairy and woolly and was perfectly adapted to the extremely severe climate of the Arctic Circle and of the borders of the advancing ice sheets. Both in their immense geographic range and in their extremes of adaptation to different climatic zones, these three branches of the mammoth family rank as the *facile princeps* among the mammals which ruled the Northern Hemisphere during the Age of Man.



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*Stegomastodon* arriving in Arizona. After restoration by Osborn and Knight







# Mastodons of the Hudson Highlands

By HENRY FAIRFIELD OSBORN

President of The American Museum of Natural History

One of the greatest treasures of the American Museum is the unrivaled skeleton of the fossil proboscidean known as the WARREN MASTODON. The present article gives the fullest and most authentic history of this specimen which has ever been published, thanks to the testimony of several eyewitnesses who have kindly written to the author, and to others.

THE WARREN MASTODON, found in 1845, was the fifth in a series of discoveries of mastodon skeletons, beginning with Peale's first skeleton of 1799, which like the WARREN MASTODON was found in Orange County, New York. The first reference to mastodons along the Hudson was, however, as early as 1705.

The following table relative to early discoveries of the mastodon has been compiled from *The Mastodon Giganteus of North America*, which Dr. John Collins Warren published in 1852:

- 1705.—First mention of finding mastodon remains near Albany.
- 1714.—First published account of two teeth and a thigh bone found at Claverack, on the Hudson, thirty miles south of Albany.
- 1799–1801.—Peale's first skeleton, found on John Masten's farm, Orange County, New York. See Warren, Plate I, upper left-hand figure. Exhibited in London; in Peale's Museum, Philadelphia; and then disappeared.
- 1802.—Peale's second skeleton, "Baltimore Skeleton," purchased by Doctor Warren in 1848, dismantled. A very large jaw, described by Doctor Warren. See Warren, Plate I, upper right-hand figure.
- 1840–43.—Koch's "Missourium," a composite of several specimens found near Kimmswick, Missouri. Remounted by Richard Owen, in the British Museum. See Warren, Plate I, lower right-hand figure.

1844–45.—"Cambridge mastodon," found near Hackettstown, Warren County, New Jersey, twenty miles from Newark. See Warren, Plate I, lower left-hand figure.

1844.—"Shawangunk Skull," found near Scotchtown, Orange County, New York; now in the American Museum, Warren Collection.

1845.—The WARREN MASTODON in the American Museum, found on the Brewster Farm, Orange County, New York. See Warren Memoir, Vignette; also Plate I, center figure; also Plates IV to XXV.

In *An Outline History of Orange Co.*, by Samuel W. Eager, published in 1846–47, only a year after the discovery of the Warren Mastodon, is found the following quaint narrative of the succession of discoveries in Orange County, and an interesting reflection of the scientific opinions of the middle of the nineteenth century.

"We cannot, without disrespect to the memory of a lost but giant race, and slighting the widespread reputation of old Orange as the mother of the most perfect and magnificent specimens of terrestrial animals, omit to tell of the mastodon. Contemplating his remains as exhumed from their resting place for unknown ages, we instinctively think of his great and lordly mastery over the beasts—of his majestic tread as he strode these valleys and hill-tops—of his anger when excited to fury—stamping the earth till trembling beneath his feet—snuffing the wind with disdain, and uttering his wrath in tones of





EXCAVATION OF THE PEALE  
MASTODON

In 1799 there was discovered on the farm of John Masten, near Newburg, New York, the skeleton known as Peale's first mastodon. The exhumation of this skeleton, portrayed in the painting, was carried on in the year 1801. The principal figure in the foreground is Dr. Charles Willson Peale. The other two figures assisting him in holding the scroll are probably Titian and Rembrandt Peale.

This photograph shows at work twenty-one men and two boys of the twenty-six who were engaged under the direction of Doctor Peale. The elaborate machinery that occupies the center of the picture consists of a continuous bucket chain with a long trough. It was designed by an ingenious millwright to keep the excavation free of water. A number of the male onlookers and even some of the workmen wear tall beaver hats as part of the quaint dress of the period. The whole scene, painted after the manner of other scientific portraits of the day, is a delightful reminiscence of the country life along the Hudson one hundred twenty years ago.

(After photograph of the painting by Rembrandt Peale, belonging to Mrs. Bertha White, now deposited in the American Museum of Natural History.



thunder,—and the mind quails beneath the oppressive grandeur of the thought, and we feel as if driven along by the violence of a tornado. When the pressure of contemplation has subsided and we recover from the blast, we move along and ponder on the time when the mastodon lived,—when and how he died, and the nature of the catastrophe that extinguished the race; and the mind again becomes bewildered and lost in the uncertainty of the cause. Speculation is at fault, and our thoughts wander about among the possible accidents and physical agents which might have worked the sudden or lingering death of this line of terrestrial monarchs.

“Upon these subjects, wrapt in the deep mystery of many ages, we have no fixed or well-considered theory; and if we had, the limits of our paper would forbid us to argue it up before our readers, and argue down all hostile ones. But we may briefly enquire, whether the cause of the death and utter annihilation of the race, was one great overwhelming flood which submerged the earth and swept down these animals as they peacefully and unsuspectingly wandered over the plains and hills around us. Or was it some earthquake convulsion, full of sudden wrath, which tore up its strong foundations and buried this race among the uplifted and subsiding mass of ruins; or was it some unusual storm, black with fury and terrible as the tornado, which swept the wide borders of these grounds, and carried tree and rock and living mastodon in one unbroken stream to a common grave, or was it the common fate of nations, men and every race of created animals of water, land or air, which overtook and laid the giants low? that by the physical law of their nature, the decree of heaven, the race started into being—grew up to physical perfection—and having fulfilled the purpose assigned by their creation, by a decrease slow, but sure as their increase, degenerated in number, and gradually died away and became extinct. Or was it some malignant distemper, fatal as the Egyptian murrain, which attacked the herd in every locality of this wide domain—

sending its burning poison to their very vitals—forcing them to allay an insatiate thirst and seek relief in the water ponds around them, and there drank, and drank, and died? Or was it rather, as is the general belief in this community, that individual accident, numerous as the race, befell each one, and in the throes of extrication sank deep and deeper still in the soft and miry beds where we now find their bones reposing?

“We have thus briefly laid before our readers all the causes which we have heard assigned for this remarkable, ancient, and wide-spread catastrophe, and leave them to the speculation of others, while we wait for time and the developments of geology to uncover the cause.

“But when did these animals live and when did they perish, are questions equally wrapt in profound mystery, and can be answered only when the true cause of their death is found. In the meantime we ask, were they pre-Adamites, and did they graze upon the fields of Orange and bask in the sunlight of that early period of the globe?—or were they antediluvian, and carried to a common grave by the deluge of the Scriptures?—or were they postdiluvian only, and till very recent periods wandered over our hills and fed in these valleys; and that now some wandering lord of the race, an exile from the land of his birth on the banks of the great father of waters, is gone in silence and melancholy grandeur to lay himself down and die in the yet unexplored regions of the continent? On the points of vital interest in solving the great question of time and mode of death, we hazard no conjecture. Among geologists the opinion is fast gaining ground, that the epoch of the appearance of the mastodon on earth was about the middle of the tertiary period,—and that he was here ages before man was created,—that before that epoch warm-blooded terrestrial animals had not appeared. The period of their extinction is thought to be more doubtful, but probably was just before the creation of the human race.—Geologists think there is no evidence sufficient to establish the fact that man



and the mastodon were contemporary. —Time and further investigation may explain the mystery.<sup>1</sup>

#### WHEN FIRST FOUND

"The remains of the mastodon were first found in this State, near Albany, probably as early as 1705, as appears from the letter of Gov. Dudley to the Rev. Cotton Mather, of July 10, 1706—a copy of which is furnished and worth reading.<sup>2</sup> The accounts which state it to have been in 1712 are erroneous—taking, probably the date of Cotton Mather's letter (of that date) upon this subject to Dr. Woodward, as the date of the finding. They were next found by Longueil, a French officer, on the Ohio River, in 1739. In 1740 large quantities were found at Big Bone Lick, in Kentucky, carried to France and there called the "Animal of the Ohio." Since which many have been found in various parts of the Union.

