

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

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

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

STRANGE CREATURES OF THE PAST.

GIGANTIC SAURIANS OF THE REPTILIAN AGE.

BY WILLIAM H. BALLOU.

WITH PICTURES BY CHARLES R. KNIGHT.

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

ies or advances in paleontological science yet promulgated.

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

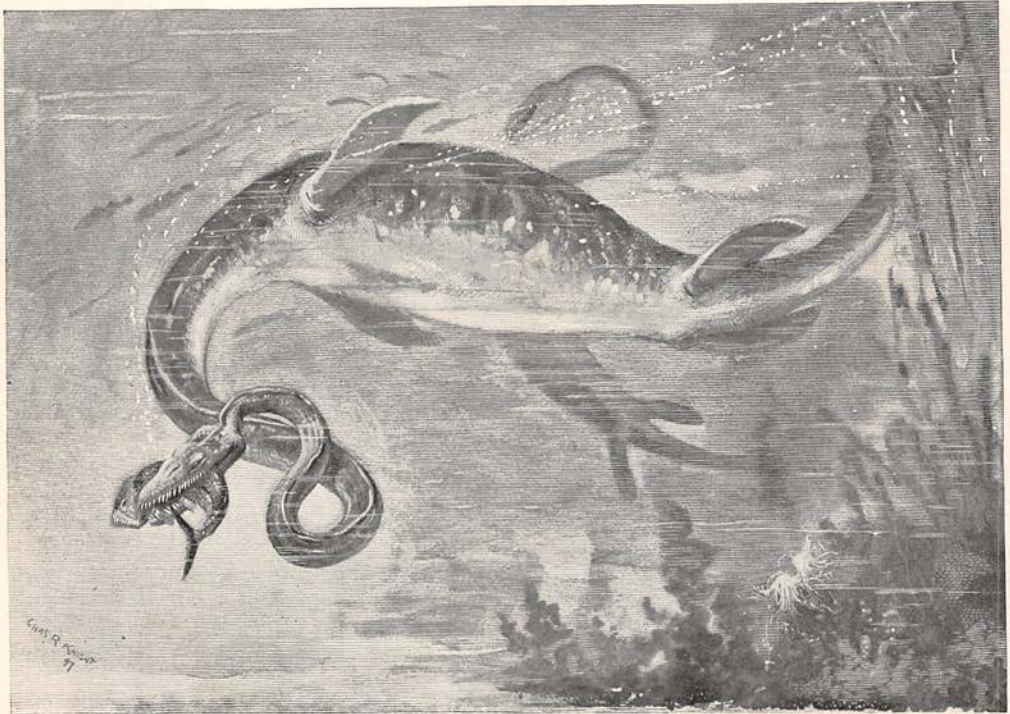
various transformations, all became extinct, so that the lizard of to-day has the dimensions and some of the habits of the original ancestral type.

It is from Texas, Pennsylvania, and New Mexico that the best-known and the largest number of Triassic lizards come. The biggest of these were perhaps *Palæoconus orthodon* and *Palæoconus dumblianus* (Cope). A Utah Triassic lizard of elephantine proportions was defined by Cope as *Dystrophelus viemalæ*. Allied to the crocodiles were *Episaurus horridus* and *haplocerus* (Cope), the former from New Mexico. These saurians were often plated like war-ships, or had sharp cutting or hooked spines on their backs, which rendered them safe from attack.

The fin-back lizard was one of the terrible monsters of the Permian era found in Texas. The skeletons so far found range from three to ten feet in length. It bears the name of *Dimetrodon incisivus* (Cope). The long back spines are often found in masses in the rocks, adhering together like sticks. In a related genus, *Naosaurus claviger*, these spines had branches, giving them the appearance of the yard-arms of ships, from which may have

been extended membranes enabling these animals to sail along the surface of the water. Owing to the great number of spines, it may be assumed that this animal never rolled on the ground like a horse. The finbacks and spinebacks were flesh-eaters. Their teeth were formidable, being finely serrate mingled with huge conic tusks. The large spines sprang from the vertebræ, and were often as long as forty inches, and formed an elevated fin for defense against some enemy not yet known. The limbs were not long enough, nor the claws sufficiently acute, for tree-climbing. The dimetrodons were both water and land animals, being able to walk on four legs.

