

in peace.» No death could have been more calm, more beautiful, than hers.

In the following May her husband followed her. Eighteen months before, he had gone out in a kind of ecstasy to his old haunts. As the great Eastern liner in which they traveled was approaching Malta, where his father had once been governor, the silvery-haired old man, happy and delighted, drew his fellow-passengers' attention to the fact that he had played there seventy-five years ago. «When we come round that corner,» he said, «you will see the fountain by which I played as a child. I remember throwing oranges into it, and my delight at seeing them flung up into the air by the upward gush of water.» As he lay peacefully but certainly dying, his sons

read to him in the deep-toned music of Homer. «I am happier than Priam,» he said gently; «for all my sons are with me.» A local preacher, hearing of his illness, sent in word to request that he might read the Scriptures to him. His son brought in the message. «Harry, my boy,» said the old scholar, happy with his Homer and his sons, «if you think it would be any comfort to him, let him come in.»

When his sons came home, Tennyson asked them many questions concerning the gentle old Benthamite, jurist, and philosopher, and his ardent, impetuous wife, who for so many years had been his near friends and neighbors in Freshwater.¹

¹ Following this paper will be one, by the same author, describing Tennyson's life at Freshwater.—EDITOR.

A GREAT NATURALIST.

EDWARD DRINKER COPE.

BY HENRY FAIRFIELD OSBORN.

EDWARD DRINKER COPE was born in Philadelphia, July 28, 1840. He attended school in Philadelphia, and studied for a brief period in the University of Pennsylvania Medical School. At twenty-three he traveled abroad, and at twenty-four he was elected professor in Haverford College, a position he soon resigned. Later he became connected with the Wheeler and the Hayden United States Geological Surveys. In 1878 he assumed the editorship of the «American Naturalist.» He held a professorship in the University of Pennsylvania and the presidency of the American Association for the Advancement of Science at the time of his death, April 12, 1897. Besides his voluminous contributions to zoölogy and paleontology, he published two well-known volumes of essays upon evolution, and several metaphysical papers.

SELDOM has a face reflected a character more fully than that of Professor Cope. His square and prominent forehead suggested his vigorous intellect and marvelous memory; his brilliant eyes were the media of exceptional keenness of observation; his prominent chin was in traditional harmony with his aggressive spirit. From this rare combination of qualities so essential to free investigation sprang his scientific genius, and, with exceptional facilities of wealth and culture in his early education, he became a great naturalist—certainly the greatest America has produced.

His ancestors were Pennsylvania Quakers remotely of English origin. His great-grandfather, Caleb Cope, although a patriotic colonist, showed his courage and his respect for law by shielding Major André from mob violence. Thomas Pim Cope, his grandfather, founded the famous mercantile shipping-house bearing the family name in Philadelphia. With these antecedents of independence and enterprise in his family, it is probable that the bias for nature-study first developed

