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## Extinct Pleistocene Mammals of Minnesota

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this bird as similar to one in possession of Mr. Schoolcraft, at the Sault Ste Marie.' ”

“Its mournful cry about the hour of my encamping, (which was at sunset) had before attracted my attention, but I could never get sight of the bird but on this occasion. There is an extensive plain and swamp through which flows the Savannah River, covered with a thick growth of sapin trees. My inference was then, and is now, that this bird dwells in such dark retreats and leaves them at the approach of night.’ ”

The latter part of this account, though presenting as it does, a mistaken impression, evidently furnished the suggestion for both the scientific and common names of this bird. That it is an evening singer or is in any special way associated with the decline of the day is erroneous and the name by which it is now universally known is without any particular significance.

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## EXTINCT PLEISTOCENE MAMMALS OF MINNESOTA.

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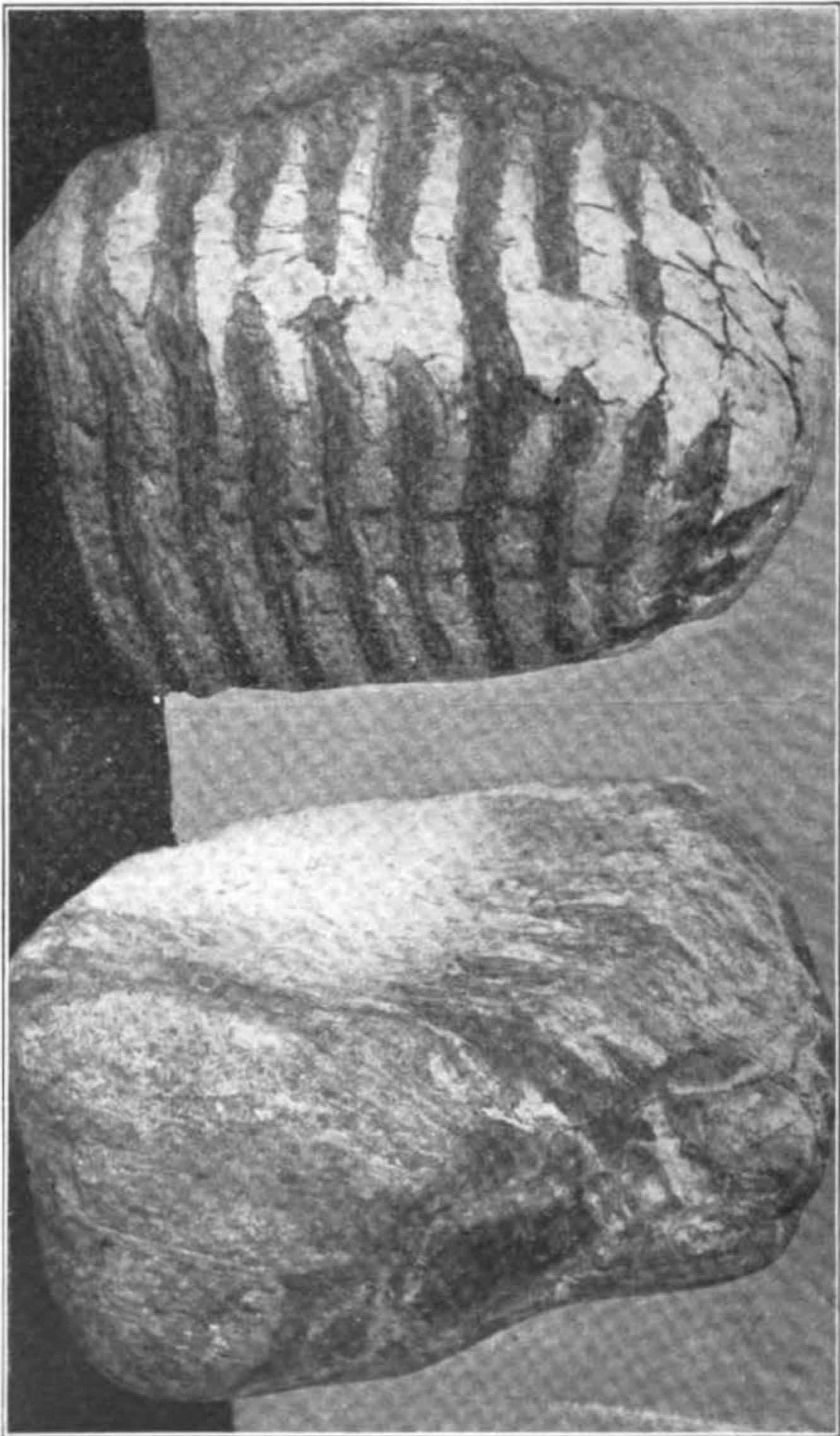
N. H. Winchell.

