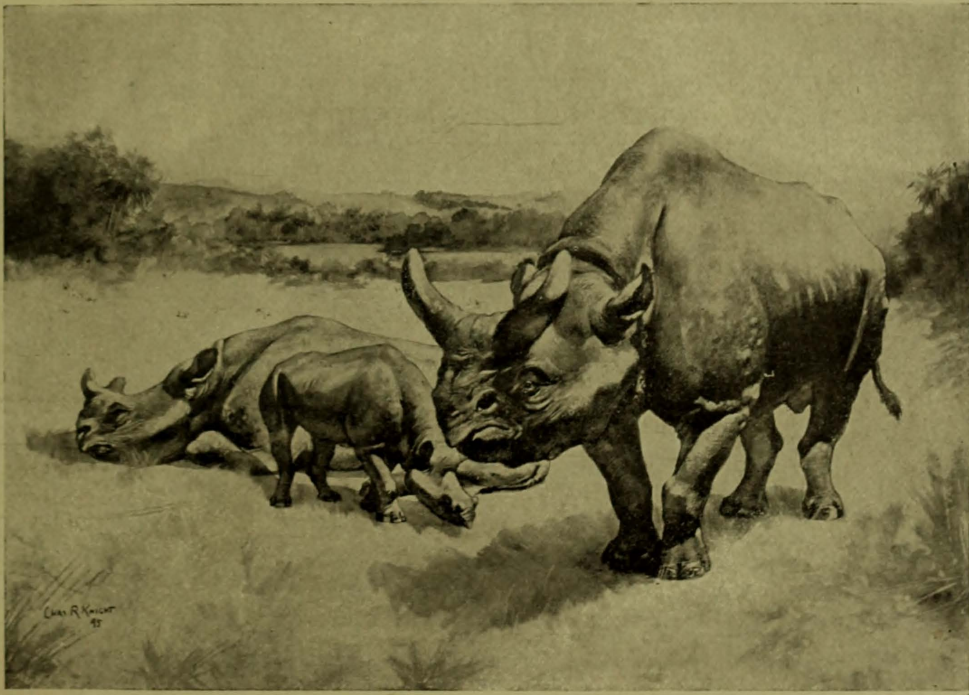


AMERICAN MUSEUM OF NATURAL HISTORY

The Collection of Fossil Vertebrates



BY

W. D. Matthew, Ph.D.

Associate Curator of Vertebrate Palæontology

SUPPLEMENT TO AMERICAN MUSEUM JOURNAL

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Guide Leaflet No. 12

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The Collection of Fossil Vertebrates

A Guide Leaflet to the Exhibition Halls
of
Vertebrate Palæontology
in the
American Museum of Natural History

By

W. D. MATTHEW, Ph.D.

Associate Curator, Department of Vertebrate Palæontology

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PREFATORY NOTE

THE COLLECTION of fossil vertebrates belonging to the American Museum of Natural History comprises the extensive material collected by the late Professor E. D. Cope chiefly between 1870 and 1890 and the much larger collections made by the expeditions which have been sent out by the Museum every year, beginning with 1891. Most of the Museum expeditions have worked in the western States.

From the beginning of the department in 1891 the collection and exhibition of these fossils have been under the direction of Professor Henry Fairfield Osborn, the curator. From 1891 to 1898, inclusive, the exploring parties in the field were under the immediate supervision of Dr. J. L. Wortman. Since that time Messrs. Matthew, Granger, Brown and Gidley have been in charge of the field work.

The funds necessary for sending out the expeditions and for the purchase of the Cope Collection have been furnished chiefly by President Jesup and Messrs. Osborn, Whitney and Constable. The exhibit illustrating the evolution of the Horse is mostly the gift of Mr. William C. Whitney.

EDITOR.



THE COLLECTION OF FOSSIL VERTEBRATES.

BY W. D. MATTHEW, Ph.D.,

Associate Curator, Department of Vertebrate Palæontology.

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INTRODUCTION.

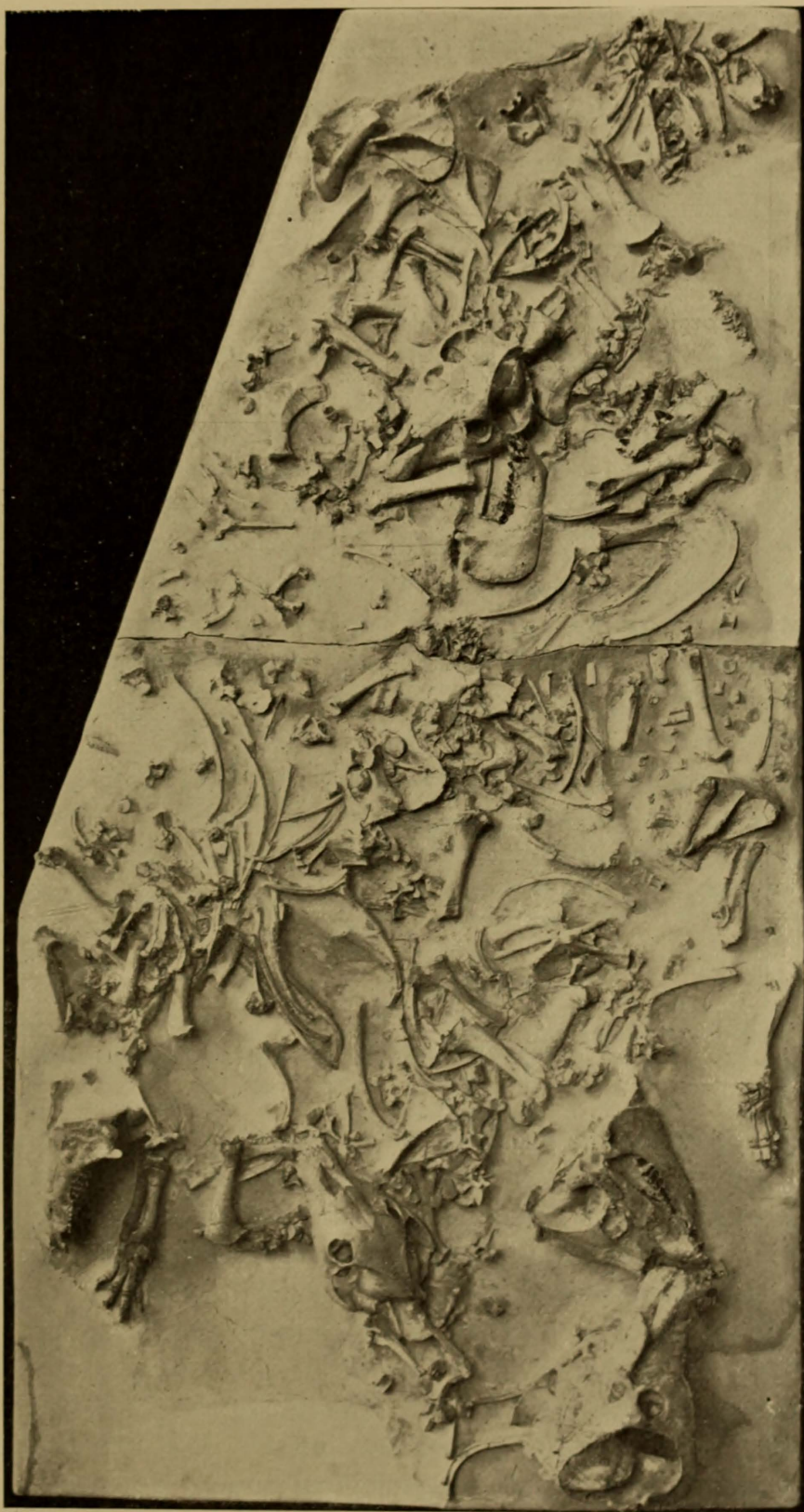
WHEN we dig beneath the present surface of the ground we sometimes find remains of ancient cities, dwellings, bones of men and animals, buried many centuries ago under accumulations of débris, deposits of river mud or drifted sand. From these have been gleaned many facts concerning the early history of mankind of which there is no written chronicle. From the study of these facts the science of Archæology has arisen, the science which deals with the early history of mankind, with the evolution of civilization.

Most of the lower animals of which the archæologist finds traces are like those now living, although a few have become extinct. But in those more ancient deposits which are now consolidated into clays, sandstones etc., indica-

tions of man are not found, and the remains of lower animals which they contain are unlike any now living—the more unlike as the rock is more ancient. These remains are called *fossils*. They consist only of the hard parts of animals (bones, shells, spines etc.). The soft parts are never preserved, and only very rarely is some trace of skin or hair, horns or hoofs, to be distinguished. As in the course of ages the mud or sand in which they are buried changes to rock, so little by little the fossils have been changed by heat, pressure and especially by the slow infiltration of mineralized waters into brittle, stony material, while retaining their outward form and usually their peculiar structure. But mud and clay, in changing into rock, settle down and contract considerably, and the fossils are flattened out correspondingly, sometimes to such a degree, in the case of a rock which has once been a soft, oozy mud, that they suggest rather a picture or a bas-relief than the original form of the animal. The fossil skeletons of marine reptiles and fishes on the walls of the corridor hall and in the case opposite the elevator have been flattened out in this manner, especially the Ichthyosaur skeletons.