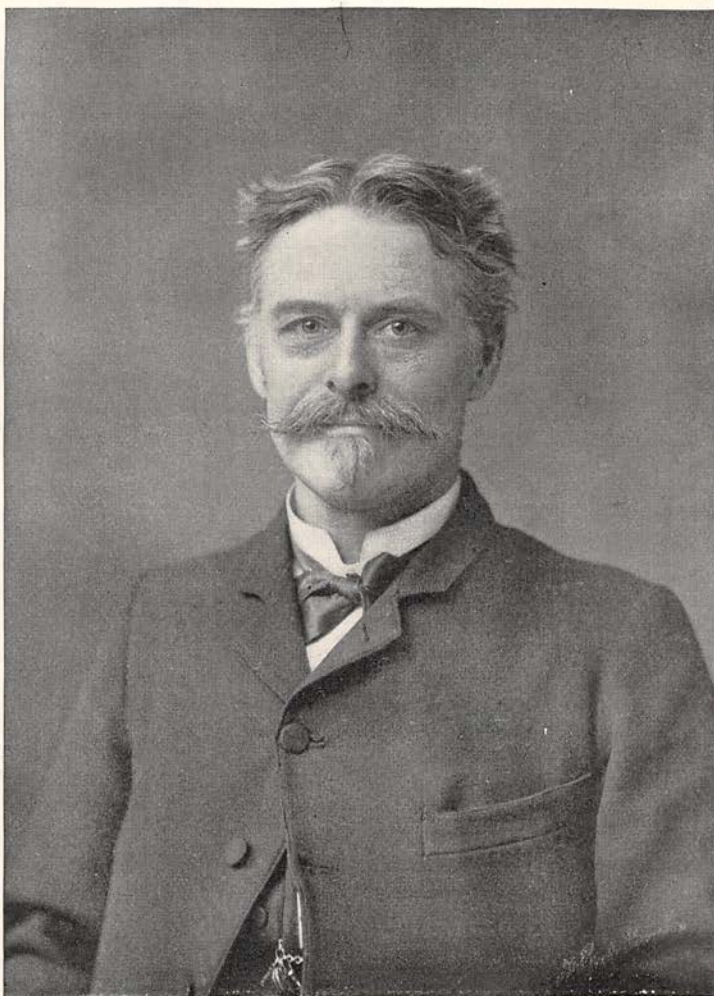
in his father, Alfred, who, although a merchant (being a junior member of the firm of Cope Brothers), did all in his power, by example, questioning, and travel, to develop in Edward the habit of original thinking. If so, this bias followed an occasional law of heredity, and accumulated as an irresistible impulse in the son. When the boy was only eight he visited the famous museum of the Philadelphia Academy, and in his journal, which fortunately is preserved, gave evidence of his precocious powers of observation by sketching a fossil ichthyosaur, and recording in quaint Quaker language: «Two of the sclerotic plates look at the eye—thee will see these in it.»

The merchant service of the family played a weighty part in his education, for before ten he had voyaged both to Boston (in 1847) and the West Indies (in 1850), making numerous notes and sketches of sea life on his way. Like every other great naturalist, he thus owed far more to his own direct schooling in nature than to his few years of formal tutoring, for he had neither college nor university

training. The following passage from a long letter to his cousin, written at the age of nineteen, shows his confidence in research:

Pleasant it is, too, to find one whose admiration of nature and detail is heightened, not chilled, by the necessary «investigation»; which, in my humble opinion, is one of the most useful as well as pleasing exercises of the intellect in the circle of human study. How many are there who are

Having passed six summers among the woods and streams of Chester County, Pennsylvania, it is not surprising to find him, at the time this letter was written, perfectly familiar with the plants, birds, snakes, and salamanders of eastern Pennsylvania, and perfectly aware of the rarity of such knowledge, for he adds to a description of his work: «Nobody in this country (or in



PHOTOGRAPHED BY F. GUTEKUNST.

EDWARD DRINKER COPE.

delighted with a «fine view,» but who seldom care to think of the mighty and mysterious agency that reared the hills, of the wonderful structure and growth of the forests that crown them, or of the complicated mechanism of the myriads of higher organisms that abound everywhere; who would see but little interesting in a fungus, and who would shrink in affected horror from a defenseless toad!

Europe, of *ours*) knows anything about salamanders but Professor Baird¹ and thy humble coz — that is, in some respects.» He refers also to his first publication in the Academy, and enjoins secrecy: «I send thee a copy,

¹ Professor Spencer F. Baird, secretary of the Smithsonian Institution, with whom young Cope worked a few months during the winter of 1859.

