GEOLOGY

Fossil Horses in America

"A Classic of Science"

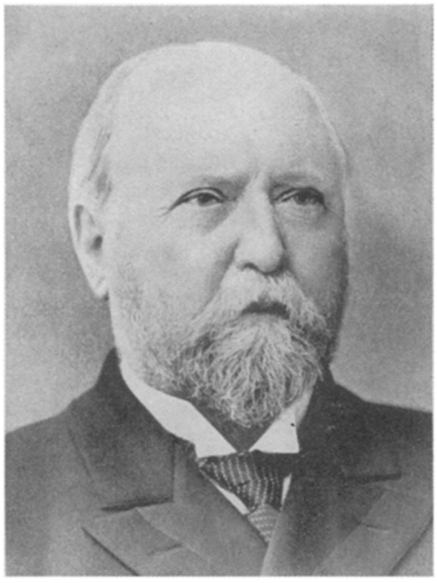
Is the Horse Today About to Become Extinct for the Second Time on the Continent of North America?

FOSSIL HORSES IN AMERICA by Professor O. C. Marsh. In The American Naturalist, Vol. VIII. Salem, Mass., Peabody Academy of Science, 1874. *This is an exact reprint of extracts from the original publication.*

IT IS a well known fact that the Spanish discoverers of America found no horses on this continent, and that the modern horse (*Equus caballus* Linn.) was subsequently introduced from the old world. It is, however, not so generally known that these animals had formerly been abundant here, and that long before, in Tertiary time, near relatives of the horse, and probably his ancestors, existed in the far west in countless numbers, and in a marvellous variety of forms. The remains of equine mammals, now known from the Tertiary and Quaternary deposits of this country, already represent more than double the number of genera and species hitherto found in the strata of the eastern hemisphere, and hence afford most important aid in tracing out the genealogy of the horses still existing.

The animals of this group which lived in this country during the three divisions of the Tertiary period were especially numerous in the Rocky Mountain regions, and their remains are well preserved in the old lake basins which then covered so much of that country. The most ancient of these lakes—which extended over a considerable part of the present territories of Wyoming and Utah—remained so long in Eocene times that the mud and sand, slowly deposited in it, accumulated to more than a mile in vertical thickness. In these deposits, vast numbers of tropical animals were entombed, and here the oldest equine remains occur, four species of which have been described. These belong to the genus *Orohippus* Marsh, and are all of diminutive size, hardly larger than a fox. The skeleton of these animals resembled that of the horse in many respects, much more indeed than any other existing species, but instead of the single toe on each foot, so characteristic of all modern equines, the various species of *Orohippus* had four toes before and three behind, all of which reached the ground. The skull, too, was proportionately shorter, and the orbit was not enclosed behind a bridge of bone. There were forty-four teeth in all, and the premolars were smaller than the molars. The crowns of these teeth were very short. The canine teeth were developed in both sexes, and the incisors did not have the "mark" which indicates the age of the modern horse. The radius and ulna were separate, and the latter was entire throughout its whole length. The tibia and fibula were distinct. In the fore foot all the digits except the pollex, or first, were well developed . . .

The large number of equine mammals now known from the Tertiary deposits of this country, and their regular distribution through the subdivisions of this formation, afford a good opportunity to ascertain the probable lineal descent of the modern horse. The American representative of the latter is the extinct *Equus fraternus* Leidy, a species almost, if not entirely, identical with the old world *Equus caballus* Linn., to which our recent horse belongs. Huxley has traced successfully the later genealogy of the horse through European extinct forms, but the line in America was probably a more direct one, and the record is more complete. Taking, then, as the extremes of a series, *Orohippus agilis* Marsh, from the Eocene, and *Equus fraternus* Leidy, from the Quaternary, intermediate forms may be intercalated with considerable certainty from the thirty or more well marked species that lived in the intervening periods. The natural line of descent would seem to be through the following genera:—*Orohippus,* of the Eocene; *Miohippus* and *Anchitherium*, of the Miocene; *Anchippus, Hipparion, Protohippus and Pliohippus,* of the Pliocene; and *Equus,* Quarternary and recent.