The cotylosaurs of the same period were burrowing lizards with solid skulls. Many species of them are found in the Permian of Texas and South Africa. They were mostly small, and, like modern burrowers, probably made their homes or nests in the ground. The most interesting item concerning these animals is that one genus of them—*Otocelus*—had a shell or carapace, and was possibly the ancestor of the turtles, or of the animals from which turtles ascended. It is evident that there was no dearth of lizard-like saurians



THE FLAT-TAILED PLESIOSAUR.

The *Elasmosaurus platyrus* (Cope) resembled Pontoppidan's figure of the sea-serpent. It was a rapacious and terrible destroyer of fishes in the Cretaceous seas. Apparently it skimmed the surface, arching its neck like a swan, ready to flee from cimoliasaurs or to plunge for its prey. A type skeleton measures forty-five feet, of which twenty-two feet comprise the neck.



THE SPOONBILL DINOSAUR.

Hadrosaurus mirabilis (Leidy) is the type skeleton in the Cope collection, thirty-eight feet long, from the Laramie Cretaceous beds. The animal was preyed on by the carnivorous leaping lizard, *Laelaps incassatus*.

in the Triassic formation, and in the older Permian era below it.

Among these animals were undoubtedly the ancestors of the large dinosaurs; but their detailed evolution and ancestry are involved in mystery. As to the order of ascent, Professor Cope and his contemporaries speak only in general terms. Much more exhaustive studies will be required, and more and completer skeletons will have to be brought to light. The evolution of the Mammalia, particularly man, is nearly complete. Not so with the dinosaurs and other reptiles; at present the geological sequence only is established. In a general way it may be said that the duration of the existence of the saurians extends from the Carboniferous period in the Paleozoic realm through the entire Mesozoic realm, or many millions of years. We have seen that the original saurian was an eight-inch salamander-like animal, found in the Paleozoic Carboniferous, or coal-measures, in Ohio. It is astonishing how great and mighty a race sprang from so diminutive and insignificant an ancestry. The Carboniferous era closed, the poor little beast disappeared from view. In the succeeding or Permian era, still in the Paleozoic realm,

many cotylosaurs appeared. They were of varied species, but all of small or moderate size—larger, however, than the above-mentioned ancestor. As the Permian advanced in age, the saurians increased in numbers, in variety, and in size. Then not only the Permian era, but the great Paleozoic age, died out, and these animals all became extinct.

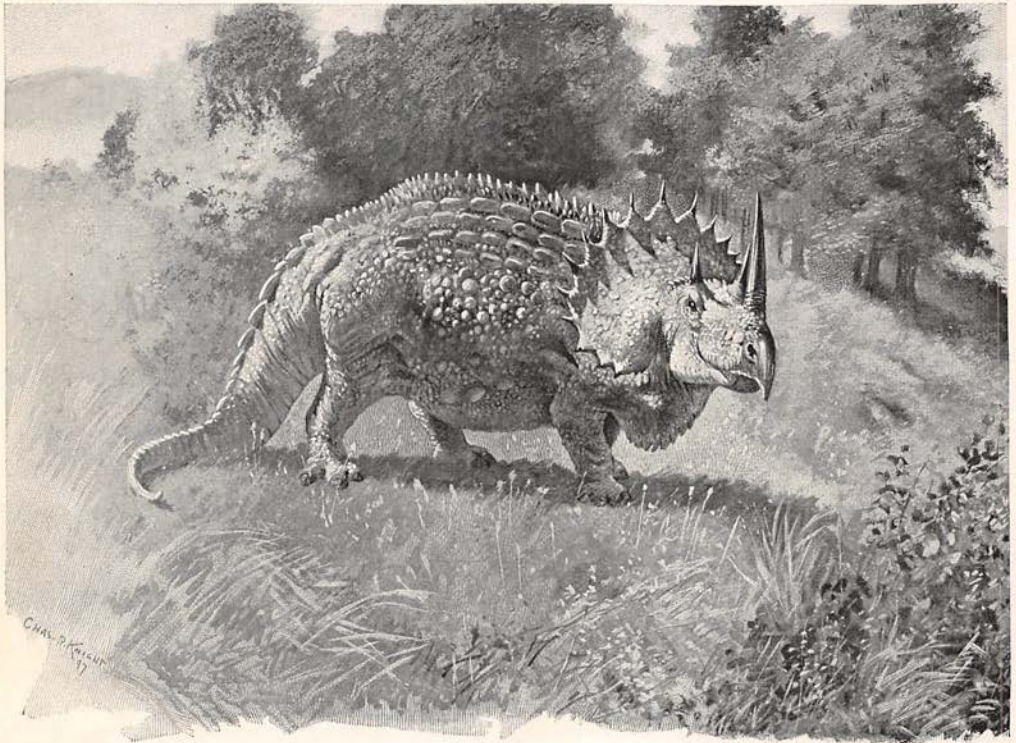
The succeeding Triassic, Jurassic, and Cretaceous formations of the Mesozoic realm, to which this article mainly refers, were the most remarkable periods of the world's history for forms of reptilian life. In them the reptiles reached their time of glory; they grew in vast numbers and to gigantic proportions. Some went in herds; food was most plentiful; conditions and climate were most propitious. The forests and jungles contained those which walked on four legs; the plains and fields, those that ran or leaped on two hind legs and tail; the lakes, those that waded, and swimmers which never ventured on shore; the ocean, those that swam with great speed and fed like ducks or sharks.