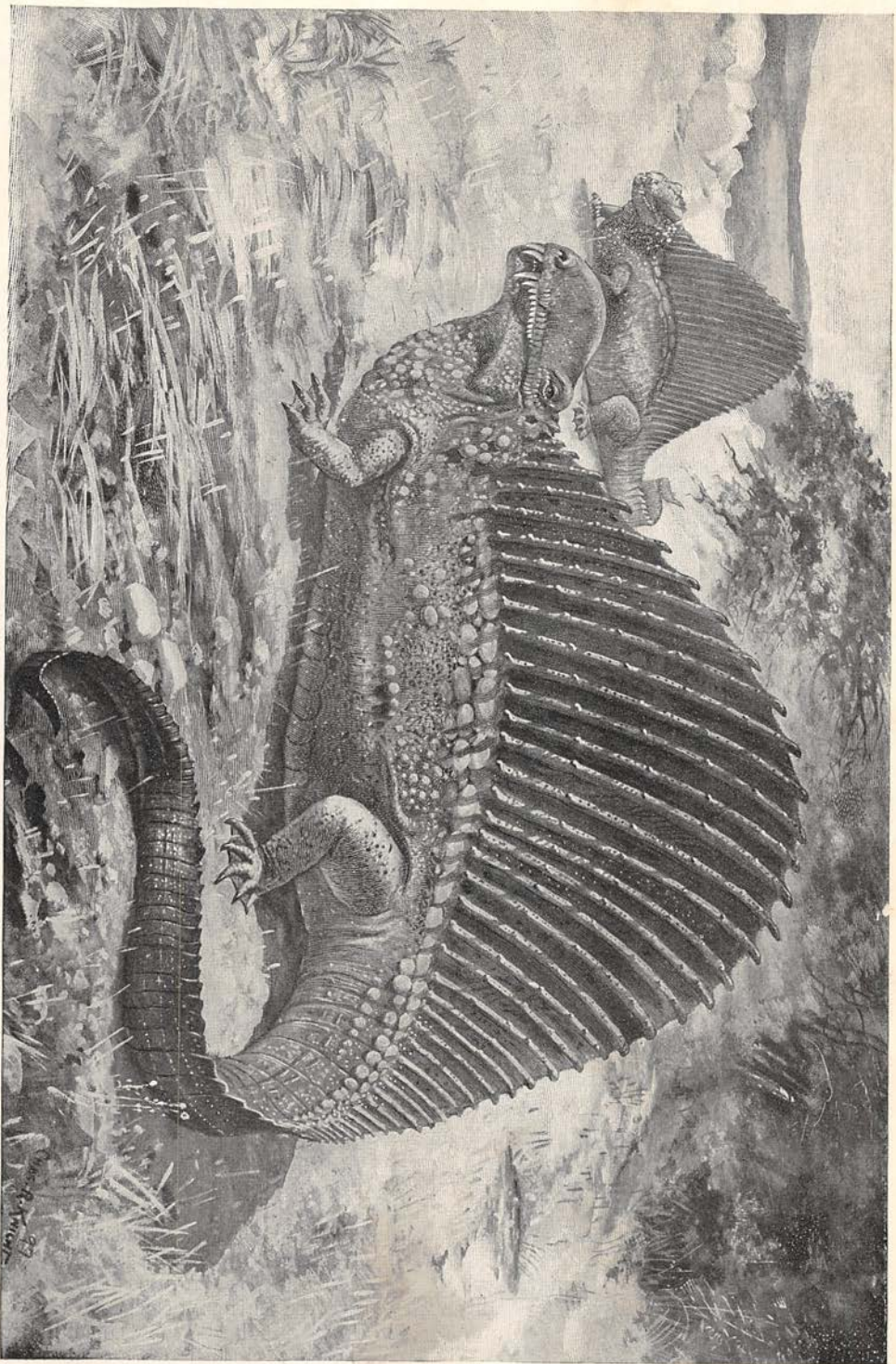
with the request that thee will neither mention nor show it; for, however trifling, I should doubtless be miserably annoyed by some if thee should.»