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### PLATES X. AND XI.

[Read May, 1909.]

There was an epoch of geological history,—how long in years or centuries we do not know, but it must have been long—which preceded the Glacial epoch, or epochs, and which followed after the Tertiary, which is commonly called Pleistocene. During the Pleistocene the climate of Minnesota was approximately the same as the present, and the country was clothed more or less with a flora similar to that of the present. The general configuration of the surface, however, was rough. There were deep-cut gorges, in the bottom of which flowed the streams. The uplands were diversified with projecting rock cliffs, about whose bases was accumulated the waste of many centuries. The only boulders that could be found were such of the fallen cliff-masses as had not yet decayed. The soils were light and fine, resulting from the disintegration of the rocks. They were sandy, or in some places clayey, depending on the conditions of drainage. There were extended tablelands, sometimes rising bench after bench one above the other. In the Archean areas there were peaks of granite and of gneiss that rose more irregularly above the general surface. Amongst these granitic knobs and along the bases of the terraced tablelands, the streams meandered with about the same crookedness as those of to-day, but with greater agreement with the boundary lines separating the different formations. They followed prevaillingly the erosible outcropping edges of the softer formations, and when they passed from one formation to another they were likely to form local lakelets, or cascades, or larger waterfalls, and these waterfalls receded up their



Elephant's Tooth, from the gravel terrace of the Mississippi at Wabasha.

valleys amenable to the same forces of erosion as those of the present day, until the streams finally reached the stage of senescence, and the waters descended quietly without waterfalls, like the base-leveled streams of southern latitudes at the present time.

With such a climate, and with such adaptable and attractive physical conditions, nothing was wanting for the existence of a fauna of the most diversified types. Indeed we know that the present fauna has its ancestry in the Pleistocene. The Glacial epoch simply caused the migration of the Pleistocene animals southward, and on the recession of the ice-border allowed the same fauna to return to re-occupy the renovated lands. It is needless to dwell on the change produced in the local physiography by the ice age. Suffice it to say that on the retirement of the ice the present conditions, approximately, were inaugurated. The river gorges were filled, the streams turned from their courses, the granitic crags were thrown down and buried and the whole country rendered more smooth.

But the fauna had suffered somewhat by the glacial cataclysm. Some of its largest species had become extinct, and some had become so dwindled in number, or so reduced in vigor, that their post-Glacial representatives are sometimes not recognized as the same species, although probably genetically the same as the Pleistocene. Of these extinct large mammals I wish to call your attention to a few whose remains have been found in Minnesota. Some of these survived the Glacial period, and returned to Minnesota and flourished during the inter-Glacial and post-Glacial epochs. If we consider these remains in the order in which they have been discovered they will appear about as follows:

1. *Eliphas primigenius*, the mammoth.

It is well known that in Siberia and Alaska the remains of the mammoth are common. It is but recent that an entire animal was found incased in ice and the flesh preserved. This specimen was photographed in its place and afterwards it was remounted in the museum at St. Petersburg in the attitude in which it had when found. The remains of the elephant, which was without much doubt only a southern species (or several species) of the mammoth of the north, have been found over a wide extent of latitude in North America, extending as far south as Mexico.

The geologic and geographic relations of the elephant with the Glacial drift, and his chronologic relations with man, have been the subject of considerable investigation. There is abundant evidence that the elephant inhabited Minnesota in late Pleistocene time. His skeleton and especially his teeth, have been discovered in several places. In general throughout the central part of the United States the remains of the elephant and of the mastodon appear to have about the same age, and it is certain that they both survived the vicissitudes of the Glacial epoch by migrating toward the south where they found more genial climate.

In the case of the discovery of a tusk only, it is usually impossible to distinguish between the elephant and the mastodon, since they

both carried enormous tusks of ivory. But their teeth were quite different. Both tusks and teeth were found at Stockton, in Winona county prior to 1885 and were brought to the attention of the Geological Survey by Prof. John Holzinger. All the facts of this discovery are published in the tenth annual report of the survey and the conclusion seems to be warranted that these remains represent the great mammoth of the north. They were embedded in the loess of that locality, which is now referred to the Iowan stage of glaciation. In the loess at points in Iowa similar elephantine remains have been exhumed, sometimes accompanied by flint arrowheads and other human relics.