The Cretaceous, the last section of the Mesozoic realm, and the nearest of these periods to our time, contained the highest forms—*lælaps*, the great leaper; *hadrosaurus*,

the long-legged wader; and agathaumas, the king of the forest; and with the close of the Mesozoic died ingloriously the dinosaurs and all other large saurians.

If we arrange these forms according to Professor Cope's theories, we must place the carnivorous saurians as follows: clepsydrops, the ancestor in the Permian; palæoctonus in the Triassic; the megalosaurs in the Jurassic, ending with lælaps in the Cretaceous; in the herbivorous or fourth line we have the thecodontosaur in the Triassic, iguanodon in the Jurassic, and hadrosaurus in the Cretaceous; and in the second line the camarasau-

places from some other quarter. Their bulk grew so great finally, reaching several tons, that it has been suggested that they mired and died—in other words, «stuck in the mud.» Morris, however, ingeniously supposes that their eggs were eaten or destroyed by a race of small mammals, which Cope suggested were the multituberculate Prototheria, allies of the existing Australian duckbill, but armed with sharp, lance-like teeth in the front part of the jaws—a race of animals, by the way, for which there is no modern equivalent, there being no existing animals with which to compare them. The successors of the sau-



THE HORNED DINOSAUR.

The *Agathaumas sphenocerus* (Cope) is based on the reconstruction of a possibly identical and prior restoration, *Triceratops prorsus* (Marsh). This elephantine Laramie Cretaceous dinosaur, twelve to fourteen feet in length, was herbivorous and harmless, but so well protected as to be free from molestation.

rus alone, with ancestors and successors unknown. Between the last two lines is a third line of the stegosaur types. It is only the carnivorous line that runs straight from the cotylosaur to lælaps. Why did the large saurians ultimately become extinct, while the small, inoffensive lizards persisted? We may assume that the dinosaurs, being generally distributed over the whole globe, migrated during the Paleozoic and Mesozoic ages; that when extinguished on one section of the globe, others gradually took their

places in the Cænozoic age were the Lacerilia, or small lizards similar to those found about farm fences to-day.

In two ways these ancient reptiles have been of value to mankind: their remains have enabled scientists to determine accurately certain geological horizons; and from some of their branches they gave origin to the Mammalia and to man himself; that is, one type in the carnivorous line, not yet determined, was regarded by the late and ever-lamented Professor Cope as one of the

ancestors of man. Had he lived, that missing type would have been identified, and named in this article.

According to geologic reckoning, the dinosaurs were among the highest types of life on earth several million years ago; they left only occasional tracks in the rocks, and now and then a petrified skeleton. These bones, when examined, show how the animal must have moved about, either in water, on land, or in air; the teeth and jaws indicate what he ate, whether of flesh, fish, or vegetation; his limbs suggest whether he walked, leaped, waded, or swam. It is interesting to note the diversity of powers which these dinosaurs possessed, including every function given to diverse animals, even that of flight, illustrated in the related group of pterosaurs; they were also often endowed with beaks and claws like birds, but without the functions of flight. In general, some of them resembled kangaroos, while others suggested the rhinoceros, and still others corresponded to our notions of mythical sea-serpents. Some of them leaped about on land, some lived near the ocean, certain varieties waded only in lakes, some inhabited the forests, and some were amphibious. Certain types walked on two hind limbs, balanced by the tail, and others moved squarely on four feet.