From this time on his range extended with astonishing rapidity—first among the living reptiles and amphibians; then among living and Paleozoic fishes; then among the great extinct reptiles of New Jersey and the Rocky Mountains, which form the subject of the accompanying article; finally among the ancient American quadrupeds. He acquired in turn a masterly knowledge of each type. Irreverent toward old systems, eager and ambitious to replace them by new ones of his own, with unbounded powers of hard work, whether in the field or at his desk, he rapidly became a leading spirit among the workers in the great realm of the backboneed creation, both in America and Europe. While inferior in logic, he showed Huxley's unerring vision of the most distinctive feature in a group of animals, as well as the broad grasp of Cuvier and of Cuvier's famous English disciple, Owen. While most men of our day are able to specialize among the details of an order, or at most of a class, Cope, at the age of thirty-four, had in his mental horizon at once the five great classes, although since Owen's time they had been greatly expanded by paleontological discovery. He was thus the last and the most distinguished representative of the old school of comparative anatomists. His high pressure of thirty-eight years' work was not consistent with excelling accuracy. We have often to look behind the returns in using Cope's work. Yet if it lacks German exactness, French beauty of presentation, and the solidity which marks the best English scientific workmanship, its dominant principles are sound, and its chief anatomical generalizations will endure longer than those of either Owen or Cuvier.

With this peculiar fitness for great studies came first the glorious opportunity of entering the unknown Western field as a pioneer with Marsh and Leidy. In 1866 he was the first to find along the New Jersey coast remains of the leaping dinosaur, *Laelaps aquilunguis* (p. 14), and he anticipated Huxley in comparing these reptiles with the birds. In 1871 he extended his explorations westward into what is now the most arid portion of Kansas, among the remains of the ancient marine monsters, the ram-nosed mosasaur and the sea-serpent or elasmosaur (p. 16). Following up the rapid advance of government exploration in the Rocky Mountains between 1872 and 1878, he discovered in New Mexico, Colorado, and

Wyoming the great amphiœlians, the gigantic camarasaurus, and the frill-necked dinosaur agathaumas. As a pioneer in exploration among these giant animals, he was obliged to draw his conclusions largely from fragmentary and imperfect materials, leaving the field open to Professor Marsh's more exhaustive explorations, which were supported by the government. Yet, as the ensuing article shows, Professor Cope illuminated the incomplete fragments with his reasoning and his fertile imagination. When a bone came into his hands, his first step was to turn it over and over, to comprehend its form thoroughly, and to compare it with its nearest ally, then to throw out a conjecture as to its uses and its relation to the life economy of the animal as a whole. One often found him virtually living in the past, vividly picturing to himself the muddy shores of the Permian seas of Texas, where the fin-back lizards basked, or the great fresh-water expanses of Wyoming and Montana, where the dinosaurs wandered. His conclusions as to the habits and modes of locomotion of these animals, often so grotesque as to excite laughter, were suggestive revivals from the vasty deeps of time of the muscular and nervous life which once impelled the mighty bones. It is fortunate that some of this imaginative history has been written down by Mr. Ballou, and that although physically enfeebled by a mortal illness, Professor Cope in his last days was able to convey to Mr. Knight, the artist, his impressions of how these ancient saurians lived and moved.

The second feature of his opportunity was, of course, that this pioneer exploration came early in the age of Darwinism, when missing links, not only in the human ancestry, but in the greater chain of backboneed animals, were at the highest premium. Thus he was fortunate in recording the discovery in north-western New Mexico of by far the oldest quadrupeds known, in finding among these the most venerable monkey, in describing to the world hundreds of links—in fact, whole chains—of descent between the most ancient quadrupeds and what we please to call the higher types, especially the horses, camels, tapirs, dogs, and cats. He labored successfully to connect the reptiles with the amphibians, and the latter with the fishes, and was as quick as a flash to detect in the paper of another author the oversight of some long-sought link which he had been awaiting. Thus in losing him we have lost our ablest and most discerning critic. No one has made such profuse and overwhelming demonstra-