From fossils we can interpret the history of the world of life during the long ages before man appeared. The science which deals with the ancient history and evolution of the animal kingdom is Palæontology (*παλαιολογία*, ancient, living beings, science). It tells us of a long period of time before Man appeared, probably millions of years, during which Mammals of great size and unfamiliar form were the dominant animals—of a yet longer era before that, during which huge Reptiles were rulers of earth, sea and air—and of other still more ancient periods during which Amphibians, Fish and Invertebrate Animals held sway in turn. Vertebrate Palæontology deals only with the higher classes of fossil animals, the Vertebrata, or those that have backbones (fish, amphibians, reptiles, birds and mammals).

Earth-history or geological time has been divided into many parts according to the evidence furnished by the rocks and the fossils contained therein. The principal subdivisions are shown in the accompanying table:



FOSSIL SKELETONS IN THE ROCK

This slab of soft chalky clay contains five skeletons of an extinct animal. One is an old male, the other four are young

THE COLLECTION OF FOSSIL VERTEBRATES

GEOLOGICAL ERAS, PERIODS AND AGES.

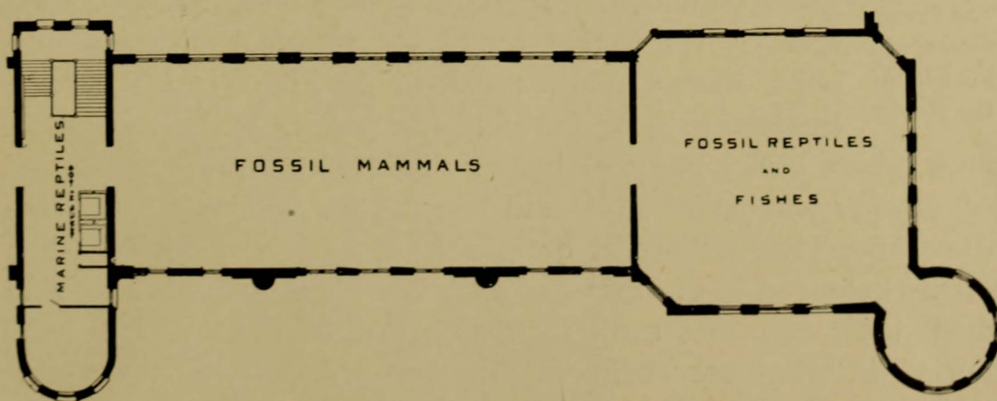
Eras.	Periods.	Ages.
Cenozoic	Quaternary	Age of Man, 50,000 years
	Tertiary	Age of Mammals, 3,000,000 years
Mesozoic	Cretaceous	Age of Reptiles, 7,000,000 years
	Jurassic	
	Triassic	
Palæozoic	Permian	Age of Amphibians and Coal Plants, 5,000,000 years
	Carboniferous	
	Devonian	Age of Fishes, 2,000,000 years
	Silurian	Age of Invertebrates, 10,000,000 years
	Cambrian	
Eozoic	Algonkian	(No fossils)
	Archæan	

The estimates in years of the geological periods given in this table, which is arranged in descending order from the most recent to the most ancient time, must be understood to be merely very rough approximations. There is no known method of finding any exact equivalent in years of any geological period, although the relative length of each to each is much more nearly known. The estimates given herewith are based on the careful study of the subject made by C. D. Walcott, Director of the U. S. Geological Survey. In concluding his discussion Dr. Walcott stated his belief that the duration of geological time (the entire period included in this table) might be measured by tens of millions of years, but not by single millions or by hundreds of millions.

To give the visitor a clear idea of these extinct animals, the skeletons usually have been removed entirely from the rock in which they were found and have been mounted as much as possible like skeletons of modern animals. To mount a petrified skeleton in this manner is a very difficult matter, for such skeletons are rarely perfect, and the bone is always very brittle and more or less shattered and crushed out of shape. In the mounted skeleton the missing parts have been restored in tinted plaster, modeled from other individuals or from nearly related animals in which these parts are known. The outlines of the restored parts of bones are marked off with red lines, while entire bones modeled in plaster are marked with a red cross, or with a red circle if supplied from other individuals. All the skeletons are original specimens except the *Megatherium* at the far end of the hall; and all are of extinct animals except a few which are placed with the others for comparison. With each fossil skeleton will be found, besides a descriptive label, a small model and a water-color restoration of the animal, showing its probable appearance during life and indicating its supposed habitat. The transparencies in the windows show the localities where the fossils are found, chiefly in the Bad-lands of the western States.

How Fossil
Skeletons
are
Mounted.

GENERAL ARRANGEMENT.



The collections are arranged to illustrate the geological history and evolution of the different groups of Vertebrata, especially those of North America. They fill two large halls and a corridor.

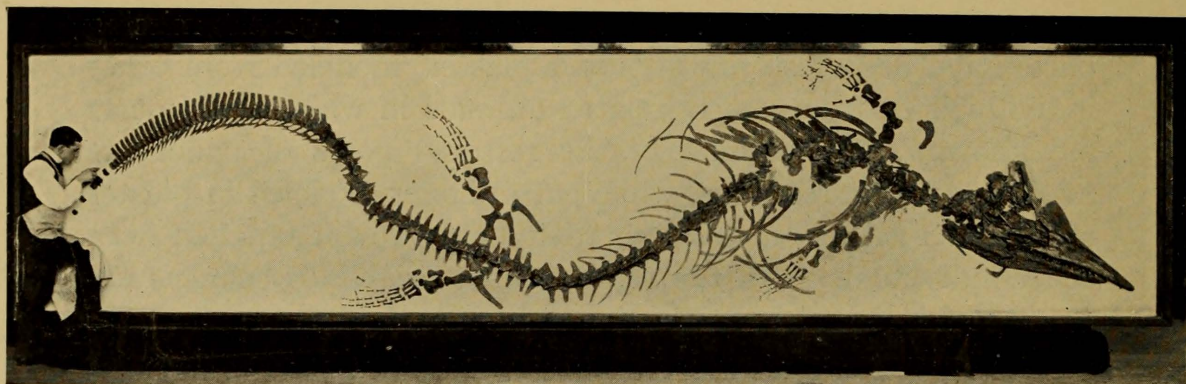
General Arrangement
of Collections.

East Wing. Hall No. 406. Fossil Mammals.

East Wing. Hall No. 407. Fossil Reptiles, Amphibians and Fishes.

In addition

East Corridor, No. 405 (in which are the elevator and stairways), contains fossil Marine Reptiles and Fishes of the Age of Reptiles.



SKELETON OF THE GREAT MARINE LIZARD IN THE EAST CORRIDOR

THE EAST CORRIDOR. No. 405.

On stepping from the elevator the visitor sees before him a case filled with skulls and skeletons of the marine reptiles and fishes which inhabited the great inland sea that once spread over the center of the North American continent, from Canada to Mexico. The reptiles were of kinds now long extinct, *Plesiosaurs* with long snaky neck, short bulky body with long flippers and stubby tail, and *Mosasaurs* with short neck and longer tail. Some of the fishes were ancestors, collateral or direct, of certain modern fishes, others belonged to groups now extinct. These animals lived and died, their carcasses sank to the bottom of the sea, and were buried in whatever sediment was being deposited there—soft white ooze in the open sea, dark gray or black mud nearer the shores. In the course of ages this ooze or mud settled gradually and consolidated into chalk or shale. Afterwards as the continent rose above the waters and assumed more nearly its present dimensions, the rivers flowing over the broad plains excavated

The Preservation of Fossils in the Rocks.



HUNTING FOR FOSSILS IN THE BAD-LANDS
Members of the American Museum Expedition of 1894 in the Uinta Basin, Utah

broad shallow valleys in the chalk and shale. In the dry climate of the present day the sides of these valleys often are bare rock, carved by wind and the infrequent storm-bursts of rain into the fantastic maze of cliffs and winding cañons known as "bad-lands." Here and there, projecting from an outstanding ledge or trailing in fragments down some crumbling slope, a fossil bone may be seen by the trained eye of the collector as he searches along the rock exposures; and quarrying in around the bone he is sometimes rewarded by a skull, sometimes by a string of vertebræ, occasionally by a whole skeleton, buried in the rock except for such parts of it as have been weathered out and washed away.

To excavate the fossil without damaging the brittle bones, buried as they are in a weak and shattered mass of heavy shale or chalk, is a slow and delicate operation, requiring special methods and considerable care and skill. Then the specimen must be packed, and sent in to the Museum, where the rock is removed and the specimen is prepared for exhibition. When the bones are as much crushed and distorted as those represented in the photograph (page 10) the matrix is removed from one side only, and the specimen is thus placed on exhibition.

Temporarily placed in the bottom of the case is a large Plesiosaur skeleton, only partly removed from the rock. This specimen unfortunately lacks the skull. Beside the lower stairway is a Mosasaur skeleton, the finest specimen of its kind ever found, and above it is a large fish skeleton which was found in the same strata in western Kansas. Beside the upper stairway are three skeletons of Ichthyosaurs, another long extinct group of marine reptiles, of fish-like appearance, paralleling the modern Whales among mammals.

EAST WING. HALL NO. 406. FOSSIL MAMMALS.

The ancestors of our modern quadrupeds are to be found in the East Wing, No. 406, together with many extinct races more or less nearly related to them. All the fossil specimens of each group of mammals are placed together in one alcove, where they have been arranged according to their geological age. Thus all the fossil Horses, direct

THE AGE OF MAMMALS

(CENOZOIC, OR TERTIARY AND QUATERNARY.)

