

the body of a foot and a half; in color it was deep rusty brown, sometimes darker, sometimes lighter, according to peculiarities of preservation; its texture somewhat resembled the fibers in the hard outer covering of cocoanuts. Outstanding from this were the scarcer, flattened, considerably longer, black, but flexible bristles that apparently were evenly distributed over much of the body. Particularly graced with them were such parts as the chin, eyelashes, and ears. On the tip of the short tail they formed a long, fan-shaped tassel, but even there were only one mm. thick. The trunk was well covered with dense, short hair. On fore and hind limbs the longer coarse hair had an average length of one foot two inches; at the lower portions it was considerably shorter.

As usual in mammals with dense underfur the epidermis in the mammoth was extremely thin and rather smooth, in that respect quite unlike the thick, horny, rugose, sparsely bristled skin of living tropical elephants. The leathery portion, however, according to various researches, proves to have been as thick as or thicker than that of present-day proboscideans. The histological character is essentially the same in both, neither of them possessing sudoriparous or sebaceous glands. Neuville suggests that the mammoth in evolving from ancestors living in a warmer climate and adapting itself to boreal conditions greatly reduced its epidermis.

No more important factor could be cited indicating the coldness of the climate in which the mammoth lived, than the abundance of fatty tissue just below the hide. On the belly of the Beresovka male this layer was three and a half inches thick. Fat of any kind is practically absent in recent elephants, as is usual in game of tropical Africa except the hippopotamus. Its presence positively shows that at the time of death the mammoths preserved as ice-mummies were not on the verge of starvation. What better protection against the oncoming rigors of winter could be imagined than such an accumulation of fat, common in many boreal land and aquatic mammals and always in those that hibernate.

Several lucky circumstances have contributed towards our fairly satisfactory knowledge about the feeding habits and food of mammoths. From what we know about living elephants the experienced can tell from a glance at the molars that the mammoth secured its livelihood essentially by grazing and not by browsing. Its cheek-teeth present a densely crowded condition of the component transverse plates with comparatively even, yet characteris-