"No locality,<sup>3</sup> except the Big Bone Lick, has contained a greater number of these remains than Orange County. The first were discovered in 1782, about three miles south of the village of Montgomery, on the farm now owned by Mr. Foster Smith. These bones were visited by Gen. Washington and other officers of the army while encamped at Newburgh in 1782-3. The Rev. Robert Annan, who then owned the farm, made a publication at the time, describing the bones, locality, etc., which caused Mr. Peale subsequently to visit this county.

"In 1794 they were found about five miles west of the village of Montgomery, just east of the residence of Archibald Crawford, Esq., and near the line of the Cohecton turnpike. In 1800 they were found about seven miles northeast from Montgomery, on or near the farm of Dr. George Graham. In 1803, found one mile east of Montgomery, on the farm now owned by Dr. Charles Fowler. These were the bones

dug out by Mr. Peale of Philadelphia, in 1805 or 6,—and the writer, then a boy at school in the village, saw the work in progress from day to day. In 1838 a tooth was found by Mr. Daniel Embler, of Newburgh, on or near the farm of Samuel Dixon, Esq., of that town. In 1844, found eight miles southwest from Montgomery, on the farm of Mr. Conner, near Scotchtown, in Wallkill. In 1845, found about seven miles east of Montgomery, on the farm of Nathaniel Brewster, Esq.; and, in the same year, on the farm of Jesse C. Cleve, Esq., in Hamptonburgh, about twelve miles southeast of Montgomery. They were also found in the town of Goshen some years since, but the time and locality we do not know. There have been at least a dozen findings of these bones in the County. From these enumerations it would appear as if the village of Montgomery was the center of the circle of these various findings

"The animal [the skeleton found on the farm of Nathaniel Brewster and subsequently known as the Warren Mastodon] was supposed to be of great age—judging from the length and size of the tusks, and from the fact that some bones, which in young animals are separate, in this had grown firmly together.

#### POSITION OF THE BONES WHEN FOUND

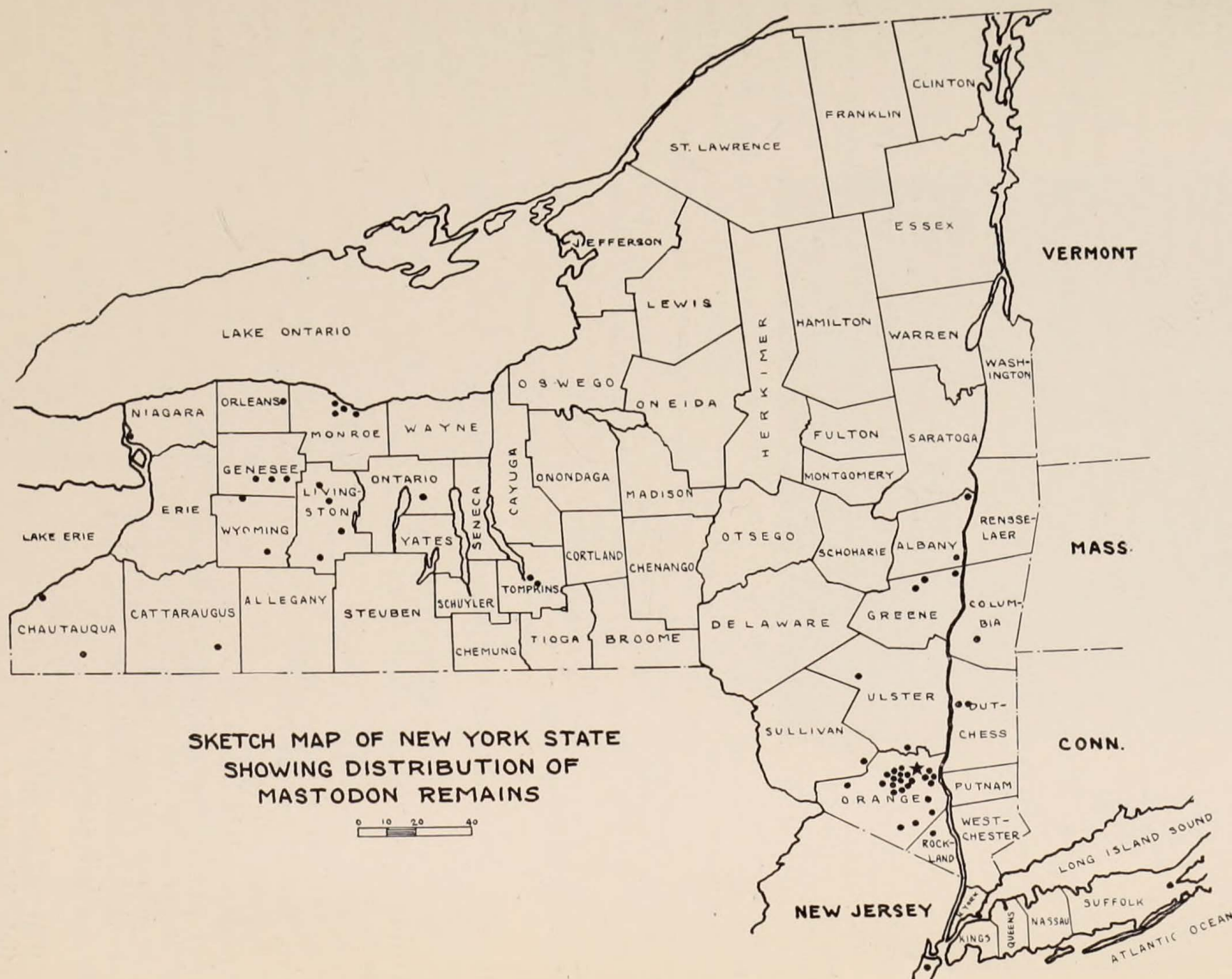
"Having measured the giant, let us inspect the place where found, uncover his resting place and observe his position in death. Mr. Brewster was digging out marl, and his workmen came upon the skeleton, every bone of which they succeeded in exhuming. Though wanting some of the toes of the fore-foot, we believe they were found and carried away in the pockets of some of the early visitors. Like all others in this County, these were found in a peat formation, but of very limited extent, between two slate ridges. They were six feet beneath the surface—yet so deep was the peat below that its bottom could not be reached with an iron rod of several feet in length. The animal was thus held in suspension, and as the spot was wet and spongy, never dry perhaps from the

<sup>1</sup>The reader is referred to an article entitled "Did the Indian Know the Mastodon?" by Jay L. B. Taylor, *NATURAL HISTORY*, 1921, pp. 591-97; also to the article by William B. Scott "On American Elephant Myths," *Scribner's Magazine*, 1887, p. 469.

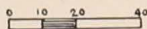
<sup>2</sup>This letter is not reproduced in the present article.

<sup>3</sup>Remains indicating 300 animals were found at Kimmswick, Missouri.





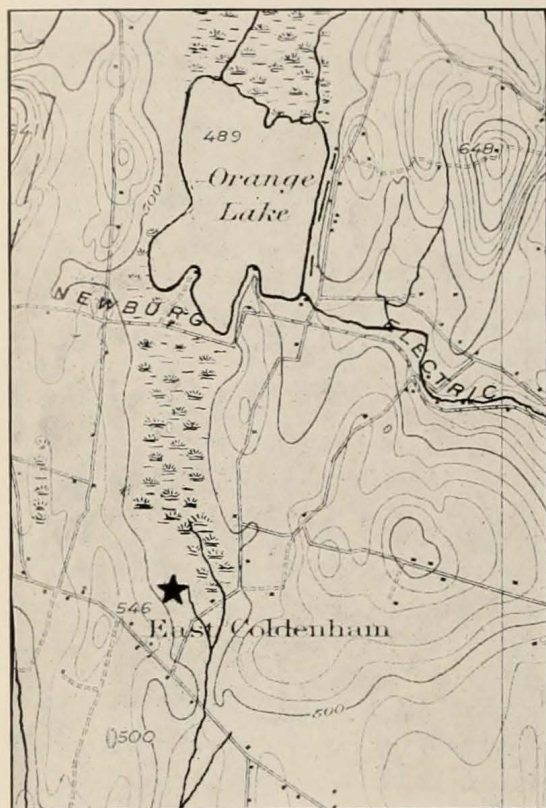
SKETCH MAP OF NEW YORK STATE  
SHOWING DISTRIBUTION OF  
MASTODON REMAINS



# DISCOVERY SITES OF MASTODONS IN NEW YORK

This map, taken from that which appears in the article entitled "Mastodons of New York," by Dr. John M. Clarke (New York State Museum, *Bulletin* 69, published 1903) shows, by the concentration of the dots just north of the Hudson River Highlands in Orange County, how numerous are the mastodon remains in that area. The site where the Warren Mastodon was discovered—formerly known as the Nathaniel Brewster Farm but now called the Sycamore Farm—is indicated on the map by a star





The Warren Mastodon was discovered on the site marked by the star, in the valley south of Orange Lake and about two hundred yards north of the Cochection Highway at East Coldenham. The skeleton was at first known as the Brewster Mastodon because of the fact that the farm on which the find was made was the property of one Nathaniel Brewster, a grandson and namesake of whom is now the owner of the land. Reproduced from the Newburgh Quadrangle Topographical Survey, State of New York, United States Geological Survey, edition of September, 1903, reprinted September, 1910

time he entered, it caused their perfect preservation.