The remains of what was presumed to be a mastodon were found near Northfield in the excavation of a gravel bank in 1879. But, as the specimen consisted of only a part of a tusk it may have belonged instead to an elephant. This discovery is mentioned in the final report of the Geological Survey, vol. 2, p. 670.

A similar statement concerning the finding of mastodon remains in Winona county, at Minnesota City, is to be found in vol. 1, of the final report, p. 264; and further, in vol. 2, p. 397, at Stillwater in Washington county. These may also have been elephant tusks, since in neither case was the identification reliable in the absence of the characteristic teeth. It is to be noted that in both these cases the remains were imbedded in terrace gravel pertaining to the flooded-river stage of the Wisconsin epoch, and hence probably much later in date than the elephant remains found in the loess at Stockton in Winona county.

According to Mr. E. E. Woodworth a large elephant's tooth and a large bone from the skeleton were found some years ago in a marsh near Fair Haven, Stearns county. These were very hard and black, and the tooth particularly had a hard shining surface.

Some years ago a large elephant's tooth was found in Nobles county, in the southwest corner of the state. According to Mr. T. B. Walker who procured it and presented it to the Museum of the Minnesota Academy of Science, where it is still preserved in good condition, it was found in gravel at about twenty-seven feet below the natural surface.

Judge Crosby, of Hastings, recently presented to the Historical Society, at St. Paul, a large fragment of (apparently) the top of the femur of an elephant, which was found in gravel in the terrace of the Mississippi.

Mrs. Harriet C. Amberson, of Minnesota, also lately presented to the University museum similar large fragments of the skeleton exhumed in Minneapolis about fifteen years ago at the site of the carshops of the Minneapolis & St. Louis railroad.

The writer was in Europe at the time of this important find, and the specimens were scattered, and largely lost sight of. According to the *Minneapolis Times* a cylindrical tusk was found that measured nine feet in length and eight or nine inches in diameter, and bones of all sizes and shapes were so numerous as to prove the former presence of an entire animal. A single tooth was found but was ruth-

lessly crushed by the workmen, its fragments indicating, according to the description, that it was elephantine. Mr. S. C. Amberson, foreman, made an attempt to get all the pieces together. After his death Mrs. Amberson preserved the large fragment of the femur, which she lately presented to the University Museum.

According to statements made in the *Minneapolis Journal* Nov. 19, 1908, a number of mammoth bones were found at lake Minnetonka by workmen in dredging in thirty feet of water off Huntington's point, near Arcola, about 100 feet from the shore. These remains embraced a hip bone, eight vertebræ and a leg bone. I have not been able to see these bones.

In 1891 Prof. A. F. Bechdolt, of Mankato stated that he found a "tooth of a mastodon," with a fragment of the lower jaw, in a ditch being dug by the city in one of the streets of Mankato.

Capt. Jos. Buisson stated that a mammoth tooth was found opposite Lake City, near Stockholm, on the shore of lake Pepin.

Toward the northwest, in North Dakota, Dr. Upham has given the particulars of the finding of elephant's (or mammoth's) remains at an excavation through the Herman beach near Ripon in Cass county. This is published in his memoir on Lake Agassiz for the United States Geological Survey, p. 322. In this case several teeth and vertebræ, as well as tusks, were found. These lay below the gravel of the beach and about a foot below the upper surface of the Wisconsin till sheet. These fossils must be considered as of about the same date, as the teeth taken from the river gravels further south, though probably somewhat later.

About two years ago a small elephant's tooth was found at Wabasha, in the gravel terrace of the Mississippi river, and I gave a description of the circumstances and of the nature of this tooth in a paper read before this Academy in May, 1907. It was brought to me by Mr. John D. Stritch, but was found by his brother George P. Stritch who was superintendent for the railroad in the excavation of the terrace for ballast and grading. By the steam shovel it was thrown on the car with the gravel, was transported to Greathorn spring, which is between Dresbach and River Junction, in Winona county, where, in unloading the car by steam plow, it was scraped off the car with the gravel, and was first observed on the dump by Mr. Stritch.\* It is illustrated by plate X.