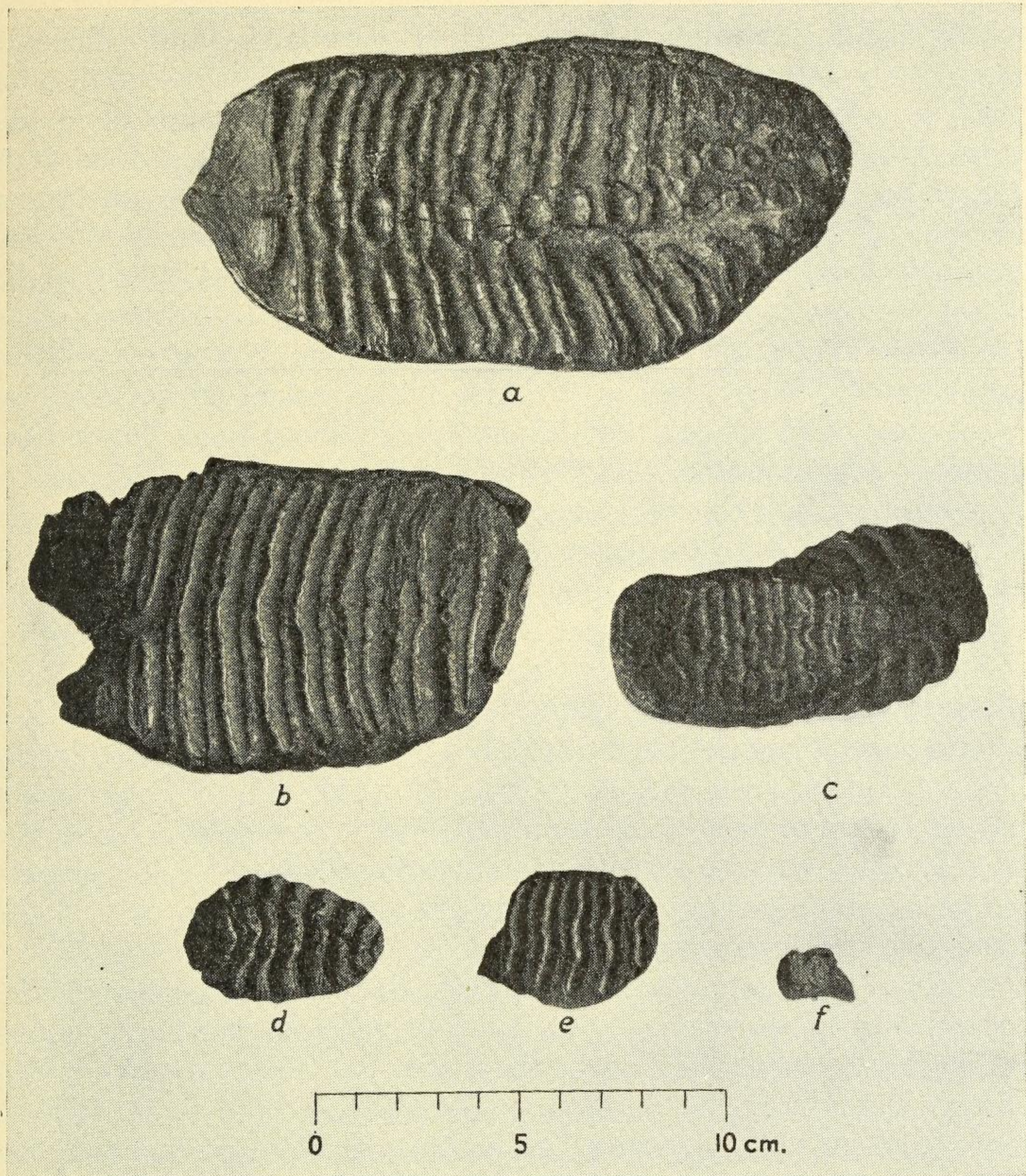


Fig. 16. Various stages in the development of upper and lower molars of the mammoth (*Elephas primigenius* Blumenbach). Anterior portion pointing toward left.

a. Third right lower molar at height of efficiency. Enclosed within the high rims of enamel of each of the numerous transverse lamellae or their parts lies the softer and lower dentine. The lamellae in turn are surrounded and united by cementum. Anteriorly this molar is worn low.

b. Second right upper molar. Some of the anterior transverse lamellae have been shed, and the remaining ones are more worn than in Fig. *a*.

c. Third right lower molar. Some of the posterior lamellae have not yet moved up from the jaw to the grinding surface.

d. Second left upper milk molar before piercing the gum. The individual transverse lamellae, still crested, have not yet been united by cementum.

e. Second left upper milk molar well worn, some of the transverse lamellae in front having been shed.

f. First left upper milk molar with a grinding surface of only 12 mm. This cheek-tooth belonged to a calf probably not more than a year old.

tically rough, crown surfaces. Their peculiarity and efficiency are greatly influenced by the singular action of food-stuffs under the pressure and friction of mastication. It is the amount of silicate, grit, and other hard materials contained in the food that causes an unequal rate of wear of the three principal substances composing these grinders. Under these circumstances the excessively hard enamel parts always remain as ridges, whereas the softer dentine and cementum form alternating depressions. The transverse plates of the cheek-teeth vary somewhat in complexity and number; from three in the first (milk molar) to as many as twenty-seven in the sixth or last molar. Osborn¹⁰ has shown that Jefferson's mammoth (*E. jeffersoni*) of the American Pleistocene, from Indiana, may have as many as thirty in the upper molar and from twenty-four to twenty-six in the lower.

The masticating surface of the large, broadened molars* of the mammoth forms an efficacious milling apparatus for the grinding to pieces of the rather tough, but very nourishing, boreal meadow plants. A similar arrangement would not answer so well for the bulky, succulent masses of tropical vegetation on which the living Indian and African elephants subsist. The relatively compact nature of the fodder of the mammoth may have helped lessen the need for accommodating immense digestive organs and finally have led to a general reduction in size of the animal's body, back of the head, as mentioned above.

Borodin¹¹, was able to identify the plants found between the molars and in the stomach of the Beresovka mammoth. Above its ice mausoleum the flora of these Siberian forest meadows still showed essentially the same characteristics as thousands of years ago at the time of the victim's entombment. The average temperature may have then been responsible for a more uniform, milder climate, somewhat lacking the intense severity of present winters

¹⁰ Osborn, Henry Fairfield, 1922, Amer. Mus. Novitates No. 41, pp. 1-16.

¹¹ In: Salensky, W., 1905, Compt. Rend. Séan. VI Congrès Internat. Zool., Genève, (1904), p. 72.

*The molars, as in other elephants, after emerging from the gum gradually move forward in the jaw. As the upper portion, the grinding surface, is worn down, the originally long, anteriormost roots are absorbed or "eaten up" within their sockets by special cells, the osteoclasts. Thus only a flat, thin, center portion of the anterior part of the molars remains. As this is pushed out beyond the forward part of the socket the thin pieces of the composing plates break off easily, the worn ones being replaced by succeeding new ones from the rear. In this way the rather voluminous and heavy molars are easily accommodated in so limited a space and retain their efficiency till a relatively advanced age.

and allowing the forests to reach as far as about 74° North. The food gathered in abundance by the Beresovka mammoth just before death consisted of various kinds of grasses (*Alopecurus*, *Hordeum*, *Agrostis*, *Atropis*, and *Beckmannia*). Sedges were represented by two forms of *Carex*. A mint (*Thymus*), pods of a leguminous plant (*Oxytropis*), wild poppies (*Papaver*), and seeds of the northern butter daisy (*Ranunculus*) made up the list. Some pine needles and bits of wood figure as incidental occurrences.

