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OF

EDWARD DRINKER COPE
1840-1897

BY

HENRY FAIRFIELD OSBORN

PRESENTED TO THE ACADEMY AT THE ANNUAL MEETING, 1929
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LETTER OF TRANSMISSION

January the thirtieth,
Nineteen hundred twenty-nine

Edward Drinker Cope, one of the greatest palaeontologists and anatomists America has produced, died on April 12, 1897. Sometime before his death his secretary, Miss Anna M. Brown, had begun work upon his extraordinarily extensive and difficult bibliography. These materials passed into my hands together with a nearly complete set of Cope's writings and his two great collections of fossil vertebrates, including fishes, birds, reptiles and mammals, now in the American Museum of Natural History. Under my direction the bibliography was completely revised by Miss Jannette May Lucas and extensive scientific annotations were made by Dr. William Diller Matthew, Dr. W. B. Veazie, Dr. E. W. Gudger and Dr. William King Gregory. The portions concerning batrachians and reptiles have been verified by Dr. G. Kingsley Noble.

Shortly after Professor Cope's death, Persifor Frazer published a brief bibliography and biography. At the memorial meeting of the American Philosophical Society on November 12, 1897; a biographic symposium was held at which Theodore Gill reviewed Cope's work among the reptiles and fishes, while his contributions to geology and mammalogy were discussed by William Berryman Scott and myself. Appreciative, independent biographies were also written by Hosea Ballou, Marcus Benjamin, J. S. Kingsley and Persifor Frazer, by myself, and Miss Helen Dean King. The prolonged and intensive research into the extremely full life and works of Cope, in which I was first aided by Mrs. Hermann O. Mosenthal, dates back to 1897. This research was suspended for several years and then renewed with still deeper and more extensive research by Miss Helen Warren in the year 1928, continuing up to the present time.

Professor Cope's family has been warmly sympathetic in this
great undertaking and has generously donated to the Osborn Library of the American Museum, the entire family and scientific correspondence of Professor Cope, beginning with the diaries of his boyhood. Some members of Professor Cope's family at the instance of his daughter, Mrs. Julia Cope Collins, have generously contributed a sum to aid in this research, which has been partly sustained also by the Osborn Research and Publication fund of the American Museum of Natural History.

Thus step by step all the materials have been brought together and are now assembled in condensed form for the present Biographical Memoir of the National Academy of Sciences, prepared with the able aid of Mrs. Helen Warren Brown. It is expected that this relatively brief and concise biography of fourteen thousand words will be followed by a volume giving a more comprehensive account of the life and works of this man of remarkable genius.

The bibliography of Cope will be of incalculable value to all workers in vertebrate zoology and palaeontology, as well as in biology and philosophy, because it points out all the available sources, of both permanent and very fugitive character, in which may be found the outpourings of his lifelong observations and the brilliant series of generalizations which flowed from his creative mind.

Henry Fairfield Osborn.
INTRODUCTION

Edward Drinker Cope was born in Philadelphia, the cradle of American philosophic and scientific thought, on July 28, 1840, grew up a contemporary of the palaeontology which Georges Cuvier had founded in 1799, and spent his life and a considerable fortune in its furtherance. Happening to be born with an observing and enquiring mind, he absorbed in childhood the stores of natural history painstakingly gathered by pioneer scientists of the sixteenth, seventeenth and eighteenth centuries, worked them over with genius, adding as he grew older a first hand acquaintance with the unbelievably ancient fossils discovered by fur-traders in the plains of Nebraska, Montana, Wyoming, Colorado, Kansas, New Mexico, Oregon and Texas, and proceeded to astonish his conservative predecessors by setting forth overwhelming evidence of the theory of evolution as traced from fossil through living forms, from the lowest single-celled organism to man.

Altogether he contributed more than 1,300 papers to scientific literature, making known more than 600 species and many genera of extinct vertebrates new to science, many of which he had personally discovered in the Cretaceous strata of Kansas or the Tertiary of Wyoming and Colorado. Among these were some of the oldest known mammalia, obtained in New Mexico where he had served with the United States Geological Survey under G. M. Wheeler in 1874. In 1885 Cope wrote with some satisfaction that he had traced successfully the primitive ancestry of the reptiles, birds and fish, back to their point of origin and that among the mammalia he had done the same thing for the deer, the camels, the musk, the horse, the tapir, the rhinoceros, the cats and dogs, lemurs and monkeys, and had important
evidence of the origin of man among the mammals. The marsupials he had traced only in part and was also still baffled by the exact tree of the bears, elephants, hyenas and hogs.

**Ancestry and Boyhood**

The Copes of Philadelphia were Quakers, and like many members of the Pennsylvania Society of Friends, very prosperous. They were a branch of an old and distinguished Wiltshire family, one member of which, Oliver, having fallen upon hard times, bought some land from William Penn in 1687 and moved his family to America. They prospered and Oliver’s great-grandson, Thomas Pin Cope, became in 1821 proprietor of the Cope line of packets running between Philadelphia and Liverpool. Alfred Cope, son of Thomas, was therefore able to live a more or less retired life in the family place “Fairfield” not far from Philadelphia and to indulge his love for cultivating fine trees, rare shrubs and flowers.

At Fairfield his son, Edward, was born in July 1840 and grew up under his father’s tutelage. His early education although ostensibly aimed to make of him either a farmer or a shipowner, when taken into relation with his strong natural bent, moulded him firmly into a man of science. He was taught the names, characteristics and proper care of the trees and plants under cultivation in his father’s eight-acre farm. He was encouraged to observe the habits of the farmyard beasts and to keep pets. He was trained to make accurate maps, beginning with a diagram of the farm and branching out to the several states, the whole United States, the continent of North America, and finally the world. He learned a primary division of animals from his father:

- Pigs have bristles,
- Cows have hair,
- Birds have feathers,
- Snakes are bare.

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He was also permitted, as he grew older, to use his father’s library which included such natural history texts as Mark Catesby on the *Natural History of Carolina, Florida and the Bahama Islands*.

When he was six years old Edward was taken to a museum in Philadelphia, either Barnum’s or the one in the Academy of Natural Sciences building. There he saw the Mastodon skeleton and Koch’s disproportionate *Hydrachus* (Zeuglodon), the water king, which had been constructed from the remains of three skeletons to the astonishing length of 114 feet. Stuffed monkeys, alligators and crocodiles were also on display and Edward wrote a full description of the trip to his grandmother, stating characteristically: “Does thee know what that is? I will tell thee.” The following year the boy was taken to Boston on one of his grandfather’s ships and wrote a little journal along the way, sketching in it starfish, dolphins and flying fish, as well as the Bunker Hill monument. A year or two later he was taken to Cuba and was evidently deeply impressed by the tropical scenery; when he was seventeen he wrote from memory a very vivid description of a ride along a southern beach, skirting a most convincing jungle and palm trees. When he was about nine years old he was sent to school in Philadelphia and his visits to the Academy Museum became frequent. He went alone or with school-fellows and kept careful account of what he had seen, often illustrating by sketches of the animals his attempts at classification by name and characteristics. At thirteen, in 1853, he was sent to the Friends Select School at Westtown, Pennsylvania, where his lessons were usually well reported but the conduct of his restless and mischievous spirit often fell below par; this in spite of many remorseful promises of reform.

The Westtown School library seems to have been well-stocked; there in February 1856 Cope, at the age of fifteen, read Darwin’s *Voyage of a Naturalist* and pronounced it too full of geology. The course of school study, however, was the routine.

reading, mathematics, Bible study, penmanship, Greek and Latin with a little chemistry thrown in. In the summer the young naturalist made strides ahead in his favorite studies; not being very robust he was sent by his father to work on farms of various relations. These farms differed from year to year; the first was a garden truck farm, the next devoted to wheat and corn and another to fruit raising. By his own account the lad employed his spare time in studying “nurserying, ornithology, herpetology, botany and flageoletology.” He explored meadows, woods and fields, collecting birds, snakes, insects, reptiles, fish and flowers, for later comparison in the Philadelphia museum. He became more and more embued with the beauty in Nature, of which he had a strong sense, more and more eager to unravel the plan and meaning of life, both physical and mental, and more and more determined not to become a farmer.

YOUTH

He was persistent in this latter determination and advanced so many arguments against the economic wastefulness of the contemporary methods of farming that, when he was nineteen, his father finally gave in and set him to studying French and German under a private tutor. Dr. Joseph Thomas, the scholar selected, was an excellent linguist and developed in his pupil a fluency and familiarity with languages which was of great value to him. Cope consented to the language courses with the express understanding that they would “enable me to read useful books of a literary or scientific character.”

His first formal contribution to scientific literature came during this same year of 1859 with his communication of a paper on the Salamandridae to the Academy of Natural Sciences at Philadelphia, in whose halls he had been an interested student since his sixth year.

The ambitious youth soon convinced his father of the necessity of his studying comparative anatomy at the University of

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Philadelphia under Dr. Joseph Leidy as it would give him a proper knowledge of how to treat stock, should the occasion arise. He further remarked that he was already, at the age of twenty, familiar with the main points of anatomical structure and could perfect himself in the minutiae in a winter.

**Young Manhood**

Having completed the course with Leidy in the early Spring of 1861, he spent some months in cataloguing the reptilian collection of the Academy of Natural Sciences and then proceeded to Washington to study the herpetological collections of the Smithsonian Institution under Professor Spencer F. Baird. The winters of 1861-2 and 1862-3 were passed thus in war-torn Washington, while the summers were spent in farm work and in scientific writing. Most of the papers of these years were on herpetology, but one ventured into ichthyology and one into mammalogy. At the age of twenty-two, in the Spring of 1863, Cope went abroad to study the collections at Berlin, Leyden, Munich, Vienna, Paris and London. He remained abroad a year and returned in 1864 to an appointment as professor of natural science in Haverford College, a post he held for three years and then gave up in favor of scientific exploration and writing.

**Manhood**

Cope was married in July 1865 by the Quaker ceremony to his distant cousin, Annie Pim. Their only child, Julia, was born in July of the following year. In March 1867 Cope visited Agassiz at Cambridge and examined the great Brazilian collections. Three months later his own life as an explorer of remote and hazardous fields began with the apparently mild proposal of taking his wife and baby to the Virginia Springs for a vacation.

There, in Montgomery County, he explored the cave fauna—a type of investigation in which he was again engaged shortly before his death, thirty years later. In October 1867 he progressed to Maryland, examining the Eocene and Miocene beds which lie between the Potomac and Patuxent rivers. The next
March he turned his attention to the New Jersey marly sands near Pemberton in Burlington County. These he explored with his new found friend, Professor Othniel Charles Marsh of Yale, who was to become one of his bitterest rivals. But in 1868 they explored the marl peaceably together and found three new saurians of apparently known genera, though Cope was not certain of this classification and ascribed them tentatively to Mosa-saurus, Glavialis and Brimosaurus. The summer of 1869 found him among the mountains of McDowell County, North Carolina, hunting insects, salamanders, and fish and investigating the caves of the Black range, Craggy, Blue Ridge and Great Smoky mountains. Later in the season he lived near Raleigh inspecting the Miocene marl which exists thereabouts. In 1871 Cope's private explorations, which had thus far been financed from his own slender allowance, took him to the Kansas Cretaceous, but his field trips thereafter were in part financed by the national or State Geological Surveys with whom he had first become affiliated in 1865.

Work with Geological Surveys

Cope was busy with Herpetology in 1865, when Dr. Worthen of the Illinois State Geological Survey sent him the remains of a carboniferous salamanderlike amphibian for description. He named the creature Amphibamus grandiceps and transferred his enthusiasm for hunting living reptiles into seeking out the fossil forms. Extinct and living forms he considered together and light was shed from one to the other. In 1870 he gave expression to the results of his studies in a well-illustrated Synopsis of the Extinct Batrachia, Reptilia and Aves of North America, a brief diagnosis of groups with descriptions of new genera and species from the coal measures of Linton, Ohio. This was supplemented in 1875 by a Synopsis of the Extinct Batrachia from the Coal Measures, which appeared as part of the annual report of the Ohio Survey.

In 1872 his friend F. V. Hayden offered him a post with the U. S. Geological Survey and Cope went to Wyoming to examine the Bridger and Bitter Creek regions with a driving activity
which exhausted him and ended in his first serious illness. The trip began like so many of Cope’s with three days and three nights in a stage coach, bumping and jerking into the Wyoming wilderness, and consisted in weeks on horseback in an arid land amid constant danger of Indians, who were decidedly upon the warpath, but who fortunately considered Hayden mad and consequently an object of especial divine protection. The following summer Cope worked in the Colorado Miocene, again with Hayden and in 1875 his *Vertebrata of the Cretaceous Formations of the West* was published by the Government Printing Office. Cope’s work with Hayden, however, culminated in the publication in 1884 of a volume, popularly known as Cope’s Bible: *The Vertebrata of the Tertiary Formations of the West.* Book One of this work comprised the first half of Cope’s final report to the Hayden Survey. It includes the Eocene faunas and a part of the Oligocene (Lower Miocene) Rodentia, Insectivora, etc., Carnivora. The second book, to include the Oligocene (Lower Miocene) Ungulata and the Miocene (“Loup Fork”) fauna was never published although a large number of the plates prepared under Cope’s direction by William Diller Matthew were published in 1915 by the American Museum of Natural History with the co-operation of the U. S. Geological Survey. The failure to get this volume published was one of the great disappointments of Cope’s life. When it became apparent that the original Congressional appropriation for the publication would not be available, he spent many weary weeks and months in Washington from 1886 until 1890, trying to get a special item covering the costs passed as part of the Sundry Civil Bill. He waited upon Congressmen, Senators and Secretaries of the Interior, interviewed, prepared briefs, pleaded, and waited. Several times the item was approved by the Senate, but failed in the House. Finally Cope was referred back

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to Major Powell and the volume eventually appeared in the much abridged form of 1915.

Cope served as palaeontologist with the U. S. Geological Survey of the territory west of the 100th Meridian under G. M. Wheeler in 1874 and 1875, working in New Mexico, Montana and Oregon, and eventually publishing his report with that of Wheeler in 1877. The summer of that year [1877] Cope worked with the Wheeler Survey in the Permian of Texas, the results of his investigations being published in several bulletins of the Survey.

Besides his connection with the U. S. Geological Survey, which terminated when Marsh was placed in command, Cope worked with the Indiana State Survey, with the Canadian Geological Survey, and with the Texas State Survey. In the Indiana work he collaborated with Wortman publishing an Account of the Mammalian Fauna of the Post Pliocene Deposits in the State of Indiana in 1884 as part of the fourteenth annual report of the State Survey. His studies took him to Canada in the eighties and he became connected with the Canadian Geological Survey with the resultant publication of his Vertebrata of the Swift Current Creek Region of the Cypress Hills in that body's annual report of 1885, and of his Vertebrata from the Tertiary and Cretaceous Rocks of the Northwest Territory in the Contributions to Canadian Palaeontology, of 1891. The following year he returned to Texas, serving with the State Survey. The chief publication resultant was A Preliminary Report on the Vertebrate Palaeontology of the Llano Estacado which appeared in 1893, occupying ninety pages of the fourth annual report of the Survey.

Twenty Years of Intensive Research

The years after his retirement from the faculty of Haverford College were not solely devoted to work for the various Geological Surveys mentioned above. From late autumn until

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early Spring of these years Cope lived in Philadelphia, studying and describing the fossils collected on summer journeys and those sent him by other collectors in the same fields, writing long monographs and short papers, correcting and revising endless proofs, lecturing before the Franklin Institute and the Academy of Natural Sciences, and after 1878 publishing the *American Naturalist* as well. During these winters he occupied no professorial chair, though in 1873 he was considered by Princeton College for the Chair of Natural History. He was not enthusiastic about this position, however, because it would cut into his hours for research, and President McCosh of Princeton, on the other hand, was unenthusiastic about Cope, or so Cope thought, because of his advanced views regarding evolution. Occasional summers of these twenty years of research were spent away from the collecting fields. During the summer months of 1875 Cope remained in Philadelphia in charge of the division of organic material in the permanent exhibit of the Educational department at the Centennial Exposition; geological and palaeontological specimens of the United States were assembled under his direction and in later years he frequently referred to the Exposition with great pride.

In 1878 he went abroad to attend the Dublin meeting of the British Association for the Advancement of Science, to renew his familiarity with the fossil collections at London, Paris and Rheims, and to make the acquaintance of palaeontologists and geologists to whom he was already known through his writings. Among these men in the order of Cope's personal preference were, Professors W. Boyd Dawkins, Leith Adams, Macalister (of Dublin), Traquair (of Edinburgh), and Thomas Huxley—all palaeontologists of the Vertebrata—and among geologists, Professor John Evans, Mr. Hicks of Wales and Mr. Pengelly of Cornwall.

Returning to his field work, Cope visited California and Oregon in 1879 making the friendship of Professor Condon of Oregon, with whom he had long discussions of his present work in the Silver Lake district, of the fossils he had found and discovered in the past, and of those he hoped to find in the
future. 1881 took him back to the Santa Fe trail and New Mexico, this time working alone, while in 1882 he returned to Oregon. During the next three summers his eagerness to increase his funds, for the purchase and collecting of material for his precious monographs, led Cope into disaster. He had inherited more than a quarter of a million dollars after his father's death in 1875 and with almost childlike faith he invested his capital in silver mines in Mexico. He personally investigated the mines and detected silver, but failed to detect the schemes of promoters. Seeing his misplaced trust too late he feverishly threw good money to cover bad. Finally in 1886 he realized that he was in very straightened circumstances; he struggled with poverty for the rest of his life.

Honors came to Cope during his years of intensive research. In 1872 he was made a member of the U. S. National Academy of Sciences and in 1878 of the Societie Geologique de France. The Bigsby gold medal of the Geological Society of London was awarded to him the following year. In 1886 he was elected a member of the Imperial Society of Moscow and received the honorary degree of Doctor of Philosophy from the University of Heidelberg. This was his only academic degree. In 1891 the results of his research were recognized by the award of the Hayden Memorial medal. Distinction had also come to him through his connection with the Academy of Natural Sciences, the American Philosophical Society and the American Naturalist, of which he was editor and publisher.

Connection with the Academy of Natural Sciences and the American Philosophical Society

Cope's connection with the Academy of Natural Sciences at Philadelphia began with his first visit to its halls, when he was six years old. The publication of his first paper in the Academy Proceedings of 1859 strengthened the bond his constant childhood visits had made and upon coming of age in 1861 he became a member of the Academy, whose herpetological collections had already afforded him his first scientific job. For twenty years thereafter Cope's shorter papers, with the exception of
those appearing in the *American Naturalist*, were usually published by the Academy.

He served it as Curator from 1865 until 1873, as Corresponding Secretary from 1863 until 1876 and as a member of the Council in 1879, but he was not satisfied with it and his outspoken criticism of the management of its affairs, which he believed placed buildings before publications and wealth before accomplishment, made him many enemies. He suggested three fundamental changes in its organization without avail: first that a series of fellowships open only to experts of established reputation be inaugurated; second, that the officers of the Academy should be selected from the fellows only; third, that the Professors should be, *ex officio*, members of the Council. This attempt to keep science for the scientists, as far as the actual machinery was concerned, was frowned upon and defeated.

Finally in 1883 Cope resigned from the Academy and in 1885 described himself as elected to "a position of honor if not emolument in the American Philosophical Society." For years those papers not published by the U. S. Geological Survey, the *American Naturalist* and the *Open Court* or the National Academy of Sciences were included in the proceedings of the American Philosophical Society. Yet in making his will Cope forgot the Philosophical Society and remembered the Academy.

**Editor of the American Naturalist**

*The American Naturalist* of Salem, Massachusetts, was for sale in 1878; Cope bought a part interest. He moved the magazine to Philadelphia and arranged to edit it jointly with Professor A. S. Packard. In 1887 he became editor-in-chief and so continued until his death, but although it provided him with an organ for disseminating his opinions on science, sociology, religion and government and thus increased his prestige and influence, the *Naturalist* was a constant drain upon his purse and upon his energy, as its publishers were numerous, difficult to manage and expensive.

Cope's two most important contributions to the literature of Evolution were issued independently of the *Naturalist*, the
Origin of the Fittest being brought out by Appleton in 1886 and Primary Factors of Organic Evolution by the Open Court Publishing Company in 1896.

Later Years

It being apparent in 1886 that Cope had been swindled out of his patrimony and that something must be done to meet even the modest expenses of his family, he leased his Philadelphia dwelling and moved into the adjoining house which he had previously used as a workroom and storehouse. He merely pitched camp among the bones and manuscripts and set up house-keeping. He began negotiations for the sale of his North American fossil collection and endeavored to secure an appointment as Assistant Secretary of the Smithsonian Institution, but failed. He was, therefore, doubly glad to receive the professorship of geology and mineralogy at the University of Pennsylvania in 1889 and to occupy that position until 1895, when he was transferred to the professorship of zoology and comparative anatomy previously held by Dr. Joseph Leidy.