The footprints of the Triassic red sandstone of the Connecticut valley, and of the same formation in New Jersey or Pennsylvania, are familiar to many people. The creatures which strode along the flats of the Triassic estuaries were various in genera and species, and were formerly thought to have been gigantic birds. There are also impressions in the stone that were made by these animals squatting on their haunches. About one hundred and fifty species of extinct saurians have been discovered on this continent, but it is now known that they, at one time or another, inhabited nearly the whole globe.

One can imagine the singular appearance of troops of giant saurians perhaps standing motionless, or marching or wading slowly along the water's edge, ready for a plunge at passing fishes or swimming reptiles. In the active pursuit of land prey they ran like ostriches or leaped like kangaroos. It is believed that only one group of them belonged to types which are necessarily marine animals, while many of them were representatives of the types which at the present day pertain only to fresh water. Six of the Dinosauria were terrestrial, and the structural adapta-

tions necessary for swimming are wanting. Eight were crocodiles in form, of which only fresh-water representatives now exist. Only a few species had the shortness of limb which would enable them to swim the waves of the open sea for any period of time. These observations apply to all marine vertebrates with separated digits the life of which is spent in the water and that rely on their limbs for progression, unless their bulk be such as to render them independent of the waves, or unless they have wings.

One of the Laramie animals, *Hadrosaurus mirabilis* (Leidy), a wader, may be called the spoonbill dinosaur, having a goose-like head over three feet in length. In the jaws of a single specimen were counted two thousand and seventy-two teeth. Otherwise its form slightly resembled that of the kangaroo. For a reptile the head had an unusually backward elevation, remarkably contracted at the fore part of the jaw. The total length of a specimen in Professor Cope's collection is thirty-eight feet. The fore limbs were small, and were possibly used at times for support, but rarely for seizing, the phalanges of the hands being hoof-like rather than claw-like. The head was borne on a vertical neck in the same manner as a bird's head, and its general appearance must have been bird-like. The nature of the beak and teeth indicate a diet of soft vegetable matter. It could not have eaten the branches of trees without breaking the teeth of the lower jaw, but it could have scraped off the leaves. The appearances indicate even a softer food. Could we suppose that the great Laramie lakes on the Rocky Mountain borders supplied an abundance of aquatic plants without woody tissue, the conditions would have been appropriate to this curious structure. Aquatic plants could easily have been gathered by this double spoonbill, and have been tossed, by bird-like jerks of the head and neck, back to the mill of the small and delicate teeth. Of teeth it had four and one half successive sets. In order to submit the food to the action of these vertical shears, the jaws must have been opened widely during mastication, and not unnaturally, as in birds and reptiles the mouth opens to a point behind the eye. The eye was evidently of large size, but the ear was small. As there is a large nasal duct, the hadrosaur must have had the sense of smell. Its huge hind legs were useful in wading in water productive of food. When the bottom was not too soft it could wade to a depth of ten or more feet and pull up aquatic plants from the bottom. If not too



THE AMPHIBIOUS DINOSAUR.

Amphicoelium altus (Cope) was one of the tallest lizards, the type skeletons being from sixty to eighty feet in height. It could wade and lift its head above the surface to browse on overhanging branches, or lower it to the bottom for vegetation. It could not swim or walk on land, because of its many tons' weight. It was alone omnivorous, eating everything it could reach or seize.

large, fishes might also have been its prey, provided they were not covered with the bony plates which distinguished most of the Laramie fishes, and which protected them from these particular enemies.

A great leaper was *Laelaps aquilunguis*, a dinosaur found by Professor Cope, in 1866, in the Cretaceous greensands of New Jersey. It had a relative in the far West which also did some leaping, and is known as *Laelaps incrassatus* (Cope). These leaping dinosaurs were carnivorous or flesh-eating animals. It would appear that among their victims were the type of lizards just described as hadrosaurs, and that they also attacked each other. Thus the Western *Laelaps* preyed on the Western *Hadrosaurus mirabilis*, and the Eastern *Laelaps* preyed on the Eastern *Hadrosaurus Foulkii*. The short fore legs of a *Laelaps* suggest the habit of using chiefly the hind limbs. It moved in an erect attitude, as its tracks found in the rocks in many places show. Its prehensile claws formed instruments for holding prey. *Laelaps* had long hind-leg bones; the modern leapers, the kangaroos, have short femurs; the cursorial birds, however, have a similarly short femur, but do not leap; so the form of femur is not conclusive. The modern iguanas have long femurs, and progress by simultaneous motion on all fours; they do not leap, and

man, with a long femur, runs only. Leaping animals must therefore have other reasons for leaping than the length of the legs.