From the above enumeration of characters it appears out of question, as formerly believed, that Indian elephants could be modified forms of the Siberian mammoth and had merely wandered southwards into the more luxuriant forests of tropical Asia, and in adapting themselves, had lost their heavy pelt and gradually changed otherwise. As shown above, the Siberian mammoth was in many ways too highly specialized to figure as an ancestor of the living Indian elephants, which must have evolved from some other form.¹²

As an argument against the boreal character of the mammoth there has been advanced the fact that in southern regions its remains were found mixed with those of such tropical types as the cave hyaena (*Crocota crocota spelaea*) and the cave lion (*Leo leo spelaea*), that actually had gnawed its bones. The Pleistocene European hippopotamus (*Hippopotamus major*) has been cited to the same purpose.

It is not so uncommon a feature among various groups of recent mammals to travel about in regions having relatively great differences in temperature and presenting a variety of environments. Our American bison once roamed from the plains of northern Mexico to the woodlands of Canada beyond Slave Lake. Another example is our puma, of which Theodore Roosevelt writes in his admirable account: "It is found from the cold, desolate plains of Patagonia to north of the Canadian line, and lives alike among the snow-clad peaks of the Andes and in the steaming forests of the Amazon." Another instance is offered by a race of white-footed mice (*Peromyscus*), whose footprints Dr. E. W. Nelson records having seen at 15,000 to 16,000 feet above sea-level on the volcanic ashes of Mt. Orizaba, Mexico. It thus furnishes the altitude record for North American mammals.

In Africa the browsing elephant (*Loxodonta africana*), with

¹² Osborn, Henry Fairfield, 1910, 'The Age of Mammals,' New York, p. 419.

its preferred haunts in denser wooded parklands, roams also over trackless swamps and enters arid desert stretches. The grazing buffalo (*Syncerus caffer radcliffei*) leaves the plains and invades forests, making itself at home even at 10,000 feet. Both on Mounts Kenya and Kilimanjaro records of the two visiting snow-fields and glaciers are at hand. More surprising still are the giraffe (*Giraffa camelopardalis tippelskirchi*), exploring the mountain forests of Kilimanjaro, and the eland (*Taurotragus oryx pattersonianus*), going even beyond to the mountain meadows. The lion in East Africa ascends from the lowlands to above 7,500 feet as in the Rift Valley and within the range of the mountain gorilla (*Gorilla beringeri*) on Mount Sabinyo,¹³ reaching altitudes where the temperature during the night may drop below the freezing point. The lion has been bred with success freely exposed to the wintry rigor of the climate of Dublin. Leopard (*Panthera pardus suahelica*) and hyaena (*Crocuta crocuta germinans*), also typical animals of the lowland, go to over 9,000 feet on Mount Kenya. There, up to 15,000 feet, near the border of eternal snow, hyraxes (*Procavia mackinderi mackinderi*) too occur, differentiated only subspecifically from the lowland form. Colobus monkeys (*Colobus abyssinicus kikuyuensis*) are none the worse for icy-cold nights at 10,000 feet, though equally at home in the hot valleys far below. River-horses (*Hippopotamus amphibius*) even in captivity seem not to be so susceptible to cold as generally believed. In the zoological garden in London at least they were known to take their tubs in frosty weather.

Africa, with its very restricted mountain areas, gives no fair basis as to what happens in Asia with its more extensive ranges and mountain plateaus, or to what might have taken place in this respect during the glacial periods of the Pleistocene. Even among recent mammals the list could be increased considerably. One need merely mention the hardy, long-haired Manchurian tiger and the well-furred snow-leopard with firmly established haunts in colder climes though their closest relatives inhabit the tropics. The camel (*Camelus bactrianus*) and the yak (*Poephagus grunniens*), that survive the icy blasts of the Tibetan plateaus, show not the slightest effect in their welfare or reduction in breeding on descending into more temperate zones.

Certain it is that many of the high lands of the Pleistocene presented a wide, open expanse with an abundance of excellent

¹³ Philipps, J. E. T., 1923, Geogr. Journ. London, LXI, p. 247.

pasturage, as indicated by the large herds of gregarious mammals. There should be no surprise that some of the southern carnivores, like the lion, hyaena, and others, followed up such promising prey. Perhaps the borders of rivers in the summer offered also an abundance of choice fodder to the hippopotamus. All points considered, there is no reason why the hairy mammoth should not have wandered south. Its rambles may even have been undertaken during the colder season.

Being great nomads, like most of their relatives, the mammoths unquestionably wandered back and forth through most of the northern countries of Europe, Asia, and America. During the moist, cool climate of the third glaciation they made their first appearance in Western Europe, going as far west as the British Isles, at that time a peninsula, with the North Sea firm land; and even to Denmark and Scandinavia, where it was probably the remaining glaciers that stopped them at 62° North in Norway at Saejervaskter in Vaage; attaining, however, to 65° 30' North in several places in Finland bordering the extreme north of the Gulf of Bothnia.¹⁴ They also went southward to northern Spain and to Italy within the neighborhood of Rome. From northern Siberia they passed over to Alaska and America by way of Bering Strait or the Aleutian Islands before the separation of these continents took place, thence to California and across to North Carolina.¹⁵ On the American continent their evolution progressed into still more gigantic forms as they reached evidently more inviting regions farther south.