He went joyously to his work with the Texas Survey in 1892 and 1893, investigating both that state and North Dakota. These were his last Western trips; the remaining three summers of his life were varied only by short trips to eastern caves, such as the Port Kennedy caves in Pennsylvania and the Megalonyx caves in Ohio and Kentucky. The sale of his North American fossil mammalian collection was concluded in 1895 to the American Museum of Natural History, which also later secured the Pampean collection he had bought from Buenos Ayrian scientists in Paris in 1878. Cope hated to part with his North American mammalian more than any other feature of his poverty, but he remained gay and cheerful despite his disappointment and despite the fact that he was beginning to be threateningly ill. In 1896 he was elected to the presidency of the American Association for the Advancement of Science and would have delivered the presidential address in August 1897 had his long-menaced health held out. He fell ill in the spring of 1897 and continued doggedly to attend his classes at the
University, but in April he became really very ill and on the
twelth of that month he died. Shortly before his death he
delivered in delirium a brilliant and unified lecture on the
Felidae and his last conscious sight was of giant bones, piled
on every side of his cot. The Quakers, from whose Society
Cope had resigned in 1878, came to bury him and to help ex-
ecute his will, dated October 1, 1895, the principal provisions
of which were as follows:

I hereby appoint Jno. B. Garrett of Philadelphia and Henry F. Osborn
of New York to be the Executors of this Will. In case of the death
of either party, I appoint as substitutes Asa S. Wing of Philadelphia
and William B. Scott of Princeton, N. J., the former in place of J. B.
Garrett, and the latter in place of H. F. Osborn.

... Of my scientific books I direct that all which they desire
shall be taken by the Biological School of the University of Pennsyl-
vania for their library, and the remainder shall be sold and the proceeds
divided equally between my wife and daughter.

Of my collections, I direct that all those preserved as wet prepara-
tions shall be given to the Academy of Natural Sciences for their
museum.

I leave my osteological collections to the School of Biology of the
University of Pennsylvania for the use of original investigators pri-
arily, and for use by students when said specimens are not in use
by original investigators.

My collection of minerals I present to the University of Pennsylvania
to be placed in their general collection. My collection of skins of ani-
mal together with the skeleton which accompanies each skin, if any
there be, I present to the Academy of Natural Sciences of Philadelphia.

My collection of Fresh water Mollusca I present to the School of
Biology of the University of Pennsylvania; the first set of duplicates
to go to the Cincinnati Society of Natural History, and the second to
the American Museum of Natural History of New York.

My palaeontological collections I divide into three parts. First, the
North American Collection; Second, the South American, i.e., the
Pampean Collection which I purchased of the Buenos Ayrian Ex-
hibitors at the Paris Exposition of 1878, and small collections from
the West Indies and Mexico; Third, European Collections, chiefly from
the Miocene of Allier, France. I direct all these to be sold for the
benefit of my estate. I advise my executors that these collections have
cost me about $50,000.00. I place no restrictions on them as to the
manner of sale except that it may be done as soon as the best advan-
tage indicates.

Of the proceeds of all sales hitherto mentioned in this will, I direct
that my debts shall be paid. . . . The remainder, which I suppose
will amount to about $40,000, I leave to the Academy of Natural
Sciences of Philadelphia as an endowment for a professorship or
curatorship of Vertebrate palaeontology under the following conditions:
Said professor shall be an original investigator of merit who shall be
elected by the Council of the Academy and shall have the approval
of the U. S. National Academy of Sciences, as an original investigator
of merit. His position and services shall be those of a professor as
defined in the present by-laws of the Academy: i.e., he shall have entire
charge of the material embraced in his department, and the curators
shall not interfere with his jurisdiction excepting to see that he does
not neglect his duties. Of the income of this sum, $400 per annum
shall be used for the procurement of vertebrate fossils either by col-
lection or by purchase.

The remainder of my real and personal estate I leave to my wife
during her lifetime; and after her death to my daughter, Mrs. Julia
C. Collins. In case both die, I leave said remainder, one half to my
son-in-law, W. C. Collins, and the other half to augment the purchase
fund of the chair of vertebrate palaeontology in the Academy of Natural
Sciences.

Codicil. March 24th, 1896.

I direct that after my funeral my body shall be presented to the
Anthropometric Society and that an autopsy shall be performed on it.
My brain shall be preserved in their collection of brains, and my
skeleton shall be prepared and preserved in their collections, in a locked
case or drawer, and shall not be placed on exhibition, but shall be open
to the inspection of students of anthropology. The remainder of my
body, I direct, shall be burned and my ashes be preserved in the same
place as shall contain the ashes of my esteemed friends, Dr. Jos. Leidy
and Dr. Jno. A. Ryder.

Contribution to Geology and Stratigraphy

Inextricably involved in Cope’s chosen task of unravelling
the problems of life, the structure, functions, development and
phylogenetic descent of animals, as well as the broad meta-
physical questions which underlie and condition all these prob-
lems, were his investigations of geology. These were in his
eyes subordinate to palaeontology, but necessary to its proper
chronology, consequently he had very little to say concerning
structural or dynamic problems of geology and regarded every
question in that field from the strictly historical view. Stratig-
raphy, the determination of limits, distribution, succession and
geological date of the formations in which his fossils were embedded, as well as the correlation of these formations with their equivalents in other parts of the world, constituted his geological occupations; for he could make out the phylogenies of the various animal groups only after he had determined the true chronological order of succession of the genera composing the phyletic series.

When Cope began his studies in the Cretaceous of Kansas in 1871, the whole region was comparatively new and for the most part geologically unexplored; he was, therefore, forced to work out the stratigraphical succession for himself. This was most fortunate, since it made him personally familiar with the strata in which the fossils lay, a rare opportunity for scientists of that day, among them, Leidy, who had worked all his life from bones picked up by chance passersby from the surface of the ground where they had been weathered out of the matrix. Sternberg’s method of getting out skeletons and shipping them so far as possible in situ had not yet been perfected, so Cope came to geology through palaeontology. Accordingly most of his writings on the subject are scattered through his palaeontological papers and would be very difficult to reassemble, but in the opinion of Professor William Berryman Scott, from whose material this article is prepared, those scattered observations of Cope’s were epoch making.

They came, says Professor Scott, at a time when “the haziest ideas were entertained regarding the position and succession of most of the numerous and extensive fresh-water formations, which characterize the western part of the country. It would be an exaggerated claim to say that he had brought order out of the chaos, but it is hardly too much to say that he, more than any other single individual, contributed to this great result. Such was his power of insight that he was occasionally too far ahead of his contemporaries, and only of late have certain of his views received their just meed of appreciation. In some instances, indeed, we are coming back to the opinions which he first promulgated, but which were ignored or rejected at the time.
"Great as his genius undoubtedly was, Cope was not, even as an investigator perfect and free from every fault; to use a Gallicism, he had 'the defects of his qualities.' He was so impressed with the immensity of the work to be done, with the necessity of speed, and with the shortness of the time allotted to him, and he was often so carried away by the rushing impetuosity of his thought, that he published no little hasty and ill-considered work. He frequently made blunders that a little more care and consideration would have enabled him to avoid, so eager was he to say what he had to say, and then pass on to the attack of some new problem. To balance this defect, however, he had no tendency to pose as infallible, or to defend errors simply because he had himself committed them. While extremely clear as to his own opinions and the grounds upon which he held them, and while ready to give and take hard knocks in the defense of his views, he was always ready, on good reason being shown, to change those views, and he allowed no weak regard for fancied consistency to hamper the freedom of his thought. . . . Those who are familiar with the vast and desolate regions where the work was done, and who know the great difficulties which the pioneer explorer has to overcome, will view the matter in a very different light and will always regard with admiration the rapidity, clear-sightedness, and skill with which the great complex of fresh-water deposits was marshaled in orderly array, their succession determined, and their equivalences with similar deposits in other parts of the world made out."

This correlation of the various fossiliferous horizons of North America with those of Europe, made possible by Cope's wide and accurate knowledge of the successive vertebrate fauna of both continents, was one of his most valuable contributions to geology. Of this Professor Scott wrote in 1897:

"Of late it has become rather the fashion to deprecate as premature all attempts at correlating American and European formations and even to deny the possibility of making such correlations in any trustworthy way. From the strictly geological point of view, such a conservative attitude is natural
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enough; but Cope did not regard the question from a purely geological standpoint. He was, above all things, a zoologist, and his principal life work lay in tracing the origins, phylogenies, and relationships of animals, their migrations and geographical distribution, and he clearly saw that such determinations could not be successfully undertaken unless the order of successive appearance of the various animal types in the different continents could first be established. To this end, geological correlations of widely separated deposits are an indispensable necessity, and a false correlation is better as a working hypothesis than none at all, for it sets up a definite thesis in place of vague surmises.

"In several of these determinations of the equivalences between the fresh-water Tertiaries of North America and those of other continents, Cope was a pioneer, and while not all of his correlations have stood the test of fuller knowledge, many of them have only grown stronger with the advance of time and stand out as guide-posts in the further prosecution of the work. For example, his correlations of the Wasatch with the Suessonian of France (in which he followed Marsh), and of the White River with the Oligocene of Ronzon, have been abundantly confirmed by discoveries undreamed of when the equivalences were first suggested. The value of these determinations to the morphological palaeontologist can hardly be overestimated, and every investigator owes a debt of gratitude to Cope for his labors in this department of geology."

A cursory survey of Cope's work in geology, taken in the order of geological chronology, begins with his single interest in the Permian rocks among the Palaeozoic formations. A controversy about the existence of Permian rocks in the United States had been going on since 1852, when Marcou had reported their presence in Texas and Swallow, Meek and Hayden had confirmed this discovery by finding them in Kansas as well, in 1858. Other authorities disputed this determination and maintained that there was no well-defined Permian rocks in the United States. In 1877 Cope obtained his first specimens of Amphibia and Reptilia from Texas and proceeded to publish a
series of descriptions of extinct vertebrata from the Permian and Triassic Formations of the United States, in which he fully determined the Permian character of rocks in both Texas and Illinois. The researches of I. C. White and Fontaine upon the plants and of C. A. White upon the invertebrates later confirmed Cope's conclusions.

This identification of horizons in regions where they had not previously been known continued in Cope's work in the Triassic, Jurassic and older Cretaceous. Though he neither discovered new formations, nor corrected the reference of those mistakenly placed in the geological columns, he did investigate very thoroughly, especially in the Cretaceous. He was the first to discover Dinosaurian remains in the Laramie stage, and is said to have been the first to recommend the reference of that horizon to the Cretaceous, a radical innovation which was finally adopted by his contemporaries, as it proved its value in giving a fixed point in the obscure formations intervening between the Cretaceous and Tertiary.

In the unravelling of the fresh-water Tertiaries which cover such vast areas of the West lay Cope's most signal service to geology. It is difficult to exaggerate the value of these services according to Professor Scott, who has summed them up, as follows:

"First of all should be mentioned his discovery and identification of the Puerco, or oldest Eocene, which may fairly be called 'epoch-making.' Not only was a very extensive, entirely new and highly significant fauna brought to light, but also the existence of a long time-interval between the Laramie and the Wasatch was demonstrated, showing that the supposed continuity of sedimentation connecting those horizons was illusory. This discovery necessitated an entire change in the views concerning the geological history of the Western region in post-Cretaceous times. The Puerco carried the Eocene much farther back than had been expected, and opened up a new world to the palaeontologist.

"The succeeding Wasatch formation had been discovered and named by Hayden, and its correlation with the Suessonian
of Europe had been pointed out by Marsh, but it is to Cope that we owe much the greater part of our knowledge concerning its distribution, its relations, and its place in the geological column. Personally, or through his collectors, he thoroughly explored the Wasatch of New Mexico and Wyoming, elucidating its fauna with wonderful skill and insight, and strengthening the theory of its close correspondence to the Suessonian of France, with which his studies in that country had made him familiar.

"In the Bridger formation, Cope added very largely to what was known regarding the vertebrate fauna, and established the position of the Wind River beds as forming a substage at the base of the Bridger and making a transition from the older Wasatch to the Bridger proper. He also made a classical series of investigations upon the fishes of the Green River shales, and pointed out the probable equivalence in time of these beds with those of the Wind River substage. He first described the fauna of the Manti beds of Utah of approximately contemporaneous age."

Hayden and Leidy had very thoroughly examined the White River formation and its very rich vertebrate fauna, and Leidy in his famous monographs had determined these beds as being of Miocene age. Cope challenged this determination and referred the formations rather to Oligocene, stressing the importance of their correspondence with European formations, but the followers of Leidy remained firm adherents of the Miocene determination and considerable confusion resulted. The misleading Miocene determination remained in use for some time, despite Cope's detection of White River beds in North Dakota two hundred miles north of the first discovery and his extension of the range of that formation into the Swift Current region of the Northwestern territory of Canada. Fossils sent him by the Canadian Survey facilitated this latter determination and showed him certain resemblances to the contemporary life of Europe in addition to those which he had detected in the United States.

The Amyzon shales of Nevada and central Oregon and the
Florissant beds of Colorado came under Cope's examination during his preparation of a description of a series of fishes which had been obtained from these formations. He was inclined to consider them of Oligocene or late Eocene age, although somewhat in doubt as to their exact geological date, because of the absence of decisive stratigraphical indication and because fossils common to them and other localities were lacking. In dealing voluminously with the abundant vertebrate fauna of the John Day stage, Cope had little to say regarding its geology beyond that which had been said by his predecessors. In the Loup Fork, however, his observations were original and contrary to precedent.

Leidy had first described the Loup Fork fauna from fossils sent him by explorers and fur traders, who had picked up bones lying on the surface of the ground. These had been weathered out from overlying Pleistocene deposits and were intermixed with too many extinct and peculiar genera to altogether retain their modern classification. Leidy accordingly determined this admixture of fauna as Pliocene, but Cope was suspicious of this reference from the first. When his opportunity of personally examining the Loup Fork beds presented itself, he sought out areas where the strata were at the surface and where no newer overlying formations could falsify his collections. He thus accurately determined the actual elements of the Loup Fork fauna and found them lacking the Pleistocene forms which former casual collections had mistakenly included in them. He came at once to the belief that the Loup Fork beds were not Pliocene at all, but Upper Miocene and extended their area to New Mexico, Texas and the valley of old Mexico. Though considered a great reform in Western stratigraphy by many American geologists this determination was not universally adopted, and while some authorities continued to uphold Leidy's reference confusion prevailed, much to the embarrassment of European writers.

Having determined the fauna as Upper Miocene, Cope proceeded to show that the formation is divisible into two distinct substages. Grinnel and Dana had discovered certain lacustrine
deposits in the valley of the Smith River in central Montana in 1875 and determined them as Pliocene, by which they supposedly meant Loup Fork. Cope sent a collector into this region and from the material gathered showed that these beds which Cope assigned to Nebraska and South Dakota as well as Montana, constituted a substage of the Loup Fork and were older than any part of that formation which had been known up to that time. This determination was of significance in helping to bridge the gap between the John Day and the typical Loup Fork and eventually proved to be of great value in making correlations with the fresh-water deposits of the European Upper Miocene.

The Pliocene of the interior portion of the United States was at this time very vaguely known, but during his studies of the fishes Cope identified certain beds in Idaho and Central Oregon as Pliocene and proposed the name Idaho beds for them. He also was the first to make known the Blanco beds of Texas, describing their stratigraphy, geographical distribution and fossil contents, and thus disclosed one of the most typical and unmistakable of North American fresh-water Pliocenes.

In the Pleistocene, Cope's work consisted in the determination of the successive mammalian faunas and the consequent foundation of the divisions of the North American Pleistocene. This work was thoroughly done in the Sheridan or Equus beds of the West and Southwest in widely separated localities, and in the caverns of the East. Notable among these caverns were his early and later investigations of the extensive assemblage of Pleistocene vertebrates in the Port Kennedy bone cave of Pennsylvania, which formed the subject of one of his last publications. The Sheridan beds and the Megalonyx beds of the East, he at first considered Pliocene, but eventually changed his opinion and classed them with the Port Kennedy faunas as Pleistocene.

Investigations of the geology and palaeontology of the Atlantic coast, though they formed Cope's first introduction to palaeontology, yielded up such fragmentary and unsatisfactory
material that the results of his labors are less apparent and he remains the geologist, palaeontologist and evolutionist of the Western plains.

Contributions to Herpetology

Cope was a naturalist, not a specialist in one branch of natural history. Herpetology, however, was the first field to interest him and remained one of his chief studies, so that his work in this line ranks with the specialization of many men. The first exhibit of the Museum of the Academy of Natural Sciences at Philadelphia of which the six-year-old boy wrote to his grandmother was the mammal Hydrarchus (Zeuglodon) then falsely labelled the whale-like lizard. Visiting the Museum a year or so later, he noted in his little journal: “Some saurians which are fossil skeletons that are found in the rocks of England, but it is very curious that they are monstrous sea lizards.” In the woods and fields at Fairfield, in the school grounds at Westtown and during summers on the Pennsylvania farms of various cousins, he sought salamanders, snakes and tortoises under roots, stones, fallen trees and layers of leaves and identified his trophies with those described in his father’s library or preserved in the Academy Museum.

Just before his fifteenth birthday he wrote to his father, “I caught a large water snake or water wampum, as they are called here—one of the Colubers—in Brandywine and brought it home. It was about as long as my leg, but very thick for its length. . . . I afterwards found it had eaten a large bull frog . . . . I soon convinced myself it was not (poisonous) by examining its mouth which wanted fangs, and as all non-venomous have, it had four rows of teeth in its upper, and two in its lower jaw, and two rows of scales under its tail.” Throughout his life he collected snakes, toads and salamanders whenever he found a strange species, shipping them home, some

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1 See Theodore Gill, Retiring Presidential Address before the American Association for the Advancement of Science, 1897; also Proceedings of the American Philosophical Society, November 12, 1897.
alive and some in alcohol, from the muddy streets of San Antonio, the deserts of New Mexico and the mountains of Nevada and North Carolina. When Cope was nineteen, in 1859, his first formal contribution to scientific literature appeared in the April Proceedings of the Academy of Natural Sciences under title, *On the Primary Divisions of the Salamandridae, with descriptions of Two New Species*. Therein the youthful scientist instituted modifications of the systems previously adopted in the United States.

While still too young to become a member of the Academy, which he joined in 1861 upon coming of age, he occupied several winter months in cataloguing the serpents contained in its Museum and introduced innovations in the systems of classification then in use. He next studied the herpetological collections of the Smithsonian Institution under Spencer F. Baird and then went abroad for his intensive study of the collections of England, France, Austria, Holland and Prussia. His studies covered besides specific details and general taxonomy, the consideration of anatomical details of the reptiles and amphibians, the modifications of general organs, geographical distribution, genetic relations and physiological consequences. For five years his publications were devoted almost exclusively to the reptiles and amphibians and through this channel he entered palaeontology, writing in 1865 his first paper in this field, a description of the stegosaurian amphibian called *Amphibamus grandiceps*, and though the scope of his writings widened thereafter to palaeontology, geology, philosophy and even sociology, he never lost sight of his interest in herpetology nor ceased contributing to it.

Theodore Gill has said of Cope: "He found Herpetology an art; he left it a science; he found it a device mainly for the naming of specimens; he left it the expression of the co-ordination of all structural features." Cope approached herpetological classification boldly and critically surveyed the work of the authorities of the day, Duméril, Bibron and Günther. Where he saw that changes were needed he calmly proposed that they be
made and backed up his suggestions with such sound reasoning that they were adopted.

The anurous amphibians and the saurian reptiles were differentiated in groups, at the time Cope's work began, chiefly on account of superficial characteristics: such as the mode of fixation of the tongue, or its lack; the development of the toes to disklike expansions at the tips, or to simple attenuation; and the presence or absence of teeth. Cope proceeded to investigate the group anatomically and reached new conclusions. He found that important differences existed in the structure of the sternum, especially in the connection of the lateral halves; that in the common tree-toads of Europe and North America the so-called clavicle and coracoid of each side are "connected by a longitudinal arched cartilage which overlaps that of the opposite side" while in the common frogs the clavicles and coracoids of both sides are connected by a single median cartilage. He named the former of these groups, the toads, Arcifers and the latter, frogs, et cetera, Firmisternials and placed the Firmisternials higher in the evolution scale because of their more highly developed shoulder girdle. The development of teeth he first regarded, with his contemporaries, as a very important factor of classification, but later came to subordinate.