Laelaps, in taking long leaps, struck its prey with the hind legs. The fore limbs, being small, must have been less efficient as weapons in attacks on such creatures as the hadrosaurs. So far as is known, there were but few animals then living which could withstand a long pursuit on land, except in the case of certain lizards. *Laelaps* had to contend with

hard-shelled turtles, armored crocodiles, and swift sea saurians. These it must have captured by sudden movements, as it is not likely that its grasping toes furnished much, if any, swimming power. The lightness and hollowness of the long bones of the hind legs of *Laelaps*, and their flexure, are altogether appropriate to great powers of leaping. The feet must have been elongate, the toe-bones slender, corresponding with those of the eagle, while the great claws in which they terminated were relatively larger and more compressed than in birds of prey. The tail was moderately long, rounded, and strong, and not so much of a support as a resource for striking a blow and for throwing an enemy within reach of the kick or grab of the terrible hind legs. As a kicker *Laelaps* stands unrivaled among animals. In this respect it exceeded the foot-blow of the ostrich, which can easily kill a man.

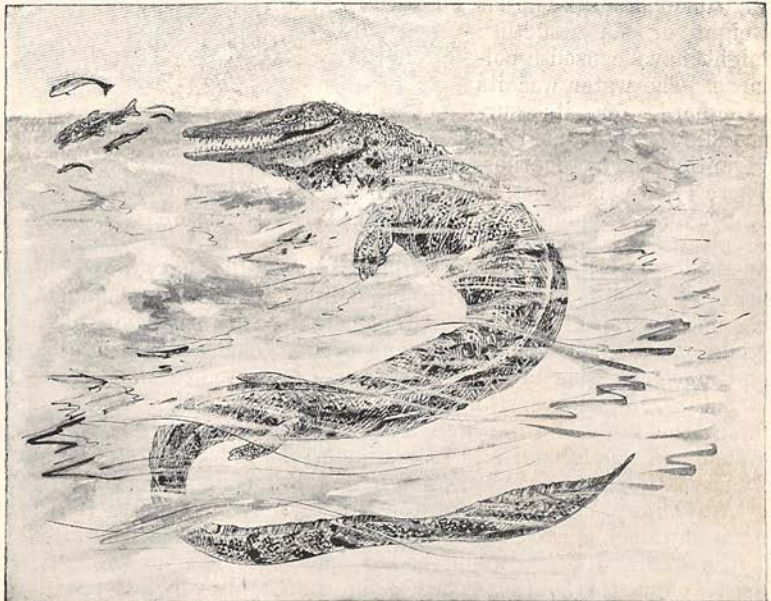
A huge dinosaur from the Laramie formation was the horned agathaumas. Its ponderous horned skull suggests the appearance of a rhinoceros, and its high, curved back and bulk an elephant. No animal known had a more powerful armature upon its skull than this creature. In front was a knife-like beak, on the nose a stout horn, on the top of the head a pair of large pointed horns, and on the back of the head a row of sharp projec-

tions. This skull, armored with horns and beak, in shape a wedge, was supported by massive bones, making a formidable weapon for offense and defense. Of all the later dinosaurs, this one alone had large fore limbs, showing that it walked on four feet. Fortunately for contemporary animals, this beast lived on herbs and grass; otherwise it might have slain the remaining forms of life within its territory; whereas its great powers of fighting merely marked it as a good object to leave unmolested in its pursuits, which were possibly as peaceable and tranquil as those of cattle. It was an animal of the forest and jungle. One of the species, *Agathaumas silvestris* (Cope), is distinguished by its nose-horn pointing forward; another, *Agathaumas sphenocerus* (Cope), by its nose-horn pointing straight upward. These walking citadels had to be attacked from behind, if at all, by their active contemporary, the *Laelaps incrassatus*. The restoration of *Agathaumas sphenocerus* herein is based on Professor O. C. Marsh's prior reconstruction of *Triceratops prorsus*.