Encouraged by slight fluctuations of temperature while glaciers were slowly advancing and retreating during the Pleistocene period the mammoths, like other mammals, shifted according to seasonal changes, either north or south, just as some of the African elephants nowadays accommodate themselves to dry and wet periods by traveling from the lower plateaus into the mountain forests and to escape from the annual grass-fires of the savanna into the safety of extensive swamp-lands. At the close of the glacial periods their haunts must have vitally changed. The mammoths apparently were not able to follow any more in the wake of the retreating ice and must have encountered conditions that sealed their fate.

Most interesting is the evidence of what the gigantic beasts

¹⁴ Holst, Nils Olaf, 1913, *L'Anthropologie*, XXIV, pp. 363-364.

¹⁵ Matthew, W. D., 1915, 'Mammoths and Mastodons,' *Amer. Mus. Nat. Hist.*, No. 43, Guide Leaflet Series, p. 6.

must have meant to the cave-dweller of Europe. The Crô-Magnon men of France¹⁶ were the first to leave for posterity authentic outlines of these monsters they had hunted. One of the finest examples is the sketch of a huge, shaggy tusker cut into a slab of mammoth ivory found in "La Madeleine" cave. This and other equally characteristic pictures, such as a curious little figure of the mammoth found at Predmost, furnish proof of the absorbing interest early Paleolithic man evinced in glorifying the enormous beast his heroes succeeded in overpowering. These early artists evidently wished to commemorate the bearer of so bountiful a supply of meat. They undoubtedly used parts of it as talismans, as in the case of a child's necklace of mammoth ivory beads found at Predmost.

In all probability the extinction of the mammoths was a gradual process and may have lasted hundreds of years or more. No single cataclysm, as Howorth¹⁷ believed, could have been widespread enough to account for their abundant, mostly scattered remains throughout the Holarctic regions preserved, as they are, in such different ways. Besides innumerable traces in northeastern Siberia, the neighboring Polar Sea, and the American continent, great accumulations of their fossil bones occur also in certain places in Europe. Predmost in Moravia, where some eight hundred or nine hundred individuals were counted, is particularly famous, but the mammoth deposits near Cannstadt in Würtemberg and Hofstade in Belgium illustrate similar instances.

According to all authentic reports the mammoths preserved as ice-mummies, and found under various conditions of entombment, perished singly. Some of them were in prime condition, as young and fat individuals prove, and had plenty of fodder in their stomachs. These facts strongly favor the view that they met with accident, as instanced by the Beresovka and other finds. For this reason they have hardly any direct bearing on the real causes of extinction of their race that is to be set at a much later period. In a way they might be compared with the frozen body and a skeleton of the African buffalo found by Ross¹⁸ and Mackinder, respectively, at about 14,000 feet on the glaciers of Mount Kenya. Wandering away from one of the many herds in the plains these rovers had perished on their unknown but curious excursion.

¹⁶ Osborn, Henry Fairfield, 1921, 'Men of the Old Stone Age,' 3rd ed., New York, pp. 397-398, figs. 197-199.

¹⁷ Howorth, Henry H., 1887, 'The Mammoth and the Flood,' London, p. xviii.

¹⁸ Ross, W. McGregor, 1911, *Journ. East Africa and Uganda Nat. Hist. Soc.*, II, p. 63.

It is significant that only the most gigantic mammals of this decidedly gregarious Pleistocene fauna have been transmitted to posterity in frozen condition. Their tremendous weight and relative clumsiness seem to have played an important rôle. Did they slip and fall, or were they precipitated to depths where cold would preserve them? Or were some of their bewildered troops devoid of the necessary agility and grit to extricate themselves from overwhelming storm and deep snowdrifts? Or did furious gales and blizzards cover them alive with icicles that quickly grew to encasing blocks of ice? As regards greater catastrophies, subsiding land-masses may have brought their doom, or inundations engulfed them. A few may have found their final resting places in swamps and bogs. Considering the various finds, certainly some and perhaps all of the contingencies enumerated contributed their share to the final extinction of the mammoth.

Every spring as a result of the setting in of warmer weather the important Siberian rivers move enormous masses of ice towards the Polar Sea. The clearing away of these obstructions is watched with intense excitement by the inhabitants of these ice-bound regions. A few months of river navigation means new freedom of traffic. They again can rove far and wide. It is then that hungry dogs may lead their masters to the masses of strongly smelling meat of the "mamonto" that has incidentally been uncovered along the thawing coves and banks.