Applying his principle of a skeletal basis of classification, Cope dissected the lizards and redistributed them into new divisions, based upon an equation of all skeletal characteristics: such as, structure of the cranium, concordance and variations in the development of bones, structure of the vertebrae, shoulder girdle, teeth, tongue and pholidosis; rather than the previous superficial grouping by tongue form, arrangement of scales, and development of legs and feet. This new method of classification became a matter of bitter correspondence between Cope and the old school herpetologists, but finally won recognition through the sanction of the British Museum catalogues. It crystalized into two volumes which remain, though out-dated, the only comprehensive works on American Herpetology: The Batrachia of North America, published in 1889,
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**Contributions to Ichthyology**

Cope's contributions to the classification and evolution of the fishes proved to be of such great importance that many of the orders and suborders recognized by him have been adopted by subsequent ichthyologists, especially in America. Beginning with the fresh-water fishes of the Carp family in 1861, he published a series of papers from 1864-1891, including *Partial Catalogue of the Cold-blooded Vertebrata of Michigan; Synopsis of the Cyprinidae of Pennsylvania* and *Observations of the Systematic Relations of the Fishes.* Some of the most interesting genera of North American fresh-water fishes were first made known by him (1864-1869). He attempted to arrange them in natural groups and was the first to appreciate the importance of certain characters, such as the structure of the dorsal fin and the relation of the air-bladder to the digestive tract.

His next great series of contributions (1871-1891) dealt with the natural subdivisions of the entire series of fish-like vertebrates. In these papers the following subjects of major interest were dealt with:

1. The division of the fishes into classes and subclasses.
2. The analysis and reclassification of the old and unnatural group of "ganoids."
3. The division of the higher teleosts, or Actinopteri, into no less than twenty-four orders, eight of which survive today.
4. The grouping of a series of fresh-water families, including the suckers, carps, loaches, characins, etc., into the order Plectospondyli.
5. The breaking up of the old unnatural assemblage of eel-like fishes into several orders and many families.
6. The analysis and classification of the Devonian fossil...
fishes generally called crossopterygians into a series of orders and suborders.

Cope's contributions to the fresh-water fishes, like his observations on the snakes and lizards, were based at all points on personal observation of the material and an adventurous spirit in the discovery of new and hitherto neglected anatomical characters of possible value as criteria of classification. His studies on the classification and phylogeny of fishes as a whole were based partly upon a large collection of skeletons of fishes from all parts of the world, which he had purchased from Professor Joseph Hyrtl of Vienna.

Cope's influence in the subsequent development of ichthyology was far greater than would appear on the surface because many of his orders and suborders were adopted with slight modifications in the classification of the fossil fishes in the British Museum by Dr. Arthur Smith Woodward.

**Contributions to Mammalogy**

Cope's most numerous and voluminous writings were devoted to mammals, and to appreciate the importance of his contributions in this group it is necessary to cast a brief glance over the history of mammalian palaeontology. Cuvier, the founder of this branch of science, had represented the *école des faits* in opposition to Geoffrey St. Hilaire, and founded a school wholly opposed to generalization as to the origin and succession of animal life, and firmly adherent to the Special Creation hypothesis. As a master of comparative anatomy, Cuvier exerted an immense influence upon the succeeding French palaeontologists, such as Jourdan, Croizet, Christol, De Blainville, Aymard, Lartet and Pomel. It is true that De Blainville and Gervais showed a wide range of knowledge but Gaudry was the first of the French palaeontologists to grasp the spirit of evolution. In Germany, Jager and Blumenbach ranked as more or less voluminous descriptive writers, while Kaup showed superior powers of analysis.

Cuvier's unnatural classification of the hoofed animals into the *Solipeds*, or horses, and *Pachyderms*, or rhinoceroses and
hippopotami, prevailed and was adopted even by Leidy in this country. Richard Owen, by far the greatest anatomist after Cuvier, made a decided advance, and, as in the classification of the fishes and reptiles, was the direct predecessor of Cope. Partly anticipated by De Blainville, he defined the new mammalian orders, Marsupialia and Toxodontia, and especially broke down Cuvier's classification of the Ungulates by distinguishing the Perissodactyla from the Artiodactyla upon the basis of foot structure, the importance of which Cuvier himself had only dimly perceived.

In this country the earlier contributions of Jefferson, Harlan and Gibbs were over-shadowed in the mid-century by the numerous valuable works of Leidy, who became at once the founder of American vertebrate palaeontology, although in deference to the theologic spirit of the times he held in check the philosophical spirit both in anatomy and evolution. Thus, from all this long post-Cuvierian period and immense number of facts, there issued only two generalizations, the first of which may be regarded as the great laws or principles in the evolution and classification of the mammalia. These laws are as follows:

1. The Law of Brain-Growth—This principle, that the older mammalia had smaller brains, and that in order of succession there was a steady increase in brain size, was enunciated by Lartet, and has been subsequently elaborated and demonstrated by Marsh.

11. The Classification of the Hoofed Animals by Foot-Structure—This was discovered by Owen in his division above alluded to, which first directed attention to the importance of differences in the feet.

The three vertebrate palaeontologists of the new period who responded most fully to the Darwinian movements were Huxley, Marsh and Cope. Huxley unwillingly entered the field, but soon found an opportunity of overthrowing Cuvier's Law of Correlation. His greatest generalization was the central position of the order Insectivora. He had, however, few opportunities of working upon fossil mammals; he erroneously placed Paloplotherium instead of Hyracotherium in the ancestral horse.
line, and erroneously supported Reichert’s theory of the homology of the quadrate bones. Cope and Marsh alike responded to the Darwinian impulse but along entirely different lines. In Russia appeared Waldemar Kowalevsky, who had a short but brilliant career in mammalian palaeontology. He announced the third great principle:

III. Law of Adaptation of Foot Structure in Ungulates by Reduction, Accompanied by Shifting of the Metapodials—Kowalevsky’s ancestral type of ungulate or protungulate, like that of Huxley, was believed to possess five digits.

In the meantime the gifted John A. Ryder, of Philadelphia, was attacking the problems of the mechanical evolution of the feet and teeth from the Lamarckian standpoint.

Cope, who had practically entered mammalian palaeontology in 1870, found a great field of facts lying fallow before him, with the three principles outlined above as means of interpretation. Keen to wed philosophy with anatomy, in 1873 he added to the generalizations of Huxley and Kowalevsky the additional principle:

IV. The Ancestors of the Hoofed Animals Possessed Bunionodont, or hillock-like Teeth—This prophecy was speedily verified by Wortman’s discovery of Phenacodus. This discovery led Cope on to a reclassification of the entire group of ungulates by foot-structure—the logical outcome of the movement in which Owen, Huxley, Ryder and himself had participated. This classification centered about the following principle:

V. The Law of Taxeopody: that the Primitive Feet of Hoofed Animals were Serially Plantigrade, Like those of the Bear, with Serial Unbroken Joints—Thus he proposed in the early eighties the four new orders, two of which have been permanently adopted into palaeontology: Equivalent to these are three orders proposed by Marsh:

### Cope
- Taxeopoda, 1882
- Amblyopoda, 1875
- Condylarthra, 1881
- Diploarthra, 1883

### Marsh
- Protungulata, 1884
- Amblydactyla, 1884
- Clinodactyla, 1884
Kowalevsky, in 1873, had pointed out the significant articulations of the metapodials in the *Artiodactyla*; Cope here showed the still greater importance of the mutual articulations of the podials, firmly establishing thereupon the orders *Condylarthra* and *Amblypoda*, uniting Owen's *Perissodactyla* and *Artiodactyla* into the *Diplarthra*, and by hypothetical phyla connecting the *Proboscidea* and *Hyracoidea* with a still-to-be-discovered plantigrade, bunodont stem, the "protungulate" of Huxley, Kowalevsky and Marsh. These generalizations despite errors of detail and interpretation which Rutimeyer and Osborn have pointed out, constituted the first distinct advance in mammalian classification since Owen demolished Cuvier's "pachydermata"; they rank with Huxley's best work among similar problems, and afford a basis for the phylogenetic arrangement of the hoofed orders which has been adopted by all American and foreign palaeontologists.

Having thus raised the foot and head, regions of the body so long neglected by the followers of Cuvier (with the exceptions noted), to a position of prime importance in classification, it was his good fortune to discover in the collections from the Puerco or basal Eocene the following law:

VI. *Law of Trituberculy*: that all Types of Molar Teeth in Mammals Originate in Modifications of the Tritubercular Form—It became apparent to him that the hoofed mammals had sprung from clawed ancestors, but the Wasatch period was too remote from the parting of the ways to furnish conclusive evidence. This evidence came in a flood from the underlying Puerco fauna, the systematic evidence of which constitutes the most unique section of Cope's work among the extinct mammalia. From this material originated the above great generalization—namely, that the primitive pattern of the molar tooth consists of three great tubercles, a generalization modified and extended by Osborn, Gregory and others. Around this *trituberculy* center the whole modern morphology of the teeth of the mammalia and the establishment of a series of homologies in the teeth of most diverse types, applying even in the teeth of man. The force and application of the trituber-
cular law Cope clearly perceived, but left to others fully to work out and demonstrate. It promises ultimately to give us the key to the entire phylogeny of the mammalia, extending to every division of the marsupialia and placentalia.

Thus the final philosophical working basis for the evolution of the hoofed, as well as the clawed, animals has been well established, for, as Professor Marsh observes in his monograph on Dinocerata, “the characters of the most importance in the evolution of the Ungulates are the teeth, the brain, and the feet.”

It now only remained for Cope to take another step beyond Huxley and Kowalevsky and, aided by fortunate discoveries in the field, he demonstrated that the ancestors of the hoofed animals were clawed animals, establishing the seventh law:

VII. *The Hoofed Orders Arise from the Clawed Types of Creodonta and Insectivora.*

So much for the great generalizations which establish Cope’s historical position in mammalian palaeontology. These are the mountain peaks, the points where explorations and discovery were followed by happy inspiration, in a chain of contributions which includes his exposition of the faunal succession of the mammals from the base to the summit of the Tertiary, as well as two or three discoveries of great interest in the Cretaceous. His most conspicuous work relates to the Puerco, with its extremely primitive hoofed and clawed animals and primates. Here he established the existence in this country of the *Plagiaulacidae* and defined the order *Multituberculata.* That from the Wasatch is perhaps next in value, and in succession rank his contributions from the John Day, Loup Fork, Blanco, Palo Duro, and Port Kennedy Bone Cave.

**COPE AS A FIELD EXPLORER**

As an explorer he had marked success, finding the unique skeleton of *Hyrachyus,* of *Loxolophodon,* a name which was telegraphed to the American Philosophical Society, and converted by the operator into *Lefalophodon.* He also found the last of the great race of Uintatheres at the top of Washakie
Mountain of central Wyoming. In the Bridger, Cope himself found the lower jaw of *Anaptomorphus*, a little monkey with a dental formula like that of man, which, owing to its extreme antiquity, occasioned him a greater surprise than any discovery he ever made. We owe to him alone our knowledge of the scanty Wind River fauna. From the White River Oligocene his materials were poor and his work less satisfactory. From the rich Upper Oligocene, with the assistance of Wortman, he secured fine collections and has especially enriched our knowledge of the *Anchitheriidae*, *Felidae* and *Canidae*. From the Upper Miocene, Deep River and Loup Fork beds he has practically originated all that we know, especially of the rhinoceroses, horses, mastodons, camels, and other ruminants and carnivora. Of the latter fauna his most complete papers were upon the evolution of the *Oreodontidae*. His latest contributions to our knowledge of the fossil mammalia were upon the fauna of the Blanco and Palo Duro, or Goodnight beds of Texas, and the rich cave fauna from Port Kennedy, Pennsylvania, brought together by his warm friend, Dr. H. C. Mercer.

The *Tertiary Vertebrata*, Vol. III, of the Hayden quartos, published in 1884, is his most inspiring contribution to palaeontology, including his studies of all the vertebrate fauna of the Tertiary Lakes west of the Rockies. This work of over a thousand pages and seventy-five plates is said to have been the despair of the Public Printer, owing to the constant additions made while in press. It extends from the Puerco to a portion of the lower Miocene fauna. Besides the full description and illustration of the great hoofed orders above alluded to, it contains the full exposition of the characteristic forms of *Creodonta*, an order of primitive Carnivora, which, as we have seen, he separated from the Marsupialia in 1875, and in which he placed six families of mammals from different parts of the world. It will be observed that this volume is entitled “Part I.” Cope had in mind a second part which would hardly have been less voluminous. The plates for this part were all prepared and in themselves constituted such an important feature in American palaeontology that at the urgent instance of the present
Before leaving the mammals it is fitting to speak of his Lamarckian work upon "kinetogenesis," or the mechanical origin of the hard parts of the body, especially the teeth, vertebrae, and limbs. An invaluable paper by his friend and later colleague, Ryder, put him upon this line of investigation, the results of which he published in a long series of papers, culminating in his memoir upon the "Origin of the Hard Parts of the Mammalia" and in his collection of essays upon the "Origin of the Fittest" and "Primary Factors of Organic Evolution." One of his chief motives in these researches was the demonstration, which he believed they afforded, of the hereditary transmission of the effects of individual efforts, use and disuse. Even if this Lamarckian motive is subsequently shown to be an illusive one by our future knowledge of the real nature of evolution, these investigations lose little, if any, of their intrinsic value. First, as in all his work, he brings together an immense array of valuable facts and observations; second, he extends the principle of the independent origin of similar structures; third, he in most cases successfully establishes the actual mechanically adaptive or teleological relations of the parts described; fourth, he traces the course of phylogenic modification in a number of important organs and thus establishes certain obscure homologies, notably those in the teeth of Amblypoda, Coryphodon and Uintatherium.

Contributions to Ornithology

Cope was an occasional contributor to the literature of ornithology. He was the first to recognize Laelaps aquilunguis as the probable link between birds and reptiles. He continued to contribute short descriptions of birds from time to time but never became more than an intelligent and well-informed amateur in ornithology. However, a school essay written at
the age of seventeen gives strong indication of an accurate
knowledge of the habits of birds and shows that Cope might
have developed into a popular bird-man if he had not hap-
pened to concentrate his forces in other fields of natural his-
tory. In that essay the youth said in part, regarding the Yellow
Breasted Chat:

"Often while passing along some retired lane in the country, have I
stopped to listen to the singular notes of this bird as they came suddenly
upon my ear, like the whistling of the wings of a dove or teal . . .
causing me to look up in the expectation of seeing some wild fowl
flying off before me . . . . One may readily discover the bird's
whereabouts by answering him . . . . He will give you some curious
specimens of ventriloquism. His shrill whistle will seem far ahead,
when on its ceasing you will be greeted with a note not unlike the
half-suppressed creak of an old bull-frog, deep in the thicket beside
you; if you stop, he raises his key, almost exactly imitating the call
of the partridge, varying it with some deep guttural sounds, much like
the barking of young puppies. If you happen to be near his mate and
her nest, his anxiety becomes very great; he scolds incessantly, mixing
up his whistles and croaks into a most singular jargon of sounds. But
if you will sit down on the grass and be right quiet, before long his
notes will cease, and if you look carefully under the thicket, you will
most likely see him, with his tail up and head down, peering at you
with his dark eye, from the lower branch of some sumach. If he finds
he is discovered, he becomes more bold and will fly out into the air
above your head, where with legs hanging straight down, and tail stick-
ing straight up, he will jerk about, rising pretty high with his short
concave wings, and then dropping lower and lower when he glides off
into the thicket again. On clear moonlight nights his notes may be
heard till long after midnight . . . . the country people call him the
mocking bird.

"This is perhaps the most difficult bird to shoot that we have . . .
Catesby, an Englishman, who spent some time travelling through the
country in the 16th century, in his Natural History of the Colonies,
says that he tried his best to obtain specimens himself, but could not,
and had to apply to the Indians, who with all their ingenuity found
it a difficult matter . . . .

"In size he is somewhat less than the cat bird; the color of his back
and wings . . . olive green, and his throat and breast bright yellow.
In form he differs from all other birds, excepting an East Indian
species with which he is arranged in the genus 'Icteria.' Naturalists
differ very widely, as to what family this genus should be referred to.
His trivial name, 'polyglotta,' indicates his musical powers."
Cope had been diverted from herpetology, as we have seen, by the arrival of *Amphibamus grandiceps* and had swung to an enthusiasm for palaeontology which resulted in his monumental researches, explorations and publications for various State and National Geological Surveys from 1866 until 1897. Beginning in 1866 he was the first to find along the New Jersey coast remains of the leaping dinosaur, *Laeleps aquihingitis*, and he anticipated Huxley in comparing these reptiles with the birds.\(^9\)

In 1871 he extended his investigations into the most arid portion of Kansas and there found remains of the ancient marine monsters, the ram-nosed mosasaur, and the sea-serpent or elasmosaur. Following up Custer's army into the Rocky Mountains between the years 1872 and 1878, he discovered in New Mexico, Colorado and Wyoming, the great *Amphicoelias*, the gigantic *Camarasaurus* and the frill-necked *Agathaumas*. In 1877 he received his first fossils from the Permian of Texas and his investigations thereafter revealed a new fauna, rich in species widely different from any previously known.

Working often alone, except for guides, he was obliged to draw his conclusions from fragmentary and imperfect materials and he felt always the necessity of hastening the publication of his findings that he might be the first to herald them. When a bone came into his hands, Professor Cope slowly turned it over and over to thoroughly comprehend its form 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. He studied the soil and rocks which had entombed the mighty bones, pictured to himself the muscles and nerves which had clothed them and made possible a locomotion to the methods of which the bones themselves bore mute testimony. His mind's eye saw vividly the muddy shores of the

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\(^9\) See also, Contributions to Mammalogy, Ichthyology, Geology, and Work with Geological Surveys. Also, Osborn, *Impressions of Great Naturalists.*

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Texas Permian seas where the fin-backed lizards basked, and the great fresh-water expanses of Wyoming and Montana where the dinosaurs wandered. He spoke of these things graphically and today they are visualized in many of our great museums through his inspiration.

PHYLLOGENY OF THE VERTEBRATA

In reconstructing the history of the animals from their bones, Cope, through his great knowledge of anatomy, was also able to connect the ancient species with their modern descendants and to fill in many gaps both in human and animal ancestry. He was fortunate in finding in northwestern New Mexico by far the oldest quadrupeds known at that time, in finding among these the most venerable monkey then known, in describing to the world hundreds of links in the descent of the horses, camels, tapirs, dogs and cats. He worked out (though these views have been modified by later work) the connection between the amphibians and the reptiles and between the amphibians and the true fish, and he was quick as a flash to detect in the paper of some other author the oversight of some link for which he had long been searching.

His final pronouncement of views concerning the phylogeny of the true fishes, amphibians and reptiles was given in the Proceedings of the American Philosophical Society for 1892 (pp. 278-281). The ancestral type of the bony fishes was thought to be “probably the Ichthyomous order of the subclass of sharks (Elasmbranchii).” These he selected because “they are hyostylic, and have cranial segmentation, the basioccipital element being conspicuous. The fins are primitive and those of all other types of fishes might have been derived from them.” This view is now being modified by the opinion that much of the simplicity of the sharks is degenerate; the Ichthyotomi are now considered as probably the most primitive of known sharks, but too definitely elasmobranchs to be ancestral to the teleostomes and the two are thought to be of equal antiquity palaeontologically.
There remained some doubt in Cope's mind as to the probable ancestry of the batrachia and he remarked "that it cannot be considered to be yet settled." He was at first a supporter of the Haeckelian belief that they had been derived from the Dipnoi or Dipneusta, but later discarded this theory in favor of Theodore Gill's proposal of the Crossopterygians. He suggested particularly the Rhipidopterygia, in which he included the families of Holopteriidae, Tristichopteridae, Osteolepididae, Coelacanthidae, "and perhaps some others." The origin of the amphibia is now sought in or near the crossopterygians and the osteolepids are believed to be closest to this ancestry of any known forms.

He was less cautious about the reptiles, which at that time were admittedly differentiated from the amphibian stock, although the exact point of departure remained in obscurity, and concluded that the batrachians which were nearest to the reptiles were the "Emblemata of the Permian epoch." It is now usually accepted that the Emblemata among the amphibia are closest to the reptiles, perhaps because this term is used for a grade of structure which appears to be primitive for amphibia, but the origin of reptiles is now sought farther back than the Permian.