This tooth contains ten double plates of hard enamel folded close so as to make double transverse ridges, the dentine in each plate being quite scant. The width of the intervening layers of cementum is but slightly more than that of the plates. The greatest width of the tooth is three inches and its greatest length, on the grinding surface is  $4\frac{1}{2}$  inches.

The interesting feature exhibited by this tooth is its gravel-worn exterior, showing that it was for a time subjected to the rolling and wearing action incident to the transportation and deposition of the gravel and stones of the terrace, and hence that it dates from the

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\*At present this tooth is owned by Mr. O. O. Whited of Minneapolis.

time of the formation of the terrace, which was the Wisconsin epoch. The cementum which on one side, and at one end, spreads outward from between the plates and covers by a continuous layer the whole side of the tooth, is worn off on the other side. That side of the tooth which is the opposite to the grinding surface is worn away so that it presents a smoothly rounded yet bluntly wedge-shaped edge, the enamel and the dentine being cut by the gravel-worn surface uniformly, and together showing a polished rounded form resembling that of numerous boulders and stones that were subjected to the wear and tear of the tumultuous and driftladen waters. The enamel of the plates expands and becomes a continuous mass, with no dentine nor cementum, and this fact seems to have given the tooth greater firmness and endurance in the root portion than in the crown. If, within the jaw, the tooth had any connection with a porous bony tissue, or terminated at the roots by any processes or vanishing plates of enamel, it shows no trace of such articulation. The view on the left of the photograph\* shows the grinding surface and one side almost entirely denuded of cementum which on the other side is so nearly intact as to wholly cover the enamel plates. The view at the right shows the rounded condition of one end of the tooth, together with a portion of that side which is still covered by the spreading cementum. It also shows the rounded form of the root where the enamel and the cementum are equally worn down to a smooth surface.

This list of elephant remains of Minnesota is probably far from complete.

There is evidence therefore, within Minnesota, that the mammoth was a denizen here from the time of the loess of the Iowan epoch, that he continued through the fourth inter-glacial stage, the Peorian, survived the intensity of the Wisconsin ice epoch (which was the last) and lived on the surface of the Wisconsin till sheet long afterwards; and, considering his late extinction in Siberia, it is reasonable to infer that the ancestors of the American Indian were familiar with his enormous bulk, and slew him with their stone-headed arrows.

As to the Mastodon, it is very probable while no remains have been sufficiently demonstrated within the limits of Minnesota, and those of the Mammoth are well verified, and we cannot safely therefore affirm that the Mastodon ever inhabited the state, yet that he did, and that his remains are liable to be discovered. Judging from the comparative numbers of the mastodon and the elephant found at the celebrated Big Bone lick in Kentucky, it seems that the range of the mastodon was more southerly than that of the mammoth. Of the teeth found at that celebrated locality, the relative numbers were such that the mastodon were five to one of the mammoth.

2. *Castoroides ohioensis*. Next in order of discovery, was the great extinct Ohio beaver, whose size was about that of the present black bear. This discovery was made at Minneapolis, at the corner of Washington avenue and Fifteenth avenue north in 1879, in the process of digging for a cistern. There is a full description of this dis-

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\* Plate X.

covery in the eighth annual report of the Geological Survey of the state, and from it are taken the following facts:

The specimen was eight feet below the surface, under the sandy loam that lies on the brick clay, and about 20 feet above the level of the river, near the bottom of the sand and gravel. It was accompanied by some *Unio* shells. Its relation to the gravel, and to the topography of the valley, indicates that the animal inhabited the region when the border of the ice-sheet had already retired to the northward of Minneapolis, but that the river was maintained at a maximum flood stage by the dissolution of the ice fields that lay further north, and probably covered the northern part of the state. That is, it was cotemporary with the closing stages of the Wisconsin epoch. The specimen found at Minneapolis is preserved in the museum of the University. It consists of the left ramus and the lower left incisor. Its size indicates an animal somewhat larger than the specimen first found in Ohio and described by Foster, and also larger than that found in New York. It is however a little smaller than that described by Wyman from Memphis, Tennessee. The whole length of the specimen, when the parts are united, is  $9\frac{1}{2}$  inches, of which  $5\frac{1}{4}$  inches consist of the projecting, uncovered incisor, a portion of the jaw having been broken away on the under side. The jaw contains four molars, perfectly preserved. Their outer surfaces are finely striated perpendicularly, and crossed transversely by undulations of growth, while the great incisor is externally grooved longitudinally with eighteen or twenty grooves, which are about twice as wide as the ridges that separate them. The four molar teeth have a structure like that of elephant's teeth, i. e., they are composed of transverse hollow lamellæ of enamel, embedded in a cementum, which also seems to fill, at least originally, the interior of the lamellæ.