Mighty are the struggles oncoming spring leads against the wintry forces. For a while great portions of these streams are dammed up by mountains of constantly shifting ice-floes. When these finally break through, parts of a new channel are often enough quickly ploughed up. After the generally sudden subsidence of these temporary floods, the old, abandoned stream bed freezes over again, imprisoning huge blocks of ice, debris, and all. Some of the water for a while held below the icy cover drains off and here and there large scattered pits are left between the chaotic masses. After years have leveled out these sites, ponderous beasts like mammoths wandering over such treacherous places might easily break through, be instantly killed, or become hopelessly mired. Later on erosive material piled over all may have formed the basis for the surface soil that practically furnished permanent protection. A few frozen bodies found in what was considered alluvial soil, mixed with pieces of ice, in a position as if ready to walk off, may have perished in this manner.

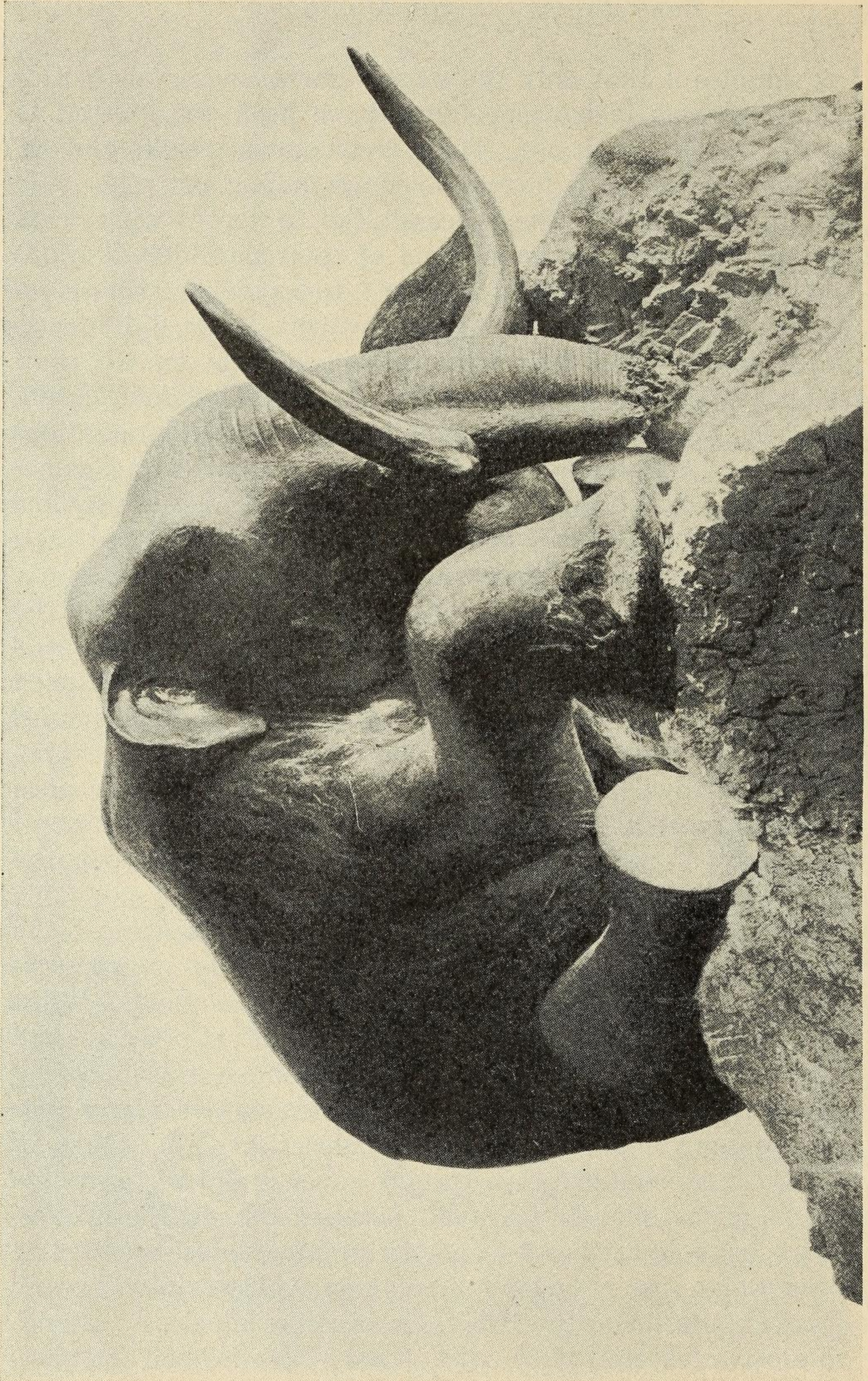


Fig. 17. The mounted mammoth unearthed in 1901 on the banks of the Beresovka River, northeastern Siberia, as it appears on exhibition in the Zoological Museum in Petrograd. The animal has been partly restored. Much of the real skin could be used in the mounting. Some of the hair has been replaced.