As to his scientific attainment in the field of taxonomy or classification, apart from his genius, which is indefinable, we signalize his appreciation of the most significant or diagnostic character in a group. Among his fellow-workers in the same field, whether upon the fishes, amphibia, or mammals, he was quick to comprehend and seize upon a strategic position. While others were plodding on serenely in the description of facts, giving all an equal value, Cope, with an eagle eye, would swoop down upon some great distinctive fact and point out its supreme importance. Thus he projected the mammalian order, Creodonta, out of numerous forms, such as Palaeonictis, Hyaeodon, Arctocydon, which had been discovered and studied for many years in France. It is to be regretted that he did not more willingly surrender some of his own hypotheses. He
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clung to his erroneous mechanical explanation of the origin of ungulate foot structure long after it had been disproved by the present writer. Like all of us, perhaps, he loved his own hypotheses, and he once observed in jest in regard to a fossil which had opposed one of his theories, “I wish you would throw that bone out of the window.”

He was no respecter of authority per se. Even if sometimes mistaken, his fearless criticisms were chiefly animated by high ideals and readiness to change the existing order of things. He was full of cheer and determination when things looked most unpromising, allowing nothing to disturb the composure which is so essential to research.

Contributions to Sociology

As the Copes' only child, Julia, grew up her father became interested in the education of women and through that subject in various other sociological problems. He proceeded to publish his opinions. He believed that women, being the mothers of the race and equal contributors to its development, should enjoy opportunities for intellectual development equal to those of men.11 He sent his daughter to Miss Burnham’s School at Northampton, Massachusetts, stipulating that she should study as much science as possible. Later, in 1885, he transferred her studies to the newly-opened Bryn Mawr College where Woodrow Wilson and other recent graduates of the Johns Hopkins University were young professors. He continually admonished his daughter to study, telling her that the best beloved woman was she who combined beauty with intelligence and an informed mind.

That woman of any race, however, is predestined to a physical and mental inferiority to the man of her own race Cope firmly stated; giving the physical disabilities as “inferior muscular strength and child-bearing”; and the mental disabilities as “inferior mental co-ordination, and greater emotional sensibility.

which interferes more or less with rational action.” He stated the differences between the sexes as follows: 12

“The struggle with Nature has given the male of man superior muscular strength and superior rationality. Both have been forced upon him, the first by exertion, the second by experience. Necessity has also compelled him to undergo labor of body and of mind for long continued periods, so that his powers of endurance have been cultivated. Knowing the danger of physical conflict with his kind, he has learned to exercise a certain control of his manners and language. As regards women, their maternal instinct and the care of children have cultivated their affections rather than their rational faculties. Their occupations, although often laborious, have been generally less severe than those of men; hence results their inferior muscular strength, which is from two-thirds to one-half that of a man of the same race and condition. Their affectional nature has led women to cultivate the aesthetic and to excel in the adornment of their persons and their homes. For natural reasons they have become more cleanly than man, more refined, and more attentive to small matters. The general effect of the preponderance of the emotional element in the female mind is to render it more liable to the temporary loss of the coordinate action of its parts, than in the man. This fact is illustrated in the greater ease with which women fall into tears, syncope, hysteria, etc. On the other hand women learn many things with great facility, and are quite as skillful in the use of languages as men.”

Cope opposed woman suffrage, because he regarded man as woman’s natural protector and legislator, because he believed the suffrage should be restricted rather than increased in any case, and because he doubted woman’s power of becoming a serious economic or political factor. They would vote through emotional suasion either with or against their husbands and lovers, he thought, and similarly in economics, although some women might be successful in business or professional undertakings, even they would be dependent upon capital produced by masculine effort. Woman suffrage he therefore discarded as an unnecessary promoter of family quarrels, of which there were sufficient causes already, and an instigator of sexual

12 *The Marriage Problem*, by Prof. E. D. Cope; published from The Open Court of November 15 and 22, 1888, by A. E. Foote, 1223 Belmont Avenue, Philadelphia, 1888.
discord which would react evilly upon the race through the
deterioration of feminine attributes.

Regarding marriage Cope was very advanced. He ap-
proached the problem almost as a physician approaches the
sick, and begged for as calm and unprejudiced a view of the
situation as possible. He believed in monogamy as the best
economic and psychological adjustment of the biologic problem
to civilization. He believed that when monogamy failed two
root causes were culpable: mental, spiritual and physical igno-
rance; and serious divergencies of character and conduct due
to ancestry and education. His first reform of the marriage
laws concerned unions which involved insane persons, habitual
drunkards, and drug addicts: to these when single he would
forbid marriage, and when married he would enforce separation
"for the all-sufficient reason that such unions cause a great
deterioration of the race."

Of normal marriage he remarked: "Eighteen hundred years
of Christianity finds us in as great difficulties as ever, but
with our sense of justice quickened and our sympathies de-
veloped. We have as a basis the fact that most of the white
race at least, are capable of a generous and self-sacrificing
intersexual passion, which, if treated with reasonable consider-
ation, is of lasting character." Taking this view and the
acknowledged failures of the existing system as a starting point,
Cope stated his premise: "What is necessary is that matrimonial
changes shall be removed from the domain of caprice, and
shall be only permitted after a full and fair trial," and ex-
pounded his golden mean: the contract marriage. This solu-
tion provided for three arbitrarily successive contracts; to
have the same value and effect as the existing marriage con-
tract and the same bearing upon support, property and divorce
as the laws then prevailing in Pennsylvania, which Cope cited
as the most liberal in the country. The time limits of the con-
tracts should increase so as to prevent women of mature age
from being deprived of support: the first contract, for pre-
viously unmarried persons, should endure for five years and
should be renewable only at the desire of both parties; the
second contract should then run for ten or fifteen years and
should lapse only at the desire of both parties; the third con-
tract for permanent relations should then be available. In
cases of second marriage the longest contract next in order for
either party should be obligatory, except in cases where one
person had hitherto been unmarried when the previous time
contract of the other should be duplicated for the new marriage.
Divorce at the expiration of a contract should be granted
without publicity, the custody of children being settled as under
prevailing laws. A man should be held responsible for the
support of his children after divorce, but not of his wife if
she be childless. In that case, as her divorce was of her own
choosing, she should support herself or be supported by her
family.

Throughout the discussion of the marriage problem, educa-
tion and suffrage, Cope was insistently the biologist, interpret-
ing his sociology by the laws of nature and led to optimism
by his belief in evolution. He was an intense Lamarckian and
stated in his "Origin of the Fittest," "I have learned the con-
nection between the motion of animals and the development of
their structure by my studies of paleontology. It is a satis-
faction to me to be able to prove the fatherhood of mind or
living personality over living nature. It will be the next step
to prove that it has been so over dead nature, also. . . . In
the proper way and at the proper time mind controls. To find
out how this is and when and where, is the great problem of
science, also therefore of progress and prosperity."

Cope was a theist in evolution, probably because so long as
his orthodox Quaker father lived he was continually requested
to reconcile his theories with the religious views in which he
had been strictly trained. His affection for his father and his
real devotion to a faith, which was after all less troubled by
dogma than many sects of his generation, helped him. In fact
he justified his early acceptance of the Darwin theory in 1871
as a "Shaker of false faiths and an aid to that which is founded
on a rock, that that which cannot be shaken may remain." After
his father's death he began to feel that the need of curtailing
his views to avoid controversy and scandal in a small circle was too severe a strain upon his adventurous imagination. He accordingly resigned from the Society of Friends in 1878, but remained a theist in philosophy and a creative evolutionist in scientific theory.

Conclusion

The most conspicuous feature of Cope's character from boyhood upward was independence; seldom has a face reflected a character more fully. 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.

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 works, 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 human thought along, and that Edward Drinker Cope was one of these men.

We may contrast three great Academicians: Joseph Leidy, Edward Drinker Cope and Othniel Charles Marsh. Whereas in Leidy we had a man of the exact observer type, Cope was a man who loved speculation. If Leidy was the natural successor of Cuvier, Cope was the natural successor of Lamarck. Leidy, in his contributions to the academy, covered the whole world of nature, from the Protozoa and Infusoria up to man, and he
lived as the last great naturalist in the world of the old type who was able by both capacity and training to cover the whole field of nature. Cope, in contrast, mastered—and this mastery in itself was a wonderful achievement—the entire domain of vertebrates from the fishes up. Marsh, with less breadth and less ability, nevertheless was a palaeontologist of a very high order and had a genius for appreciating what might be called the most important thing in science. He always knew where to explore, where to seek the transition stages, and he never lost the opportunity to point out at the earliest possible moment the most significant fact to be discovered and disseminated.

It is most interesting to contrast the temperament of these three men, Joseph Leidy, Edward Drinker Cope and Othniel Charles Marsh. They were as different as any three men could possibly be made, both by nature and nurture. As Professor Edward Smith said, in one of his addresses on Leidy, "scientists are only mortals after all." Your scientific genius may hitch up with a star on one hand and with an anchor on the other. Whereas Leidy was essentially a man of peace, Cope was what might be called a militant palaeontologist; whereas Leidy's motto was peace at any price, Cope's was war whatever it cost. I do not know that I can find from Shakespeare any characterization of Joseph Leidy, but I think in Henry IV there is a very apt characterization of my friend Edward D. Cope:

I am not yet of Percy's mind, the Hotspur of the north; he that kills me some six or seven dozen of Scots at a breakfast, washes his hands and says to his wife, "Fie upon this quiet life! I want work."

Perhaps there was a scientific providence in all this; perhaps such antagonistic spirits were necessary to enliven and disseminate interest in this branch of science throughout the country. The subtle combative quality in a palaeontologist is a strange quality; it is a strange inversion, because the more ancient and difficult the study, the more refractory the fossil, the greater the animation of discussion regarding its relationships. From this subtle ferment there arose the famous rivalry which existed not between Leidy and either of the others, because it was impossible to quarrel with Leidy, but between Cope, the descendant of a Quaker family, and Marsh the nephew of a great philan-
thropist. This rivalry was tonic to Cope and although in his eagerness to publish his discoveries and theories before Marsh could produce similar material he made careless mistakes, still "the scowl of his foe" (Marsh) remained, as in the Celtic poem, "the sun which caused him to grow."
INTRODUCTION

This bibliography has been rearranged from the manuscript copy of a "Bibliography of the Published Writings of Edward Drinker Cope, 1859-1899," by Anna M. Brown.

In the revision material from the bibliography included in Dr. O. P. Hay's "Bibliography and Catalogue of the Fossil Vertebrata of North America,"¹ and Persifor Frazer's "Catalogue chronologique des publications de Edward Drinker Cope"² has been incorporated. Indebtedness must also be acknowledged to Mr. F. W. Ashley of the Library of Congress, to Dr. Witmer Stone of the Academy of Natural Sciences of Philadelphia, to Dr. W. P. Wilson of the Commercial Museum, Philadelphia, to Mr. John Ashurst of the Free Library of Philadelphia, and to Mr. Charles W. Johnson of the Boston Society of Natural History who have most kindly helped both to verify and to locate references.

In the arrangement of the titles an effort has been made to keep to the following rules:

I. Dates
   A. So far as can be ascertained the titles are arranged in chronological sequence in accordance with their respective dates of publication.
   1. Dates of publication are taken from

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a. Dates on the brochures.
c. Dates of acknowledgment for the various parts of the publications of the American Philosophical Society as published in their Proceedings.

B. In cases where an article has appeared in instalments covering two or more months the date of the first instalment has been adopted.

C. When no date of publication could be found
   1. Verbal communications were listed under the dates of the proceedings.
   2. Volumes were placed at the beginning of the year.
   3. Those titles having the month but not the day of publication were placed at the beginning of the month.

D. Dates following volumes are those of the year in which the verbal proceedings were held. When there is a discrepancy between this date and the one selected as the index date, the latter is, to the best of belief, that of actual publication.

E. An abstract of an article appearing previous to the publication of the full article is separately listed. (Sec, II C.)

F. Titles found in the manuscript but impossible to locate and undated manuscripts of Cope's have been placed together, without numbers, at the beginning of the bibliography.

II. Titles
   A. Published titles stand as printed save for uniformity of capitalization.
   B. Verbal communications and untitled editorials are titled as follows:
      1. According to the titles published in the indices of the volumes, except in cases where the title failed to agree with the subject of the communication.
      2. According to some title published later as in the "Index" of the Academy.
      3. By supplying a title enclosed in ( ), using in almost all cases those in Miss Brown's bibliography.
   C. Titles of abstracts, when changed from but of later date of publication than the original are indicated under the original article.

III. Abbreviations
   A. The titles of all publications are abbreviated in accordance with the schemes most commonly used.
e. g. Amer. Journ. Sci.—American Journal of Science
Amer. Nat.—American Naturalist
Ann. & Mag. Nat. Hist.—Annals and Magazine of Natural History
Lippincott’s Mag.—Lippincott’s Magazine
Pal. Bull.—Paleontological Bulletin
Proc. A. A. A. S.—Proceedings of the American Association for the Advancement of Science
Smithsonian Contrib. to Knowledge—Smithsonian Contributions to Knowledge
Southern Mag.—Southern Magazine
Trans. Amer. Entomol. Soc.—Transactions of the American Entomological Society
Zool. Anz.—Zoologischer Anzeiger

1. In cases such as the Annals and Magazine of Natural History and the American Journal of Science where the title of the publication has undergone change the title now in use is the one chosen throughout the bibliography.

B. Miscellaneous abbreviations
1. (Hay) means that the preceding note or succeeding title is quoted in Hay’s “Bibliography and Catalogue of the Fossil Vertebrata of North America.”
2. * means not personally seen
Some Points in the Zoology and Geology of Glycaphuatl, by Robert Ramrod, A. E. C.

A Satire on the Philadelphia Academy. Evidently seen by Persifor Frazer since it is quoted by him in the *American Geologist*, Vol. 26, 1900, pp. 70, 71. No trace could be found.

**Organic Matter**


**Biology**


A collected volume of manuscript. Contents: Catalogue of Reptilia of the Upper Amazon.

**Bibliography**


- An annotated synopsis of the subfamilies and genera with descriptions of the new species *Amblystoma conspersum* and *Desmognathus ochrophaea* from Pennsylvania.


- Tortoises and a crocodile from West Africa, including the new genus *Heptathyra* of the former and a new genus of snake, *Olisthenes*, from South America.


With a key to the genus *Elaps*, and a description of a new species, *Elaps melanogenys*.


Including descriptions of the new genera *Pyxnomodon* from Siam and *Zoetes* from Ningpo, China.

Remarks on Reptiles (Changes in Nomenclature: Species of *Tantilla*: Specific Characters of *Lepidosternum floridanum*).

Gives a synopsis of the genus *Tantilla*.


West Indies, Buenos Aires and San Salvador.


*Cyclura baculifera* Cope.


The Academy of Natural Sciences of Philadelphia acknowledges no month for this signature. A preliminary paper on the anoline Squamidae mostly from Cuba.


With some general remarks on distribution and the dividing line between the neotropical and nearctic groups of fauna.


A description of two new species *Ameiva corvina* and *Plestiodon longirostris*.

With a synopsis of species.


\textit{Chrosomus eos} and \textit{Leucosomus rhothius} (\textit{Cyprinella analosiana} Gerard of Potomac basin) found in Susquehanna basin.


Dividing \textit{Elapomorphus} into three genera \textit{E.}, \textit{Phalotris} and \textit{Apostolepis}. Specimens described from Paraguay and Guadalaxara, Mexico.


From Siam, Philippine Islands (?) and Trinidad, respectively.


The \textit{H.} and \textit{A.} from West Indies, Central and South America.


From Cuba, New Providence Isl., St. Thomas, New Grenada (Colombia), Paraguay, Panama and Nicaragua.


The Academy of Natural Sciences acknowledges no date (month or day) for these pages. See the "Index," p. xiii. From New Grenada (Colombia), Paraguay, Central America and the West Indies. With a synopsis of the skink genus \textit{Mabuia}.


The Academy of Natural Sciences acknowledges no date (month or day) for these pages. See the "Index," p. xiii.


The Academy of Natural Sciences acknowledges no date
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(month or day) for these pages. See “Index,” p. xiii. Both from West Africa. Other additions to the “Catalogues of West African reptiles recently published by Drs. Gray and Duménil.”


The Academy of Natural Sciences acknowledges no date (month or day) for these pages. See the “Index,” p. xiii. A specimen of this Dum. and Bib. species discovered in Texas is placed in the genus Virginia.


First characterization of this genus.


With a synopsis of the Bufonidae.


3 Corneous thickening on interior metatarsus of Trachycephalus during breeding season. Manubrium sterni present in certain South American Bufones.


Discussion and corrections on Calamaridse and a new synopsis of the Problerotrinidse.


8 New species from Cedar Swamps, New Jersey.


Mostly from Tropical America. Synopses of Trachycephalus and Scaphiopus.

179
   June 1863, pp. 229, 230, one figure. (Reprinted, Ann. & Mag.
   Nat. Hist., 3d. Ser., Vol. XIII, 1864, pp. 181, 182, one
   figure).

   V. confluenta.

.39 Descriptions of new American Squamata, in the Museum of
   Mostly from Tropical America including several of Xantus' specimens from Cape St. Lucas, Lower California.

1864.40 Contributions to the Herpetology of Tropical America. Proc.


.42 On the Characters of the Higher Groups of Reptilia Squa-


   Gronias nigrilabris Cope N. Sp. with rudimentary eyes, and
   Ethostoma peltatum Stauffer N. Sp., from Conestoga Creek, Lancaster Co., Pa. Pacilichthys mesicus Cope N. Sp. from
   Platte River, Fort Kearney, Neb.

1865.44 Sketch of the Primary Groups of Batrachia salientia. Nat.

.45 Partial Catalogue of the Cold-Blooded Vertebrata of Mich-
   276-285.

   From collections of the Flint Scientific Institute, the State Agricultural College. Several new species. Several specimens from Pennsylvania and Kansas discussed in footnotes.

.46 Partial Catalogue of the Cold-Blooded Vertebrata of Mich-

   Continuation of preceding. Several new species described in footnotes. On p. 85 “Note on fishes brought from Platte River, near Fort Riley, by Dr. Wm. A. Hammond.” On pp.
   87-88 “Supplementary note on a peculiar genus of Cyprinidae—Ericynba buccata Cope, N. G. et Sp.”
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This is Cope's first palaeontological contribution. Moodie remarks, "The publication of the type species of this genus began the researches of Professor Cope on the extinct amphibia of North America, which he continued for so many years with such excellent results. The description was based on a single specimen, belonging to Mr. Joseph Evans of Morris, Illinois, who loaned it to Dr. Worthen for the Illinois Geological State Survey, in order that it might be described. The type has been destroyed by fire; so I am informed by Mr. L. E. Daniels of Rolling Prairie, Indiana. There are two other known specimens of the species. One is in the collection of Mr. Daniels, and the other No. 794 of the Yale University Museum." The genus is an important one among fossil amphibia and is made by Dr. Moodie the type of a distinct family.


.50 Megaptera spynia.


With a list of species sent by Dr. Sartorius to the Smithsonian Institution from near Vera Cruz and the table-land and southern mountains of Mexico. Also a synopsis of the genera of Hylidae.


*Amphibamus grandiceps* redescribed and figured. See 47.


The original, verbal communication, is not indexed. The title was given by Frazer (1902), but in the Index of the Academy (1913) the title is given as: On a Species of Seal and on Cetaceans. No date of publication acknowledged by the Academy of Natural Sciences, see, “Index,” p. xiii. It seems obvious that the more likely date for this signature is early in 1866, since the preceding signature was dated December 26, 1865, and the subsequent signature for the earliest part of Vol. XVIII is acknowledged June 11, 1866.


No date of publication acknowledged by the Academy of Natural Sciences. See 53, note.


Title in Index: On an Aturia from the Marl of New Jersey.


No date acknowledged by the Academy of Natural Sciences. See “Index,” p. xiii. With descriptions of the new lacertilian genus *Cachryx*, and *Colostethus* of the Ranidae.


No date acknowledged by the Academy. See "Index," p. xiii. Nine lines describing a young skeleton presented to the Academy.


See 68 for original notice. Adequate description here.


Notes occurrence of Scaphiopus holbrookii near Schuylkill, New York. Compared the genera Hyla, Scytops, Osteocephalus and Trachycephalus, which he considered represented a natural series measured by the relative degree of ossification of the cranium.


Rhabdosteus described.


Brief notice of fossils in cave, Wythe Co.


Thirty-three species of Elasmobranchii and one Teleost (*Sphyrena speciosa*) determined by fossil teeth from Charles Co., Maryland. Two species of *Theocharma* based on isolated teeth; review of American fossil Cetacea, with descrip-
tion of several new species, types in the Philadelphia Academy collection.


  New species are: *Cyrinella cercastigma*; *Hypselepis cocco-gensis*; *H. galactinus*, *H. ardens*; *Photogenis telescopus*, *P. leucoidus*, and *P. scabriceps*.