OTHNIEL CHARLES MARSH

Professor of vertebrate paleontology at Yale discovered many fossil animals of North America, especially horses, dinosaurs and toothed birds. He was born in 1831 and died in 1899.

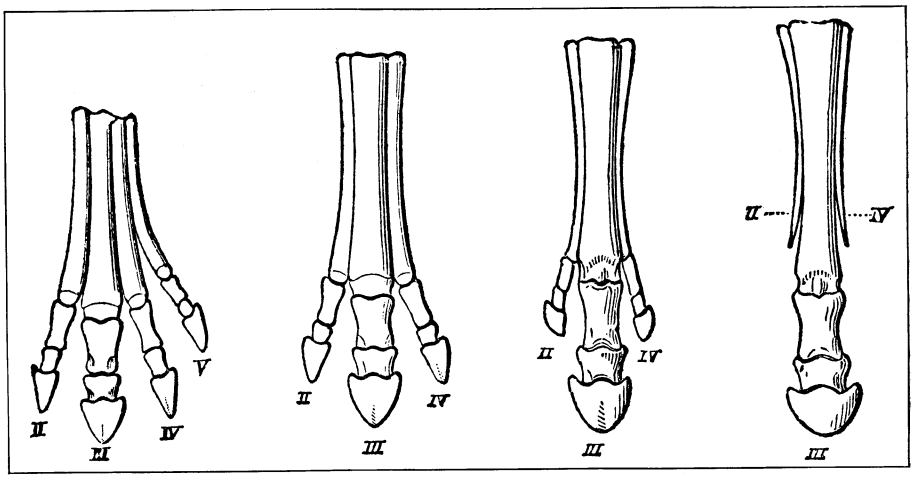
The most marked changes undergone by the successive equine genera are as follows: 1st, increase in size; 2d, increase in speed, through concentration of limb bones; 3d, elongation of head and neck, and modifications of skull. The increase in size is remarkable. The Eocene *Orohippus* was about the size of a fox. *Miohippus* and *Anchitherium,* from the Miocene, were about as large as a sheep. *Hipparion* and *Pliohippus,* of the Pliocene, equalled the ass in height: while the size of the Quaternary *Equus* was fully up to that of the modern horse.

The increase of speed was equally marked, and was a direct result of the gradual modification of the limbs. The latter were slowly concentrated, by the reduction of their lateral elements and enlargement of the axial one, until the force exerted by each limb came to act directly through its axis, in the line of

Marsh's description of Triceratops, the three-horned dinosaur which he discovered, was the Classic of Science in the SCIENCE NEWS LETTER for March 28, 1931.

motion. This concentration is well seen, *e. g.,* in the fore limb. There was, 1st, a change in the scapula and humerus, especially in the latter, which facilitated motion in one line only; 2d, an expansion of the radius, and reduction of the ulna, until the former alone remains entire, and effective; 3d, a shortening of all the carpal bones, and enlargement of the median ones, ensuring a firmer wrist; 4th, an increase in size of the third digit, at the expense of those on each side, until the former alone supported the limb. The latter change is clearly shown in the above diagram, which represents the fore feet of four typical genera in the equine series, taken in succession from each of the geological periods in which this group of mammals is known to have lived.

The ancient *Orohippus* had all four digits of the fore feet well developed. In *Miohippus,* of the next period, the fifth toe has disappeared, or is only represented by a rudiment, and the limb is supported by the second, third and fourth, the middle one being the largest. *Hipparion,* of the later Tertiary, still has three digits, but the third is much stouter, and the outer ones have ceased to be of use, as they do not touch the ground. In *Equus,* the last of the series, the lateral hoofs are gone, and the digits themselves are represented only by the rudimentary splint bones. The middle, or third digit, supports the limb, and its size has increased accordingly. The corresponding changes in the posterior limb of these genera are very similar, but not so striking, as the oldest type (*Orohippus*) had but three toes behind. An earlier ancestor of the group, perhaps in the lowest Eocene, probably had four toes on this foot, and five in front. Such a predecessor is as clearly indicated by the feet of *Orohippus,* as the latter is by its Miocene relative. A still older ancestor, possibly in the Cretaceous, doubtless had five toes on each foot, the typical number in mammals. This reduction in the number of toes may, perhaps, have been due to elevation of the region



HOW THE HORSE LOST HIS TOES

Fore-feet of the horse's ancestors. Orohippus had lost his thumb, Miohippus his little finger as well, Hipparion had two useless hooflets, which in the modern horse are represented by splint bones, Eohippus, with a rudimentary fifth toe, was a later discovery.

inhabited, which gradually led the animals to live on higher ground, instead of the soft lowlands where a polydactyl foot would be an advantage.