The cramped position, broken bones, large amount of clotted blood in the body cavity, as observed in the Beresovka mammoth, point, as Salensky shows, towards instantaneous death by accident. The victim did not even have time to throw out or swallow the quantities of fodder between its molars and in process of mastication. Salensky gives a cause for such a tragedy. During extremely rigorous winters the formation of wide fissures in the ground is not rare in northeastern Siberia. With the oncoming warmer season these clefts rapidly fill with water which may cause extensive subterranean washouts. Later some colder spells may cover such basins with a sheet of ice, below which the percolation of the remaining water continues in other directions, thus giving rise to what really amounts to an underground cave. Subsequent strengthening of the surface ice and final covering with humus, until level again, would form a sufficiently strong cover for everything except the weight of so colossal a beast as the mammoth or rhinoceros. Late in summer such places might be specially weakened and the unfortunate animal crashing through into the cavities would be instantly imbedded in the masses of ice and frozen debris loosened by the accident. Severe storms and periods of intensive freezing that usher in winter would soon remove all traces of the entombed. For thousands of years the victim might never be moved, except through the infinitely slow processes of floods and similar erosive actions.

Without question all those mammoths discovered frozen in practically fresh condition were at the very moment of their destruction surrounded by a temperature that completely excluded decomposition. The perpetually frozen ground of northern Siberia acted much like a modern refrigerator. For periods variously estimated at anywhere from 12,000 to 25,000 years, such ice-mummies may have reposed far below the protecting mantle of tundra vegetation. Here, as in the vast expanses of the "taiga," the swampy Siberian forests, they were, so to speak, permanently protected, the ground being frozen generally at three feet below the surface even during the hottest of summers. That great numbers of these and other mammals perished without being preserved in such perfect fashion is sure. In some places the earth and the shores of certain islands along the Polar Sea were literally crammed with their bones. The solid clay of higher sites inland preserved them pretty well, but elsewhere climatic conditions