- **Birdlike characters in *Lalaps* and *Compsognathus*.**


  Including two new species of boas of the genus *Lichanura*.


  *Elasmosaurus platyrurus* Cope, preliminary description.

- **An Examination of the Reptilia and Batrachia obtained by the Orton Expedition to Ecuador and the Upper Amazon, with Notes on Other Species.** *Proc. Acad. Nat. Sci. Phila.* Vol. XX, 1868, pp. 96-140.

  Including new saurian genus *Opheognomon*, Synopses of the genera *Leptognathus* and *Pithecopus*, *Liocephalus*, *Celestius*, *Xenodon*.


  Genotype in the Academy collections.
88 On the Vertebrae of a Serpent from the Green-Sand of New
(Title: On Fossil Snakes from New Jersey.)
*Palaeophis littoralis,* Cope.


90 On the Distribution of Fresh-Water Fishes in the Allegheny
2 Phila., Ser. 2, Vol. VI, pp. 207-247. (Separates, December,
1868.)
Systematic list of the species; description of new species;
and discussion of distribution due to geological and physi-
ographical causes.

91 Synopsis of the Extinct Reptilia found in the Mesozoic and
(?) George H. Cook, State Geologist, 1868, Appendix B, pp. 733-
738.

92 Synopsis of the Extinct Mammalia of New Jersey. Geology
Dec. of New Jersey. George H. Cook, State Geologist, 1868, Ap-
2 pendix C, pp. 739-742.

93 On the Fresh-Water Origin of Certain Deposits in West
2 pp. 157, 158.
Raritan clays.

94 On Some Remains of Extinct Cetacea from the Miocene
2 1868, pp. 159, 160.
Two new species described. *Agaphelus* (modern) N. G.

95 On New Species of Extinct Reptiles, (*Clidastes ignavus*
2 Vol. XX, 1868, p. 181.
Isolated vertebrae from Cretaceous of New Jersey.

96 Second Contribution to the History of the Vertebrata of the
2 Phila., Vol. XX, 1868, pp. 184-194.
Two genera, thirteen species described, mainly from the
Calvert formation, types mostly in Academy collection.

and twenty-two figures.
Systematic arrangement of genera and species, with con-
siderable natural history data.
Descriptions of various species, mostly new, from North and South America and Africa.

Six species differentiated.


Brief descriptions of groups, with descriptions of new genera and species from Linton, Ohio, coal-measures and from Trias.

Based upon part of a skeleton of a whale cast ashore in 1866 on the New Jersey coast.

*Cladastes, Adocus,* additional characters of *Lalaps*.


Including the new genera *Loxopholes* (lizard) and *Lystris* (snake) from Colombia.

*Elasmosaurus orientalis, Amblyrhiza inundata,* brief notes.

6 Including new genera Panaspis (lizard from Australia) and Letheobia (snake from Zanzibar).


Quotation of a letter from Cope, which, however, does not refer to pathologic but a normal condition in mosasaur jaw.


Three species of fossil Teleosts and seven Elasmobranchs determined by fragments from Coastal Plain of eastern United States.


Popular description and restoration of Cretaceous types.


Notice of a new genus, Thorius, from Mexico.


Stercodectes tortus brief description; Wythe Co., Va., fauna.


Exhibition of a Heloderma horridus from Tehuantepec.


Tretosphysis, Zarhachis, Eschrichtius, etc., Calvert formation of Maryland and Miocene of New Jersey.


Contains much new material written in by Cope. Part I (pp. 14-32)—Systematic Synopsis of the Species of the
Cetaceans of the West Coast of North America—is entirely his. Also contains descriptions of new species inserted by Cope.


Loxomylus longidens, named, no description.


Holops described from an incomplete cranium and Ornithotarsus from parts of hind leg bones, tooth from New Jersey Cretaceous; Macrosaurus proriger (=Tylosaurus) upon fragment of muzzle (? Mus. Comp. Zool.) from Kansas Cretaceous.


Cidastes propython, Polycotylus latipinnis, Ornithotarsus immanis, brief abstracts of descriptions.


Mostly from Mexico, two from the Island of St. Martins, Spanish West Indies, and with a list of species in Orton’s collection from PEBAS, Equador, on the Upper Amazon and in Sumichast’s from Tehuantepec, Mexico. Three new genera: Symphimus and Teleolapsis (Mexican snakes), and Stereocyclops (raniformian from Brazil).


List of species and descriptions of five new mammals and five new myriapods from Virginia. Extended descriptions of Amblyrhiza and Hoxomylus from Anguilla.


Nine species of Teleosts and Elasmobranchs based on teeth and various fragments from Coastal Plain of eastern United States.


Review of Gegenbaur’s essay.


Mesoteras kerrianus.


Eschrichtus polyphorus described; Hadrosaurus triops and Hyrinen cassinica, based on vertebrae; Polydecis bitubulatus upon a tooth. The second and third of supposed Cretaceous age “intrusive in Miocene beds.”

EDWARD DRINKER COPE—OSBORN


Indian drawings.


Exhibit of fishes from Green River shales—2 named but not described.  See also No. 154.


Fishes barely referred to.


An abstract of 153.


Abstract four lines.


Abstract of No. 156.


*Asineops squamifrons* N. G. et Sp., two species of *Clupea* and one of *Cyprinodon*.


*Leptomylus cookii*, Cope.


A new genus of Dicynodont reptiles from the Permian of South Africa.  (Type believed to be in the collections of Yale University.)


First record of this genus from the United States.
EDWARD DRINKER COPE—OSBORN

21 Verbal notes.

Discussion of affinities of various species; Pneumatoparia described.


The first considerable report on the fresh-water fishes of N. C. 81 species are described. Included are descriptions of a considerable number of new as well as old species from sections reaching from Maine to Indiana.

21 Abstract, seven lines.

Recent and extinct. Notes. Ichthyopterygia and Anomodontia.

Including a new genus of snake, Enulis.


With a catalogue of the families of the Reptilia and a note on the stratigraphic relation of the orders.

167 Note in Reply to Dr. Seeley's Remarks on my Interpretation of the Structure of the Cranium of Ichthyosaurus. Proc. A. A. A. S. XIX Meet. 1870, pp. 246, 247.

For fishes, 5 species of *Saurocephalus*, and 1 each of *Ichthyodectes*, *Apsopilix* and *Sphyraena*, are described, and a tooth of *Enchodus* sp., is briefly referred to.


Two species of *Asineops* are described; the genus *Erematopterus* is established and the species *E. nickseri* described; 2 genera of *Clupea* are described as is also *Osteoglossum encoastum* N. Sp.


Eight reptiles from Utah, Colorado and Wyoming. In fishes 1 Cottid, 2 Salmonids, 4 Catostomids, and 11 Cyprinids including 15 new species are described.


Jan.

Species of *Saurocephalus* Harland and *Ichthyodectes* gen. nov. are described from specimens collected by Professor B. F. Mudge in the Cretaceous of Kansas. Abstract of 175.


Feb.

*Adocus syntheticus* described; metatarsals of *Laelaps*.


See 171 for note on new genera. Five species of *Saurocephalus* (three new) described, one *Saurodon* and *Ichthyodectes ctenodon* Sp. N. For preliminary account see No. 171.


Chiefly Cyprinid fishes of supposed Pliocene age: *Diasstickus*, *Oligobelus*, *Anchybopsis*, *Rhabdoaria*, new genera, based upon pharyngeal bones except the last.


Additional observations upon *Adocus* Cope, with a key to the species; *Zygoramma*, *Honorophus*, new genera of Adocidae, based upon fossils from the New Jersey Cretaceous.


Report upon collections of Ophidia and Batrachia from Pellas, Ecuador (Hauxwell), Brazil (Thayer Exp.), Turk’s Island, W. I. (Ebell), and St. Eustatia (van Rijgersma). *Enuliaus* gen. nov. ophid. from Nicaragua.


*Stethaprion*, *Holotaxis*, *Plethodectes*, *Odontostilbe*, new Characid genera described. Five new species of Siluride, and three new Chromide (Cichlide) described.


Types in the Smithsonian Institution. King expedition.


Notice of additional collections from Anguilla, *Laxomylus latidens* described.


Abstract of 196.


Fer-de-lance a serious pest on the islands of Martinique and Guadaloupe, might be reduced by importation of *Oxyrrhopus* which feeds on them.


Eleven species listed and some described, including three new species mainly West Indian stragglers brought up by the Gulf Stream.


*Centropristis subligularius* and *Gobiesax strumosus* N. Sp., from Hilton Head, S. C.


*Priacanthus altus* and *Hemiramphus macrorhynchus*.


Tenable description of *Liodon ictericus*, *L. mudgei*, *L. dyspelor*, *Clidastes cinerionum* (sic).


Exhibit and remarks on four species found above the mouth of the Rio Negro.
EDWARD DRINKER COPE—OSBORN


11 Oral remarks on certain anatomical structures as a basis for taxonomy of Silurids.


15 Structure serving as basis for differentiation from other fishes and for classification in the system.


18 For abstract see 186. Preliminary notice of the fauna. Sec. No. 200.


18 Descriptions of Liodon sectoria n. sp., Zygoramia microglypha n. sp., Catapleura ponderosa n. sp., Bottosaurus macrorhynchus Harlan, Hadrosaurus ovatus n. sp., all from the New Jersey Cretaceous.


18 Prymnetes and Anapedopogon, new genera.


18 Diastichus Cope referred to the Cobitida.


18 Descriptions and notices of thirty-four species of mammals, thirteen of them new, and Praotherium, N. Gen.


18 Description of skeleton from St. Bartholomew, W. I.


18


EDWARD DRINKER COPE—OSBORN

Redescription of Bathmodon, Loxolophodon described. Compare No. 266. This report is reviewed in Amer. Journ. Sci. (3) III, May, 1872, and must therefore have been published in May or earlier.


EDWARD DRINKER COPE—OSBORN


Two new species of Chelonia described and one new crocodilian.


The instalments appeared in May, July, August and September, respectively.


May


Separates, June 8, 1872. Date taken from Miss Brown's MSS. Critical review of Marsh’s contributions on Mosasaurs.


June


25

Eschrichtius davidsonii.


June

25

Preliminary description.


July


Includes descriptions of species from the Mammoth Cave. Amblyopsis spelaeus the only fish.


July

25

Abstract of 259.
Abstract of 266.

July Abstract of 260.


This bulletin includes first descriptions of Mesonyx and several new Chelonia.

This is the first of a series of notices describing new genera and species of fossil vertebrates discovered by Professor Cope or his assistants during his expeditions for the Hayden Survey in 1872 and 1873. The descriptions were written in the field and forwarded by mail (in two instances by telegraph) to Philadelphia for immediate publication. They are in large part transcripts from his field notebooks which are preserved in the files of the American Museum.

Their purpose was in part to anticipate the work of Professor Marsh, who was known to be studying fossil faunas of the same regions, and between whom and Cope there was a growing rivalry. They precipitated a bitter controversy, turning mainly on the correctness of the stated dates of publication. Professor Cope, in reply to Marsh's claim that the papers were seriously antedated published sworn statements from the printers that the papers were printed and delivered as dated, and somewhat less conclusive evidence as to the distribution of the separata to scientific institutions or individuals within a few days of the stated dates.

Although Professor Marsh failed to retract his charges, it is clear from this evidence, coupled with the internal evidence afforded by close study of the papers, comparison with field notebooks and other considerations that the bulletins were printed and, in most cases if not all, some copies were distributed approximately at the printed dates of publication. Any intentional antedating is out of the question. Under the circumstances it appears wholly proper to accept the accuracy of the dating.

W. D. M.
EDWARD DRINKER COPE—OSBORN


Aug. 3


First descriptions of Helotherium (\textasciitilde Orohippus\ Marsh of identical date), Stypolophus (\textasciitilde Sinopa\ Leidy), Pantoelotes, Pseudotomus (here referred to Edentata but in fact a rodent allied to Paramys\ Leidy) Hadrianus (earliest land tortoise).


First descriptions of Miacis, Tomitherium (\textasciitilde Northarctus\ Leidy), etc.


First description of Agathaumas.


"Lefalophodon,\" (intended for Loxolophodon) with three species, also badly misspelled. The telegram was evidently sent upon discovery of the fine skull which is the type of \textit{Eobasileus cornutus} by Professor Cope at Haystack Mountain in the Washakie basin. It is the first published announcement of his Dinocerata discoveries, but they are here \textit{referred to} the genus \textit{Loxolophodon} based upon a Coryphodont from the Lower Eocene. With conjectural corrections of specific names. See 286.


First description of \textit{Synoplotherium} and \textit{Eobasileus}. The relationship of the former to \textit{Mesonyx} was not yet recognized; it was thought to be allied to \textit{Anchippodus (Tillodontia)}, the enlarged canine being mistaken for an incisor.

The new genus \textit{Eobasileus} is here based upon the species \textit{cornutus} with a number of fragmentary specimens as types, not including the fine skull which is the type in the telegram.
from Black Buttes, written later than this notice but published earlier (see No. 255). Errors of transmission in the telegram being corrected, and the stated dates of publication being accepted, the type specimen of *cornutus* is the complete skull and the monotypic genus *Eobasileus* rests upon this species. It may be remarked incidentally that neither the original type of *Tinoceras* Marsh nor the skull subsequently used by him as a neotype of the genus is congeneric with *Eobasileus*.


- Chiefly an extended account of the discoveries noticed in the telegram from Black Buttes, published a few days earlier.


- See 246 for abstract.


- See 248 for abstract.


- Descriptions of several characteristic species of Mosasaurs from the Kansas chalk: *Edestosaurus* (=*Clidastes*) *tortor* and *stenops*, *Holcodus* (=*Platecarpus*) *coryphaeus*, *Liodon* (=*Tytosaurus*) *proriger* and *dyspeter*, etc. The first page only appeared in the previous number of the *Proc*.


- Description of *Cynocercus incisus* gen. et sp. nov. (based on caudal vertebrae, ? *Toxochelys*) and of *Hyposaurus vebbia*, crocodilian, the latter from the Benton shales. For abstract, see 229.

For abstract, see 233.


Revision of the genera and species with descriptions of sixteen species. For abstract, see 239.


First description of *Coryphodon* remains from the Evanston (Wyoming) Wasatch. Referred here to the Perissodactyla. The material studied included upper teeth and various fragments of the skeleton, but no lower molars, and the affinity to the European genus *Coryphodon* Owen, then known chiefly from the lower teeth, was naturally not recognized. The name *Loxolophodon*, subsequently used for a genus of *Unitatheriidae*, was here first proposed tentatively for *B. semicinctus*, a second species of *Bathmodon*, in case it should prove generically distinct. For abstract, see 247. The paper was read Feb. 16, 1872. In case the date of publication is really as late as September the genera *Bathmodon* and *Loxolophodon* will date from No. 213.


The Kansas pterodactyles are recognized as belonging to the genus *Ornithocheirus* Seeley, typically from the English chalk and greensand. Two new species *O. umbrosus* and *harpyia* described. For abstract, see 232.


First description of the gigantic marine Cretaceous turtle *Protostega* based on remains from the Kansas chalk now in the American Museum collections. *Atlantochelys* and *Pneumatosaurus* referred to the same group. For abstract, see 231.


Color changes due to contraction and expansion of chromatophores.

Anaptomorphus aemulus. First record of a recognized primate from the North American Eocene.


Three new species described: Crocodilus subulatus and sulciferus, Anostira radulina.


Correction regarding the teeth of Eobasileus cornutus—Hay.


EDWARD DRINKERCOPE—OSBORN


7 For abstract, see 276. Trichophanes hiatus and Anyzou mental. new genera and species.

7 For abstract, see 275. Description of Metalophodon armatus and Alligator heterodon from Black Buttes Eocene.

7 Followed by note of the secretary correcting errors in the original which was issued as Pal. Bull. No. 5 (See, 1872 .255). Corrected version of telegram describing Loxolophodon.


4 No description.


Partial annotated list of species from the Bridger Basin with description of *Oligatenuis* gen. nov. and five new species of mammalia. Issued privately March 8, not reprinted—Hay.


Key to genera.


On the Primitive Types of the Orders of Mammalia *Edubilia*. Read before the Amer. Philos. Soc., April 18, 1873, printed and then withdrawn on June 20, 1873. A few separates still in existence. Separate May 6, 1873. Discussion of the broader affinities of the Eocene mammals, especially those recently discovered in the Bridger Basin.
EDWARD DRINKER COPE—OSBORN

.305 Memory and Reminiscence in Animals. *Independent* Vol. XXV, 1873, p. 710.


A slightly extended form of 299.

.307 On Prof. Marsh’s Criticism. *Amer. Nat.* Appendix to July p. i (8 lines only.)


*Trionyx heterogyptus* and *Platemus thomasi* from Bridger formation.

.309 Palaeontological Bulletin—Preliminary. 2 pp. (Gives titles and dates of Palaeontological Bulletins 1-13.)


Fourteen species described, eleven new.


Description of *Mesonyx* and *Synoplotherium* and discussion of their affinities.


Description of the complete skeleton of *Hyrachyus* found by Professor Cope in the Bridger Basin in 1872.


First bulletin descriptive of discoveries made by Professor Cope in the Tertiary (Oligocene and Miocene) of northeastern Colorado in 1873. Like the preceding series these were apparently sent in from the field and are in considerable part transcripts from his field notebooks. Describes *Aeluroidon* (=*Martes* mustelinus) and *Aceratherium* (=*Aphelops*) megalodus, both from the Miocene (Pawnee Creek beds) near Pawnee Buttes.


Describes various Oligocene (White River) fossils from northeastern Colorado. *Colotaxis* gen. nov. (=*Ischyromyx*), *Symborodon* and *Miobasilus*, Titanotheriidae, *Peltosaurus* and four species of *Testudo*.

Describes Oligocene (White River) mammals, chiefly Insectivora and Rodents. Nine new genera.

*Portheus* lestrio and *P. gladius* described and *Daptinus* N. Gen. established.

Three species of *Conchiaopsis* and one of *Peplorhina*.

On the title page this paper is said to be extracted from the Seventh Annual Report of the U. S. Geological Survey of the Territories, but it does not appear in that volume.—Hay.

*Achanodon* and *Phenacodus*, new genera.

Unsigned. Cited by Frazer.

One species described; *Rhineastis*, *Amyzon*, *Clupea*.

For the original title and first date of issue see 358.


336 Review of the Vertebrata of the Cretaceous Period found West of Mississippi River. Section I—On the Mutual Relations of the Cretaceous and Tertiary Formations of the West.


Rhinecestis pectinatus, Amyzon commune and Clupea theta new species.


Reprint April 13, 1874—date from Miss Brown's MSS. Plagopterus, Meda, and Lipomeda, new fossil genera with 3 species. Twelve freshwater fishes (5 new species) from Lake Utah. Eight species (5 new) from streams in Utah and Arizona.


Reprints April 13, 1874—date from Miss Brown's MSS.


Discussion by Cope, LeConte and Frazer on age of " lignite" beds of N. E. Colorado.


Genhosteus prosopis from Peru.


E. ramosum "horns" on lower jaw.


Notice of exhibition of Symborodon crania.


Critical comment on views of Hawkins and Leidy. Three lines.


Description of bones of head—no species assigned.


First notice of the genus as viviparous.


Middle Eocene, older than Parisian.


Describing two new batrachian genera, Buboniatus and Dysichthys. Seventeen Nematognathi listed, seven described as new.


Synonym of Symborodon trigonoceeras.


Exhibition of fragmentary skull and of walrus skull from Accomac, Va.


Poebrotherium, an ancestor of the Camelidae.


Six new species described: Panolax new genus.
1874. 358 Report upon the Vertebrate Fossils discovered in New Mexico Nov. with Descriptions of New Species. Note from Miss Brown's MSS. Issued as a separate (pp. 1-18) on November 28. The same paper as 324.


1875. 363 Report on the Geology of that Part of Northwestern New Mexico examined during the field season of 1874. Ann. Report upon the Geogr. Explorations and Surveys West of the 100th Meridian . . . (Wheeler). Being Appendix LL of the Annual Report, Chief of Engineers for 1875, pp. 961-1007. Pls. II, V, VI, figs. 1-18. When Appendix LL, etc. was issued as a separate the pagination was pp. 61-116.

1875. 364 Report on the Remains of a Population observed on and near the Eocene Plateau of Northwestern New Mexico. Ann. Report upon the Geogr. and Geol. Explorations and Surveys West of the 100th Meridian . . . (Wheeler), pp. 166-173, figs. 1-6. (Exactly the same text as 408. The figures are lacking in the former.)