WESTERN LAKE BASINS and CHARACTERISTIC MAMMALS

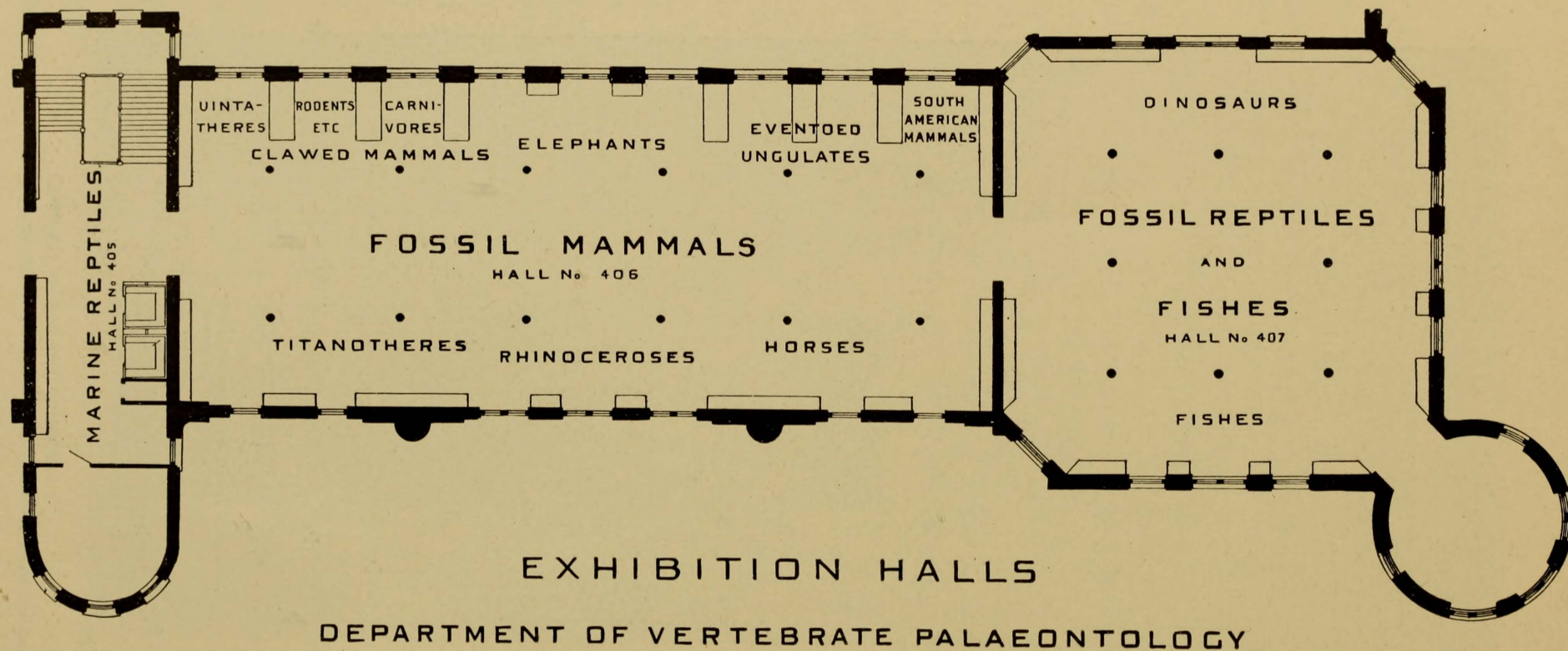
THE TERTIARY FORMATIONS ARE REPRESENTED IN WESTERN AMERICA BY A SERIES OF DEPOSITS FORMED ON THE BOTTOMS OF SUCCESSIVE FRESH-WATER LAKES. THEIR TOTAL THICKNESS IS NEARLY 12000 FEET, REQUIRING PROBABLY TWO OR THREE MILLION YEARS TO FORM

IN THE SEDIMENTS OF THESE LAKES WERE BURIED THE REMAINS OF MANY OF THE ANIMALS WHICH LIVED AROUND THEIR SHORES, LEAVING THUS A RECORD OF THE SUCCESSIVE SPECIES WHICH INHABITED THE LAKE REGION

PERIODS	LAKE BASINS	THICKNESS	CHARACTERISTIC MAMMALS
RECENT AND PLEISTOCENE	EQUUS AND MEGALONYX	150	ELEPHANTS, LAST MASTODONS LAST GROUND SLOTHS, LAST SABRE-TOOTH TIGERS CAMELS, ONE TOED HORSES, CAVE BEARS PECCARIES, TAPIRS, DOGS, WOLVES, FOXES, RABBITS
	BLANCO AND PALO DURO	150	GROUND SLOTHS, CAMELS, ONE TOED HORSES, FIRST MYRMAS, FIRST TRUE CATS, PECARIES, RABBITS
	LOUP FORK	400	MASTODONS, TRUE HORNLESS RHINOCEROSSES LAST OREODONTIS, CAMELS, THREE TOED HORSES DEER, FIRST PRONG-HORN ANTELOPES
	DEEP RIVER	150	TRUE HORNLESS RHINOCEROSSES, OREODONTIS, CAMELS FIRST MASTODONS, FIRST TRUE DEER
MIOCENE	JOHN DAY (OREGON, NEVADA)	1000	HORNLESS AND TWIN HORNED RHINOCEROSSES LAST ELOTHERES, OREODONTIS PRIMITIVE CAMELS, PRIMITIVE DEER RODENTS, DOGS, WOLVES, FOXES, ETC. CATS (SABRE-TOOTH TIGERS)
	WHITE RIVER (NEV., S. DAK., N. DAK., COL., CANADA)	1000	HYPOPTAMIDS, PROTOCERAS, PECCARIES LAST CREODONTIS, DOGS, CATS, FIRST BLAVEN ELOTHERES, CUBS, RHINOCEROSSES, TAPIRS FIRST THREE-TOED HORSES (MESCHIPPUS) SWIMMING RHINOCEROSSES (AMYNODONTIS) LAST TITANOTHERES, OREODONTIS ABUNDANT FIRST TRUE HORNLESS RHINOCEROSSES PRIMITIVE DEER, LAST PRIMATES, RODENTS, INSECTIVORES
OLIGOCENE	UINTA (UTAH)	800	PRIMITIVE RHINOCEROSSES and AMYNODONTIS TITANOTHERES, ELOTHERES, CREODONTIS FIRST CAMELS, FIRST OREODONTIS, TAPIRS FOUR-TOED HORSES, PRIMATES, RODENTS LAST UNTATHERES, DOG-LIKE CREODONTIS (MACH)
	BRIDGER (WYOMING, UTAH)	2000	UINTATHERES TITANOTHERES (PALEODONTIS, TELMATOTHERIUM) PRIMITIVE RHINOCEROSSES (HYRACHYUS) FIRST ELOTHERES (ACHENODON) LARGE CREODONTIS (MESONYX) CAT-LIKE (PACHYURUS) and DOG-LIKE (MACH) CREODONTIS FIRST BELEODONTIS, ARTIODACTYLUS (HOMACODON) FOUR-TOED HORSES (OROKIPPUS) LAST PRIMITIVE GROUND SLOTHS PRIMATES, RODENTS, BATS, LAST TILLODONTIS
	WIND RIVER (WYOMING)	800	LAST CORYPHODONTIS, FIRST UNTATHERES FIRST TITANOTHERES, LAST CONDYLARTHIS FOUR-TOED HORSES (PROTOROKIPPUS), PRIMATES, CREODONTIS, RODENTS, BATS, TILLODONTIS
	WASATCH (WYOMING, NEW MEXICO)	2000	AMBLYPODS (CORYPHODON) CONDYLARTHIS (PHENACODUS) FIRST FOUR-TOED HORSES (HYRACHYUS) FIRST TAPIRS (SYSTEMODON) FIRST ARTIODACTYLUS or CLOVEN-HOOFED ANIMALS PRIMATES (MONKEYS or LEMURS) CREODONTIS or PRIMITIVE CARNIVORES, (RESEMBLING CATS, DOGS and BEARS) FIRST RODENTS TILLODONTIS, INSECTIVORES PRIMITIVE GROUND SLOTHS
Eocene	TORREJON (NEW MEXICO)	300	CONDYLARTHIS, PHENACODONTIS and AMBLYPODS CREODONTIS, PRIMITIVE EDENTATES FIRST PRIMATES, LAST MULTITUBERCULATES
	PUERCO (NEW MEXICO)	500	CONDYLARTHIS or PRIMITIVE HOOFED MAMMALS CREODONTIS or PRIMITIVE CARNIVORES MULTITUBERCULATES (MONOTREMES) PRIMITIVE EDENTATES (GROUND SLOTHS)
AGE OF REPTILES	LARAMIE	5000	
	CRETACEOUS		

DIVISIONS OF THE AGE OF MAMMALS

Characteristic fossil mammals, and the geological formations in which they are found



or collateral ancestors of the modern Horses, Asses and Zebras, are in one alcove, arranged in series from the most ancient to the most recent. The most ancient and structurally primitive groups of mammals come first, the most modern and familiar types come last.