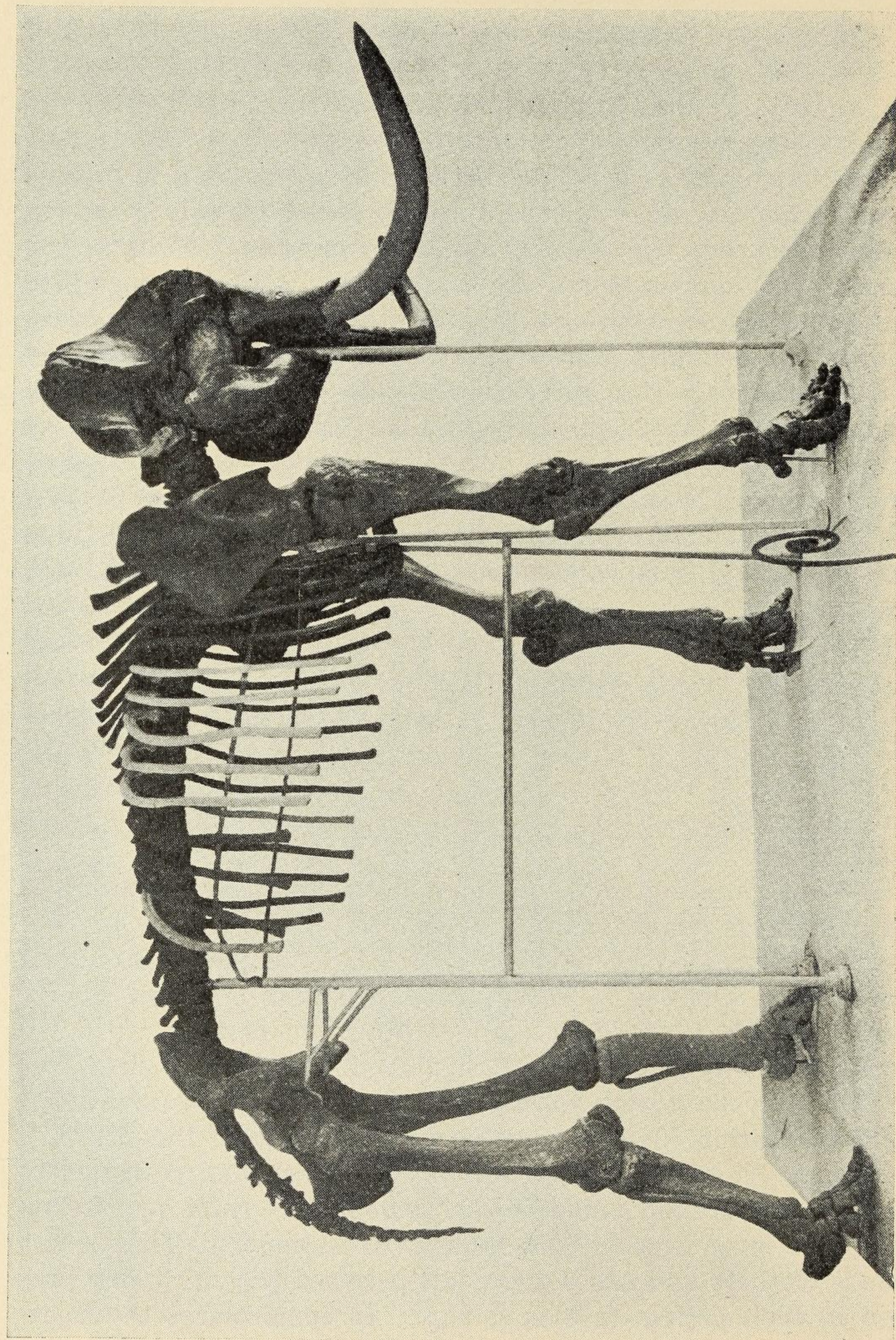


Fig. 18. The Beresovka mammoth skeleton as mounted in the Petrograd Museum. One tusk and several ribs had to be replaced. To the top of the head the animal's height is given as ten feet nine inches.

fostered the more rapid decay of others, or without doubt there would be many more.

Mammoth tusks have for many reasons aroused considerable interest. To the scientist they are the permanently growing second pair of upper incisors, composed mainly of a solid but peculiar dentine, the "ivory" of commerce. To the poor Siberian hunter, with his pick and ax ready to chop into pieces whatever tusks he can discover on his migrations in the wilderness, they are "white gold." To the Chinese artist the delicate, fine texture and peculiar pallor of the easily carved substance brings new incentive for his varied talents.

Strongest is the claim of the superstitious. Small parts of mammoth ivory have meant to him the chance of his life. They have served even as relics of Christian saints. We are told that devout prayers addressed to them have given earnestly hoped for succor and success. Heathen with still stronger beliefs deeply implanted in their hearts as regards the occult powers of this marvelous substance have had their satisfaction too. Equally many-sided were the supposed medicinal virtues of mere scrapings. The Chinese have been more beguiled by them than by their "dragon bones." And western Europe did not free itself so very long ago from faith in such wonder cures. With their application, hemorrhages, ulcers, broken bones, epilepsy, fevers, plague, and cholera¹⁹ would all vanish, according to the fancy of many. For that very reason they furnished princely revenues. As many as sixty tusks from the fossil mammoth deposits at Cannstadt were sent to the pharmacy of the Court, and became the precious powder of the "Licorne."

Gross credulity has been carried even into other channels. What of the warrior whose sword hilt, carved of mammoth ivory, is worth more to him than one wrought of gold or silver?

In the matter of art Siberia itself has made little use of its great supply of ivory. Only a few figurines, animals, characteristic scenes of the native land, often in heavy relief or bold freedom, combs, vases, and boxes, are made in certain centers. Export of the crude tusks after all has been the mainspring of their efforts.

A great impulse to the exploitation of Siberian mammoth ivory along the edge of the Polar Sea, its cliffs, and islands near the mouth

¹⁹ Kunz, George F., 1916, 'Ivory and the Elephant,' p. 239.

of the Lena, was given when Catherine II, Empress of Russia, took a personal interest in the matter. In October 1771 she wrote to Voltaire²⁰: "But what proves, I think, that the world is a little older than our nurses tell us are the finds of bones of elephants long ago extinct in these regions and imbedded several fathoms below the surface of the ground in northern Siberia. Scientists . . . have said that it is fossil ivory, but, how is it possible? fossils do not grow in the form of very complete elephants."

Some time before, she had given orders to investigate the archipelago later known as the "New Siberia Islands," whose highest point attains 1,200 feet. The southern two, low, and completely uninhabited Liakhoff Islands were named in honor of the fur merchant who, following the tracks of an enormous herd of reindeer coming from the north, discovered what later proved to be inexhaustible mines of mammoth ivory. The Czarina also had conferred on Liakhoff the exclusive right to hunt and to collect ivory on them.

Many huge tusks were partly sticking out of the sand and others, together with bones, were constantly swept up on the shores by the waves. To what depth do these marvelous deposits cover the sea-bottom no one seems to know. Did these vast stores of wealth come from further inland, and were they carried out to sea with the crushing masses of ice in the spring? Here and there a frozen mammoth might have been moved thus along when whole sections of the partly thawed up river banks were undermined or torn out. Or did countless numbers of these huge beasts make their last desperate stand in these regions before the land was swallowed up by the sea?