1875. 365 [Synopsis of the Genera Crotalus and Eutaenia, together with descriptions of one New Genus and Seven New Species]. Report upon the Collections of Batracians and Reptiles made in portions of Nevada . . . during the years, 1871, 1872, 1873, 1874 by Dr. H. C. Yarrow. Report, U. S. Geogr. Surveys West of the 100th Meridian . . . (Wheeler) Vol. V, Chap. IV, pp. 532-535. (Material inserted in Yarrow's Chapter.) (4to.)

New genus is Chilopoma (preoccupied) now a synonym of Thamnophis.

1875. 366 Report upon the Collection of Fishes made in Portions of Nevada, Utah, California, Colorado, New Mexico and Arizona
during the years 1871, 1872, 1873 and 1874. (With H. C. Yarrow.) _Report, Geogr. and Geol. Explor. and Surveys West of the 100th Meridian_ (Wheeler) Vol. V, Chapter VI, pp. 630-703, Pls. XXVI-XXXII (4to.).

Systematic arrangement with descriptions of all the fishes collected by all the naturalists of all the expeditions working in the states during the years named. Several new species are described.


Review of Seeley.


Review of Hector.

373 A New Mastodon. _Amer. Nat._ Vol. IX, 1875, p. 56.

_II. productus from Santa Fe—no description._


Abstract report of Cope's party.

375 The Value of Palaeontology. (The Significance of Palaeontology—Cover Title.) _Penn Monthly._ Vol. VI, pp. 55-62.

A very slightly changed form of the introduction in 361.

Description of *Mastodon productus* and *Steneofiber pannus* from Santa Fe bed of New Mexico.


2 Distinction from *Titanotherium*.


2 Concerning the relationships of *Thespesius* and *Ischyrosaurus*.


Extended report on Wasatch vertebrate fauna with descriptions of twenty-eight new species.


Florida as a distinct subdivision of the Austroriparian region.


*Pleuropteryx clavatus* and *Hyphasma laevis*, new genera and species, described, and a new species of *Ceraterpeton*.


Brief notice of crocodilia and chimaeroid fishes.


Application of theories outlined in No. 335 to the evolution of carnassials. Primitive tibio-astragalar articulation in Eocene carnivora.
EDWARD DRINKER COPE—OSBORN


Characteristics of feet separate Bathmodon and its allies from Proboscidea as a distinct order, Amblypoda, with two suborders, Pintodonta (Bathmodon) and Dinocerata (Uintatherium and Loxolophodon).


List with a few annotations. Agabelus gen. nov.


Pliauchenia described with two species. Hippotherium calamarium and Aphelops jemesanus from Santa Fe marls, New Mexico.


June Lacks discussion contained in 396, but is otherwise the same.

28


27


27 Sarcolemur described (Bridger Eocene); Canis or Amphicyon ursinus from Santa Fe beds.


27 'Dicrocerus' (=Mericyodon) from Santa Fe beds. This fauna probably Upper Miocene.


27 Evolution of feet and teeth Poebrotherium, Procamelus, Pliauchenia, Camelus, Auchenia.


A fuller form of 390. Brief note on Mesozoic and Tertiary
in northern New Mexico, description of Typothorax cocci-narum.


31 Vultur umbrosus described from Santa Fe marls.


New bufoniform genera Cranopsis, Crepidins and Olotis; lacertilian genus, Chalcidolepsis. Synopses of Conophis, Coniophanes, Rhadinara, Tantilla, and of the genera related to Stenorrhina. The footnotes include descriptions of a number of new species from Mexico and the new lacertilian genus Epaphelus.


Including a new iguanid genus, Scytomycterus.


Oreostias bairdii and O. ortonii N. Sp.


Read under the title “Indications of Descent Exhibited by the North American Tertiary Mammalia” before the A. A. A. S. Appears as title only in the Proc. A. A. A. S.


According to Cope this paper was issued in 1876. See, Cope. 1886,920, p. 286. Ceratodus vinzelooii Cope.

Characters of the Creodonta, proposed as a new suborder of Insectivora.


*Osphyolax.*


See 364.


*Diatryma gigantea.*


Partly intermediate between Edentata and Insectivora. Two families. Ectoganiidae and Calamodontidae. *Esthonyx* and *Anchippodus* related to *Brinaceus.*


Review of Wasatch fauna and comparison with Suessonian of Europe.


Suborder, Mesodontia based on combination of Creodont
and Primate characters of 'Tomitherium' of New Mexican Wasatch. [This was due to finding mixed remains of a Creodont and a primate]. Order Bunotheria proposed to include Creodontia, Mesodontia, Insectivora, Tillodontia and Taeniodonta also perhaps Prosimiae.


Fifteen species described, mostly from Judith River Cretaceous; *Zapsalis, Uronautes, Champesaurus, Scapherpeton, Hemirypus* new genera.

23 Notice of Orton’s expedition.


23 Note on correlation of Judith River formation.


General characters of Wasatch fauna compared with Suessonian of Europe.


15 Date taken from Introduction.


*Ichthyacanthus* gen. nov. and a new species of *Leptopharcus* and *Tuditamus* described.


*Dystrophus ciemae.*


*Caenobasileus tremontigerus.* An artefact genus, based on fragments of Tertiary mastodon teeth incorrectly pieced together. See also 448.


Description of the braincast of *C. elephantopus* from the New Mexican Wasatch. Separates April 25, 1877. Date from Miss Brown’s MSS.


*L. incrassatus*, no description.


Notice of skeleton of the *Elasmosaurus serpentinus* from Nebraska, and part of skeleton of *E. orientalis* from Upper Missouri.

Characters of teeth in Trachodontidae.


Brief description of brain of *Coryphodon*.


Description of the braincast of *P. occidentalis* from the Upper Tertiary of New Mexico (Santa Fe beds). Separates June 15, 1877. Date from Miss Brown's MSS.


Abstract of 491.


Sixteen fishes described including 5 new genera and 14 new species.


Discussion of the fragmentary remains on which 4 species have been erected.


*Amphiemys* gen. nov.

First description of *Camarasaurus supremus* from the Morrison formation near Cañon City, Colorado. Based upon vertebrae. This is a little later than Marsh's first description of an Opisthocoelian (Sauropod) dinosaur from near Morrison, Colo. Marsh, however, used a pre-occupied name (*Titanosaurus*) so that Cope's name is the earliest available name for an American Opisthocoelian.


Notice of exhibit and title of a paper.


Notice of *Dystropheus* (no name); and of Indian drawings from a mound near Davenport, Iowa.


Exhibition of *Elasmosaurus serpentinus* skeleton, name, no description.


See also 430. Notice of *M. tremontinus*—no description [probably meant for "Caenobasileus tremontigerus"].


Notice of an efficient collector.


Descriptions of species of *Toxochelys* (*Chelonia*), *Ichthyodes, Anogmus, and Orichardus*, etc. (*Pisces.*)

paragraph of the original paper is appended at the end of
the second article.) Abstract, "Remains of a Huge Saurian

Teeth of dinosaurs, etc., from Phoenixville, Pa.; Permian
vertebrates from Illinois; Eryops skull and skeleton from
Permian ("Triassic") of Texas.

On Reptilian Remains from the Dakota Beds of Colorado.
Pal. Bull. No. 26, pp. 193-196 (For final paragraph see
explanation given for 453).

Caulodon (teeth of Camarasaurus) and other vertebrates
from Morrison formation, Cañon City, Col.; "Clepsydrops"
limbatis from the Permian of Texas.

On Amphicelias, a Genus of Saurians from the Dakota

Description of A. altus and "A." latus. Republished,
Proc. Amer. Philos. Soc. Vol. XVII, pp. 242-246, and also as

The structure of animals is directly modified by their
movements, and in adaptation to their habits and environ-
ment. [No clear distinction is made between the effects on
the individual and upon the phylum.]

The Saurians of the Dakota Epoch. Amer. Nat. Vol. XII,
Jan. 1878, pp. 55, 57.

Summary of 455.


The Affinities of the Dinosauria. Amer. Nat. Vol. XII, 1878,
Jan. pp. 57, 58. (Cited by Hay.)
Comments upon Owen's discussion in article describing
Omosaurus.

Mount Lebanon Fishes in Dakota. Amer. Nat. Vol. XII,
Jan. 1878, p. 57.

genera in Mt. Lebanon, Dakota and Westphalia deposits.

Descriptions of New Vertebrata from the Upper Tertiary
Abstracts, "New Artiodactyle of the Upper Tertiary,"

224
First descriptions of Deep River fauna (Montana) and Republican River fauna (Kansas-Nebraska); new species from Pleistocene of Oregon and Washington. Two new species each of Cyprinoid genera, *Anchybopsis* and *Alburnops*. First abstract includes tenable descriptions of *Pithecestes*, *Cyclopidius* and *Brachymeryx*, new genera. Second abstract, tenable description of *Tetrarhopdon campistus*.


Dinosaur teeth from Phoenixville, Pa.


On the Saurians recently discovered in the Dakota Beds of Colorado. *Amer. Nat.* Vol. XII, 1878, pp. 71-85, figs. 1-6, 319-17. Descriptions with figures of *Camarasaurus* and *Amphicoelias*, description of *Tichosteus*.


Note on position of *Erisichthys*. Cited by Hay.

The Snout of Fishes from the Kansas Chalk. *Amer. Nat.* Vol. XII, 1878, p. 129.

Abstract, eight lines.


Description of *Ticholetus zygomaticus*, gen. et sp. nov. from Deep River beds of Montana.
Note on Fossils obtained by Mr. Russell S. Hill, including Bones of *Proteus gigas*. *Amer. Nat.* Vol. XII, 1878, p. 137. Cited by Hay.


A New Genus of *Dinosauria* from Colorado. *Amer. Nat.* Vol. XII, 1878, pp. 188, 189. Description of *Hypsiroplius obscurus* gen. et sp. nov.

A New Deer from Indiana. *Amer. Nat.* Vol. XII, 1878, p. 189. Description of *Cariacus dolichopsis* n. sp. from Pleistocene of Indiana.


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Criticisms of Lesquereux' conclusions upon the Cretaceous-Tertiary boundary formations in the Rocky Mountain region.

A New Genus of Cystignathidae from Texas. Amer. Nat. April Vol. XII, 1878, pp. 252, 253. 
Syrrophus marnockii.

Chevron bones are homologous with intercentra of dorsal and cervical vertebrae of Permian reptiles.


Descriptions of Diadectes, Bolosaurus, Pariotichus, Ecto- cynodon, Clepsydrops natalis skeleton, Dimetrodon, Epicordylius (=Eryops), Empecochiles (=Diadectes), Theropleura, Pariaxys, "Cricotus heteroclitus", Zatrachys, Trimerorhachis, Rachitomus (=Eryops), etc. With the exception of Eryops, these are the first descriptions of the Texas Permian fauna.

Description of Epanterias amplexus gen. et sp. nov. from Morrison formation, Cañon City, Col.


Humeri of certain Permian reptiles appear to be of fossorial type.

227

One hundred and twenty species listed from upper Amazon. Three new genera and thirty new species established.


Critical comment on President’s Annual Report. Unsigned Review. Cited by Frazer.


Diagnosis of *Aphelops fossiger* and *malacorhinus* from Republican River beds of Kansas.

On the Classification of the Extinct Fishes of the Lower Types. *Proc. A. A. A. S.* XXVI Meeting, 1877, pp. 292-300. (For abstract see 439.)

Critical discussion of bases of differentiation between the lower forms of fishes.


Results of a questionnaire.


Shedding of the horns is not periodical or even frequent.

A New Species of *Amphiceras*. *Amer. Nat.* Vol. XII, 1878, pp. 653, 654, 1 fig.

Description of *A. fragilimus* from Morrison beds near Cañon City, Col. [part of a gigantic vertebrate].


Description of *D. molaris* from Permian of Texas. Unsigned. Cited by Hay and Frazer.


Abstract of paper read before British A. A. S. 1878.


Abstract of paper read before the British A. A. S. Title only in *Proc. British A. A. S.* 1878, p. 571.


Construction of the vertebrae. *Eryops* is probably similar.


Notice of the palaeontological discoveries of Dr. Lemoine in the Lowest Tertiary of France.


Abstract with diagnoses of orders and suborders; *Dimetrodon cruciger* sp. nov. from Permian of Texas. Abstract of paper read before the National Academy of Sciences, Nov. 7, 1878.


Based upon collections of Sternberg, Wortman and Day in...


Tenable description of *Enhydrocyon* gen. nov. For full paper see 516.


Progressive shortening of the neck during the Cretaceous.


Unsigned. A brief note calling attention to observations of Professor Snow and to his paper in Review of Science and Industry—Hay.


Explanation of the mechanical causes operating to evolve the carnassial teeth.


Note on John Day fossil mammals. *Merycopater* gen. nov. (=*Agriocherus*); *Machcerodus brachyops* transferred to *Hoplophoneus*.

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For abstract see 510.


The evidence for evolution—ontogeny and phylogeny; the laws of evolution—acceleration—adaptation—kinetogenesis; the metaphysics of evolution; the morals of evolution.


Anchisodon gen. nov. type Hyracodon quadriplicatus from White River beds of N. E. Colorado.


Notice of Marsh's article describing Sauranodon gen. nov. (=Baptanodon). Unsigned. Cited by Hay.


Amyzon fish fauna distinct from that of Green River, probably later than Bridger horizon.


Actinodon Gaudry compared with Rhachitonus Cope (= Eryops) and Euchirosaurus with Dimetrodon of Texas Permian. Unsigned. Given on Dr. Matthew's authority.


Xiphotrygon acutidens described.

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*Aceratherium* (=Canopus) triguianum n. sp. described from John Day formation of Oregon. Diagnosis of Aphelops.


Notice of article in *Amer. Journ. Sci.* by Osborn and Spier.


*Camarasaurus leptodirus* and *Hypsirhophus secleyanus* described from Morrison beds near Cañon City, Col.


Notes chiefly on amphibian and fish fauna in parts of Western Montana.


*Siredon tigrinus* Velasco, probably identical with *Amblystoma mavortium* Baird.


*A. prestanta* described from John Day formation of Oregon. Type of *Kalobatippus* Osborn, 1916.


List of ten species from John Day formation, Oregon.


For the states of Chihuahua, Guanajuato, and the Isthmus
of Tehuantepec, Mexico, Costa Rica, Santa Domingo, Dominica, Tobago, and northwest Bolivia. Including the new genera of snakes, *Procinura* and *Malachylodes* from Mexico, and synopses of the genera *Syrrhophus* and *Cystignathus*.


American Naturalist article contains figures of *Aphelops fossiger*, *megalodus* and *malacorhinus* skulls.


Annotated list of species found.


Description of *Arctotherium simum* sp. nov. from Shasta Co., Cal.


Remarks on *Arctotherium simus* and *Xantusia riversiana*.


Continuation of researches upon collections made by Wortman, Sternberg and Day in 1878-9 in the John Day basin. Chiefly descriptions of carnivora, rodents, peccaries and Agriochoeri from the John Day formation.


Unsigned editorial. Cited by Frazer. Scientific specimens and apparatus should be admitted free whether or not intended for sale.


*H. spectans* from John Day basin of Oregon (Rattlesnake formation) now referred to Pliohippus.


May be equivalent to Green River formation. Fossils, Crocodilus, Clastis and Priscacara.


Description of the skull of *E. molaris* from Permian of Texas. Now referred to Diadectes. Cotylosauria proposed as a suborder of Theromorpha to include Diadectes.


*Triplopus cubitalis* gen. et sp. nov. from Eocene of Washakie basin of Wyoming.


Characters of vertebrae scapular and pelvic arches in Eryops.


Unsigned.


Coast Range formations Tertiary, not Archaean. Sequence of formations in the John Day basin.


Unsigned. Cited by Hay. Criticism of references to Cope’s recent discoveries.


Peraceros superciliosus gen. et sp. nov. described. *Aphelops malacorhinus* referred to this genus. Both from Republican River beds (Pliocene) of Nebraska.


Discoveries of Dr. Anton Fritsch in the Permian "Gaskohle" of Bohemia, and of Dr. Wiedersheim in the "Bunter Sandstein" of Switzerland: discussion of the genus *Cricotus*.


Triplopus ancestral to *Aphelops* through *Canopus* gen. nov. From *Aphelops*, *Peraceros* leads into African rhinoceroses and *Ceratorhinus* into *Rhinoceros* proper. *Aceratherium* side branch.


Revised classification and discussion of affinities and phylogeny. The Miacidae and Mesonychidae are here included in
the order; the former as ancestors of the Canidae, while the Felidae are derived from Oxyaenidae. Pp. 76-80 appeared Aug. 3; pp. 81, 82 were printed Sept. 9.


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Lipomyzon from Klamath Lake, Oregon.


Tenable description of *Bathyopsis fissidens*. Abstract of 592.


A systematic and descriptive account of the 157 species then known. It was reprinted in the report for 1881 and 1882, published in 1883.


Unsigned editorial. Cited by Frazer.


List, with references to publication of 51 species.


Notice of *Charadrius sheppardianus*.


*Bathyopsis fissidens* gen. et sp. nov. described in abstract. *Clastis* sp. and *Pappichthys* named from scales and vertebrae. Read by title before the Amer. Philos. Soc. Dec. 3, 1880, but withdrawn for publication by the U. S. Geol. Survey.


Unsigned editorial.
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Notice of article by Whiteaves on discoveries in Devonian of Baie des Chaleurs. Unsigned. Cited by Hay.

Notice of Dr. Allen's description of *Palaospora bella*—Hay, and of *Charadius sheppardianus* from Amyzon beds of Colorado. Type of latter in Amer. Mus.

Unsigned notes. Cited by Hay. Brief notes of various papers on vertebrate palaeontology. *Stegosaurus=Hypsirho-

plbus*.

Explanation of the origin of specialized foot structures of ungulates through kinetogenesis.

First descriptions of fossil mammals from the Puerco of New Mexico. *Periptychus carinidens, Deltatherium funda-

minis*, new genera and species.


Tabular key, taken from Rept. U. S. G. S. Terr. (Tertiary Vertebrata.)

Key to families, geological distribution of genera, characters of each family and key to included genera; descriptions of *Triplopus cubitalis* and *T. amarorum*, pp. 377-386, printed May 14; pp. 387-401, May 16.

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Note on the Structure of the Posterior Foot of Toxodon.
Based upon specimens in the Ameghino collection purchased by Professor Cope (Cope Pampean Collection, Amer. Mus. Nat. Hist.). The structure forbids reference to Perissodactyla or Artiodactyla and suggests Proboscidean affinities.


June Further discussion of the evolution of the foot construction in various ungulates. Read before the National Academy of Sciences, April, 1881.

June Analytical descriptions cannot be superseded by pictures. Editorial.

June Research. Teaching is a collateral activity. Unsigned editorial. Cited by Frazer.

June List of 37 species from White River and John Day formations.

June Description C. condon from a partial skeleton (in Rutgers College).

July Unsigned editorial. Cited by Frazer.

July Trisodon quirirensis gen. et sp. nov, based upon a lower jaw from the Puerco formation of New Mexico; and Delatherium absarokee (afterwards type of Didelphodus) from Wasatch formation of Bighorn basin, Wyo.
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.613 Champosaurus, from Puerco formation of New Mexico.


.618 Conoryctes, Catathlæus and Miochenus, new genera, from the Puerco formation. Abstract of 618.


.621 Descriptions of Periphythus, Conoryctes, Triisodon, Delta-therium, Catathlæus, Anisonehus, Miochenus—13 species of these and other genera. Cope does not at this time appear to have been certain whether this fauna was from his Puerco formation or not. "Their horizon is below the Wasatch and they represent a different fauna from that of those beds." See 616 for first notice.


.624 Unsigned editorial. Cited by Frazer. Rules of Internat. Geol. Congress approved, except as to requirement of figure for valid description of new forms. A description is necessary; but that it should be "clear and adequate" is to demand too much.


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.623 *Ptilodus mediacus* gen. et sp. nov. described from a tooth from the Puerco formation of New Mexico.


.625 Belodon buceros and ocolonax described, the former from a skull.


.628 Preliminary description of skeleton of *Phenacodus primaeus* from Bighorn basin (Wasatch) of Wyoming. Condylarthra proposed as a suborder of Perissodactyla.


.630 Systemodon based upon specimens from Bighorn Wasatch (incorrectly) referred to *Hyrocotherium tapirinum*.


.633 *Eryops reticulatus* and *Zatrachys apicalis* described; other Permian genera cited as occurring.

.634 (Legal Insanity.) *Amer. Nat.* Vol. XVI, 1882, pp. 33, 34.


.636 Description of type (jaws, foot, etc.) of *Mioclaenus* (now *Diacodexis*) *brachystomus* from Wasatch of Bighorn basin.


.638 Characters of *Calamodon, Tillotharum* and *Esthonyx* compared.