"Beginning at the bottom, the following were deposits which from time to time filled up the pond:

- 1, Mud, more than ten feet,
- 2, Shell Marl, three feet,
- 3, Red Moss, one foot,
- 4, Peat, two feet.

The bones laid below No. 3 and occupied nearly the position the animal did when alive, and the whole position that of one mired. If there ever was one that came to his death in that way, this is the one.

"In Godman's Natural History, article Mastodon, is recorded an instance of the same kind [the preservation of stomach contents], and puts the

fact beyond all question, that the contents of the stomach of the Brewster [Warren] mastodon were found. The animal was dug up in Wythe Co., Va., and the stomach found,—the contents carefully examined, and found to be in good preservation. They consisted of reeds half masticated—of twigs of trees, and of grass or leaves.

We have made free use of the article written by Dr. A. J. Prime, of Newburgh, and found in the *American Quarterly Journal* of October, 1845, and various newspaper publications made by the same gentleman."

Thus ends our quotation of the quaint narrative of Samuel W. Eager.

#### OTHER REMINISCENCES OF THE DISCOVERY

The American Museum is indebted to Mrs. George F. Elliott of Westfield, New Jersey, for the following reminiscence of the discovery, contained in a letter of March 21, 1906, addressed to the late J. Pierpont Morgan, the donor of the Warren collection to the American Museum. Mrs. Elliott, writes:

"I was much interested on reading in this morning's *Tribune* of your recent purchase of the American mastodon from the Warren heirs; interested firstly, because it will now be given to the public; secondly, because it was found on, or in, my grandfather's farm in East Coldenham, six miles west of Newburgh, on the Newburgh and Cochection turnpike. As a child I distinctly remember the excitement that prevailed in the neighborhood at the find and during the time it was on exhibition in my grandfather's barn. It was wired and set up on the premises. Doctors Warren, Hitchcock, Blackman, and Prof. Silliman were all there at times. The location where it was found was in a depression or sort of basin of marl, which they were taking out for improving the land elsewhere. The head was struck first, for the animal was standing erect, as it had sunk in the soft marsh. Even the contents of the stomach were intact, consisting of twigs as large as a





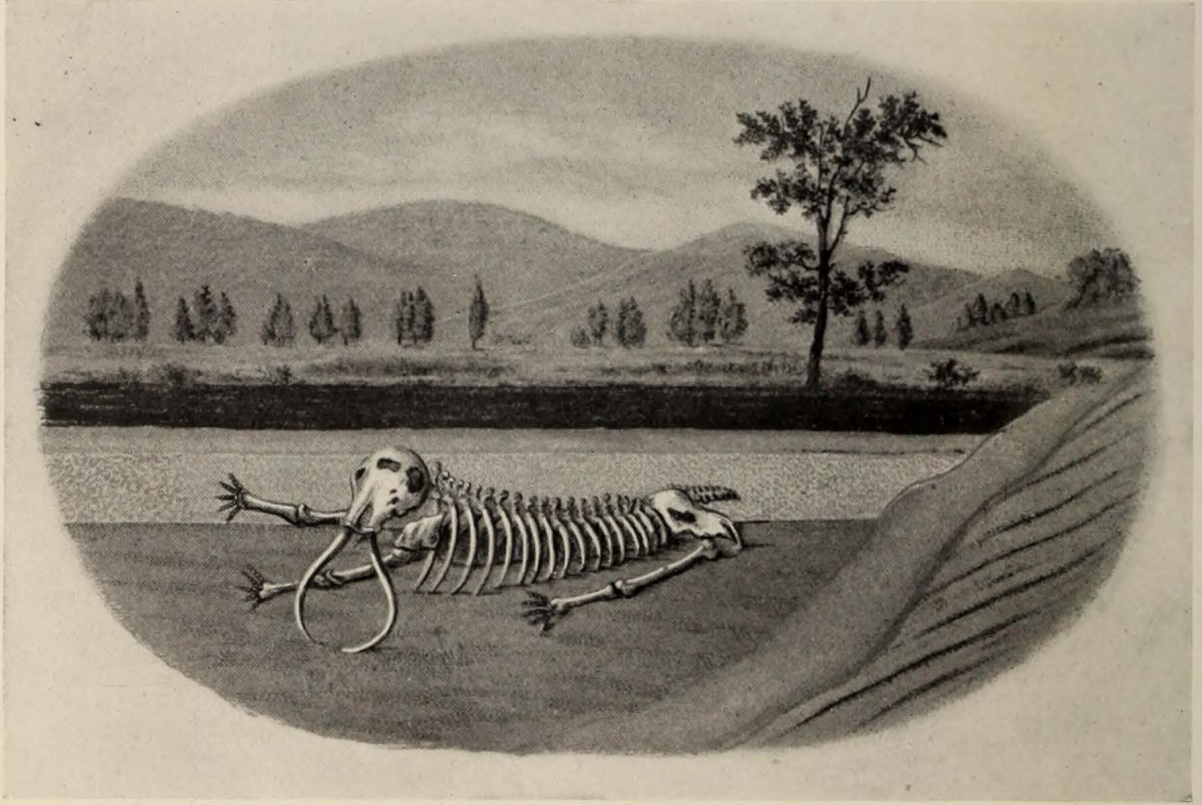
I was present at  
the original discovery  
of the Harver Mastodon  
discovered in 1845  
and assisted in the  
Exhibition of same

J. A. Brownwell  
M. G. Bain

Sep 2<sup>nd</sup> 1907

Mich





#### THE WARREN MASTODON IN SITU

Vignette showing the Warren Mastodon as it was stretched out when originally discovered about six miles northwest of Newburg and about one mile south of Orange Lake. The vignette, which appeared originally in color on the title page of Doctor Warren's *Mastodon Giganteus of North America*, is designed to show the succession of strata under which were found the skeletal remains. Usually all these strata were covered during the wet season with a depth of water varying from one or two feet to six or eight feet, but during the unusually dry season of 1845, the year of the discovery of the skeleton, the area had almost dried up. According to Doctor Warren, the position of the extremities shows that the animal, at the time of its destruction, was making strong efforts to extricate itself from the abyss into which it had plunged. Beneath the body and limbs is a stratum of clay but the body was embedded in light-colored shell-marl, which incased the head, the right anterior limb, spinal column, part of the ribs, pelvis, and the tail. Above the shell-marl was a layer of red moss of a pinkish color; the top layer was of dark-colored peat a foot or two in thickness; above this in ordinary seasons was the depth of water already referred to





On Saturday, August 19, 1922, the writer visited the locality where the Warren Mastodon was discovered and had the good fortune to meet Mr. Nathaniel Brewster, the grandson of the original owner and excavator of the skeleton, who with his daughter, Miss Brewster, gave the writer a most courteous reception.

