SCIENCE

VOL. LXX FRIDAY, OCTOBER 4, 1929 No. 1814

Paleontological Monographs of the National Geological Surveys: DR. HENRY FAIRFIELD OSBORN 315

Obituary:

Arthur S. Loevenhart: DR. H. S. GASSER. *Recent Deaths* 317

Scientific Events:

The Roosevelt Memorial of the American Museum of Natural History; The Yale Institute of Human Relations; The Pan-American Institute of Geography; The Iron Alloys Committee of the Engineering Foundation; Princeton Doctorates of Science 321

Scientific Notes and News 324

University and Educational Notes 328

Discussion:

Some New Laws for the Solar System: DR. WILLIAM MARIAS MALISOFF. *A Study of the Fire Blight Pathogen within Living Tissues:* DR. H. R. ROSEN. *Proposed Amendments to the International Rules of Nomenclature:* PROFESSOR J. C. ARTHUR. *Odd Stories about Scientific Names:* DR. L. O. HOWARD 328

Scientific Apparatus and Laboratory Methods:

New Methods in the Study of Fossil Shark Teeth: DON L. CARROLL 331

Special Articles:

The Internal Temperature of the Earth's Crust: FRANK M. GENTRY. *A Blue Mutation in the Rat (Mus Norvegicus):* DR. ELMER ROBERTS 332

Science Service x

SCIENCE: A Weekly Journal devoted to the Advancement of Science, edited by J. MCKEEN CATTELL and published every Friday by

THE SCIENCE PRESS

New York City: Grand Central Terminal

Lancaster, Pa. Garrison, N. Y.

Annual Subscription, $6.00 Single Copies, 15 Cts.

SCIENCE is the official organ of the American Association for the Advancement of Science. Information regarding membership in the Association may be secured from the office of the permanent secretary, in the Smithsonian Institution Building, Washington, D. C.

PALEONTOLOGICAL MONOGRAPHS OF THE NATIONAL GEOLOGICAL SURVEYS

By Dr. HENRY FAIRFIELD OSBORN

SENIOR GEOLOGIST, U. S. GEOLOGICAL SURVEY

THE forthcoming issue of Monograph 55 by the U. S. Geological Survey renders opportune a review of the continued encouragement by our government of research in vertebrate paleontology since the establishment of the National Geological Surveys. Monographic description of the extinct mammalian and reptilian life is referred to in the preface of the forthcoming volumes as follows:

Joseph Leidy, Edward Drinker Cope and Othniel Charles Marsh, who successively served as members of U. S. government surveys of the west, were the founders of American vertebrate paleontology. Leidy's memoir of 1869, entitled "The Extinct Mammalian Fauna of Dakota and Nebraska, Including an Account of Some Allied Forms from Other Localities, Together with a Synopsis of the Mammalian Remains of North America," marked the end of the first period of exploration. Cope's great memoir of 1885, entitled "The Vertebrata of the Tertiary Formations of the West," marked the end of the second period of exploration.

Meanwhile the subject had become too broad to be comprehended in a single work.

Accordingly, Marsh, as vertebrate paleontologist of King's survey of fortieth parallel, planned a series of exhaustive monographs on special groups of extinct birds, reptiles and mammals which should treat in great detail the anatomical structure and form the basis of a systematic classification. For these monographs he carried out the most intensive field

explorations known to science and published a large number of preliminary papers which fairly revolutionized our knowledge of these and many other groups. In 1880 the Fortieth Parallel Survey under Clarence King published his monograph on the "Odontornithes, an Extinct Group of Birds of North America." In 1883 the U. S. Geological Survey published his paper entitled "Birds with Teeth," and in 1886 his monograph on "The Dinocerata, an Extinct Order of Gigantic Mammals." This was the first of the series of five monographs projected for publication by the U. S. Geological Survey on the Dinocerata, the Stegosauria, the Ceratopsia, the Sauropoda, the Brontotheridae. The monograph last indicated has developed into the present monograph 55 on the titanotheres, which covers a much broader field than that contemplated by Marsh for the monograph on the Brontotheridae.

