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Dragon's blood

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DINOSAURS
WITH SPECIAL REFERENCE TO
THE AMERICAN MUSEUM COLLECTIONS

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Chapter I
THE AGE OF REPTILES.

Its Antiquity, Duration and Significance in Geologic History.

Palæontology deals with the History of Life. Its time is measured in geologic epochs and periods, in millions of years instead of centuries. Man, by this measure, is but a creature of yesterday—his "forty centuries of civilization"[1] but a passing episode. It is by no means easy for us to adjust our perspective to the immensely long spaces of time involved in geological evolution. We are apt to think of all these extinct animals merely as prehistoric—to imagine them all living at the same time and contending with our cave-dwelling ancestors for the mastery of the earth.

In order to understand the place of the Dinosaurs in world-history, we must first get some idea of the length of geologic periods and the immense space of time separating one extinct fauna from another.

The Age of Man. Prehistoric time, as it is commonly understood, is the time when barbaric and savage tribes of men inhabited the world but before civilization began, and earlier than the written records on which history is based. This corresponds roughly to the Pleistocene epoch of geology; it is included along with the much shorter time during which civilization has existed, in the latest and shortest of the geological periods, the Quaternary. It was the age of the mammoth and the mastodon, the megatherium and Irish deer and of other quadrupeds large and small which are now extinct; but most of its animals were the same species as now exist. It was marked by the great episode of the Ice Age, when considerable parts of the earth's surface were buried under immense accumulations of ice, remnants of which are still with us in the icy covering of Greenland and Antarctica.

The Age of Mammals. Before this period was a very much longer one—at least thirty times as long—during which modern quadrupeds were slowly evolving from small and primitive ancestors into their present variety of form and size. This is the Tertiary Period or Age of Mammals. Through this long period we can trace step by step the successive stages through which the ancestors of horses, camels, elephants, rhinoceroses, etc., were gradually converted into their present form in adaptation to their various habits and environment. And with them were slowly evolved various kinds of quadrupeds whose descendants do not now exist, the Titanotheres, Elotheres, Oreodonts, etc., extinct races which have not survived to our time. Man, as such, had not yet come into existence, nor are we able to trace any direct and complete line of ancestry among the fossil species known to us; but his collateral ancestors were represented by the fossil species of monkeys and lemurs of the Tertiary period.

Fig. 1. The Later Ages of Geologic Time.
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The Age of Reptiles. Preceding the Age of Mammals lies a long vista of geologic periods of which the later ones are marked by the dominance of Reptiles, and are grouped together as the Age of Reptiles or Mesozoic Era. This was the reign of the Dinosaurs, and in it we are introduced to a world of life so different from that of today that we might well imagine ourselves upon another planet.

None of the ordinary quadrupeds with which we are familiar then existed, nor any related to nor resembling them. But in their place were reptiles large and small, carnivorous and herbivorous, walking, swimming and even flying.

Crocodiles, Turtles and Sea Reptiles. The Crocodiles and Turtles of the swamps were not so very different from their modern

descendants; there were also sea-crocodiles, sea-turtles, huge marine lizards (Mosasaurs) with flippers instead of feet; and another group of great marine reptiles (Plesiosaurs) somewhat like sea-turtles but with long neck and toothed jaws and without any carapace. These various kinds of sea-reptiles took the place of the great sea mammals of modern times (which were evolved during the Age of Mammals); of whales and dolphins, seals and walruses, and manatees.

Pterodactyls. The flying Reptiles or Pterosaurians, partly took the place of birds, and most of them were of small size. Strange bat-winged creatures, the wing membrane stretched on the enormously elongated fourth finger, they are of all extinct reptiles the least understood, the most difficult to reconstruct and visualize as they were in life.

Dinosaurs. The land reptiles were chiefly Dinosaurs, a group which flourished throughout the Age of Reptiles and became extinct at its close. "Dinosaur" is a general term which covers as wide a variety in size and appearance as "Quadruped" among modern animals. And the Dinosaurs in the Age of Reptiles occupied about the same place in nature as the larger quadrupeds do today. They have been called the Giant Reptiles, for those we know most about were gigantic in size, but there were also numerous smaller kinds, the smallest no larger than a cat. All of them had short, compact bodies, long tails, and long legs for a reptile, and instead of crawling, they walked or ran, sometimes upon all fours, more generally upon the hind limbs, like ostriches, the long tail balancing the weight of the body. Some modern lizards run this way on occasion, especially if they are in a hurry. But the bodies of lizards are too long and their limbs too small and slender for this to be the usual mode of progress, as it seems to have been among the Dinosaurs.

ANIMALS OF THE AGE OF REPTILES. LAND REPTILES. DINOSAURS corresponding to the larger quadrupeds or land mammals of today.
CROCODILES, LIZARDS AND TURTLES still surviving. SEA REPTILES. PLESIOSAURS
ICHTHYOSAURS
MOSASAURS corresponding to whales, dolphins, seals, etc., or sea-mammals of today. FLYING REPTILES OR PTEROSAURS.
BIRDS WITH TEETH (scarce and little known). PRIMITIVE MAMMALS of minute size (scarce and little known). FISHES and INVERTEBRATES many of them of extinct races, all more or less different from modern kinds.