Mr. Brewster pointed out the original boxes, excellently constructed, in which the skeleton was originally packed and transported from place to place for exhibition. Although a small boy at the time, being only three years of age, he distinctly recalls placing his little fist in the eye socket of the mastodon skeleton. He also recalls the spot where the mastodon was found, now buried beneath a pond of considerable size. On September 6, 1922, Mr. S. H. Chubb visited the site with his excellent camera and photographed Mr. Brewster pointing to the spot in question (see lower picture; the upper picture shows another view of the same locality). The relation of the site to its environment is shown in the map on p. 8.



man's finger, and were gathered in a bushel basket. The tusks were also perfect when found, but crumbled on coming in contact with the air. There is a brooch in the family with the head in 'profile' of one of my uncles carved on it, made from a piece of the outside of these tusks; there is also a part of a tooth that broke off after it was set up. My oldest brother, who now occupies the homestead, has much interesting data in connection with it, also an engraving of the different strata of soil in which it was found, with a cut of each separate bone, and would furnish you, no doubt, with anything of interest to you in connection with it. It was sold to Doctor Warren by my father while he had it on exhibition either in Hartford or in New Haven."

Another reminiscence is that contained in a letter received at the American Museum on August 16, 1907, from Mr. W. M. Nelson of Equinunk, Wayne County, Pennsylvania, who writes:

"So far as I know, I am the only living man today<sup>1</sup> who saw the skeleton of the animal taken from the marl pit on the farm of Nathaniel Brewster, six miles west of now Newburgh City, where the road runs north to Orange Lake. I saw the entire skeleton taken out and bones wired together by Doctor Prime, of Newburgh, in Mr. Brewster's barn. This was done in sections so it could be set up and taken down and shipped in the boxes as freight. It was on exhibition about the country by Wm. Brewster and Clinton Weeks, son and son-in-law of Mr. Brewster.

"Squire Eager's history of Orange Co., New York, gives the dimensions of the skeleton as follows: length of skeleton 33 feet; skull between eyes 2 feet, 1 inch; length of skull 3 feet, 10 inches; number of bones 220; ribs, 20 on each side. Total weight of bones, 1995 pounds. . . . The mastodon's backbone was found about 5 feet below the surface in the marl pit. Every bone was found and wired, except one toe

bone, about the size of an egg. I was a boy some 16 or 18 years old at the time and took it all in. I remember nothing about Professor Warren. Doctor Prime wired the bones together and I saw him most every day at the work of setting up the skeleton. I do not know whether this history is of any interest to you now, but it will hold water, so far as my memory is concerned."

The above reminiscences may be supplemented with the account of the discovery gathered from the memoir by Doctor Warren published in 1852:

"The summer of 1845 had been unusually dry; many small lacustrine deposits were exposed by the drought, and their contents removed to fertilize the neighboring fields. The spot above described, though usually covered by a small quantity of water, had been left dry (an occurrence never known before); and Mr. Brewster, wishing to avail himself of its contents, had employed a number of laborers to remove them. The men had dug through a thickness of two feet of peat-bog, a layer of red moss about a foot thick, and then fell upon a bed of shell marl (*vide Vignette*).<sup>1</sup> After raising about a foot of this, they struck on something hard; and a question arose whether it was a rock, a bone, or some other substance. Night approaching, it was necessary to intermit their labor until the following day.

"Mr. William C. Brewster, son of the proprietor, and Mr. Weeks, his son-in-law, with assistants, in the presence of a large number of persons, neighbors, and travellers, proceeded to examine the object of their curiosity. The stroke of a spade brought up a portion of bone, and everyone was then willing to believe they had discovered the last retreat of one of the ancient mastodon inhabitants. The labor of exhumation then proceeded rapidly; and the part struck was ascertained to have been the summit of the head. This, being uncovered, disclosed to the eyes of the spectators the full extent of the cranium, which was four feet in length.

<sup>1</sup>Another survivor is Mr. Nathaniel Brewster, a grandson of the owner of the farm at the time of the discovery, who is shown on p. 33 pointing to the spot from which the skeleton was recovered.

<sup>1</sup>The vignette is reproduced on p. 32 of the present article.



The lower jaw was distorted a little toward the left side. The bones of the spine, tail, pelvis, and ribs, were successively found, for the most part in their natural relation to each other. The anterior extremities were extended under and in front of the head, as if the animal had stretched out its arms in a forward direction to extricate itself from a morass, into which it had sunk. The posterior extremities were extended forward under the body. The tusks lay with their convexities outwards, their anterior extremities opposed to each other nearly meeting; and thus the two tusks, taken together, described a large part of a circle. (*Vide Vignette.*)

"At the end of the second day's labor, the whole of the skeleton had been obtained, with the exception of the posterior part of the sternum, a few bones of the feet, and a number of the caudal vertebræ, some of which were recovered afterwards. The bones were in an almost perfect state of preservation. They were not black, like most of the mastodon bones, but of a brown color, like those of a recent human skeleton, which had been in use a considerable time. It is worthy of remark, that no mastodon bones but those belonging to this individual, and no other bones excepting two or three of animals recently entrapped in the mire, were found in this deposit."<sup>1</sup>

"Doctor Prime, who was present, describes its appearance as follows:— 'In the midst of the ribs, embedded in the marl and unmixed with shells or carbonate of lime, was a mass of matter, composed principally of the twigs of trees broken into pieces of about two inches in length, and varying in size from very small twigs to half an inch in diameter. There was mixed with these a large quantity of finer vegetable substance, like finely divided leaves; the whole amounting to from four to six bushels. From the appearance of this, and its situation, it was supposed to be the contents of the stomach; and this opinion was confirmed on removing the pelvis, under-

neath which, in the direction of the last of the intestines, was a train of the same material, about three feet in length or four inches in diameter.'"<sup>1</sup>

#### TOUR OF EXHIBITION

Owing to the fact that the bones were buried in a pure shell-marl layer, they were, when found, in a perfect state of preservation; of light brown tint, not of the dark brown or nearly black tint of the mastodon skeletons exhumed from swamp muck, which are discolored by decaying vegetable matter. As narrated by two eyewitnesses, the skeleton was wired together and set up in such form that it could be exhibited for three or four months during the years 1845 and 1846, in the city of New York and in several New York and New England towns. Luckily, it does not appear that any of the parts were lost during this period of exhibition and travel.

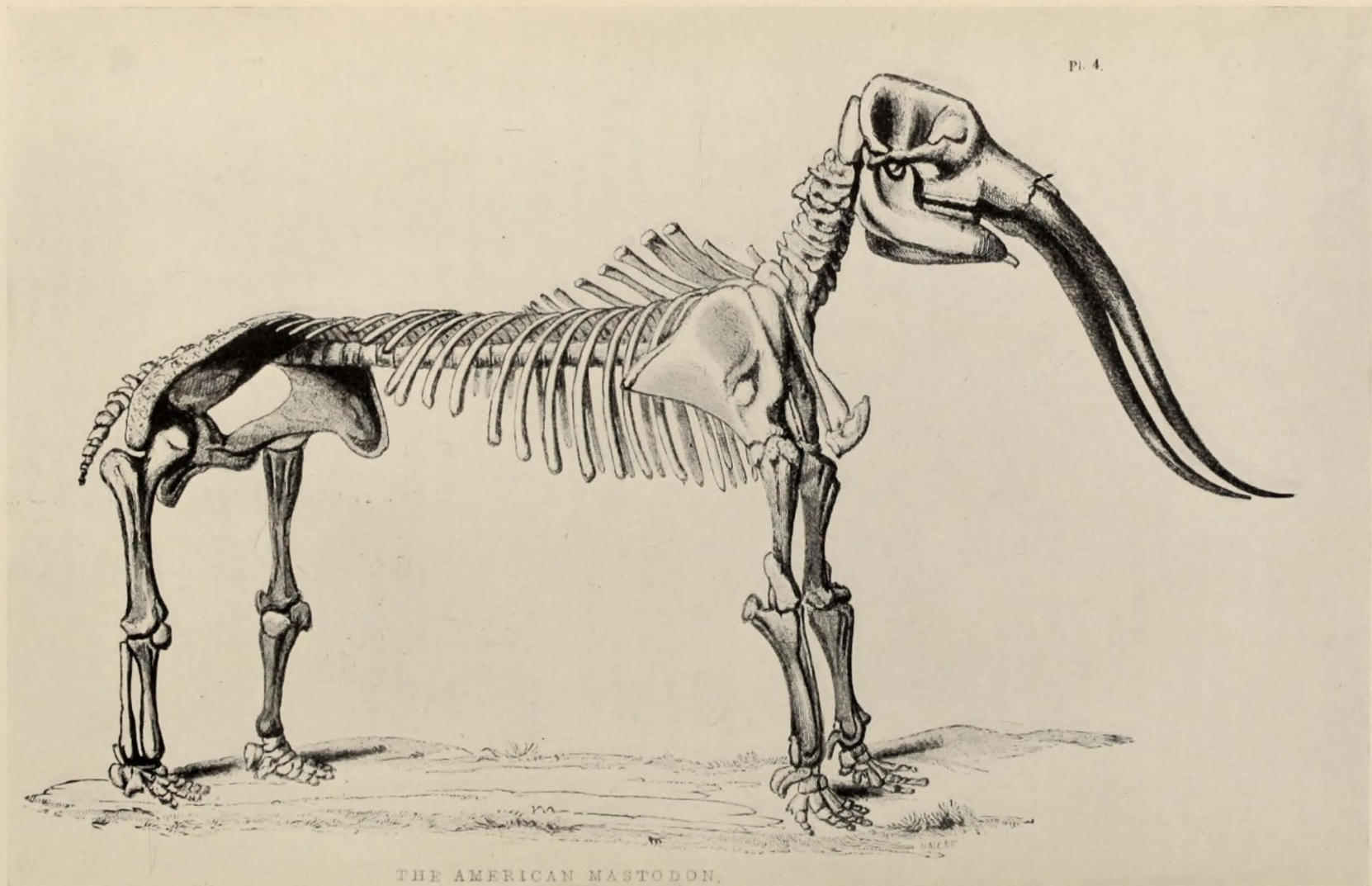
The excellently made boxes in which the skeleton of the Warren Mastodon was transported from point to point for exhibition still remain in the possession of Mr. Nathaniel Brewster. The impression which the mastodon made on observers in the city of New York is shown by an extract from the journal of one of the pupils of the New York Institute for the Deaf and Dumb, October 16, 1845:

"Having been kindly invited by the proprietors of this wonderful exhibition, we went up into the Minerva Rooms, 406 Broadway, and looked at the American Mastodon, one of the greatest curiosities in the world, according to my imagination. We steadily gazed at it with much astonishment. The bones of it are articulated together or fastened to each other by iron nails so as to form a skeleton, and it is now exhibited in this city. Two long artificial tusks measuring ten and a half feet in length are fixed into the

<sup>1</sup>The *Mastodon Giganteus* of North America, by Dr. John C. Warren, pp. 5 and 6.

<sup>1</sup>*Idem.*, p. 144.

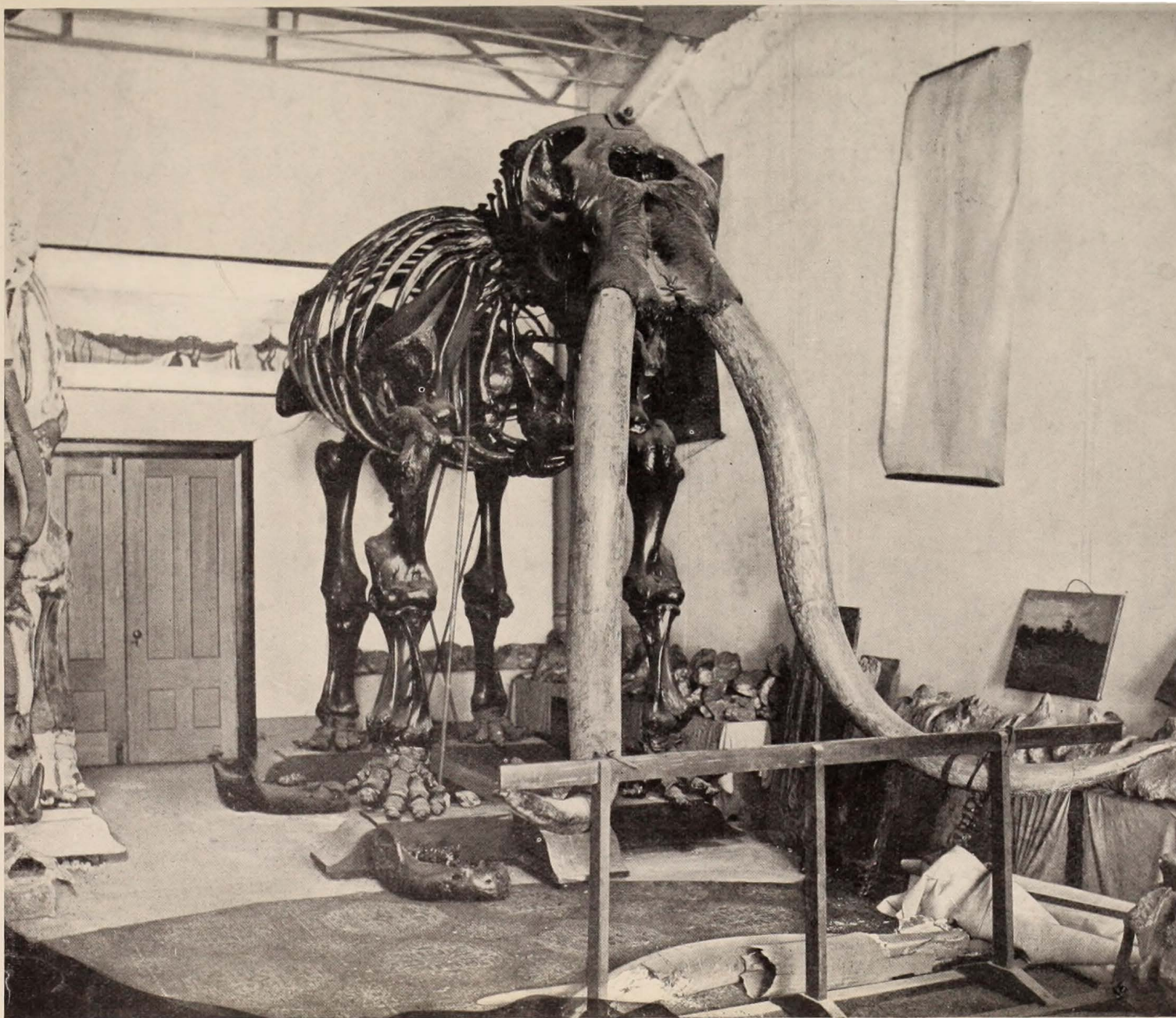




THE WARREN MASTODON AS IT WAS MOUNTED SHORTLY AFTER ITS DISCOVERY

The figure is reproduced from the *American Journal of Agriculture and Science*, Volume II, Number 2, conducted by E. Emmons, Albany, and A. J. Prime, Newburg. In their article, "The Great American Mastodon," Messrs. Emmons and Prime remark: "The skeleton has since been arranged and set up, and this has been done with great care and the strictest attention to the articulating surfaces of all the bones, which we believe has not been the case with others which have been put together"





THE WARREN MASTODON  
AS REMOUNTED IN 1849

For fifty-seven years, that is from 1849–1906, the Warren Mastodon, remounted as shown in the picture, was exhibited in the Warren Museum in Boston. In 1906 it was acquired, thanks to the generosity of the late J. Pierpont Morgan, by the American Museum.

The skeleton, as here depicted, is covered with heavy black varnish. The imitation tusks are made of papier-maché and were so lengthened as to sweep the ground and curve outwards at the extremities. The chest and backbone were raised two feet above the top of the shoulder blade, or scapula, and as a result the natural height of the animal was increased from nine feet to twelve feet. Beneath the Warren Mastodon are tusks and grinding teeth of other specimens. Around the base of the walls are many vertebrae of the giant *Zeuglodon*, the archaic fossil whale of southern United States.

As photographed in the interior of the Warren Museum, 92 Chestnut Street, Boston



skull; the old tusks of nature are almost corrupted, and it is said that they were found entire in the skull when first discovered, but they have fallen in pieces so that they cannot be made fast. The large vertebræ of its spine or backbone gradually increase in size from the extremity of the tail to the head. We could stand below the long ribs. We examined the legs and bony toes with great curiosity. The whole bones weigh 2002 pounds but they must have weighed 20,000 pounds when it was living. The skeleton measures 29 feet in length, and the height of its head, 12 feet, that of its back, 10 feet, and the width of the pelvis, 6 feet.

"The skeleton, which has been brought to this city for a show, was found in a marl bed on a farm at Newburgh, of New York. I am very proud of that skeleton first discovered in this state.