The gradual elongation of the head and neck, which took place in the successive genera of this group during the Tertiary period, was a less fundamental change than which resulted in the reduction of the limbs. The process may be said to have already begun in *Orohippus,* if we compare that form with other most nearly allied mammals. The diastema, or "place for the bit", was well developed in both jaws even then, but increased materially in succeeding genera. The number of the teeth remained the same until the Pliocene, when the front lower premolar was lost, and subsequently the corresponding upper tooth ceased to be functionally developed. The next upper premolar, which in *Orohippus* was the smallest of the six posterior teeth, rapidly increased in size, and soon became, as in the horse, the largest of the series. The grinding teeth at first had very short crowns, without cement, and were inserted by distinct roots. In Pliocene species, the molars became longer, and were more or less coated with cement. The modern horse has extremely long grinders, without true roots, and covered with a thick external layer of cement. The canine teeth were very large in *Orohippus,* and in this genus, as well as those from the Middle Tertiary, appear to have been well developed in both sexes. In later forms, these teeth declined in size, especially as the changes in the limbs afforded other facilities for defence, or escape from danger. The incisors in the early forms were small, and without the characteristic "mark" of the modern horse. In the genera from the American Eocene and Miocene, the orbit was not enclosed behind by an entire bridge of bone, and this makes its first appearance in this country in Pliocene forms. The depression in front of the orbit, so characteristic of *Anchitherium* and some of the Pliocene genera, is, strange to say, not seen in *Orohippus,* or the later *Miohippus,* and is wanting, likewise, in existing horses. It is an interesting fact that the peculiarly equine features acquired by *Orohippus* are retained persistently throughout the entire series of succeeding forms. Such, *e. g.,* is the form of the anterior part of the lower jaw, and also the characteristic astragalus, with its narrow, oblique, superior ridges, and its small articular facet for the cuboid.

Such is, in brief, a general outline of the more marked (*Turn Page*)

GENERAL SCIENCE

"Classics of Science" Used As Labels in Museum

DOZENS of "Classics of Science" that appeared in SCIENCE NEWS LETTER are being used as museum labels in the Missouri State Museum, Jefferson City, Mo. A. C. Burrill, curator, explains that the classics of science have been framed between two panes of glass, with taped edges. They have been hung with picture wire near the museum exhibits they best illuminate.

changes that seem to have produced in America the highly specialized modern *Equus* from his diminutive, four-toed predecessor, the Eocene *Orohippus*. The line of descent appears to have been direct and the remains now known supply every important intermediate form. It is, of course, impossible to say with certainty through which of the three-toed genera of the Pliocene that lived together, the succession came. It is not impossible that the later species, which appear generically identical, are the descendants of more distinct Pliocene types, as the persistent tendency in all the earlier forms was in the same direction. Considering the remarkable development of the group through the entire Tertiary period, and its existence even later, it seems very strange that none of the species should have survived, and that we are indebted for our present horse to the old world.

Science News Letter, February 25, 1933

From Page 115

To these four particles there might be added the alpha particle, which is the heart or nucleus of the helium atom, with a mass about four times that of the proton or heart of the hydrogen atom. It is considered to be a unit used in atom building. Prof. G. Gamow, the Soviet authority in atomic structure, says that atomic nuclei are composed of neutrons and alpha particles, with one proton in atomic hearts of odd atomic number.