According to Prof. A. J. Allen the *Castoroides* cannot be put into the same family as the modern beaver, but has affinities that ally it with the chinchilla, the veschacha, as well as the muskrat. The entire skeleton has never yet been found. It ranged over the whole United States, from South Carolina to New York and to Mississippi, and from Texas to Minnesota.

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3. *Ovibos cavifrons*. In 1903 the skull of the musk ox was found by Mr. J. W. Franzen, now curator of our museum, where he has kindly placed the specimen. This discovery was made on the farm of Mr. McCracken, between Wabasha and Theilman, near the railroad from Wabasha to Zumbrota. The specimen was about ten feet below the surface, in a gravel terrace, of the valley. By Mr. Franzen I have been furnished with the accompanying photograph of this specimen. It consists of a skull, but without any teeth. The broad horn cores are conspicuous, but they do not embrace any of the curving horn terminations. The whole specimen is considerably worn and reduced so as to have lost most of its projecting angularities.

It belonged to a small animal, probably not mature: width transverse  $5\frac{1}{2}$  in., extreme width, including the horn cores,  $8\frac{1}{2}$  inches, length, front to rear  $8\frac{1}{4}$  inches.

The region in which this specimen was found is within the "drift-

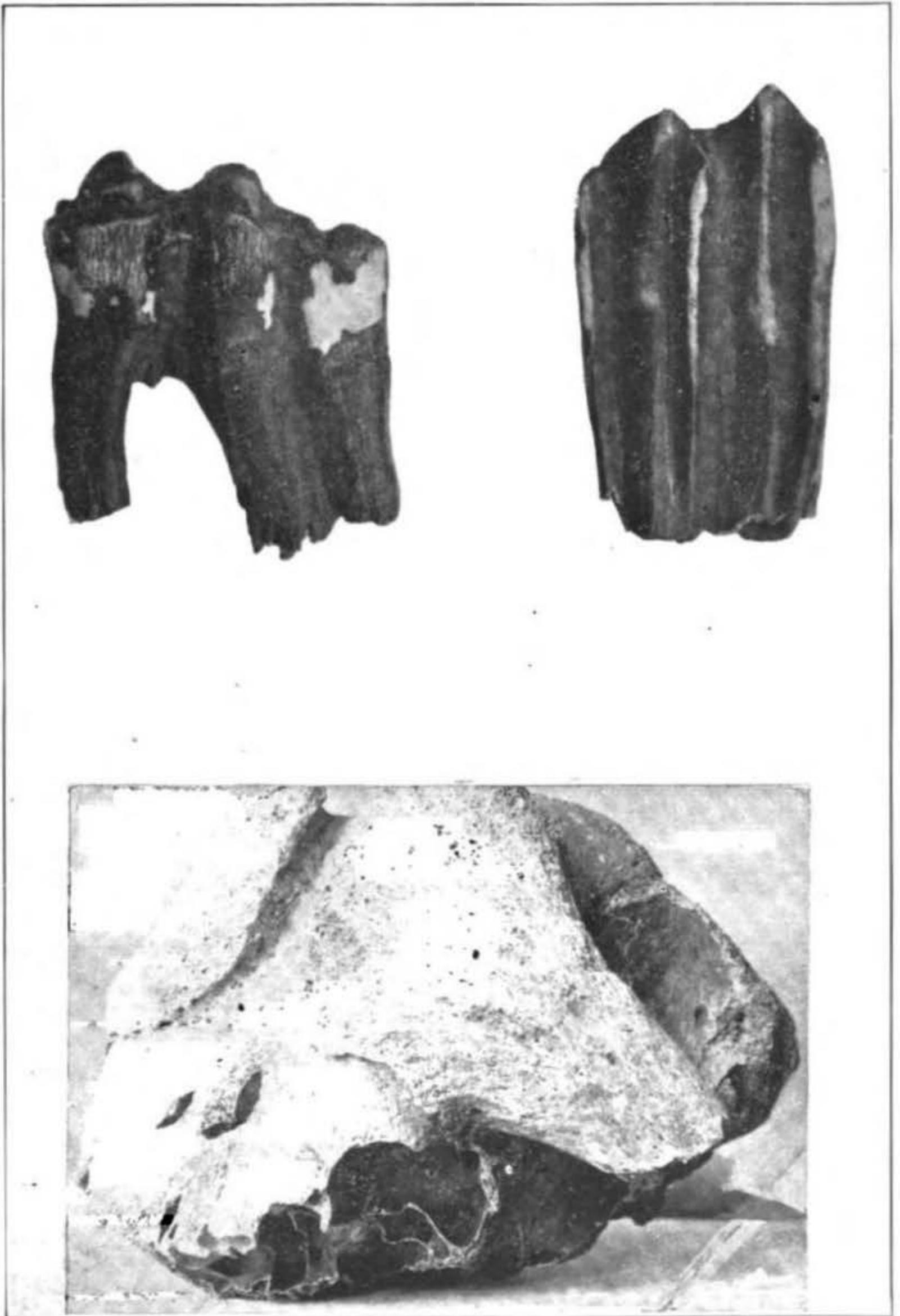
less area" of the state, as usually limited, but it is not as yet known how much drift pertaining to some of the older epochs of the Glacial period may still exist below the veneer of loam with which the region is covered. There is a conspicuous terrace formation extending along the Mississippi valley, which also ascends the tributary valleys, meeting with a series of terraces which were of the same date but which were formed from material derived from the west, brought down the valleys by the rivers whose sources were within the glaciated area. These conspicuous terraces are of the age of the Wisconsin epoch, and doubtless contain materials derived for the most part from the Wisconsin ice, but also embrace the wastage of the Iowan loess, which forms a surface mantle over the region. Indeed the Iowan loess must have suffered greatly from the action of the flooded streams of the Wisconsin epoch. From present knowledge it is impossible to affirm whether this skull dates from the Iowan loess epoch or from the terrace epoch of the Wisconsin, although it seems to have been found in a Wisconsin epoch terrace.