.640 Key to genera; two new, *Manteodon* and *Ectacodon.*
Notice of cranium of "Anaptomorphus" (now Tetonius) homunculus from Bighorn Wasatch. "The genus is nearer the hypothetical lemuroid ancestor of man than any yet discovered."


Unsigned editorial. Cited by Frazer.

Description of Psittacotherium multifragum gen. sp. nov. from Puerco formation of New Mexico.

The Puerco region of N. W. New Mexico.


List of Lower Carboniferous fossils, identifications by S. A. Miller.


Descriptions of fossil vertebrate collections made by J. L. Wortman for Cope in the Bighorn Basin during the summer of 1881. The descriptions are somewhat amplified and illustrations provided in "Tertiary Vertebrata," 1884. Includes a classification of the Chelonian families and genera, first description of the Eocene lemuroid "Anaptomorphus homunculus" skull; classification of Creodonta and description of various new forms; revision of the Coryphodonidae and description of new species; brief synopsis of characters and species of Phenacodus; new species of Hyracotherium, Systemodon, etc.; Mioclaenus brachystomus sp. nov. an unquestionable artiodactyl. Fauna is typical Wasatch; distinc-
tions from Wind River fauna. Descriptions of a number of new mammals from the "Catathlaeus beds" of New Mexico (Puerco).


Description of the successive Tertiary "lakes," their location and extent, character of the formations and prominent features of the faunae.


Notice of description of this English dinosaur by J. M. Hulke in *Trans. R. Soc. London* Vol. 72, Pt. III, 1881, pp. 653-662, Pls. 70-76. Unsigned. Evidently by Cope. (w. o. m.)


Further discussion of the views of E. DuBois Raymond.


Creodont characters of humerus in *Phenacodus. Mesi- scotherium* referred to this suborder; key to families.


Characters of limb bones in *Mesonyx* (now *Pachyaena*) *oxifragus*; of hind foot in *Oxyana.* Based on Wortman's Bighorn Wasatch collections.

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Ganocephala not available. Rhachitomi suborder, including *Eryops, Actinodon, Trimerorhachis, Zatrachys*, etc., in two families.


*Catopsalis foliatus* gen. et sp. nov. described from Puerco of New Mexico.


Description of *Haploconus incatus* and *Pantolambda bathmodon* new genera and species.


Discussion of the origin of adaptive changes in phyla; the nature of consciousness and its relations thereto, as a fundamental cause of evolution.


*Thylacoles*, a descendant of the *Plagiaulacidae*. *Hypriprymus* parallel not nearly related. Probably not herbivorous, perhaps egg-eating or even carnivorous.


*Didelphodus* and *Ectocion* new genera, Wasatch Eocene Bighorn basin.


Carpus of *Phenacodus* excludes it from *Perissodactyla*. The new order includes Condylarthra and Proboscidea. Key to Ungulate orders.


Notice of discovery of skull by Princeton Expedition.


_Taeniolabis sulcatus_ gen. et sp. nov., based upon an incisor tooth from the Puerco of New Mexico. Unsigned. Cited by Hay and Frazer.


Unsigned editorial. Cited by Frazer.


Descriptions of _Polymastodon taëensis_ and _Catopsalis pollux_ new genera and species. (These subsequently proved to be founded upon the upper and lower dentition of the same individual. Both are probably identical with _Taeniolabis sulcatus._) New species of _Ptilodus_ and _Haploconus_ also described; all from Puerco formation of New Mexico.


Unsigned editorial. Cited by Frazer.


Description of _Meniscoxus conquistus_ gen. et sp. nov. (from the Lance formation).


_Hemiganus vultuosus (=Psittacotherium)_ from Puerco of New Mexico.


Structure of brain and foot, etc., in _Periptychus_; description of _Hemithlaus kowalevskianus_ gen. et sp. nov., etc.


New species of _Miocleenus, Protogonia_ and _Dissacus._


Unsigned editorial. Cited by Frazer.


Construction of carpus and tarsus is fundamental to the ordinal classification. Relations of carpals and tarsals in different groups of ungulates; key to orders; phylogeny.


Descriptions of *Edaphosaurus*, *Ectocynodon*, *Diplocaulus*, *Acheloma*, *Anisodexis*, the first and last two new genera.


List of vertebrata, chiefly mammals; descriptions of a number of new species; relations of the fauna.


Classification, based primarily upon the turbinal bones, then upon teeth, alisphenoid, etc.; list of genera of each family. *Plethelurus* gen. nov. for *Pelis planiceps*.


Review of Eocene reptilian fauna; figures of *Palacophis* vertebrae; skulls of 3 species of Crocodiles, several turtles.


Unsigned editorial. Cited by Frazer.


*Diacodexis* and *Heptodon*, new genera, from the Bighorn basin.

Reduced from drawing afterwards published in “Tertiary Vertebrata.”


Extended description and illustrations of *Amblyrhiza*, etc.


Distinctions in incisors between *Uintatherium* and *Bathyopsis*; in astragalus between *Coryphodon* and *Bathmodon*. Intended as an abstract of 690.


Key to classification, geological distribution, review of genera and species with figures of many specimens from Wasatch and Bridger, White River and John Day; afterwards published in extenso in “Tertiary Vertebrata.” The groups of pages appeared successively on January 5th and 31st, and March 15.


Unsigned editorial. Cited by Frazer.


Notice of Kowalevsky's memoir.


Comment on Dollo's paper, “Note sur l'osteologie des
pp. 1-20, Pls. IV, V et VI.

688 Scudder on Triassic Insects. *Amer. Nat.* Vol. XVII, 1883,
Jan. p. 73.

5 Note on the age of the Red Beds near Fairplay, Colorado.

689 (Contemporaneity of Man and Pliocene Mammals). *Proc.

16 See also 682 and note. Later discussion 746.


16 For abstract see 683 and note.


31 Cited by Frazer.

692 Filhol's Fossil Mammals of Ronzon. *Amer. Nat.* Vol. XVII,
Jan. 1883, pp. 190, 191.

31 Review of "Etude des Mammiferes fossiles de Ronzon
(Haute Loire)," by M. H. Filhol.

693 New Mammalia from the Puerco Eocene. *Amer. Nat.*

31 Helagras prisciformis gen. et sp. nov.; Pantolestes provisionally placed in Artiodactyla with species "Mioclaenus"
brachystomus and etasicies referred to it. No other tenable
description of new forms. Abstract of 695.

694 Zoological Geography of Western North America. *Science*

9 Abstract of 697.

14 No. 36, pp. 545-563.

In the full paper appears an extended description of "Mioclaenus" ferox (≡ Clerendon), compared here with carnivorous marsupials (a view subsequently withdrawn by Professor Cope); of skeleton of Pantolambda for which a new sub-order of Amblypoda, Taligrada, is erected; of various new species, etc.; the Puerco mammals nearly all have tritubercular molars, quadritubercular molar derived from this type. For description of Pantolambda see 702 and note. Also see note on dates of publication of the various pages of this article. In the *Proc. Amer. Philos. Soc.* pp. 545-554 were printed February 14, 555-563 on March 16. Bull. published April 17. For abstract see 693.

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.697 Abstract of 766.


.697 See 694.


.698 Key to extinct American genera; descriptions with figures of principal forms from John Day and Loup Fork (some figures afterwards in "Tertiary Vertebrata," others in "Unpublished Plates of Tertiary Vertebrata"). Phylogeny and origin.


.699 Unsigned editorial. Cited by Frazer.


.700 Dioplotherium manigaulti nov. gen. et sp. from Miocene of S. Carolina. Abstract of 706 as is also 696.


.702 Skeleton characters of Pantolambda; referred to Amblypoda new suborder; Taligrada, family Pantolambidae. Antedates by one day the pages of 695 dealing with this genus.


.703 In Phenacodus cerebrum remarkably small; sylvian fissure and traces of 3 convolutions present; cerebellum with distinct vermis and large lateral lobes. Olfactory lobes large, well separated. In Periptychus olfactory lobes enormous, mesencephalon wholly exposed, no sylvian fissure.


.704 From South America. See 710.


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For abstract see 696 and 700.


The quadritubercular molar type derived from it. Predominant in Puerco Eocene.


Supposed to be a verbal communication at the Acad. Nat. Sci. Phila., March 13, 1883, but not to be found in the Proceedings.


April Vol. XXXV, 1883, p. 57.

For abstract see 704.


See also 705.


Unsigned editorial. Cited by Frazer.


April Pl. XII.

General characters, with figure, of skeleton found by Wortman in Bighorn basin of Wyoming; list of species of the genus.


This is supposed to be part of the Proc. Acad. Nat. Sci. Phila. for April 10, but is not in the volume for 1883.


An abstract of 718 but first to be printed.


An abstract of 732 but published before the article.

July 16 Review of: The Theories of Darwin and Their Relation to Philosophy, Religion and Morality, by Rudolf Schmid; Final Causes, by Paul Janet; A Critique of Design-arguments, etc., by L. E. Hicks; Development, what it can do and what it cannot do, by James McCosh; Natural Selection and Natural Theology, a discussion between Dr. Romanes and Dr. Asa Gray, *Nature* Vol. XXVI, 1883.


July 16 Willow Creek, in Eastern Oregon.


July 16 A critical summary of Lemoine’s “Recherches sur les oiseaux fossiles des terrains tertiaires inferieurs des environs de Reims.” Part II. For abstract see 724.


July 24 Eleven species listed and *Amiurus prosthistius* N. Sp. described.


July 7 Faunal list with descriptions of fishes of this region including descriptions of 6 new species of recent fishes and 9 new species out of 22 fossil forms. For an earlier published abstract see 725 and 726.


Aug. 15 A continuation of 716.


Additional remains of *Periptychus dirigonus* show that it belongs to *Conoryctes*, probably family Periptychidae. Three new species named, genus *Zetodon* (new) defined. Unsigned. Given on Dr. Matthew's authority. See 741.


Notices of various new publications chiefly on vertebrate palaeontology. Unsigned. Cited by Hay.


The paper was originally read before the A. A. A. S. but not printed in the proceedings (see the second reprint) until 1884.


Abstract only of paper read before the A. A. A. S. For other papers on *Diclonius* see 719, 721.


Abstracts of a paper read before the A. A. A. S. but not printed in the proceedings until 1884.


See 735. Probably an abstract.


Notices of various papers chiefly on vertebrate paleontology. Unsigned. Cited on Dr. Matthew's authority.

Unsigned editorial. Cited by Frazer.

Crassopholis magnicaudatus gen. et sp. nov. from Green River formation of Wyoming.

Unsigned editorial. Cited by Frazer.

For earlier discussions see 682 and 689.

Unsigned editorial.

Atomarchus multimaculatus.


Supposedly an abstract of the meeting of the Acad. Nat. Sci. Phila. on June 12. No such communication by Cope is recorded in the proceedings.


Classification, phylogeny of the groups, review of principal American Permian genera with illustrations; discussion of vertebral construction.


Editorial on Darwin's "Origin of Species."

Abstract of 758. Description of the formation. Age determined by a skull of Aphelops fossiger Cope.

Key to classification. Tricentes and Indrodon new genera described.


This volume contains only the first half of Cope's final report to the Hayden Survey upon the Tertiary Mammalia. It includes the Eocene faunas and a part of the Oligocene (Lower Miocene) Rodentia and Insectivora, etc., Carnivora. The second half, to include the Oligocene ("Lower Miocene") Ungulata and the Miocene ("Loup Fork") fauna, was never published, although a large part of the plates were made and printed. (See 1395.) Forty-two fishes are described, belonging to eleven genera, and are shown in 185 figures on 14 plates.


For abstract see 753. Headwaters of Gila R. and San Francisco about 500 feet thickness. Also probably along eastern base of Magdalena mountains.


Several new species described; extended description of Tricentes and Indrodon; Chirox described as new genus; synopsis of the Eocene lemuroid genera; characters of the fauna—tritubercular bunodont teeth and plantigrade pentadactyl feet.


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Viewed as the primitive type from which are derived the later types of mammalian molars. Of these papers the Pal. Bull. was the first to be issued, its pagination being, as usual, that of the Philos. Soc. Both these differ in only the minutest detail from the Proc. A. A. A. S., so that it seems inadvisable to regard that, published in 1884 also as a separate article. For abstract see 740.

761 [The Society of Naturalists of the Eastern United States.]

Jan.

21 Unsigned editorial. Cited by Frazer.

762 Mission Scientifique au Mexique: Recherches zoologiques;

Jan.
Trois. Partie, Rech. sur les Reptiles et les Batraciens, par
M.M. Duméril et Bocourt. Amer. Nat. Vol. XVIII, 1884,
pp. 162, 163.

Review.

763 Results of the Deep-sea Work of the “Talisman.” Amer.


21 Unsigned editorial. Cited by Frazer.

764 On Extinct Rhinoceri from the Southwest. Proc. Acad.

Jan.

29 The History of the Oreodontidae. Amer. Nat. Vol. XVIII,

17 Abstract of 786, printed before the article. Review of the
genera and list of species with phylectic relations and geologic
occurrence.


17 Affinities, classification, review of principal known genera
with illustrations. The discussion of the affinities of the
Creodonta with Marsupials, Insectivora, etc., is an admirable
example of sound reasoning in comparative anatomy, and of
clear and condensed presentation of the salient points of the
evidence then available. The pages appeared successively in
the March (published Feb. 17), April (published March 15),
and May (published April 19) numbers of the Amer. Nat.

767 [The Law and Insanity.] Amer. Nat. Vol. XVIII, 1884,

17 Editorial.

Feb. XVIII, 1884, p. 283.

17 Unsigned but in the index of the volume under Cope. Notice of Owen’s descriptions of Sceparodon from the Pleis-


Review of: Diseases of the Will, by Th. Ribot; Humboldt Library No. 52.


Chlamydoselachus-Didymodus. See also 773, 782 and 792.


See 771 for the first note on Didymodus.


Unsigned editorial. Under Cope in volume index.


Key to the American species; description of new forms. The abstract is supposed to be a verbal communication before the Acad. Nat. Sci. Phila., March 22, but is not recorded in the Proceedings.


Didelphidæ and Multituberculata. Classification of Multituberculata, description of principal forms with illustrations; phylogeny.


See also 771 and 792.


Unsigned editorial. Cited by Frazer.


Editorial note on communication by J. D. Caton.


Synopsis of family characters and affinities, key to genera; principal characters of each genus, diagnoses and synonymy of species in each. Fifteen new species or subspecies described and extended or revised descriptions of a number of others. Affinities of genera, geological distribution. For abstract see 765.

Description of partial skull in Cope Collection from Permian of Texas.


Affinities, classification, description of principal forms with illustrations. The article appeared in the August number (published July 17) and the September number (published August 15) successively.


Editorial.


Critique of: Etude sur les caractères génériques du Simédesaure reptile nouveau de la faune Cernaysienne etc. par Dr. Lemoine, 1884. Probably = Champsosaurus; position of this group of fossil reptiles.


Figures of specimens from Texas Permian. See 771 for first note.


Unsigned editorial. Given under Cope in index of volume.


Unsigned editorial. Given under Cope in index of volume.


An advance abstract of 807. It is composed of the paragraphs from the bottom of p. 25 to end of that paper, com-
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prising the author’s views of this date in regard to the phylogeny of the families.


Sept. 15


Corollary to the doctrines of archaesthetism, etc., discussed in a previous number of the *Amer. Nat.* The abstract in *Science* appeared three days previous to the original in the *Amer. Nat.* The Proc. A. A. A. S. were not published until 1885.


15 Unsigned editorial. Under Cope in index of volume.


3 An abstract of 807. See also 796 and note.


3 Abstract of paper in Proc. A. A. A. S.


20 Ordinal characters, classification, affinities of other ungulate orders; descriptions of principal known types with illustrations. The pages appeared successively in the November number (published Oct. 20), the December number (published Nov. 19) and the January number of 1885 (published Dec. 30, 1884).


20 See also 785.

803 The American Association for the Advancement of Science.


20 Unsigned editorial. Under Cope in the index of volume.


20 Review with criticism.


20 Derived from primitive reptilia, the Permian Pelycosaursa
approximately represent the ancestral type. Abstract of 819 and 808.


Based upon study of collections in National and School of Mines Museums of Mexico. Revision of the species of Mastodon, dividing into 3 genera, Dibelodon, gen. nov. type M. shepardi, Leidy, Tetrabelodon gen. nov. type M. angustidens Cuv, upon characters of incisors. Equus, key to species and descriptions of two new forms; Camelidae, key to later genera, Exebatius gen. nov.


Concise account of principal features of structure of feet in American Tertiary genera; discussion of affinities and evolution; phytogeny of families. For abstract see 796 and 799.


Description of specimens of Clepsydrops, Cricotus and Edaphosaurus; posterior foot structure in Pelycosauroidea shows marked affinities to mammalia, especially monotremes; columella auris and quadrate in Clepsydrops leptocephalus (postea Diopeus Cope = Theropleura auct. Case) constructed on pattern distinctly approaching mammalia; articulation of ribs in Embolophorus mammaloid; reason for believing that the Mammalia are descendants of the Pelycosauria.


Unsigned editorial. Under Cope in index of volume.


Unsigned editorial. Under Cope in index of volume.


Interpretation of the structure in this Permian reptile bear-
ing upon problem of origin of the mammalian ear ossicles. Abstract of 820. See 808.


19 Diagram of phyletic relations of the classes of vertebrates. Brief discussion. See also 807.


19 Review of: The psychical Relation of Man to Animals, by Prof. Jos. Le Conte, from the Princeton Review.


30 Unsigned editorial. Cited by Frazer.


30 Unsigned editorial. Cited by Frazer.


817 Marsh on the Jurassic Dinosauria, Part VIII. *Amer. Nat.* Vol. XIX, 1885, pp. 67, 68.


30 Review of: Comparative Physiology and Psychology, by S. V. Clevenger.


For abstract see 805. See also 808.


For abstract see 808 and 811.


Genealogy of the Vertebrates as Learned from Palaeontology. Trans. Vassar Brothers' Institute Vol. III, pp. 60-80. See also 824, which is nearly the same paper.

On the Evolution of the Vertebrata, Progressive and Retgressive. Amer. Nat. Vol. XIX, 1885, pp. 140-148; 234-247; 341-353. Degeneracy and adaptive specialization; embryological and palaeontological evidence; general relations of the vertebrate classes; broader features in evolution of vertebrate anatomy; the Urochorda; evolution of the Fishes and relationships of the orders; Batrachia, key to the orders, phylectic relations; Reptilia, key to orders, phylectic relations, degenerative features in their evolution; birds; key to orders of mammals, phylectic relations, evolution of feet, vertebrae, dentition, brain; instances of degeneracy; progressive evolution prevalent in higher and more recent groups, retrogressive in earlier and lower forms. The paper appeared successively in the February number (published Jan. 19), the March number (published Feb. 24), and the April number (published March 21).


EDWARD DRINKER COPE—OSBORN

24 Unsigned editorial. Cited by Frazer.

24 Comparison of Pterichthys with modern Tunicates.

With synopses of the Mexican and Central American species of the genera: Eumeces, Eutania, Coluber, Phylodactylus and of the genera of the Amphisbaenidae, including the new genus Aporarchus from Rio Grande do Sul, Brazil.

6 Lower Puerco (Polymastodon zone as now known), list of fossil mammals, descriptions of P. latimolis n. sp., Laxolophus adafinus gen. et sp. nov.; Chriacus hyattianus n. sp.; Sarcothraustes coryphaeus n. sp.

Osteological distinctions between the orders Lemuroidea and Insectivora; relations of the Condylarthra; families and genera Arctocyonidae (including Achacnodon).

20 Criticism of argument for four-dimensional space. Unsigned editorial. Under Cope in index of volume.

April Unsigned editorial. Cited by Frazer.

20 Hemiganus otariidens sp. nov.

20 Neoplagiaulax americanus n. sp., Ptilodus, Polymastodon attenuatus n. sp. from Puerco formation.

20 Note on occurrence and fossil mammals.

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EDWARD DRINKER COPE—OSBORN


851 Unsigned editorial. Under Cope in index of volume.


860 Puerco formation overlies Laramie with characteristic dinosaurs. Both, however, may be associated in the Post-cretaceous series. *Crocodilus stavlilianus* described from Laramie of New Mexico.


862 Notes on distribution; key to species of Cyclura.


267

For abstract see 841. Description of skeleton of Stereosternum "carboniferous" (Permian) and also Hyposaurus. New species of fishes of genera Apocodon, Enchodus, Diplomystus, Chironyctes and Pycnodus described.


 Unsigned editorial. Cited by Frazer.


 Unsigned editorial. Cited by Frazer.