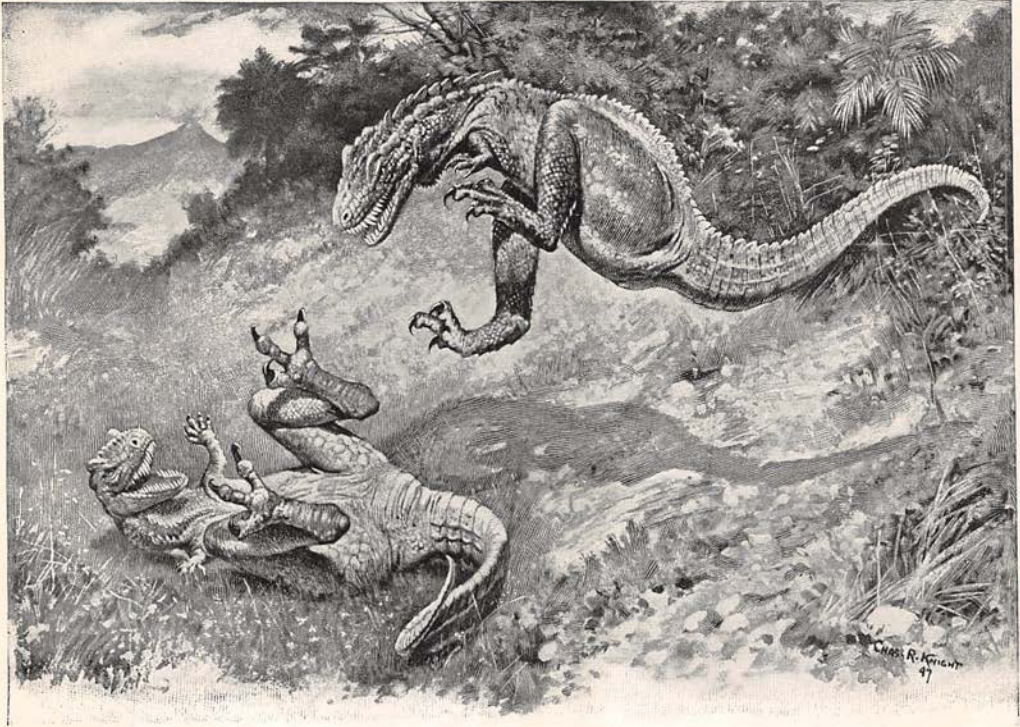
THE PIN-BACK LIZARDS.

The type specimens, *Dimetrodon tricristus* and the related genus, *Nosaurus claviger* (Cope), are from the Permian (Paleozoic age) of Texas. The skeletons found vary from three to ten feet in length, and are among the earliest forms of saurian life in the Triassic.

tion of the actual historical working of the laws of evolution, his popular reputation perhaps resting most widely upon his practical and speculative studies in evolution.

Many friends in this country and abroad have spoken of the invigorating nature of his companionship. A life of intense activity, harassed for long periods by many difficulties and obstacles, many of them of his own making, was nevertheless wholly without worry, that destroyer of the mind so common in our

and salutary reflection; and while its votary enjoys the disinterested pleasure of enlarging the intellect and increasing the comforts of society, he is himself independent of the caprices of human intercourse and the accidents of human fortune. Nature is his great and inexhaustible treasure. His days are always too short for his enjoyment; ennui is a stranger to his door. At peace with the world and with his own mind, he suffices to himself, makes all around him happy, and the close of his pleasing and beneficial existence is the evening of a beautiful day.



THE LEAPING DINOSAURS.

Laelaps aquilunguis (Cope), about twenty feet in length, from the Cretaceous of New Jersey. Its long hind legs enabled it to escape armored crocodiles and to capture the herbivorous *Hadrosaurus Foulkii*.

country. His half-century's enjoyment of research, extending from his seventh to his fifty-seventh year, can only be described in its effects upon him as buoyant; it lifted him far above disturbance by the ordinary matters of life, above considerations of physical comfort and material welfare, and animated him with a serene confidence in the rewards which Science extends to her votaries. He exemplified the truth of the words which Peacock puts into the meditation of Asterius:

. . . while science moves on in the calm dignity of its course, affording to youth delights equally pure and vivid—to maturity, calm and grateful occupation—to old age, the most pleasing recollections and inexhaustible materials of agreeable

While working at Cope's museum-residence in Philadelphia, the writer has had many queer experiences in the odd, half-Bohemian restaurants which the naturalist frequented. The quality of the meal was a secondary consideration to him, provided it afforded sufficient brain fuel. While eating he always relaxed into pure fun, and displayed a large fund of amusing anecdotes of the experiences, mishaps, and frailties of scientists, his own as often as those of others. He worked deliberately, and gave his whole mind to one subject at a time, if he considered it of special importance, this power being aided by his remarkable memory of species and of objects long laid aside for future reference.