The interesting and important fact however is this,—that the musk ox occupied the region during either the loess epoch of the Iowan ice age, or the closing stage of the Wisconsin ice age. In either case it implies that the climate was considerably colder than the present climate,—a conclusion which is indicated also by the existence of what we know only as an arctic animal in temperate latitudes. It may be inferred that the Mississippi and its tributary gorges were a favorite habitat for arctic species.

The extinct musk-ox species, *O. cavifrons*, is regarded as specifically different from the living musk-ox, *O. moschatus*, although the latter is also regarded as the genetic descendant of the former. Like the mammoth and the reindeer the musk-ox retreated southward as the country became enveloped in ice on the approach of the Glacial epoch, or successive epochs, so as to destroy his feeding grounds, and on its retirement, probably in company with the Eskimo, followed the ice border again to the arctic region.

The remains of the musk-ox have been found at several places further south, viz., in Iowa, Missouri, Arkansas, Oklahoma, Kentucky, Ohio and West Virginia. These localities are all too far south to suppose that the Wisconsin ice sheet was the prime cause of the migration that brought the musk-ox into that latitude, but they might be due to the incursion southward of the earlier Iowan ice-sheet. This leads us to refer the Minnesota specimen to the loess of the region rather than to the terrace gravel of the Wisconsin.

4. *Bison (latifrons?)* About a year ago I was shown a couple of large fossil teeth by Mr. Edstrom, a student at the University, who had procured them from the discoverer. They were found near Mora, in Kanabec county, in Minnesota, in excavating for a drainage ditch. They were below several feet of tenacious clay, and were embraced in it. They are stained a dark brown, almost black, as teeth thus buried are frequently known to be. They were associated with several other teeth, and bones, probably belonging to the same animal, but the rest were scattered and lost. In the determination of the species to which these teeth belong I have been aided by Prof. S. W.



Teeth of Bison, near Mora.  
Skull of Musk Ox.

Williston of Chicago University, and by Prof. W. J. Sinclair of Princeton University, and they concur in the following statement by Prof. Sinclair: (See plate XI.)

"They are the lower molars (2nd right and 3rd left) of two individuals of a large species of Bison, differing in several respects from a specimen of the recent species in our collection. I do not think that it is possible to be certain about the species. Your specimens are quite different from either Cervalces, the wapiti, or the moose."