 Green River Eocene fish fauna: Crossopholis a relative of Polyodon; Notogonococcus new genus, and synopsis of the Ecupodine division of the Teidae.


 With a new genus, Microyx, and a synopsis of the Ecupodine division of the Teidae.


 Unsigned editorial. Cited by Frazer.


 Unsigned editorial. Cited by Frazer.


 Review of: Catalogue of the Fishes known to inhabit the
Waters of North America north of the Tropic of Cancer, by D. S. Jordan (extracted from Annual Report, U. S. Commissioner of Fish and Fisheries, for 1884).


25 Unsigned. Cited by Hay.


25 Note on characters seen in skeleton found by Wortman and Hill in South Dakota, now mounted in the American Museum (Cope Collection).

874 Pliocene Horses of Southwestern Texas. *Amer. Nat.* Vol. XIX, 1885, pp. 1208, 1209, figs. 4-6 of Pl. XXXVI.

25 Five species noted; figure of *E. crenidens* upper molar, also of upper molars of *Hippotherium peninsulatum* n. sp. and *Protohippus castilli* n. sp. from Mexican Tertiary. Abstract of 877.


25


2 Geological notes: *Hippotherium peninsulatum* and *Protohippus castilli* further described. For abstract see 874.

878 [The Indiana Academy of Sciences.] *Amer. Nat.* Vol. XX, Dec. 1886, pp. 41, 42.

29 Unsigned editorial. Cited by Frazer.


29 Homologies of the vertebral elements in Permian Batrachia and Reptilia.


29


See 828 for abstract.
Species of *Crassopholis, Notogeneus and Priscacara* (*H. hyssacanthus* N. Sp.) described.

Study of a brain-cast and sectional skull of *Diadectes*. For abstract see 855.

Editorial. Plan for such an institution.

Description and figures of *Diclonius* and *Monoclonius*.
(This element in *Monoclonius* subsequently identified as the "frill" at the back of the neck.)

*Tetheopsis* founded upon an artefact; basicranium described by Cope in "Tertiary Vertebrata" as *Uintatherium lacustre* is a *Palaeosyops*.

Traces of a true intercentrum are present in this reptile.


With a synopsis of the genus *Trimorphodon*.

Unsigned editorial. Cited by Frazer.

891 An Extinct Dog. *Amer. Nat.* Vol. XX, 1886, p. 271
Notice of J. A. Allen's memoir on *Pachycyon robustus*.
EDWARD DRINKER COPE—OSBORN


45 Charina, Lichanura and Loxocemus. Systematic position.


Pelcopterus not identical with Ptychodus.


Mascall and Deep River faunas compared. Anchitherium ultimum and Merycochocrus obliquidens described from Cottonwood Creek, Oregon (Mascall formation). Abstract of 896.


Fuller description and discussion than in abstract; Hippotherium rectidens n. sp. from Tehuichila. For abstract see 895.


24 Editorial.


Neoplagiaulax molestus sp. nov.


Erisichthe not synonymous with Protosphyraena.


1 Unsigned editorial. Cited by Frazer.

271

Unsigned editorial.


1 Description of *Naosaurus claviger*; key to species of *Naosaurus*.


Characteristics of Camelidae; key to genera; description of ancestral series, carried back to "Pantocesta" *brachystomus* (i.e., *Diacodexis*).


Unsigned editorial. Cited by Frazer.


Unsigned editorial. Cited by Frazer.


Unsigned editorial. Cited by Frazer.


*Salmo purpuratus* from Sierra Madre, Mexico.


Fear of hognose and water snake for copperhead.


 Unsigned editorial. Cited by Frazer.


Unsigned editorial. Cited by Frazer.


Editorial.


The third or second and third upper molars in man are very commonly tritubercular as in primitive lemuroids instead of quadritubercular as in monkeys and apes. This is especially true of the higher races of man, and is regarded as a reversionary character.

[Instruction and Investigation.] Amer. Nat. Vol. XX, 1886, p. 948.

Unsigned editorial. Cited by Frazer.


Review of: Première note sur les Cheloniens de Bruxellien de la Belgique, par L. Dollo; Bull. Mus. Roy, de Belgique,
1886, p. 75; and Première note sur les Cheloniens Landemiens de la Belgique; I. c., p. 129.


.928 Mycterops ordinatus gen. et sp. nov. intermediate between Ostracoderms and primitive fishes.


Unsigned editorial. Cited by Frazer.


The exact date not known but first criticised on April 28, 1887.


Unsigned editorial. Cited by Frazer.


Remarks upon its affinities (based upon specimens from
Trias of New Mexico, subsequently removed to Tanystropheus v. Mey., and later made types of Coelophysis Cope.


April 940 Science and Immortality. *Christian Register*, April 7, 1887.

April 7


See also 942.


L. garmani n. sp.


Read at the International Geological Congress, 1887. Synopsis of classification, distribution of formations and distinctive features of vertebrate faunae. The Laramie group and Puerco are here included in the Mesozoic as Postcretacic system.


Typothorax from Triassic of New Mexico.


Additional specimens of Psittacotherium described.


Unsigned editorial.


Describes *Piptomerus* gen. nov. with three species, and a new
species of Orophosaurus from fragmentary material obtained in New Mexico.

Description of palate with upper dentition.


Unsigned editorial. Cited by Frazer.


Verbal communication to the Amer. Philos. Soc.


Reprinted as a pamphlet under the title, “A Review of the Theology of Evolution; A Reply to Dr. Montgomery.”

Based chiefly upon New Mexican collections. Additional notes on Eupelor, Typothorax, Belodon, Tanystrophaeus (olim Coelurus, postea Coelophysis); Episeposaurus gen. nov.

Unsigned editorial. Under Cope in index of volume.

Unsigned editorial. Under Cope in index of volume.

Unsigned editorial. Under Cope in index of volume.


These pages are in an article, "Catalogue of Animals collected by the Geographical and Exploring Commission of the Republic of Mexico," by M. Fernando Ferrari-Perez.


The Perissodactyla. *Amer. Nat.* Vol. XXI, 1887, pp. 985-1007; 1060-1076; Pls. XXVIII-XXXIV; figs. 1-44.

The paper appeared successively in the November and December numbers. Structure and origin of the Perissodactyl foot; characters and evolution of the cheek teeth; synopsis of families and review of principal genera in each, with illustrations of important specimens, generic keys, and phylogenies.


Unsigned editorial. Under Cope in index of volume.


*Machaerodus catopicus* from Republican River beds in Kansas.


Key to families; phylogeny of families; synopsis of principal genera in each family with key and phylogeny. See also 1031.


Notes on a nearly entire skeleton from Sao Paolo, Brazil.


Generically distinct from *Canis* on basis of number of teeth; genera *Synagodus* and *Dysodus*.

Unsigned. Cited by Frazer.


Unsigned. Cited by Frazer.


The Rodentia are derived from the Tillodontia, certain Taeniodonta being largely intermediate in structure of teeth. The Taeniodonta may also (footnote) be structurally ancestral to the Edentata. Evolution of the characteristic palinal jaw movement in rodents causing the evolution of their characteristic dentition (through kinetogenesis).


Derivation of the order from Tillodont-Taeniodont group. Character of jaw movements in rodents and mechanical effect upon the tooth structures. Parallelism in Multituberculata.


Structure of their teeth indicates palinal movement of jaws as in Rodentia.


Unsigned editorial. Cited by Frazer.

Note (on Dr. Montgomery’s argument.) Open Court Vol. II, No. 27, March 1, 1888, p. 777.


Abstract of 1009. The Puerco a distinct epoch: characters of the mammalian fauna. All plantigrade pentadactyl bunodonts and nearly all have tritubercular molars. Multituberculata present. Perissodactyls and Rodents absent. Fauna ancestral to Eocene and later faunae.


.992 Vestigial teeth of *Ornithorhynchus* indicate that the Multituberculates belong to this group instead of the Marsupials.


Abstract of paper read before the National Academy of Sciences, April 18, 1888. For complete form of paper see 1022.


*Bufo aduncus*.


With a key to the genus *Ophibolus*.


Including a new genus of lizard, *Lysiptchus*.


Figures 4 and 4a erroneously numbered 1 and 2 on Plate.


Unsigned editorial. Cited by Frazer.


Abstract of paper read before the Philosophical Society of Washington under the title, "The Relation of Consciousness to Animal Motion," on May 26, 1888.


.1015 Osborn on the Mesozoic Mammalia. *Amer. Nat.* Vol. XXII, 1888, pp. 723, 724; Pl. XIV.


Unsigned editorial. Cited by Frazer. Discussion of Powell's proposal for government reservoirs in Rocky Mountain region.


For abstract see 1002.


1023 *Charina brachyops* from Point Reyes.


The article appeared successively November 15 and 22.


Presence in Ostracoderms, *Cricotus, Diadectes,* characters of brain cast in *Diadectes* and *Belodon*.


Unsigned editorial. Cited by Frazer.


Unsigned editorial. Cited by Frazer.


Handbuch der Palaeontologie, Band III, Teleosti (finis) et Batrachia, 1888.


A modified form of 974. Diagnosis of order, key to fami-
lies and their phylogenetic relations; synopsis of genera in each family with illustrations of principal types.


Note upon Prof. Marsh’s articles on Ceratops in _Amer. Journ. Sci._ Dec., 1888. Probably identical with an unnamed dinosaur described by Cope in 1877.


_Criticism on Hervé’s article in Bull. Soc. d’Anthropol. de France, April, 1888._


1889


_Lecture before Brooklyn Unitarian Church._


1 _Unsigned editorial. Cited by Frazer._


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.1053 Bronnigart and Döderlein on Xenacanthina. *Amer. Nat.* June Vol. XXIII, 1889, pp. 149, 150.


.1053 Bronnigart and Döderlein on Xenacanthina. *Amer. Nat.* June Vol. XXIII, 1889, pp. 149, 150.

1888. "Chalicotherium" hilobatum n. sp., Haplacodon gen. et. sp. nov. five new species of White River mammalia.


Synopsis of characters and affinities, key to families and genera, list of species and key to those of North America; phylogeny; illustrations of several Tertiary American Mastodonts and comparative diagrams of skulls of American and Old World Proboscidea.


Collection sent in by Duncan from "Oregon Desert." Hippotherium relictum n. sp. described. (The collection appears to be an admixture of specimens from two or more formations. W. D. M.)


For abstract see 1037.


18 *Carophysis* gen. nov. based upon three species from the Triassic of New Mexico previously referred to *Cocelurus* Marsh and to *Tanystrophus* von Meyer.


18 Additional note describing three new species. See 1054.


1 Unsigned editorial. Cited by Frazer. Suggests the Mountain Laurel, or still better the Tulip-tree.


1 Unsigned editorial. Cited by Frazer.


3 This article appeared successively January 3 and January 30, 1890.


5 Synopsis of suborders and families; key to genera of *Mega-

theriidae*, and *Glyptodontidae*; phylogeny. Figures of *Cory-

derma* etc. *Coryderma* is now known to be a tortoise.


5 Review of Monographie der *Elephas antiquus*, Falc., führen-


5 Additional notes on *Monoclonius*, with figures or horn cores in three species, two of them new. Family Agathaumidae.


3 Unsigned editorial. Cited by Frazer.


28 Unsigned editorial. Cited by Frazer.


13 Family classification.


13 *Pteropelyx grallipes* gen. et sp. nov. (Trachodont, Judith River); notes on Agathaumidae.

.1084 [Comment on Dr. Lamb's "Olecranon perforation."] *Amer. Anthrop.* Vol. III, 1890, p. 174.


3 Unsigned editorial. Cited by Frazer.


E. D. Cope—Osborn


1090 Unsigned editorial. Cited by Frazer.


1093 Notes upon journey; recent fauna; Fossil Lake locality; list of fossil vertebrates.


1095 Certain remarks by Lester F. Ward, J. J. Stevenson and E. D. Cope at meeting of Geological Society of America.


1097 Relation of fins to legs, relation of fins to each other, nature of the supports of median fins, caudal fin and its supports.


1099 Unsigned editorial. Cited by Frazer.


1101 Unsigned editorial. Cited by Frazer.


1105 Unsigned editorial. Cited by Frazer.
NATIONAL ACADEMY BIOGRAPHICAL MEMOIRS—VOL. XIII

Unsigned editorial. Cited by Frazer.

Unsigned editorial. Cited by Frazer.

.1099 (Note on the "two-rooted" teeth described by Prof. Marsh.) Amer. Nat. Vol. XXIV, 1890, p. 571.
Teeth of Ceratopsia are not really two-rooted; the appearance is produced by absorption of centre of root above successive tooth. Dysgonus Cope 1876 was based on Ceratopsian teeth.


Exposition of theories of heredity.

Unsigned editorial. Cited by Frazer.

Synopsis of characters, affinities, classification and phylogeny, list of extinct American Cetacea.

Synopsis of families and genera; figures of some American forms.

Unsigned editorial. Cited by Frazer.


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Editorial.


Unsigned editorial. Cited by Frazer.


Review of: The Colors of Animals, their Meaning and Use especially considered in the case of Insects, by E. B. Poulton. 1890.


Gyrinophilus maculicandus.


Aelurodon compressus n. sp. Based upon a lower jaw in the Cope Collection and two rami in Mus. Comp. Zool., referred by Scott and Osborn to Ae. hyaenoides Cope. Figure of skeleton of Ae. saevus in Cope Coll.


Amia whiteavesiana, A. macrospondyla; Rhineastis rhaas; Amiurus cancellatus, A. macconnelli: all new species.


Menodus peltoceras, Canopus simplicidens, n. sp. (Types now in Amer. Mus.)


Review of: Hypnotism, by Albert Moll, 1890.

Unsigned editorial. Cited by Frazer.


Short discussion followed by a table giving superorders, orders, and families to show relationships.


Editorial.


*Macropetalichthys, Megalichthys, Platysomus and Dendrodus* briefly considered.


Abstract only.


See also 1390.


Review of: Studies in Evolution and Biology, by Alice Bodington, 1890.


*Gephyrura, Probaltostomus,* new genera described, three species from Tertiary of Ree Hills, S. D.


Discussion of characters and affinities; synopsis of families and genera. Astrapotherium and Homalodontotherium provisionally included. Based largely on Ameghino's "Mamíferos Fosiles de la Republica Argentina."


Editorial.


Unsigned editorial. Cited by Frazer.


Unsigned editorial.


First skull on record of an American fossil Equus.


Unsigned editorial. Cited by Frazer.


Editorial. Notice of Spy discoveries in Belgium, and *Homunculus* in Patagonia.


Description, with figures, of *Arctotherium simum* skull.


Comment on Ameghino’s discoveries.


*Rana virgatipes*.


New species of *Styptobasis*, *Hybodus*, *Ctenacanthus* and *Platysomus*; cranial structure of *Macropetalichthys*; pectoral limbs of *Holoneura*; paired fins of *Megalichthys*; superorders of the non-actinopterygian Teleostomi.


Unsigned editorial. Cited by Frazer.


Extracts from Stirling's memoir describing *Notoryctes*. 306
EDWARD DRinker COPE—OSBORN


Cope’s genus *Bematiscus* established in a footnote to p. 127.

25 Unsigned editorial. Cited by Frazer.


29 Unsigned editorial. Cited by Frazer.


In its finally developed form the paper is 1189.


*Manyspondylus* and *Cuorkynchus*, new genera. Notes on *Agathaumas* based upon complete skeleton found by J. L. Wortman in South Dakota (subsequently referred to Hadrosaurus = Trachodon).


Read before the Nat. Acad. Sci. Nov. 10, 1891.

*Eutania brachystoma*.


*Eutania brachystoma*.

On the Permanent and Temporary Dentitions of certain Nov. Three-toed Horses. *Amer. Nat.* Vol. XXVI, 1892, pp. 942-


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EDWARD DRINKERCOPE—OSBORN


Borophagus a hyaena, Caninartes a new musteline, Felis hillanus (earliest true cat in North America).


Collection from the Staked Plains.


Brief abstract of paper read before the Nat. Acad. Sci. in 1892.


Unsigned editorial. Cited by Frazer.


Unsigned editorial. Cited by Frazer.


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Comment on Ambrosetti’s article in Boletin, Acad. nacional de Ciencias, Cordoba.


 Unsigned editorial. Cited by Frazer.


 Unsigned editorial. Cited by Frazer.


Review of: Man and the Glacial Period, by G. Frederick Wright, 1892.


*Daimonelix.* Review of article by E. H. Barbour. These objects are regarded by Cope as rodent burrows.


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.1241 Unsigned editorial. Cited by Frazer.


   Forty-two species listed, mainly Characinidae (3 new genera and 9 new species), Siluridae (6 new species), and Cichlidae (2 new species).


 Unsigned editorial. Cited by Frazer.


 Unsigned editorial. Cited by Frazer.


 Unsigned editorial. Cited by Frazer.


Including a new ophidian genus, Trimerodytes, and a synopsis of the genera of Natricinae.


Notice of Dubois' memoir on Pithecanthropus. May belong to Homo neanderthalensis.


Unsigned editorial. Cited by Frazer.


Separates April 15, 1895.


.1297 Dr. Ryder’s Contributions to the Doctrine of Evolution. June Fourth Address before the Meeting in Memory of Dr. J. A. Ryder. In Memoriam, John Adam Ryder, 1895, pp. 15-18.


No remains of man found with the Megalonyx cave fauna in the East. Found in auriferous gravels of California with Equus fauna which was probably contemporary with the Megalonyx fauna of the Eastern United States.


Including the new genus Seminatrix from Florida.


Review of the genera based on recent contributions by Stejneger and Van Denburgh. Zablepsis and Amebopis, new.


Unsigned editorial. Cited by Frazer.
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28 Unsigned editorial. Cited by Frazer.

28 Unsigned editorial. Cited by Frazer.


28 Named X. picta in number, 1311.

26 Unsigned editorial. Cited by Frazer.

26

18

29 Unsigned editorial. Cited by Frazer.

29 Disororporus multicinctus gen. et sp. nov. from Permian of Texas.

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Continuation of discussion (1308) regarding correlation of bones of temporal region in reptilian orders.


Presidential Address, Society of American Naturalists, 1895.


Continuation of discussion in 1308 and 1315.
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Unsigned editorial. Cited by Frazer.


Unsigned editorial.


Unsigned editorial. Cited by Frazer.


 Unsigned editorial.


Unsigned editorial. Cited by Frazer.


Explorations at Nippur. The Sumerians were not Turanian but Aryan or Semitic: a highly developed type physically and socially.


For earlier abstract see 1345. Abstract of 1392.

Second Contribution to the History of the Cotylosauria.


Continues 1328.


*G. dissecta.*

American Association for the Advancement of Science.


Opening address at meeting in Buffalo, Aug. 24, 1896.


The paper was first read, under the title of the abstracts, before the A. A. A. S.


Unsigned editorial.

On Two New Species of Lizards from Southern California.


*Anota calidiarum* and *Sceloporus vandenburgianus.*

This paper appeared successively in the November (published Nov. 2), and December (published Dec. 5) numbers.


Unsigned editorial. Cited by Frazer. The proper method of forming species names from the names of persons.


Unsigned editorial. Cited by Frazer. Defends "species-making."


Unsigned editorial. Cited by Frazer.


Figures of *Otocaulus* and *Dissorophus* described in earlier notices in *Amer. Nat.*


List of fishes found in an isolated pool in Camden Co., New Jersey.


Unsigned editorial. Cited by Frazer.


Unsigned editorial. Cited by Frazer.


Unsigned editorial. Cited by Frazer.


Transferred from Condylarthra to Amblypoda forming, with the Pantolambdidae, a primitive suborder Taligrada of the Amblypoda. This is the last original contribution to mammalian paleontology published by Professor Cope before his death. It is largely in the nature of a forecast and has been completely verified by subsequent discoveries, save for the supposed relationship to the Artiodactyla.


June Classification and principal characters of the orders, families and genera, based upon Ameghino's researches.


Editorial.
EDWARD DRINKER COPE—OSBORN

For the original issue see 1072 and 1137.

See Hay 1898 A for Note.


Including a new lacertilian genus, Heterodonium from Colombia and a synopsis of the genus Himantodes.

Although full of inaccuracies this volume is the standard authority and the only comprehensive treatise on North American reptiles.

These plates were prepared under Professor Cope's direction about 1881-3 to illustrate the final volumes of his reports on fossil vertebrates for the Hayden Survey (U. S. Geol. and Geogr. Survey of the Territories) which were never published. The titles appear on the plates, but no manuscript or plate descriptions pertaining to them were found among Professor Cope's papers. The joint publication of the plates as specified in the title was arranged through the efforts of Professor Henry Fairfield Osborn. Nearly all the specimens illustrated are in the Cope Collection, American Museum of Natural History.