"It is supposed that this animal on walking along the marl bed, sunk into it by its legs adhering closely to the marl and it was drowned. It remained in it for a long time. Previous to the discovery, nobody knew the place where it was buried. We should be thankful to the proprietors who found it and took great pains to fix the bones firmly into a skeleton. What a wonderful success!! It leads us to admire the power and wisdom of our Almighty Maker who made the largest of animals."

#### DOCTOR WARREN ACQUIRES THE MASTODON

Fortunate was its purchase in 1846 by Dr. John Collins Warren, professor of anatomy in the Harvard Medical School, who paid \$5000 for it. Doctor Warren, who about this time became president of the Boston Society of Natural History, had the skeleton transferred to Boston, where it was mounted under his direction by Dr. N. B. Shurtleff; this was its second mounting. It was exhibited to Sir Charles Lyell, the distinguished English geologist, who made a tour of the United States during the years 1841-45; also to Professor Jeffries Wyman,

founder of the Museum of Comparative Anatomy, Harvard Medical School; also to Professor Louis Agassiz, who was called to Harvard University in the year 1848.

The teeth of the mastodon had been known in America since 1705 and in Europe ever since Longueil, a French officer, brought them back from the banks of the Ohio River in 1739; they had been examined and described by the great French naturalist of the period, Buffon; they had been assigned the specific name of *Elephas americanus* by the American naturalist, Kerr, in 1792; they had been falsely confused with those of the woolly mammoth of Siberia by Blumenbach, who gave this animal the name of *Mammut*; they had finally, in 1806, been properly christened 'mastodonte' by the great French naturalist, Cuvier; yet the actual structure and proportions of the mastodon still remained unknown. Consequently the discovery and mounting of the Warren Mastodon skeleton was a really great event in the science of palæontology; it rendered possible for the first time a knowledge of the complete animal. It appears, however, that Doctor Warren was not satisfied with the mounting by Doctor Shurtleff, nor with the security of the building where the skeleton was first exhibited in Boston, because in 1849 the mastodon was remounted by Mr. Ogden under Doctor Warren's direction and placed with other collections in the especially erected fireproof building at 92 Chestnut Street, Boston, which soon became famous as the Warren Museum. It was at this time that the skeleton received its coat of black varnish, was raised two feet above its natural height, and was provided with the enormous pair of papier-maché tusks.

From 1849 to 1906 the skeleton remained in the Warren Museum in the



condition shown in our photograph on page 15. Professor Warren became intensely interested in adding to his museum other specimens of the mastodon, especially those discovered along the west bank of the Hudson River, and also in securing specimens from England, France, and Germany, for purposes of comparison. Thus his collection was enriched by the acquisition of the superb head of an old bull mastodon found near the Shawangunk Mountains, and hence known as the Shawangunk head; this is one of the largest, if not the largest, bull mastodon head ever found. Through active correspondence with Professor Jean Jacques Kaup, Doctor Warren secured casts of all the specimens that Professor Kaup had discovered near Eppelsheim not far from Worms in Germany, namely, *Mastodon longirostris* (signifying long-jawed mastodon) and *Dinotherium giganteum* (signifying the terrifying giant beast), animals which at the time aroused the wonder of Europe. Thus there were soon gathered in the Warren Museum numerous specimens from different parts of the world—North America, Europe, and Asia—bearing on the history of the proboscidean order. Doctor Warren devoted his spare time for six years to the study of these animals, and in 1852 issued a splendid monograph entitled *The Mastodon Giganteus of North America*. In April, 1908, the autograph copy of this precious publication, with marginal annotations in Doctor Warren's handwriting, was presented to the Osborn Library of the American Museum, together with *The Life of John Collins Warren, M.D.*, in two volumes, by Dr. Edward Warren.

#### REMOVAL TO THE AMERICAN MUSEUM

The writer of the present article had

for years longed to secure this famous specimen for the American Museum but never dreamed that it would be possible to obtain it. It appeared that the entire Warren collection was entailed in the will of Doctor Warren and that the heirs were not at liberty to dispose of it until the decease of the last of the immediate descendants. The writer was greatly surprised, therefore, when he received a letter from Dr. Thomas Dwight of the faculty of the Harvard Medical School, indicating that the entail was at last closed and that the collection might be offered for sale under certain conditions. This letter came on a Friday afternoon and the writer left the same evening for Boston, arriving in Doctor Dwight's study on Saturday morning; he accompanied this distinguished anatomist to the old Warren Museum on Chestnut Street to view the famous skeleton for the first time. The black varnish appeared to present an obstacle, but some vigorous scratching with a penknife revealed the rich light-brown color of the bone beneath. A friendly interchange of opinions with Doctor Dwight ensued; a valuation was agreed upon for the entire collection, but there was still little thought in the writer's mind that it could be secured by the American Museum. On the Monday following, the prince of museum benefactors, Mr. J. Pierpont Morgan, authorized by telephone an offer of \$30,000. This offer was immediately accepted and a few days later Dr. William Diller Matthew went to Boston to pack up the entire Warren collection, covered as it was with a half century of Boston dust. The collection was carefully inventoried, and with it came several valuable photographs and pictures, which are reproduced in the present article.



THE FOURTH MOUNTING OF THE  
WARREN MASTODON

In removal all the original framework was left in Boston, only the bones being packed; in this separated condition the precious skeleton, covered with its thick coat of black varnish, reached New York, its native State, in safety. The first question which arose in our minds was whether it would be possible to remove the black varnish; this was answered through a series of experiments which resulted in the construction of special vats large enough to contain the longest and broadest bones, such as the thigh bones, the hip girdle, and the skull. Many weeks of immersion in pure benzine were necessary before the black varnish began to dissolve. This treatment was followed by vigorous scrubbing with pure spirits of alcohol, and one by one the bones emerged from this prolonged and very expensive bath in all the purity and beauty of color that characterized the skeleton when it was exhumed by Doctor Prime in 1845.

There still remained the problem of the tusks, which are invariably the most vital part of buried skeletons of the great proboscideans of the past. It appears that the original tusks could not be preserved entire by the methods then known. The discoverers were unable to prevent them from splitting, warping, and falling to pieces, especially at the butt. In order to preserve what could be saved intact, the butts of the tusks, already hopelessly split and warped, were sawed off under Doctor Warren's direction, and only the tips, about three feet in length, were treated and preserved. The butts, fallen into fragments, but still lying undisturbed in two of the original boxes used for transporting the skeleton, were found in the Warren Museum when the skeleton was repacked to be sent to the

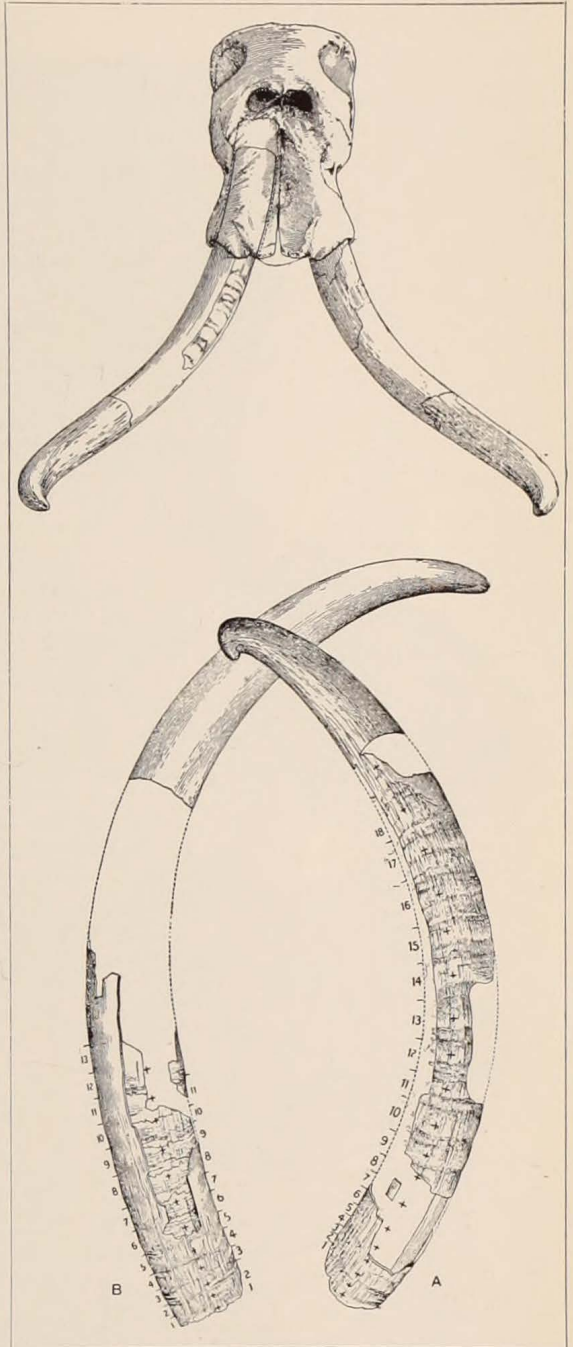
American Museum. The tips, treated with preservatives, were still intact in another box; but neither had been used apparently for measurements in making the papier-maché restorations fitted to the skull in the Warren Museum. This documentary evidence certainly was not used by Professor Warren, because in his three restorations he unfortunately accepted the erroneous original reports that the tusks as found were more than eleven feet in length; they were so described and illustrated by him in the entirely impossible position shown in the photograph on p. 37.