SOUTH (RIGHT) SIDE.		NORTH (LEFT) SIDE.	
Perissodactyls or Odd-Toed Hoofed Mammals	TITANOTHERES	AMBLIPODS	} Primitive Hoofed Mammals
	Chalicotheres	CONDYLARTHS	
		Monkeys, Bats, Rodents, Insectivores and other Small Primitive Mammals	
		Marsupials	
		CREODONTS	} Carnivorous Mammals
		CARNIVORES	
		Seals, Dolphins, Whales,	} Marine Mammals
		Sirenians etc.	
	Tapirs	MASTODONS and	} Proboscideans
	Lophiodonts	ELEPHANTS	
	RHINOCEROSES	ELOTHERES	} Artiodactyls or Even-Toed Hoofed Mammals
		Anthracotheres	
		Pigs and Peccaries	
		OREODONTS	
		CAMELS	
	Palæotheres	DEER etc.	
	HORSES	Litopterna	} Fossil Mammals Peculiar to South America.
		Toxodontia	
		Typotheria	
		EDENTATA	

SOUTH (RIGHT) SIDE.

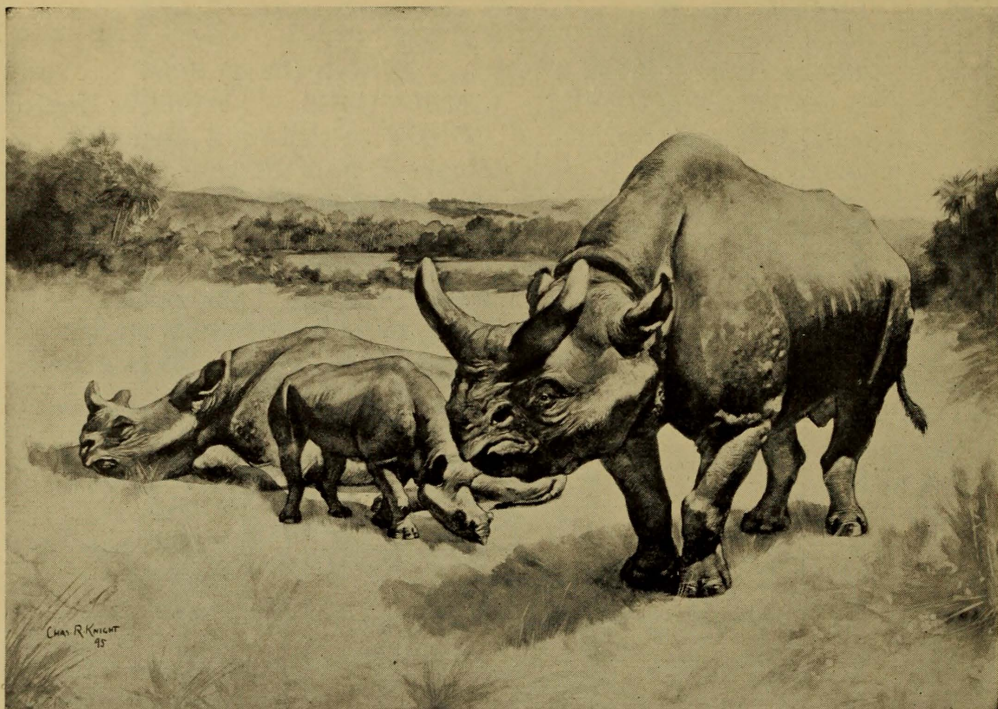
The south side of the hall is entirely devoted to the PERISSODACTYLS or Odd-Toed Hoofed Mammals in which the number of toes (in the hind foot and generally in the forefoot) is either 1, 3 or 5, while in the other main division of hoofed animals, the Artiodactyls, it is either 2 or 4; or more exactly, the axis of symmetry of the foot passes through the central toe in Perissodactyls, while in Artiodactyls it passes between two toes.

The TITANOTHERES come first in the series of Perissodactyla, large animals which suggest rhinoceroses in general proportions, but have a differently shaped head and peculiar teeth. These began as hornless animals of moderate size (Cases 1 and 17) and increased in size and developed large bony horns (Cases 3, 5 and 19) before they

South Al-
cove 1.
Titan-
otheres

became extinct. The Titanotheres occupy the first of the three main alcoves into which the south side of the hall is divided.

The second alcove is devoted to the RHINOCEROSES, which



RESTORATION OF TITANOTHERIUM, AN EXTINCT HOOFED MAMMAL OF WESTERN AMERICA

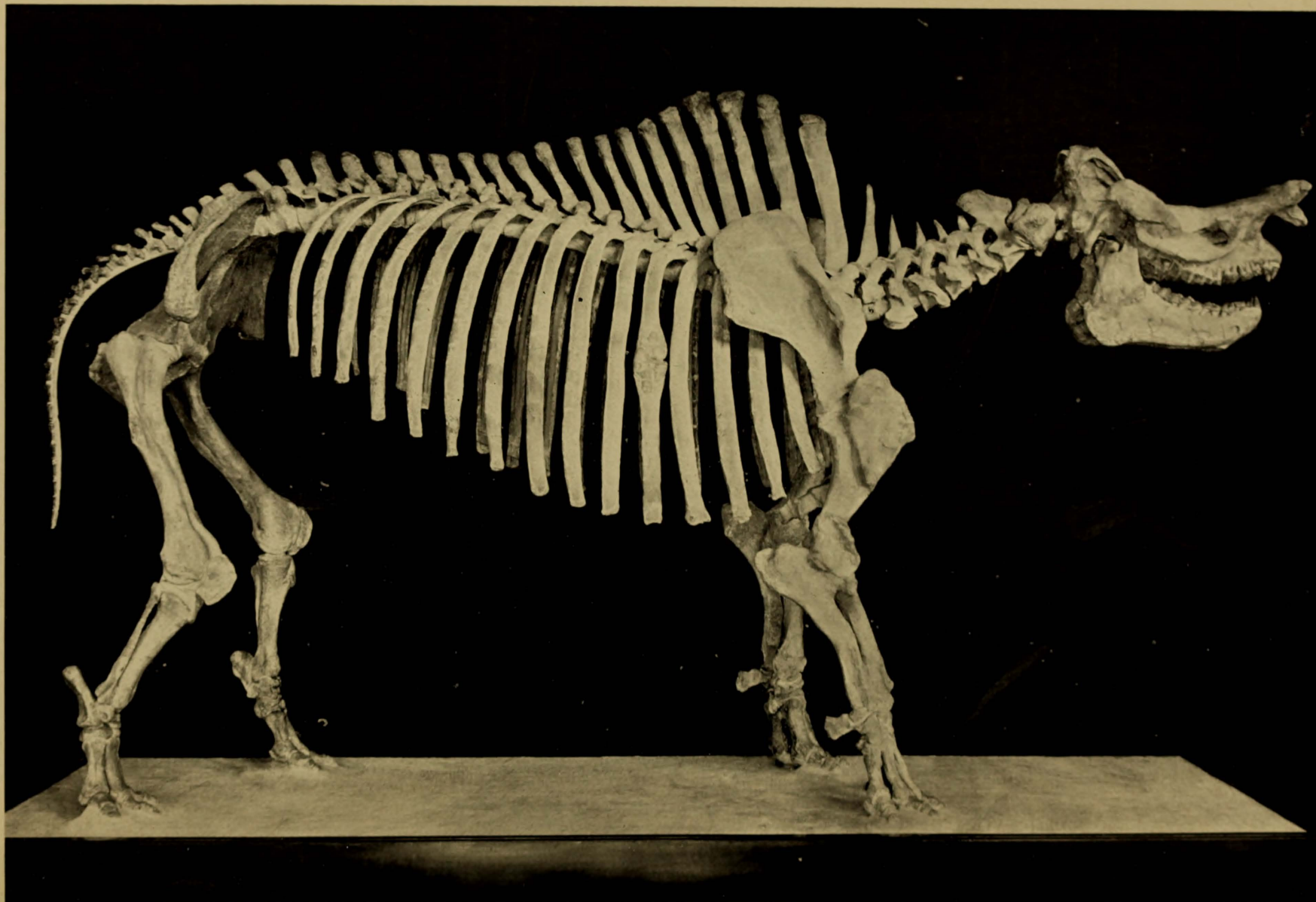
The picture shows a bull, a cow and a calf

From the original water-color, based on mounted skeleton and skulls in American Museum of Natural History

were very common beasts in North America as well as in the Old South World during the Tertiary period. They also began in the Eocene as small hornless animals (*Hyrachyus*, Case 7), but diverged in the Oligocene into cursorial, aquatic and true (terrestrial) Rhinoceroses of which the two former soon became extinct. True Rhinoceroses also became extinct in America by the Pliocene epoch, while in the Old World several of them have survived to the present day.

Third Alcove. HORSES.¹ This fine exhibit is due chiefly to

¹ For more detailed information regarding the evolution of the Horse, see Guide Leaflet No. 7, "The Evolution of the Horse." Published January, 1903.