For the monographs on the Ceratopsia and on the Brontotheridae field exploration on an unprecedented scale was begun by the U. S. Geological Survey under the direction of Marsh. For the four monographs on the Stegosauria, Sauropoda, Ceratopsia and Brontotheridae, 204 superb lithographic plates were completed under Marsh's direction. Altogether he had been engaged on this work nearly seventeen years when death interrupted his monumental labors on March 18, 1899. He left no manuscripts for either of these unpublished monographs, only a few penciled notes, unpublished wood engravings and typewritten keys to the lithographic plates.

PREPARATION OF MONOGRAPH 55

The first important step taken by Marsh in his series of contributions to our knowledge of this extinct family was the publication of his paper on "The Structure and Affinities of the Brontotheridae," published in 1874, based on the collections at Yale University. The second was his paper entitled "Principal Characters of the Brontotheridae," published in 1876. In the meantime he had made a geologic excursion to White River in South Dakota, in the vicinity of the Red Cloud Agency. This visit marks an interesting epoch in the history of paleontologic exploration for the titanotheres.

Late in the autumn of 1875 Marsh, accompanied by an escort from Fort Laramie to the Red Cloud Agency, went to the Badlands of Nebraska and Dakota. The consent of the Indians was deemed necessary to permit safe search for fossil bones in their country. This consent was obtained with difficulty, and after it had been obtained the Indians withheld their assistance. An account of Marsh's visit is given in a manuscript entitled "Sketches of the Life of Red Cloud," by Captain James H. Cook, of Agate, Nebraska, at that time serving as a scout for the U. S. Army. Captain Cook writes:

> It was in the autumn of 1875 that I first learned of the petrified bones of strange creatures that had once occupied the lands to the eastward of the agency. Two of Red Cloud's subchiefs, American Horse and Little Wound, took me to the lodge of Afraid of Horses, where I was shown a piece of bone, perfectly petrified, containing a molar tooth three inches or more in diameter. American Horse explained that the tooth had belonged to a "Thunder Horse" that had lived "away back" and that then this creature would sometimes come down to earth in thunderstorms and chase and kill buffalo.
>
> His old people told stories of how on one occasion many, many years back, this big Thunder Horse had driven a herd of buffalo right into a camp of Lacota people during a bad thunderstorm, when these people were about to starve, and that they had killed many of these buffalo with their lances and arrows. The "Great Spirit" had sent the Thunder Horse to help them get food when it was needed most badly. This story was handed down from the time when the Indians had no horses.

It was this Indian tradition of the "big Thunder Horse" which suggested to Marsh the family name of Brontotheridae, derived from the Greek word *brontos,* thunder. The popular name Titanotheres is used in Monograph 55 in preference because Titanotherium was the first scientific name applied by Leidy to one of these animals.

The first collections made for this monograph were those brought together from Colorado and South Dakota, part of them under the direction of Marsh, for the Peabody Museum of Yale University. By far the greatest collection was that brought together by John Bell Hatcher for the Geological Survey, now preserved in the U. S. National Museum. Between 1870 and 1891 Marsh published fourteen papers on these collections. These papers relate more or less directly to the Brontotheridae; the last appeared in 1891 and contained descriptions of three new types from South Dakota—*Allops crassicornis, Brontops dispar* and *Brontotherium medium.*

On June 30, 1900, the director of the U. S. Geological Survey, Dr. Charles D. Walcott, appointed the present writer vertebrate paleontologist of the survey with the duty of continuing Marsh's work of completing the four unfinished monographs, namely, on the Stegosauria, the Ceratopsia, the Sauropoda and the Brontotheridae. The Ceratopsia was entrusted to Hatcher and Lull; the Stegosauria to Gilmore, while Osborn undertook the Sauropoda and the Brontotheridae.