The photon must have a place in any list of fundamental "particles." It is the unit of light and other electromagnetic radiations, such as X-rays and gamma rays. It is possible to think of light as consisting either of waves or particles, as most convenient at the time. Or under quantum theory and wave mechanics, the newer developments of physics, it is possible to think of the fundamental entities as not waves or particles, but mathematical equations.

How speedily the theory and experimental facts of physics move these days is shown by the opening phrases of a survey of research on neutrons contributed by the Bell Telephone Laboratories physicist, Dr. Karl K. Darrow, to the Review of Scientific Instruments, February, 1933, issued on Friday, Feb. 17: "The discovery of what may prove to be the third and last of the fundamental corpuscles of matter, and what at any rate is a distinctive kind of ionizing ray (neutrons) . . . ."

As this was being published came the cabled news of the enthronement of the positive electron, the fourth fundamental corpuscle.

Negatron or Positron?

When the London correspondent of Science Service cabled the news of the confirmation by the British physicists, the news was specially relayed by telegraph to Dr. Anderson with the suggestion: "Why not christen your new particle 'positron'?"

"With regard to your suggestion," Dr. Anderson wired in reply, "we have already discussed here negatron and positron.

"Historically and derivatively the word, electron, denotes the unit charge, positive or negative, without any reference to the associated mass. The discovery that there exists a positive charge which, like the free negative electron is unassociated with any mass of atomic magnitude, requires the introduction of a new term to distinguish it from the proton which is used to denote the positive electron associated with the mass of the atom of hydrogen. We have been discussing in the laboratory for some months past the desirability of calling the free positive electron, positron, and then using the similar contraction, negatron, for the free negative electron. This makes a logical and systematic notation which should be introduced if and as soon as the existence of the free positive electron becomes established.

"If the observations obtained here, part of which are already published, are actually due to positrons then we have new experimental evidence that in passing through matter positrons lose energy more rapidly than do negatrons."

Science News Letter, February 25, 1933

PHYSIOLOGY

Secretion From Crustacean Eyes Causes Color Change

RESEARCHES on a melanin-regulating hormone in the eyestalks of crustacea, (SNL, Jan. 7, '33, p. 12) were inadvertently credited to Prof. Lloyd M. Bertholf of Western Maryland University and the University of München, whereas the actual authors of the report were Prof. Earle B. Perkins and Benjamin Kropp of Rutgers University.

Science News Letter, February 25, 1933

Grapefruit and orange production in the world has increased ten-fold in the past 40 years.

ASTRONOMY

Small Telescopes Reveal Comet Just Reported

A COMET that may become visible to the unaided eye was discovered early Thursday, Feb. 16, in the northern evening sky by Leslie C. Peltier, an amateur astronomer of Delphos, Ohio, the Harvard College Observatory has been informed. It was eighth magnitude and sufficiently bright to be visible through small telescopes or high powered field glasses.

This discovery was confirmed by other observatories.

The comet was observed between the constellations of Cepheus and Cassiopeia in the region of the Milky Way and is moving eastward.

Mr. Peltier is a veteran comet discoverer.

Science News Letter, February 25, 1933

SURGERY

Grafted Nerves Restore Normal Facial Expression

SIXTEEN patients with hideously twisted, paralyzed faces have had normal expressions and the use of facial muscles restored to them by a newly-improved nerve-grafting operation.

The operation was developed by Dr. Arthur B. Duel of the Manhattan Eye, Ear and Throat Hospital in New York, and Sir Charles Ballance, for many years surgeon-in-chief at St. Thomas' Hospital, London. Dr. Duel has described the operation in a report just published here by the Milbank Memorial Fund which, with the Carnegie Corporation, the Lillia Babbitt Hyde Foundation, the New York Foundation and a number of the surgeons' personal friends, gave the necessary financial support to the research.

In Dr. Duel's opinion, the restoration of facial movements is not only a great boon to a patient's morale in his social contacts, but is also of tremendous importance in making him self-supporting.

The new operation gives the patients the ability to use their facial muscles either voluntarily or in response to their emotions. They can put on a polite, society smile or laugh spontaneously at a funny story. Both factors are important, Dr. Duel pointed out.

Dr. Duel and his collaborator worked first with animals. They found that grafts of nerves from other parts of