These two teeth are quite different from each other. One is not worn at the crown, and appears to have been immature. It is  $2\frac{1}{2}$  inches long and  $1\frac{3}{8}$  inches wide. The outer incasing enamel embraces a roughly plano-convex cylindrical area which is loosely occupied at the root by two curved enamel lamellæ which are hollow, and which give the exterior of the tooth the appearance of being double, as they cause the body of the tooth to be divided into two main longitudinal parts. The outer side of the tooth has five prominent ridges of enamel separated by four furrows, all caused by undulating folds of the enamel. The inner side of the tooth shows simply the two main, rounded, vertical body-portions. Below the gum is a parasitic, simply tubular tooth, adherent between the two body portions in the outer angle formed by them. The roots are open below.

The other tooth is not so long vertically but is wider, and has been much worn away on the grinding surface. Its width is  $1\frac{7}{8}$  inches and its vertical length is two inches. This tooth is divided into three body-parts, but two only have internal lamellæ of enamel. The roots are closed at the bottom.

The only extinct Bison of America, so far as I can learn, is *B. latifrons*, and to that species these specimens may be provisionally referred until the discovery of more material may correct or confirm it. That was found in the Pleistocene of Texas, and has been supposed to be the progenitor of the present Bison.

These four species are only a part of the fauna of large animals that flourished in the United States in Pleistocene time. Their companions embraced extinct species of reindeer, elk, horse, lion, bear, sloth as well as the mastodon, and this fauna was spread apparently over the whole country, though not perhaps contemporary. Great and remarkable as this fauna appears, in contrast with the present, it was but the dwindling remnant of the Tertiary fauna which preceded it. From the Tertiary to the Pleistocene there was a reduction not only in the number of genera but also in the average size and number of individuals, and a similar change has continued to the present time. What may have been the cause of this extinction of the great mammals is unknown. At the present time the agency of man is paramount, but we can hardly appeal alone to that cause in the Tertiary and the Pleistocene, in the dearth of evidence that man flourished cotemporary with these great mammals. The natural and inevitable effect of the Glacial period was certainly to confine some of the great mammals to restricted quarters and to reduced food supply. They probably also combatted each other, the young especially suffering from the attacks of cotemporary carnivores. To the Glacial period is due, probably,

the practical extermination of this remarkable mammalian phase of animal life.

Whatever may be the cause, it is evident that the present exhibits but a depauperate state of the past, so far as concerns the physical and animal part of animate creation. The large, bizarre, and powerful types of life have given place to smaller and quicker-moving types. If rank, in the animal kingdom, were to be determined by the bulk of the animal, we would be justified in concluding that there had been a retrogressive evolution. But, while the body has become smaller, speaking of the average of mammalian life, there is reason to believe that there has been an increase of average cephalic power, particularly so far as regards man. The dominance of mind over matter has become more pronounced. The real progress of evolution therefore has not been retrograde, but ascensional. In place of brute force, there has appeared a greater sway of psychic force.

While therefore, from a physical standpoint, we may agree with Wallace, that we occupy a stage in the history of the earth's animal evolution, from which the largest and highest forms have just disappeared, we can affirm, it seems to me with equal assurance, that we have entered upon a stage in animal development which is higher in rank than any stage that has preceded the present, in proportion as the predominance of mind is higher than the predominance of selfish brute force.

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## THE DEVELOPMENT OF THE MINNEAPOLIS SEWER SYSTEM.

By Andrew Rinker, City Engineer.

The first sewer of the city of Minneapolis was begun June 15, 1871, 17 years after the founding and naming of the city. As I happened to come to Minneapolis that day I saw the first brick laid in the first sewer.

As I was soon afterwards connected with the city engineering department and was appointed City Engineer in April, 1877, and have continued in that position ever since, with the exception of the years 1892 to 1902, when I was in Montana, the sewer system has largely grown under my direction and supervision. But I desire here to acknowledge the faithful, able, and efficient work of my special Sewer Engineers, Mr. W. D. VanDuzee from 1870 to 1894 and Mr. Carl Ilstrup, from 1894 to the present time, to each of whom has been built a lasting monument of the best fame in these foundation civic improvements of a modern city.

From a topographical survey of the original town of Minneapolis the natural watershed into the Mississippi river was determined on for sewer drainage on the gravity system. This gravity system has been adhered to with an average flow of  $2\frac{3}{4}$  miles per hour, there being as yet no pumping of our sewage. The division of the city's