MOUNTED SKELETON OF THE TITANOTHERE, FROM THE BIG BAD-LANDS OF SOUTH DAKOTA

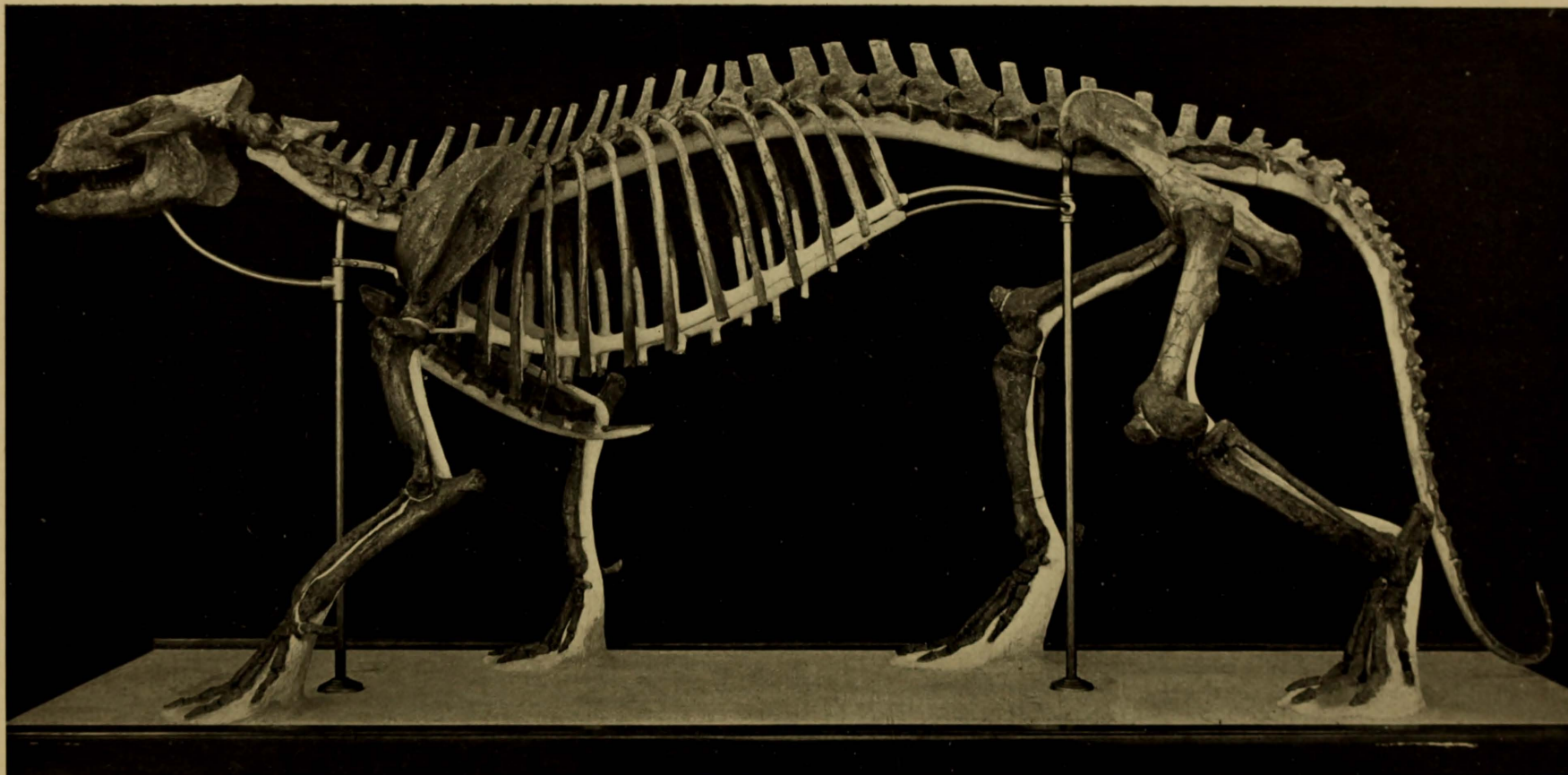
the liberality of Mr. Wm. C. Whitney. The Evolution of the South Horse is illustrated by a series of feet and skulls, and Alcove 3. of complete skeletons, from the little Four-Toed Horse Horses. of the Lower Eocene to the different varieties of the modern animal. The construction of the modern Horse, structure of the bones, the way in which the teeth grow, characters of the different races of domestic Horse and of the different wild species are shown in the end case (Case 15).

NORTH (LEFT) SIDE.

First come the AMBLYPODS and CONDYLARTHS. These groups of Primitive Hoofed Mammals are first found in the lowest Eocene strata, at the very beginning of the Age of Mammals North and they became extinct before the end of the Eocene Alcove 1. Amblypods, epoch. Like so many other races the Amblypods begin etc. with small hornless animals (*Pantolambda*) and finally develop into huge elephantine beasts (*Uintatherium*) with six horns on the skull, and great sabre-like tusks. The Condylarths were more slender types, fitted for running. The best known among them is *Phenacodus*, which is considered to represent very nearly the prototype of the hoofed mammals, although it was not the direct ancestor of the later groups.

The second alcove is devoted to Rodents, Insectivores, Bats, Marsupials and other groups of small mammals, among which are the ancestors of the Monkeys and Lemurs and col- North lateral ancestors of Man. Most of these remains are Alcove 2. small and incomplete. Here are also some very frag- Small mentary remains of ancient and primitive mammals Mammals. which represent all that we know of the evolution of the mammalia during the Age of Reptiles, before the Age of Mammals began. These teeth and jaws are of interest because they are the oldest of mammals, from some of which are probably descended all the later mammal groups.

In the third alcove are the Carnivorous Mammals, on one side the CREODONTS or Primitive Carnivora, on the other the North True CARNIVORA (Dogs, Cats, Bears, Martens etc.), rep- Alcove 3. Carnivora. resented by a number of finely preserved mounted skeletons, and a large series of skulls, together with other specimens.



MOUNTED SKELETON OF PHENACODUS IN NORTH ALCOVE 2

This animal, although not a direct ancestor, represents the prototype of the hoofed mammals

Most remarkable among extinct carnivora are the Sabre Tooth Tigers, in which the upper canine teeth are enlarged into long, curving, flattened, serrate fangs, most terrible weapons, effective no doubt against the thick hides of the primitive pachyderms.

The fourth alcove is very narrow. In it are placed
North
Alcove 4. a few remains of fossil marine mammals: Seals, Ceta-
Marine ceans and Sirenians. These groups are very imper-
Mammals. fectly known as fossils.

The fossil ELEPHANTS and Mastodons are in the next broad alcove, about the middle of the hall. The evolution of
North
Alcove 5. these animals is shown by a series of skulls. The
Probos- Mastodon skeleton and the skull and fore-limb of the
cidea. Imperial Mammoth from Texas, and tusk of the Si-
 berian (Hairy) Mammoth are noteworthy specimens.

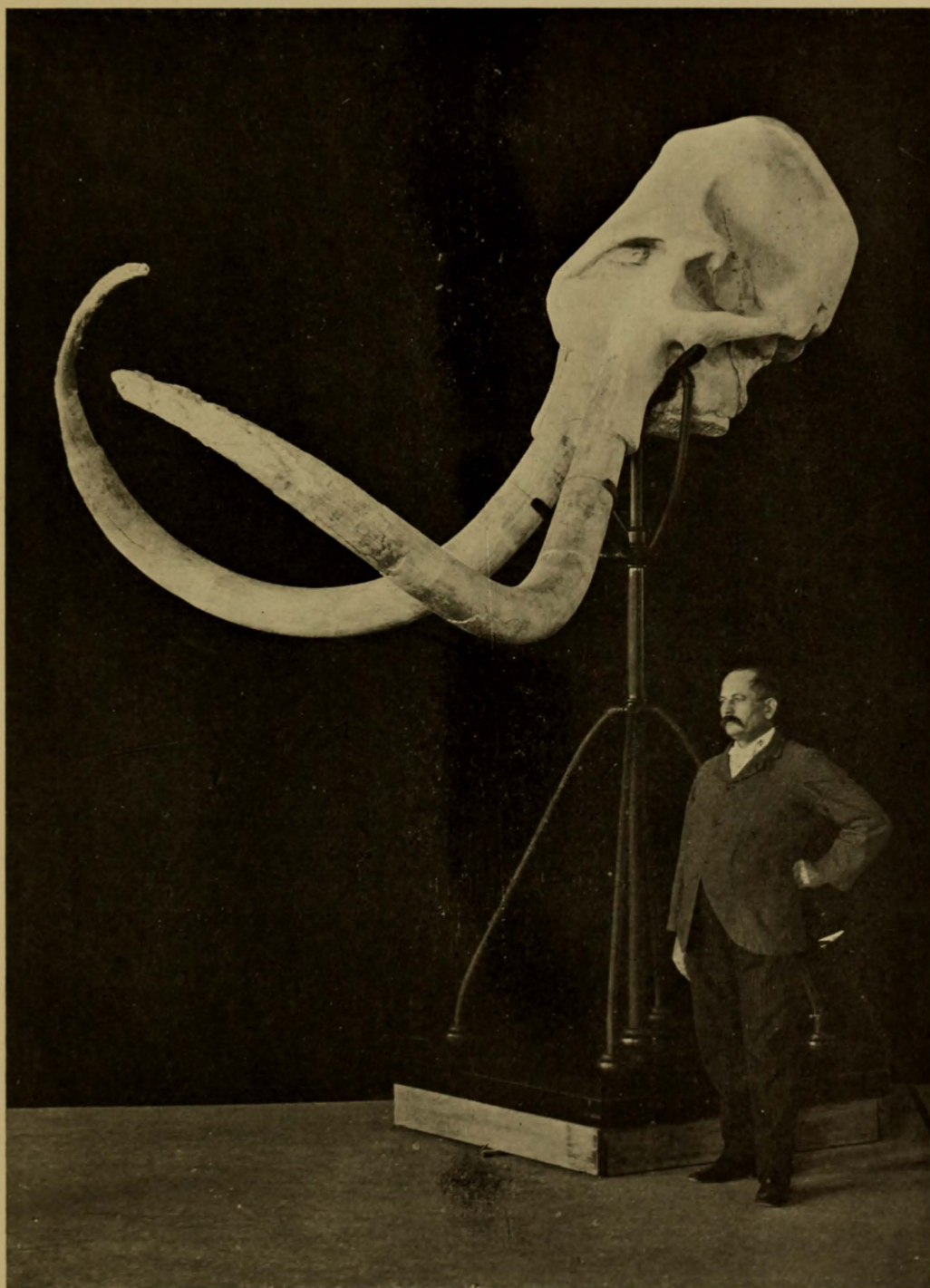
Beyond the Elephants are the ARTIODACTYLS or Cloven-Hoofed Mammals. They divide into two groups, typified by the