Fishes, large and small, were common in the seas and rivers of the Age of Reptiles but all of them were more or less different from modern kinds, and many belonged to ancient races now rare or extinct.

The lower animals or Invertebrates were also different from those of today, although some would not be very noticeably so at first glance. Among molluscs, the Ammonites, related to the modern Pearly Nautilus, are an example of a race very numerous and varied during all the periods of the Reptilian Era, but disappearing at its close, leaving only a few collateral descendants in the squids, cuttlefish and nautili of the modern seas. The Brachiopods were another group of molluscs, or rather molluscoids for they were not true molluscs, less abundant even then than in previous ages and now surviving only in a few rare and little known types such as the lamp-shell (*Terebratulina*).

Insects. The Insect life of the earlier part of the Age of Reptiles was notable for the absence of all the higher groups and orders, especially those adapted to feed on flowers. There were no butterflies or moths, no bees or wasps or ants although there were plenty of dragonflies, cockroaches, bugs and beetles. But in the latter part of this era, all these higher orders appeared along with the flowering plants and trees.

Plants. The vegetation in the early part of the era was very different both from the gloomy forests of the more ancient Coal Era and from that which prevails today. Cycads, ferns and fern-like plants, coniferous trees, especially related to the modern *Araucaria* or Norfolk Island Pine, Ginkgos still surviving in China, and huge equisetae or horsetail rushes, still surviving in South American swamps and with dwarfed relatives throughout the world, were the dominant plant types of that era. The flowering plants and deciduous trees had not appeared. But in the latter half of the era these appeared in ever increasing multitudes, displacing the lower types and relegating them to a subordinate position. Unlike the more rapidly changing higher animals these ancient Mesozoic groups of plants have not wholly disappeared, but still survive, mostly in tropical and southern regions or as a scanty remnant in contrast with their once varied and dominant role.

There is every reason to believe that upon the appearance of these higher plants whose flower and fruit afforded a more concentrated and nourishing food, depended largely the evolution of the higher animal life both vertebrate and insect, of the Cenozoic or modern era.

FOOTNOTES:

[1] The records of Egypt and Chaldaea extend back at least sixty centuries.

Chapter II
NORTH AMERICA IN THE AGE OF REPTILES.

Its Geographic and Climatic Changes.

North America in the Age of Reptiles would have seemed almost as strange to our eyes in its geography as in its animals and plants. The present outlines of its coast, its mountains and valleys, its rivers and lakes, have mostly arisen since that time. Even the more ancient parts of the continent have been profoundly modified through the incessant work of rain and rivers and of the waves, tending to wear down the land surfaces, of volcanic outbursts building them up, and of the more mysterious agencies which raise or depress vast stretches of mountain chains or even the whole area of a continent, and which tend on the whole so far as we can see, to restore or increase the relief of the continents, as the action of the surface waters tends to bring them down to or beneath the sea level.

Alternate Overflow and Emergence of Continents. In a broad way these agencies of elevation and of erosion have caused in their age-long struggle an alternation of periods of overflow and periods of continental emergence during geologic time. During the periods of overflow, great portions of the low-lying parts of the continents were submerged, and formed extensive but comparatively shallow seas. The mountains through long continued erosion were reduced to gentle and uniform slopes of comparatively slight elevation. Their materials were brought down by rivers to the sea-coast, and distributed as sedimentary formations over the shallow interior seas or along the margins of the continents. But this load of sediments, transferred from the dry land to the ocean margins and shallow seas, disturbed the balance of weight (isostasy) which normally keeps the continental platforms above the level of the ocean basins (which as shown by gravity measurement are underlain by materials of higher specific gravity than the continents). In due course of time, when the strain became sufficient, it was readjusted by earth movements of a slowness proportioned to their vastness. These movements while tending upon the whole to raise the continents to or sometimes beyond their former relief, did not reverse the action of erosion agencies in detail, but often produced new lines or areas of high elevation.

Fig. 2.: North America in the Later Cretacic Period. Map outlines after Schuchert.
Fig. 2.—North America in the Later Cretacic Period. Map outlines after Schuchert.

Geologic Periods. A geologic period is the record of one of these immense and long continued movements of alternate submergence and elevation of the continents. It begins, therefore, and ends with a time of emergence, and includes a long era of submergence.

These epochs of elevation are accompanied by the development of cold climates at the poles, and elsewhere of arid conditions in the interior of the continents. The epochs of submergence are accompanied by a warm, humid climate, more or less uniform from the equator to the poles.

The earth has very recently, in a geologic sense, passed through an epoch of extreme continental elevation the maximum of which was marked by the "Ice Age." The continents are still emerged for the most part almost to the borders of the "continental shelf" which forms their maximum limit. And in the icy covering of Greenland and Antarctica a considerable portion still remains of the great ice-sheets which at their maximum covered large parts of North America and Europe. We are now at the beginning of a long period of slow erosion and subsidence which, if this interpretation of the geologic record be correct, will in the course of time reduce the mountains to plains and submerge great parts of the lowlands beneath the ocean. As compensation for the lesser extent of dry land we may look forward to a more genial and favorable climate in the reduced areas that remain above water.