The task of preparing Monograph 55, "The Titanotheres of Ancient Wyoming, Dakota and Nebraska," has been long and difficult. First, it proved necessary to reexplore the entire Eocene and

lower Oligocene series of rocks in Wyoming, Colorado and South Dakota, where the fossilized remains of titanotheres are found, both to determine precisely their geologic succession and to close up gaps in the stages of evolution; second, it proved necessary to examine and compare the titanotheres of these geologic epochs in all the museums of this country and in several museums abroad; third, it proved necessary, in order thoroughly to understand the titanotheres, to discover and to follow many side lines of investigation that have not hitherto been followed in vertebrate paleontology.

This work has been done with the aid of many specialists, foremost among whom is my junior colleague, Professor William K. Gregory, without whose intelligent and unremitting cooperation the monograph could never have been completed.

It is, perhaps, not too much to say that this work has transformed our knowledge of the early Tertiary geology of the Rocky Mountain basin region. First, the six life periods recognized by Marsh and his no less distinguished contemporary Edward Drinker Cope may now be replaced by sixteen life periods, which may be clearly defined and separated and certain of which may be more or less precisely correlated with life periods established for western Europe. Second, a much clearer notion has been gained of the changing geographic, physiographic, climatic and volcanic conditions in Wyoming and Dakota and of their influence on the migration and succession of forms of life. Third, the wholly new method of attack on problems of vertebrate paleontology has been developed; we seek to know the entire living animal, its musculature, its mode of locomotion and its feeding habits, in order to insure the complete restoration of the body. Fourth, the study of the many branches of this group has given the most convincing demonstration that evolution, even in any one geographic region, seldom moves along a single line of descent; more frequently it moves along many lines —it is polyphyletic; in other words, it radiates, following the principles of local adaptive radiation. Finally, the history of the titanothere family in its evolution from very small and relatively weak forms into titanic quadrupeds, second in size only to the elephants, has afforded us a unique opportunity to enlarge our previous knowledge of the actual modes of evolution as well as to revise our theories as to the causes of evolution and extinction.

OBITUARY

ARTHUR S. LOEVENHART

ON April 20 the ranks of the all too small group of workers in the field of experimental therapeutics were reduced by the death of Arthur Solomon Loevenhart, and a career energetically devoted to pure science, to therapeutic advancement and to the defense and promulgation of the highest medical ideals was brought to a close.

Arthur S. Loevenhart was born in Lexington, Kentucky, December 29, 1878. He grew up in his native city, and in the course of time attended the State College of Kentucky which is located there. His early educational history is illustrative of how little the progress of science depends upon magnificent buildings or upon elaborately equipped institutes, and of how much it depends upon those rare individuals who, having caught the spirit of science, devote their lives to the pursuit of knowledge. At that time the chair of chemistry was held by Professor J. H. Kastle. The remainder of the staff of the department consisted of only one student assistant, so that it was necessary for Professor Kastle to give three or four lectures a day, supplemented by laboratory work, in order to provide instruction in the various branches of chemistry. Nevertheless, this heavy burden of routine did not prevent him from continually contributing to chemical knowledge or from presenting the subject in such a way as to inspire students to investigate its problems. Into his classes there came the young Loevenhart. Professor Kastle quickly recognized in him a keen and resourceful pupil, and Loevenhart found a wise and sympathetic teacher. The association was most fruitful. Even before Loevenhart's graduation, which occurred before his twentieth year, they had finished a joint research on "The Oxidation of Formic Aldehyde by Hydrogen Peroxide."

In the following year they started their work on lipase. In the course of this work Loevenhart made the valuable suggestion that lipase might be capable of effecting the synthesis of fats from fatty acid and glycerine, and this led to the experimental synthesis of ethyl butyrate from ethyl alcohol and butyric acid. Thus the reversibility of enzyme action was for the first time established in a clean-cut manner, there being no complication such as in the previous instance of enzyme synthesis discovered by Croft Hill in which isomaltose, not maltose, was produced under the influence of yeast maltase, the isomaltose so produced not being again hydrolyzable by the maltase.

The years 1899–1903 were spent as a medical student at the Johns Hopkins University, but this experience did not in the least decrease Loevenhart's interest in chemical subjects. It merely served to widen his horizon; a vaster field was unfolded in