Evidence for subsidence of land masses is more certain, as apparently much of this expanse once formed part of the Asiatic mainland. On some of these islands Silurian coral and Devonian limestone, volcanic rocks, indicate that uplifts, as might be expected, had a part in the present physiographic configuration. On the northernmost, Hedenström found Tertiary strata with fossil bituminous tree trunks in horizontal and upright positions, over 200 feet above sea-level. Other rich deposits of the same age with their interesting fauna and flora indicate a climate once very much warmer. But some of the lower islands off the coast show a few peculiar granite boulders and are covered with a deep mantle of drift formed chiefly

²⁰ Boule, M., 1917, *L'Anthropologie*, XXVIII, p. 187.

of sand, and buried ice in separate layers and incongruous blocks. These deposits were particularly rich in ivory tusks and masses of mammoth bones. Associated with them were the remains of other of the northern Pleistocene mammals, such as the woolly rhinoceros (*Coelodonta antiquitatis*), Siberian bison (*Bison priscus*), wild horse (*Equus caballus fossilis*), moose (*Alces latifrons*), reindeer (*Rangifer tarandus*), and musk-ox (*Ovibos fossilis*).

Unquestionably the mammoth was boreal in habits and most abundant in the colder regions. In northern Siberia, it flourished in all the territories between the Ural Mountains, Obi, Yenisei, Lena, Indigirka, and Kolyma, and particularly in the adjacent islands of the Polar Sea. These, therefore, with their fabulous stores of ivory, are the greatest graveyard of mammoths known. Von Wrangell described some parts of this region as containing hecatombs of such remains before they were ransacked by those in search of the valuable tusks. Should we wonder that for over a hundred years organized ivory collecting flourished without any apparent diminution of the supply?

The rigor of the climate imposed by far the greatest drawback to this greedy quest. At Liakhoff Island the open season lasts really but a few months. Bunge²¹ in 1882-1884 records 90° F. below freezing point in winter, with snow falling half through July. But even under such trying circumstances enormous quantities of ivory have been removed. In 1821 one trader alone sent off 20,000 lbs. Middendorff in 1841 estimated the annual output for the preceding twenty years as at least a hundred pairs of tusks. In 1881 Nordenskiöld,²² basing his opinion partly upon the amounts still shipped, considered this figure as rather too low than too high. He arrived at the conclusion that since the conquest of Siberia select tusks from 20,000 mammoths had probably reached the markets of the world.

From Westendarp we know that the fairly well stabilized imports to Europe of fossil ivory in 1872—with London then the chief market—amounted to 1,635 mammoth tusks or about 245,250 lbs., granting an average weight of 150 lbs. apiece. The proportion of well preserved ivory among such lots is surprisingly small—only 14 per cent; and a slightly larger amount, 15 per cent, is absolutely

²¹ Bunge, 1893, Congrès Internat. Zool., Moscou, Session II, (1892), pt. 2, p. 282.

²² Nordenskiöld, A. E., 1881, 'The Voyage of the Vega around Asia and Europe,' London, I, p. 404, footnote.

useless. But even the really "bad," amounting to 54 per cent, and the "still workable," 17 per cent, when treated properly and fashioned into the plainer objects passed in the trade.

For the most part these could not have been tusks of mammoths entombed in ice, the ivory of which compares well with that of recently killed elephants, but evidently had been subject to various disintegrating influences. So great was the demand for this remunerative article that in Europe mammoth tusks of far inferior quality to the Siberian product were formerly dredged in quantities from the Doggerbank by the North Sea trawlers.

In rare cases mammoth ivory is slowly impregnated with certain metallic salts and then known as odontolite or blue ivory. Used for jewelry it is highly prized for the delicate, yet vivid, blue, turquoise-like luster. The Eskimos of Alaska, according to Gilmore, are fond of a blue dye they secure from the phosphate of lime (vivianite) formed by the decomposition of mammoth tusks.

Many hundreds of thousands of these enormous tusks must have completely decayed. What great herds of shaggy mammoths may have roamed during Pleistocene times in the proximity of the circumpolar area can be deduced from Darwin's computations²³ about the possible increase of the recent elephant, considered the slowest breeder of known animals. If, at a minimum rate of natural increase, between the ages of thirty and ninety years, only three pairs of young be raised, he comes to the conclusion that "at the end of the fifth century there would be alive fifteen million elephants, descended from the first pair."

The Pleistocene mammoths during several hundred thousands of years had totally adapted themselves to a life in a monotonous, frigid zone. Uniformity indeed is the hall-mark of boreal regions as much as diversity is that of the tropics. During so long a period they gradually became highly specialized, long-lived monsters. Being excessively slow breeders they entered a stage where further evolution or even slight adaptive changes were reduced to a minimum. This meant the death warrant of their race. Perhaps in the boreal climate the balance of endocrine functions had long before been disturbed so that undesirable specialization went on unchecked and possibilities of forming varieties of greater vitality were practically eliminated. But whatever the causes of their final

²³ Darwin, Charles, 1860, 'On the Origin of Species,' 2nd ed., p. 63.

extinction, here, at least, nature has preserved from the enormous numbers of these shaggy monsters a few victims of individual accidents as ice-mummies. They have now become a unique source of information. Still others rest in frozen Siberian ground waiting to disclose more secrets of bygone ages.