When the Warren collection reached the American Museum, it was very carefully looked over in a search for remnants of the original tusks, and finally the fragmentary fossil ivory was found, but inasmuch as most of the original records had been lost and no use of these materials had been made by Doctor Warren, it remained to be proved that the fragmentary butts of the tusks really belonged with the skull. The piecing together of these butts required several months of most ingenious and patient work on the part of one of our preparators, Mr. Charles Christman. The ends of each tusk were perfectly preserved, but there was no connection between these tips and the reconstructed butts of either tusk. Fortunately, when the butts of the tusks were sawed off, a single splinter of bone broke off, and finally this splinter was found to fit exactly to a fragment of the butt. There was great rejoicing in the laboratory when the relationship of these two fragments was discovered, because it enabled us to determine positively the length of the tusks as 8 feet, 7 inches.

The rebuilding of the tusks, which required several months of most patient work, had two very important

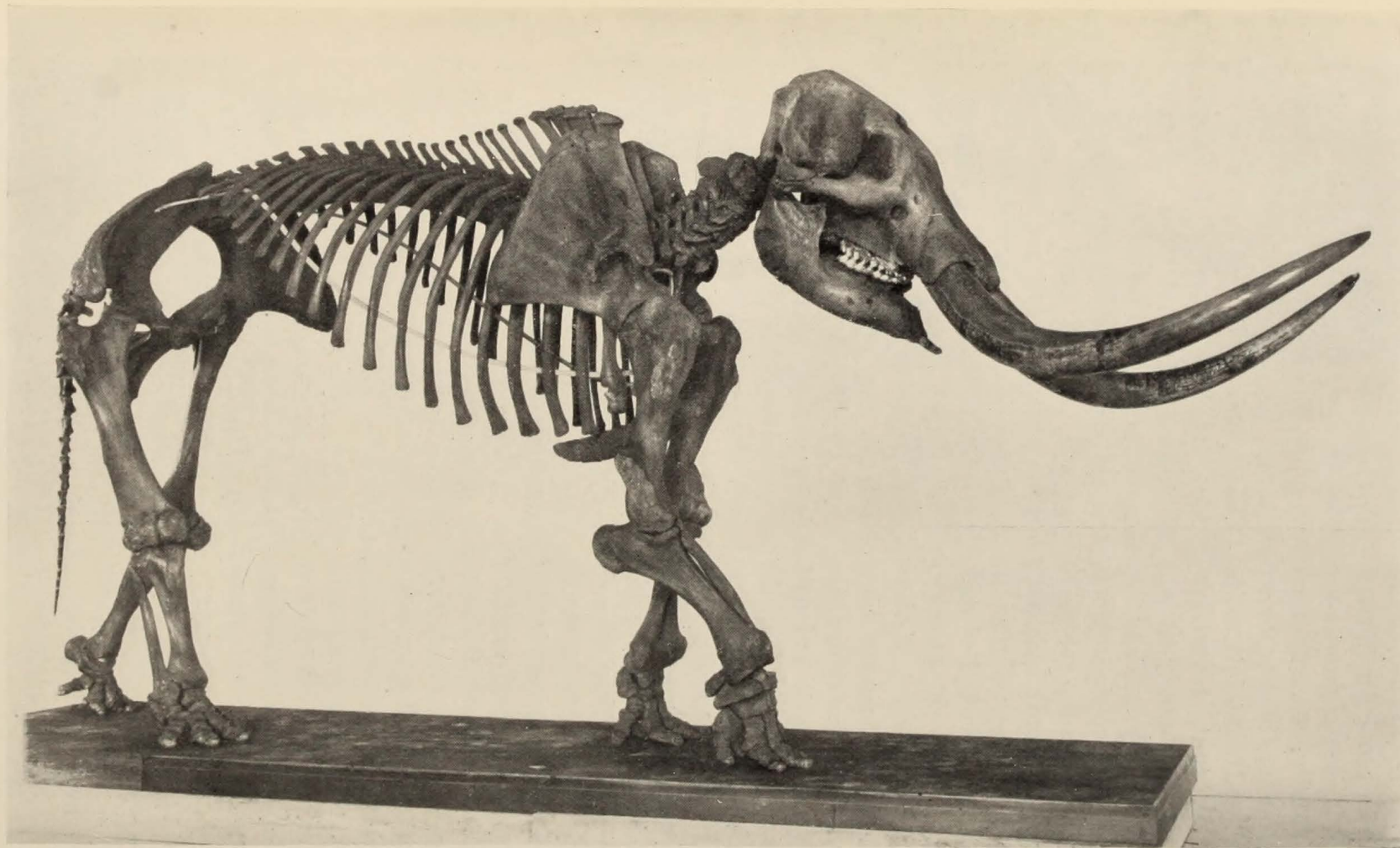


results: in the first place, it enabled us to place them properly in the sockets of the skull and to prove for the first time the exact relations of the mastodon ivories; secondly, a very painstaking examination of these tusks led to an important and most interesting discovery, namely, that it was possible to determine very closely the age of the Warren Mastodon. The ivory exhibits a series of growth rings which, counted from tip to base, seems to prove that the Warren Mastodon was perhaps thirty years of age at the time it sank into the bed of marl near Newburg. The right tusk included at least twenty-eight of these segments. The growth rings are shortest near the tip of the tusk when the animal is young, and increase in length from the tip toward the middle of the tusk, but not in a regular ratio. These growth rings do not correspond exactly in the opposite tusk, but in both tusks they are longest in the middle region. Nine smaller rings are in the lower part. The writer's theory regarding these growth rings is that during the summer season, when all the conditions of life were favorable, and perhaps during the rutting period, when tusk growth was hastened by internal secretions from the reproductive glands, the growth of ivory was very rapid, the maximum growth in the 17-18 ring being 108 centimeters, of  $4\frac{1}{4}$  inches, perhaps the maximum growth of a favorable season at the most vigorous reproductive period of life. The Warren Mastodon is an adult but not an aged specimen; the skeleton is apparently that of a younger animal than the one represented by the Shawangunk head. Some estimate the maximum age of the American mastodon at between thirty and forty years,—less than half the life span of the elephant, which attains more than one hundred years.



In repairing the tusks of the Warren Mastodon, it was found that the outer sheathing of the ivory (dentine) was in large part absent; the inner sheathing exposed a series of concentric constrictions and expansions which were observed to be approximately symmetrical on the two sides, as indicated by the two series of + signs in the lower figure. In the second place, it was noted that the intervals between these constrictions are broader in the middle stages of the growth of the tusk and narrower in the mature or later stages of its growth. On the hypothesis that these are actual annual increments of growth, the right tusk (A) consisted of about twenty-eight segments, which, allowing for the period of milk teeth and for the part worn off at the tip, would assign to the Warren Mastodon an age of perhaps thirty years.