In his field exploration his scientific enthusiasm burned still higher in pursuit of an unknown type or a missing link. Neither horses nor men could keep pace with his indefatigable energy. Heat and alkali-water were totally disregarded. From one of his Bitter Creek Desert trips he returned to Fort Bridger completely exhausted, and for weeks was prostrated with fever. Only a short time before his death, he laughingly related that after a solemn warning by a physician to avoid horse-back-riding and exposure to water, his health had been greatly improved in the course of a summer by three hundred miles' exercise in the saddle in North Dakota and several weeks' wading in New Jersey swamps. His house in Pine street became every year a greater curiosity, as the accumulating fossils, books, and pamphlets out-taxed the shelves and began to thicken like stratified deposits upon the floor in dust-laden walls and lanes.

Even his sleeping-room was piled to the ceiling, and he closed his eyes for the last time while lying upon a bed surrounded upon three sides by the loved objects of his life-work.

Appreciation of greatness is a mark of the civilization and culture of a people. Cope's monumental work, preserved in thousands of notes, short papers, and memoirs, and in three bulky government quartos, constitutes his assurance of enduring fame. Some of his countrymen, and even of his fellow-workers, allowed certain of his characteristics to obscure his stronger side in their estimate of him and his work; and during his life he received few of the honors such as foreigners are wont to bestow upon their countrymen of note. When we think more deeply of what really underlies human progress, we realize that only to a few men with the light of genius is it given to push the world's thought along, and that Edward D. Cope was one of these men.

STRANGE CREATURES OF THE PAST.

GIGANTIC SAURIANS OF THE REPTILIAN AGE.

BY WILLIAM H. BALLOU.

WITH PICTURES BY CHARLES R. KNIGHT.

AT his laboratory in Philadelphia, the late Professor Edward Drinker Cope devoted many years to the study of the fossil or petrified skeletons of the gigantic saurians, or lizard-like reptiles, found in various beds of the Rocky Mountains and other regions of the United States. These included the largest and most terrible animals that have ever inhabited the earth, few of them being less than twenty-five feet in length, and many of them reaching eighty, often with a corresponding height and a weight of tons. The skulls were examined in detail, the types of the teeth, the vertebræ, the limb-bones, and all the separate parts of each skeleton. There were also the older and smaller reptiles, discovered by exploring parties, to the structures of which he had given an equal amount of thought. During several months preceding his death his original and interesting views upon these animals, and his ingenious speculations regarding their habits, were imparted to the writer. In addition, he completed the evolution of the carnivorous line of saurians, so as to enable me to make the exclusive announcement of one of the most important discover-

ies or advances in paleontological science yet promulgated.

The early part of the Mesozoic realm is distinguished as the Triassic era. It was prolific in saurians entirely different from those which appeared in later times. Cope developed in the Triassic numerous species, large in size, some formidable in armor-plates, and others with rows of huge and terrible spines on the back. Also, in the preceding age—the Permian era of the Paleozoic—he found many saurians. Even farther back, in the older Paleozoic Carboniferous, or coal-measures, of Ohio, he discovered one saurian, the father of all lizards, the most ancient of its kind, the *Isodectes punctulatus* (Cope), which formerly figured as *Isodectes longipes*. This Ohio ancestor of the lizards was eight inches long, having the form of the modern lizard, but not its structure. Only about seven eighths of a single skeleton have been found, but sufficient to establish its commanding position in the history of life on this globe. *Punctulatus* had one relative in the Permian beds of Texas—*Isodectes megalops*, the typical poor relative, as but little is known of him. It is notable that the big saurians, after their