Pigs and the Ruminants, the latter including the greater
North
Alcove 6. part of modern hoofed mammals, but by no means pro-
Elotheres. portionally common as fossils. First among the fossil
 artiodactyls are the Elotheres, an extinct race of large animals
 distantly related to Pigs and Hippopotami. Next are the fossil
 Peccaries; then the Oreodonts, pig-like animals with the teeth

of ruminants, very abundant in America during the
North
Alcove 7. middle and later Tertiary, but extinct before the Plio-
Pigs, Pec- cene epoch. Then come the Camels, which although
caries, now found only in Asia and South America, originated
Oreodonts, in North America, and afterwards migrated to these
Camels. other continents and became extinct in their native land. The
 evolution of these animals is shown by a series of stages only
 less complete than the stages in the evolution of the Horse.

The higher ruminants (Deer, Antelope, Sheep and Cattle) are rather poorly represented in the collections. The Great Irish

Deer is the most striking among the extinct species;
North
Alcove 8. attention is also called to the mounted skeletons of
Deer, Ante- *Protoceras*, a deer-like primitive ruminant of the Oligo-
lope etc. cene epoch, and of *Merycodus*, a graceful little animal
 of the Miocene epoch intermediate between the Deer and the
 Prong-horn Antelope.



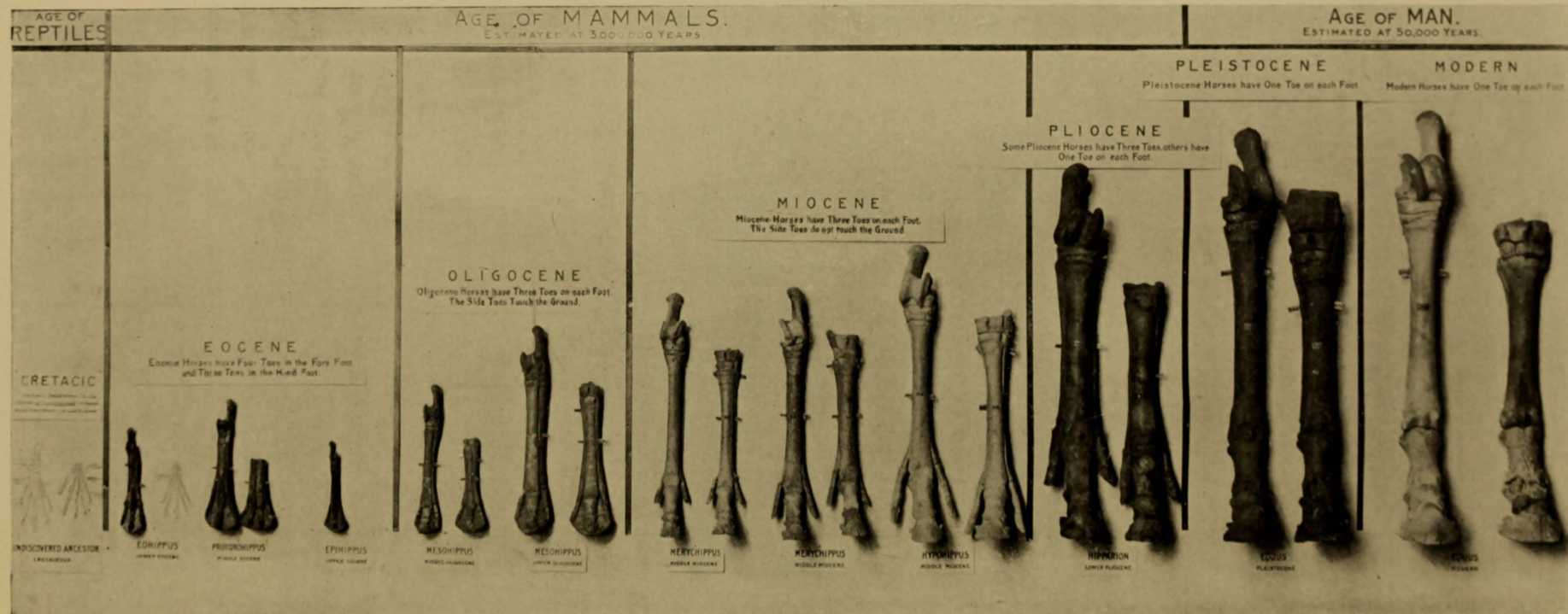
SKULL AND TUSKS OF THE IMPERIAL MAMMOTH

From a photograph of the specimen on exhibition in the American Museum of Natural History

The northeast corner of the hall is devoted to a number of peculiar groups of SOUTH AMERICAN FOSSIL MAMMALS, almost all extinct. During the Age of Mammals the two great northern continental areas were joined together from time to time, so that there has been an occasional interchange of animals and plants among them, the races developed in one continent spreading to the other. The animals of North America therefore, although mostly of species distinct from those of Europe and Asia, are more or less nearly related to them. But during most of the Age of Mammals South America was an island continent, as Australia is still; and its extinct animals are as peculiar and as different from those of the rest of the world as are the living animals of Australia different from those of other continents. It is by no means certain where these animals originally came from, but there is much evidence to show that both South America and Australia were peopled from an Antarctic continent, now sunk beneath the ocean or buried in the ice fields of the more frigid climate of modern times.

Of these peculiar South American groups the most extraordinary are the Edentates, including the Sloths, Armadillos and Anteaters which still survive, and the huge MEGATHERIA or Ground-Sloths and GLYPTODONTS or Tortoise-Armadillos which have become extinct. Others were the TOXODONTS, TYPOTHERES, ASTRAPOTHERES and LITOPTERNA, peculiar groups of hoofed animals all now extinct. Some of the Litopterna lost their side toes and evolved into a one-toed race curiously like the horses of the northern hemisphere, although not at all related to them; this is one of the most interesting examples of the parallel adaptation of two different races of animals to similar conditions of life; the horses in the plains and prairies of the north, the litopterna in the pampas of the southern continent.

The best example of the evolution of a race of animals is shown in the southeastern corner of the hall. Here is exhibited **Instances of Evolution.** the *Ancestry of the Horse*, the specimens from successive geological strata showing how the modern Horse has descended from diminutive ancestors with four toes on each forefoot and three on each hind foot, and with teeth and other



EVOLUTION OF THE HORSE. FEET

parts of the skeleton different from those of their modern representatives.

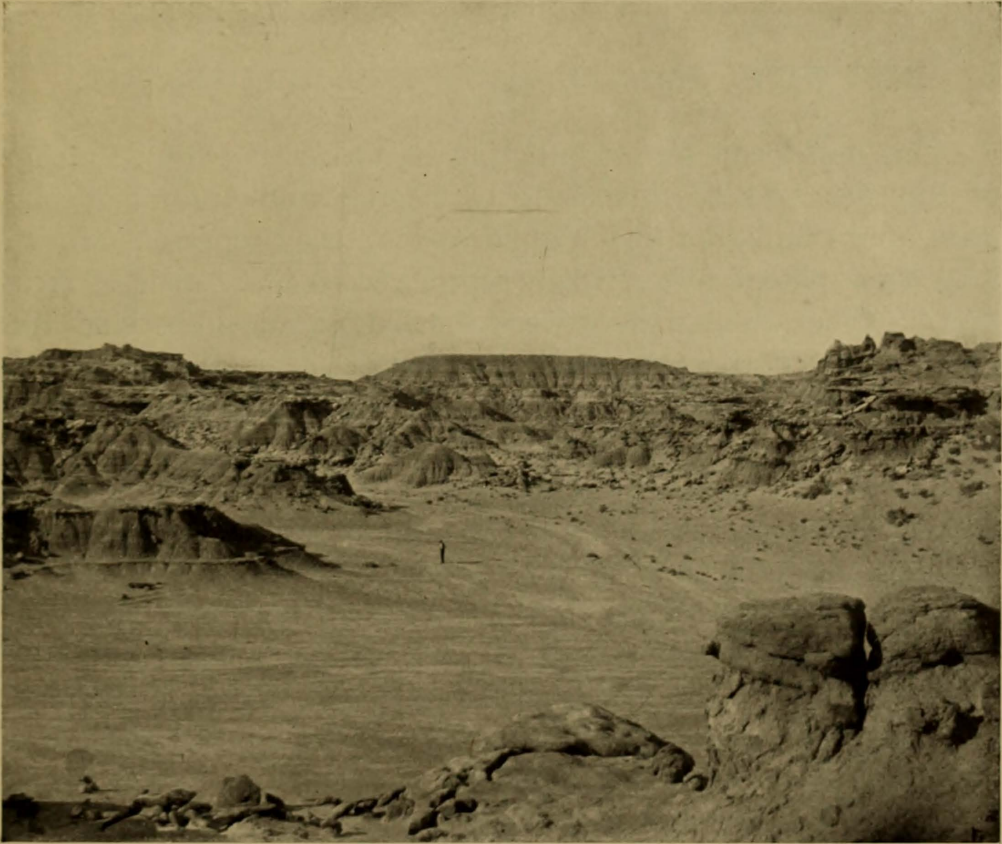
Almost equally complete, although less familiar, is the series illustrating the *Ancestry of the Camel*, which may be found on the north side of the hall near the east end. These animals, like the Horses, evolved from small and primitive ancestors to large and highly specialized descendants, and then became extinct in their former home, the broad and arid plains of western America, before the advent of civilized man, but survived to modern times in other parts of the world (Asia, Africa and South America). Less complete series are the skulls and skeletons illustrating the ancestors of Titanotheres and the ancestors of Rhinoceroses. These are ranged along the south side of the hall beginning at the entrance.