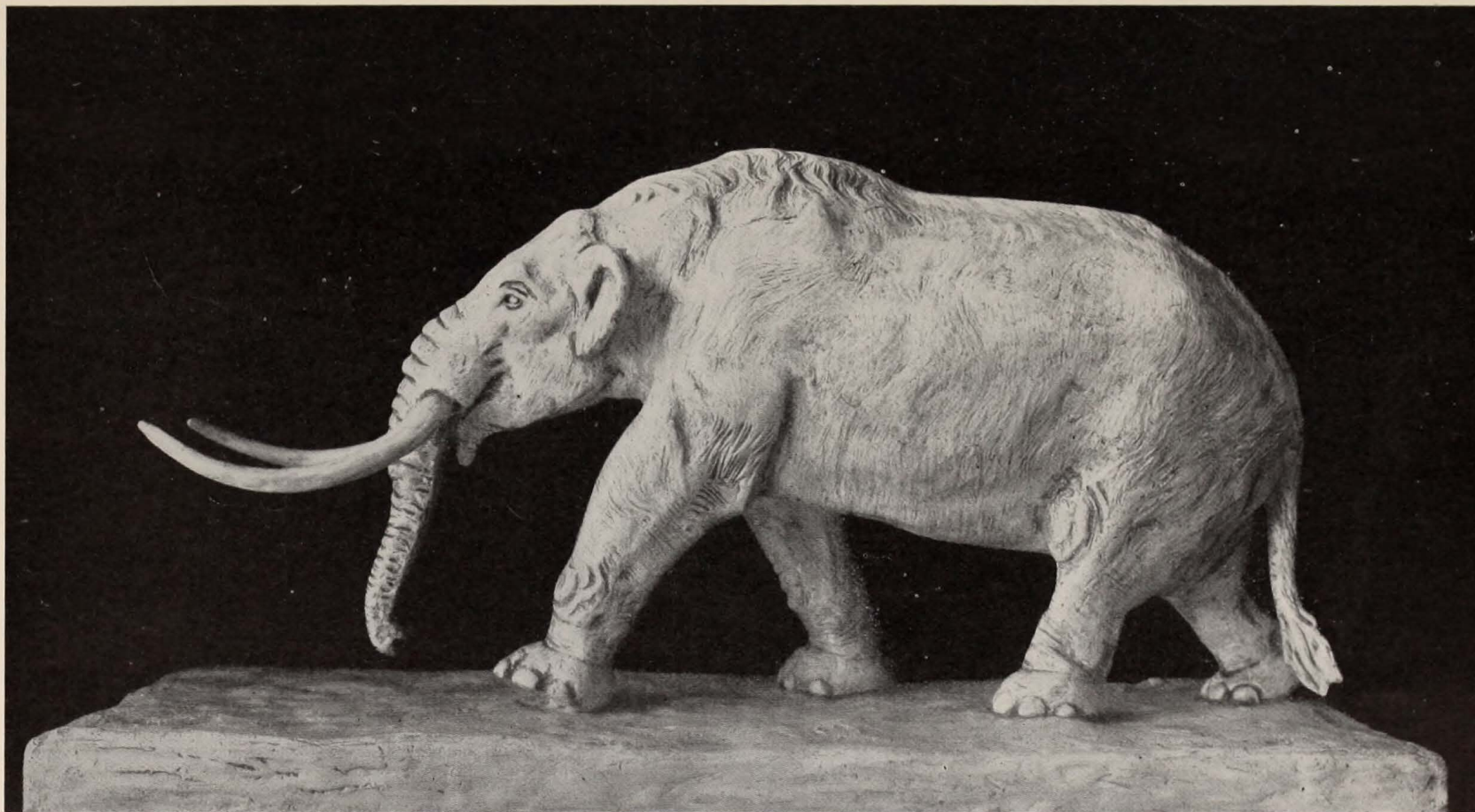
THE WARREN MASTODON AS REMOUNTED IN THE AMERICAN MUSEUM IN 1908

The skeleton is so complete that the only restorations or replacements which have been necessary are the following: caudal vertebrae 1-14, 16-28; all the terminal phalanges of the left forefoot except digit iii; and phalanx 2, digit iv, of the right forefoot. The following bones are introduced from other individuals: two posterior sternal bones, phalanx 2 on digits ii, iii, and v

MEASUREMENTS OF THE WARREN MASTODON

	Feet	Meters		Feet	Meters
Length, base of tusks to drop of tail	14 ft. 11 in.	4.55	Thigh bones: Length of right	3 ft. 5 in.	1.05
Height to top of spines of back at the shoulders	9 ft. 2 in.	2.80	Length of left	3 ft. 6½ in.	1.08
Tusks: Length of right tusk, on outside curve	8 ft. 6 in.	2.50	Pelvis or innominate bones: width	6 ft.	1.83
Length of tusk exposed	7 ft.	2.14			





MODEL OF THE WARREN MASTODON BY CHARLES R. KNIGHT

This reconstruction made by Mr. Knight under the direction of Prof. Henry Fairfield Osborn, 1912-14, is one of a series of models of the extinct and living elephants, and of the mastodons, made to a uniform scale of  $1\frac{1}{2}$  inches to the foot, or a  $\frac{1}{8}$  scale. The heights of these animals in descending order are as follows:

Imperial mammoth, *Elephas imperator*,  
 African elephant, *Loxodonta africana*,  
 Indian elephant, *Elephas indicus*,  
 Jeffersonian mammoth, *Elephas jeffersonii*,  
 Woolly mammoth, *Elephas primigenius*,  
 American mastodon, *Mastodon americanus*,  
 Pigmy African elephant, *Loxodonta pumilio*,

13 feet, 6 inches  
 11 feet,  $8\frac{1}{2}$  inches, record of Rowland Ward  
 10 feet, 6 inches, record of Rowland Ward  
 10 feet, 6 inches, type specimen, American Museum  
 9 feet, 6 inches, type specimen of western Europe  
 9 feet, 2 inches, as measured from the Warren Mastodon  
 6 feet, 2 inches, height of specimen in the New York Zoological Park





GROUP OF AMERICAN MASTODONS ALONG THE MISSOURI RIVER IN KANSAS

This restoration was made by Mr. Charles R. Knight, in 1920, under the direction of Prof. Henry Fairfield Osborn. There are two mastodon bulls, a cow, and a calf in the scene.





"THE COHOES MASTODON" AS HE APPEARED IN LIFE

This restoration is based on the most careful study of the muscular anatomy and proportions of the animal as derived from exact measurements of the skeleton, aided by comparison with the external form, skin texture, and other details in living elephants. The American mastodon had a coat of hair which somewhat resembled the hair of present-day elephants, though very much thicker and longer. The animal was thus adapted to the low temperature which prevailed in this region at the breaking-up of the Ice Age. It was a very distinctive member of the New York fauna of a few thousand years ago when mastodons may have roamed the swampy regions in herds comparable in number to those of the buffalo on the western plains fifty years ago. Parts of more than one hundred skeletons have been discovered in this state. This is the only life-size scientific restoration that has been made of the American mastodon.

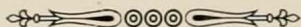
Executed, under the direction of Dr. John M. Clarke, by Messrs. Noah T. Clarke and Charles P. Heidenrich for the State Museum at Albany in 1921-22



It was very important to make another correction in mounting this animal, namely, to ascertain its exact height at the shoulders. The temptation of preparators has always been to make both mastodons and elephants much larger than they actually were in life by raising the chest portion high above the tips of the shoulder blades. In order to determine this much-mooted question, our preparator at the time, Mr. Adam Hermann, spent a day on the back of Gunda, then the favorite riding elephant of the Zoological Park; placing his two thumbs on the tip of the spine and his two index fingers on the tip of the shoulder blades, he was able to note that the shoulder blades are on practically the same level as the summit of the spine. This observation enabled us to determine positively that the height of the backbone of the Warren Mastodon at the tip of the spine is 9 feet, 2 inches above the ground, whereas the length of the animal from the skull measured at the

very base of the tusks to the droop of the tail is 14 feet, 11 inches, practically 15 feet. Thus the length of the animal's body is 6 feet, 9 inches greater than its height at the withers. Its proportions are thus totally different from those of any species of elephant. The long, low body is correspondingly broad, with an immense spread of six feet across the hips of pelvis. It is to emphasize the long, low, and broad proportions of the American mastodon, that the accompanying restorations were made by Charles R. Knight, under the writer's direction.

The reader who is interested to learn more about this subject is referred to works by Warren and others in the Osborn Library of the American Museum of Natural History, and especially to an article by Dr. John M. Clarke entitled "Mastodons of New York. A List of Discoveries of Their Remains, 1705-1902," in the Report of the State Paleontologist, 1902, New York State Museum. Bulletin, 69, p. 921.



















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