All these series have been placed according to geological age. The most ancient specimens, found in the lowest rock-strata, and hence representing the earliest stage of evolution, are placed first in the series. The most recent ones, found in the uppermost rock-strata, and representing the final stage of evolution of the race, are placed last. Arranging the species of a race from each stratum in the order of the age of the strata, we find that they show a regularly progressive change from the most ancient to the most recent. At no point in a given series can we draw a line and say: This is and that is not, a Horse—or a Camel—or a Rhinoceros. The visitor, therefore, can demonstrate for himself the evolution of the race of Horses or Camels or Rhinoceroses, within certain limits. Of the evolution of Man we have no satisfactory illustration from fossils.

It should be observed that the evolution of a race consists mainly in the adaptation of the structure of the animals to particular surroundings and habits of life. There is also a universal progress in intelligence, the more ancient animals having relatively smaller brains than their successors.

The water-color restorations by Charles R. Knight, done under the immediate supervision of Professor Osborn, mainly based on complete skeletons exhibited in this hall, show the *probable appearance* of the different extinct animals, according to our best judgment, as indicated by the characters of the skeleton, appearance of their nearest

surviving relatives and the habits of life for which the animals seem to have been fitted. The general proportions of the animal, the outlines and form of head and body, and, to a great extent, the expression of the features are usually accurately known from the fossil skeleton. The nature of the skin is sometimes but not often certainly known, and the coloring is always conjectural,



SCENE IN THE BAD-LANDS OF THE UINTA BASIN—TERTIARY FOSSIL FIELD OF
NORTHEASTERN UTAH

the palæontologist and the artist having been guided by the coloring of living relatives and the supposed habits of the animal.

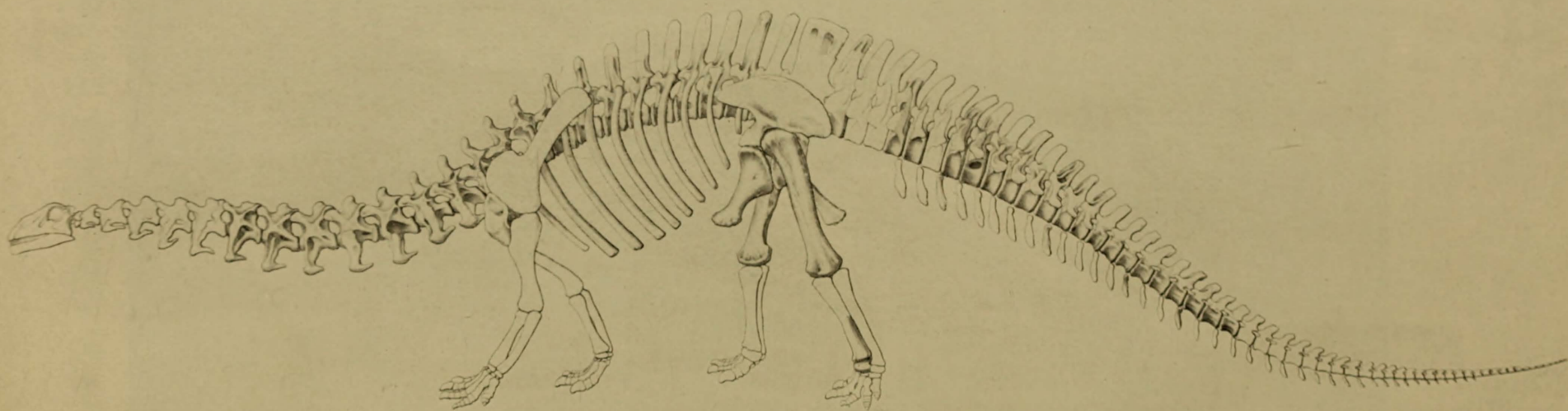
The window transparencies are enlargements from photographs of the regions where the fossils occur, and generally show the localities where unusually fine specimens in this Window
hall were found. The expeditions sent out yearly to Transpar-
the fossil fields carry with them photographic outfits, encies.
and several hundred characteristic views have been taken, from

which these have been selected. The pillar cards and general labels in the cases give detailed information about each group of fossils. One of the cases in the center of the middle aisle illustrates the method by which the fossils are collected and conveyed to the Museum. The charts at each side of the entrance show the order in which the rock-strata lie, one over another, and the kinds of fossils found in each stratum.

EAST WING. HALL NO. 407. FOSSIL REPTILES, ETC.

This hall forms an introduction to an earlier world, the Age of Reptiles. These fossils are of strange and unfamiliar outlines, quite unlike ordinary quadrupeds; they represent an era, long since passed away, when reptiles were the "lords of creation." Chief among them were the Dinosaurs, great land and amphibious reptiles to which the greater part of this hall is devoted. They occupy the north, east and west sides and the center.

The AMPHIBIOUS DINOSAURS, on the west and north sides and in the center of the hall, were the largest of land animals, **Amphibious** some of them sixty to seventy feet in length, and of **Dinosaurs**. enormous bulk. They were quadrupedal beasts, with long necks and long tails, and comparatively long and very massive limbs. The head was very small in proportion to the size of the animal, and the brain inferior to that of modern reptiles. They were cold-blooded, slow-moving, unintelligent creatures, vast storehouses of flesh which lived and grew to huge size with but little occasion for very active exertion amidst the rich vegetation of the moist and tropical climate of the reptilian era. Several incomplete skeletons of Amphibious Dinosaurs are exhibited, besides limbs and other separate parts. The *Brontosaurus* skeletons in Case 1 (on the right-hand or south side of the entrance) and in the center of the hall are among the largest. The thigh bone in this animal was nearly six feet long and weighs in its petrified state 500 to 600 pounds. The *Diplodocus* (Case 2 on the left-hand or north side of the entrance) was less robust but almost as long. This specimen lacks the fore part of the skeleton and most of the limbs, but the tail is very perfectly



SKELETON OF BRONTOSAURUS

RESTORATION OF THE SKELETON OF AN AMPHIBIOUS DINOSAUR OF THE AGE OF REPTILES. THE SKELETON WAS 65 FEET LONG



preserved. In Case 4 are limbs and other parts of several species of Amphibious Dinosaurs.

The BEAKED DINOSAURS (Predentata) northeast corner of the hall, had a horny beak or bill at the front of the jaw, and teeth at the back of it. They were most extraordinary and bizarre animals, huge in size, although not so large as the Amphibious Dinosaurs. *Stegosaurus* had a series of great bony plates projecting from the back, and stout bony spines on the tail. *Triceratops* had an enormous skull with three great horns projecting forward, and a strong bony frill projecting backward around the neck. Both these were quadrupedal animals with massive limbs and elephantine feet. *Hadrosaurus* was a bipedal dinosaur with long hind limbs and three-toed bird-like feet, but with hoofs instead of claws. Its beak was broad and flattened, as in the spoon-bill duck or *Ornithorhynchus* of Australia.

The CARNIVOROUS DINOSAURS are exhibited on the east side of the hall (opposite the entrance). They were bipeds with bird-like feet, sharp claws and large heads with sharp-pointed teeth. Some of these, the Megalosaurs, were of gigantic size, much larger than any modern carnivore. *Allosaurus* was as large as an elephant, while other Megalosaurs were even larger. Other Carnivorous Dinosaurs, such as *Ornitholestes*, were small and of slender proportions; these probably lived on the small animals of that period—toothed birds, pterodactyls, small reptiles of various kinds—while the large herbivorous dinosaurians were more probably the chief prey of the Megalosaur.

All the Dinosaurs had become extinct by the end of the Age of Reptiles. Their place was taken by the more intelligent and adaptable mammals, the evolution of which into the different kinds of modern quadrupeds has been seen in the Hall of Fossil Mammals.

On the south side of the Fossil Reptile Hall are fossil remains of four other groups of reptiles, the CROCODILES, TURTLES, LIZARDS and SNAKES, which, more fortunate than the dinosaurs, have survived to the present day, though in much diminished numbers and importance.

THE AGE OF REPTILES (MESOZOIC)

GEOLOGICAL FORMATIONS and CHARACTERISTIC ANIMALS.

THE AGE OF REPTILES PRECEDED THE AGE OF MAMMALS, AND IS REPRESENTED IN VARIOUS PARTS OF THE WORLD BY MARINE, ESTUARY AND FRESH-WATER DEPOSITS DIVIDED INTO THREE GREAT PERIODS, TRIASSIC, JURASSIC AND CRETACEOUS.

DURING THIS AGE THE REPTILES APPEARED, FLOURISHED GREATLY, AND DECLINED AT ITS CLOSE TO THEIR PRESENT IMPORTANCE. THE MAMMALS APPEARED WELL DOWN IN THIS AGE BUT REMAINED SMALL AND SCARCE UNTIL ITS END.

	PERIODS	FORMATIONS	THICKNESS	CHARACTERISTIC ANIMALS
AGE OF MAMMALS	EOCENE	TORREJON	800	MAMMALS IN LARGE NUMBERS
		PUERCO		TRUE LIZARDS and SPHENODONS ALLIGATORS and CROCODILES TURTLES NUMEROUS BONY FISHES (TELEOSTS)
	CRETACEOUS	LARAMIE	1000 5000	CARNIVOROUS DINOSAURS HERBIVOROUS DINOSAURS HORNED (HERBIVOROUS) DINOSAURS NUMEROUS SMALL MAMMALS LAST PLESIOSAURS FIRST SOFT-SHELLED TURTLES MODERN TAILED AMPHIBIANS (SALAMANDERS)
		MONTANA	1200 8700	BIRDS, PROBABLY TOOTHED. PTERODACTYLS, TOOTHLESS MOSASAURS and PLESIOSAURS GIGANTIC MARINE TURTLES DOLICHOSAURIAN LIZARDS SHARKS, CAT-FISH, STURGEONS and GAR Pikes
		COLORADO	1000 3000	TOOTHED BIRDS, TOOTHLESS PTERODACTYLS DINOSAURS MOSASAURS and PLESIOSAURS LARGE MARINE TURTLES BONY FISHES (TELEOSTS) SHARKS GANOID FISHES.
		DAKOTA	400 5000	FIRST SNAKES TURTLES
		COMANCHE	300 2600	TRUE LIZARDS and DOLICHOSAURS HERBIVOROUS DINOSAURS (GANODONTES) CARNIVOROUS DINOSAURS (MEGALOSAURS) PTERODACTYLS, TOOTHED and TOOTHLESS MOSASAURS ICHTHYOSAURS and PLESIOSAURS CROCODILES, TURTLES, SHARKS and GANOID FISHES CHIMÆROID FISHES
		PURBECK	1500 4000	PRIMITIVE MAMMALS (MARSUPIALS INSECTIVORES and MULTITUBerculATES) CARNIVOROUS DINOSAURS (CERATOSAURS) HERBIVOROUS DINOSAURS (ATLANTOSAURS) TURTLES, PTERODACTYLS FIRST BIRDS WITH TEETH (SAURURAE) ICHTHYOSAURS (TOOTHED and TOOTHLESS) PLESIOSAURS, PTERODACTYLS (TOOTHED)
		STONEFIELD SLATES (ENG) LIAS		SMALL PRIMITIVE MAMMALS LONG NOSED CROCODILES (TELEOSAURS) ICHTHYOSAURS and PLESIOSAURS FIRST HERBIVOROUS DINOSAURS TURTLES, PTERODACTYLS SHARKS and CHONDROSTEAN FISHES
		PHÆTIC RICHMOND COAL-BEDS and CONN. and NEW JERSEY RED SANDSTONES (NEWARK SYSTEM) KEUPER	3000 6000	REPTILE MAMMALS (DROMATHERIUM, TRITYLODON, MICROLESTES) FIRST CARNIVOROUS DINOSAURS LAST LABYRINTHOdonts PRIMITIVE CROCODILES (BELODON) FIRST TURTLES and PTERODACTYLS FIRST TELEOST or BONY FISHES SHARKS, CHONDROSTEAN and LUNG FISHES PLESIOSAURS (NOTHOSAURS) FIRST ICHTHYOSAURS (MIXOSAURS) PLACODONTES
		BUNTER		LARGE AMPHIBIANS (LABYRINTHOdonts) FIRST PLESIOSAURS (NOTHOSAURS)
AGE OF AMPHIBIANS AND COAL PLANTS	PERMIAN		600 1000	FIRST REPTILES (COTYLOSAURS, PROGANOSAURS and PELYCOSAURS) PRIMITIVE AMPHIBIANS (STEGOCEPHALIA) SHARKS, LUNG FISHES, CHONDROSTEAN and CROSSOPTERYGIAN FISHES
	CARBONIFEROUS			PRIMITIVE AMPHIBIANS (STEGOCEPHALIA, MOSTLY SMALL SPECIES) PRIMITIVE SHARKS and LUNG FISHES CHONDROSTEAN and CROSSOPTERYGIAN FISHES

DIVISIONS OF THE AGE OF REPTILES

Characteristic fossil reptiles, amphibians and fishes, and the formations in which they are found

Crocodiles in their palmier days were of world-wide distribution and comprised marine as well as fresh-water types. Turtles are among the commonest of fossils in the Bad-lands and some of them of very large size. Lizards and snakes, the only common reptiles of modern times, are very rare and fragmentary as fossils, and little is known about them.

Besides these surviving groups, several extinct groups of reptiles are shown on the south side of the hall. The BELODONTES, of the dawn of the Reptilian Era, were partly intermediate between Dinosaurs and Crocodiles. The still older PELYCOSAURS were remarkable for an enormous rigid bony fin on the back; among the contemporary THERIODONTES there existed perhaps the remote ancestors of the Mammals. The PTERODACTYLS or Flying Reptiles were the most extraordinary of reptiles, tailless, with batlike wings, supported on the enormously lengthened little finger, and with a spread in the largest species of twenty feet from tip to tip. The RHYNCHOCEPHALIANS are an interesting group of very primitive reptiles, of which a single species, the Tuatara, still survives in New Zealand.

FOSSIL AMPHIBIANS.

The Age of Reptiles was preceded by an Age of Amphibians, when the dominant animals were allied to modern Frogs, Toads and Salamanders, but had the skulls covered by a solid bony roof and the bodies by more or less scaly armor. These Armored Amphibians have been called **Armored Amphibians** (Stegocephalia). Stegocephalia (στέγη, κεφαλή = deck-head) or Labyrinthodonts (λαβύρινθος, ὀδούς = labyrinth-tooth, from the complicated fluting or infolding of the enamel on the teeth). Some of them, like *Eryops*, were large animals with heads eighteen inches long and a foot wide; others resembled colossal tadpoles; but the majority of them were quite small animals, either proportioned like salamanders or else long and eel-like with minute limbs or none at all.

These fossil Amphibians are the most ancient of fourfooted animals, and are not far removed from the central type from which all the higher vertebrates are believed to be descended. They are exhibited near the middle of the south side of the Hall of Fossil Reptiles.

FOSSIL FISHES.

Some of the finest specimens of fossil fishes in the collection are exhibited in the corridor hall. Others are placed in the southwest corner of the Fossil Reptile Hall. These range from the exceedingly ancient and archaic types, such as the huge *Dinichthys* of the Age of Fishes, older even than the fossil Amphibians, to more modern and familiar types such as the fossil Perch and Herring of the Green River Tertiary formation.

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American Museum of Natural History.

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- Gives free admission to its halls on Wednesdays, Thursdays, Fridays, Saturdays and Sundays.
- Provides for free illustrated lectures on Tuesdays and Saturdays.
- Provides for free illustrated lectures to teachers on Saturdays.
- Provides instruction to school children when accompanied by teachers.

WHAT IT IS DOING FOR ITS MEMBERS :

- Gives free admission at all times.
- Provides special courses of illustrated lectures.
- Gives free use of Library.
- Issues the Journal.
- Distributes Guide Leaflets.

WHAT IT IS DOING FOR SCIENCE :

During the year 1902 it maintained exploring parties in various parts of the United States and in :

Siberia,	Alaska,	Central America,	Greenland,
China,	British Columbia,	Venezuela,	Baffin's Bay,
Japan,	Mexico,	Martinique,	Hudson Bay,
	The Bahamas,	St. Vincent,	Cuba.

Maintains scientific publications :

- Memoirs—twenty-two have been issued.
- Bulletins—sixteen volumes have been issued.
- Journal—two volumes have been issued.

What the Museum Needs.

Additional members.

Increased subscriptions to defray expenses of exploring expeditions.

Funds to make additional groups similar to those in the Bird, Mammal and Ethnology Halls.

Small sums sufficient to preserve the records of the Indians of New York.

Means for collecting and preserving representative examples of animals on the verge of extinction.

Means for collecting fossils and geological specimens.

Membership Fees :

Annual Members,.....	\$ 10.
Life Members,.....	100.
Fellows,	500.
Patrons,.....	1,000.

All money received from membership fees is used for increasing the collections.

Publications.

The publications of the Museum consist of an Annual Report, in octavo, about 80 pages; the Bulletin, in octavo, of which one volume, consisting of about 400 pages, and about 25 plates, with numerous text figures, is published annually; the Memoirs, in quarto, published in parts at irregular intervals; an Ethnographical Album, issued in parts, and the American Museum Journal.