Unlike other saurians, which are often provided with unusually long necks, the head of the stegosaur, or armored dinosaur, seems screwed to its body; in fact, it was almost neckless. It had a dermal armor. This consisted, in Cope's *Stegosaurus latus*, of a double row of huge plates extending along both sides and near the ridge of the back, from the neck to nearly the end of the tail. Marsh's *Stegosaurus unguilatus*, an allied species, was armored with a single row of such spinal plates. Just above the end of the tail, *Stegosaurus latus* had four pairs of spines for defensive purposes. There were also flat spines beneath the tail, making that appendage a terrible weapon, and by no means a mere protection against flies, as in most animals. This

dinosaur was purely a land animal. It had a bird-like beak and small teeth, showing that it fed on soft vegetation. It had ponderous thigh bones, one of which is fifty inches long by fourteen inches thick, and massive feet with hoofs on the toes. Like other saurians which walked on four legs with hoofed toes, it probably avoided water and mud, as its great weight and lack of swimming power would have caused it to mire. As a walking ironclad it fed in safety. All animals must have avoided its terrible stationary armor-plates on the back, which must have cut like broadaxes. If attacked, it must have turned and used its spine-covered tail as the giants of old wielded their clubs. At the same time, it is difficult to see how such a comparatively small mouth fed so large a body, or precisely what was the animal's rôle in the economy of nature. Its extinction may have been caused by starvation.

The amphibious dinosaur, *Amphicoelium alatus* (Cope), was one of the most remarkable of the tall types. It lived in water, but never swam; it walked on the bottom, indifferent whether its head was above the surface. The type specimen measures sixty feet in length. When it raised its head and distended its anatomy to browse on overhanging tree-tops and branches, this length became height. The petrified remains of this



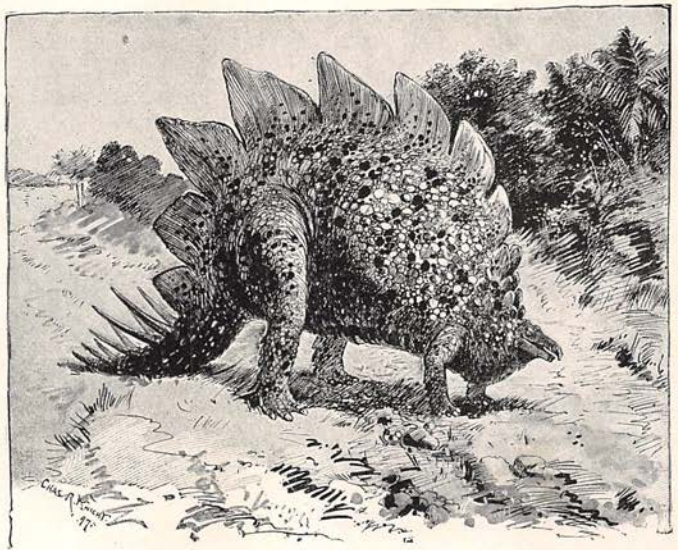
RAM-NOSED MOSASAUR.

The mosasaur *Nectoporphus proriger* (Cope) was a powerful swimmer and fighter of the ocean. Its long beak enabled it to punch its enemies, and its powerful jaws to crush them when captured. These animals ranged from thirty to fifty feet in length.

animal were found in the Jurassic or Lower Cretaceous beds of Colorado. An examination of the beds at this point shows first the remains of a shallow salt-water sea known as the Dakota formation, in which have been found fossil leaves and sharks' teeth. Underneath the Dakota lies the Jurassic, a lake-bed from which we have many monsters—megalosaurs or great carnivorous as well as herbivorous dinosaurs of diverse species. The amphibious dinosaur was undoubtedly omnivorous. It seized whatever came within its reach, whether fish, flesh, or vegetation. Its teeth were spoon-shaped at the crown. It had ambulatory limbs. Its neck and back vertebræ were hollow and probably connected by air-tubes with the lungs, to give it buoyancy at the right point. Its tail vertebræ and thigh-bones were solid and of great weight, allowing it to anchor on the lake-bottom. One of its petrified leg-bones is six feet four inches in length, and weighs about eight hundred pounds. The weight of the entire animal might have been three or four tons. It probably never came wholly out of water. Had it done so, the great weight of its structure might have caused a collapse. The water was its safeguard, for its surrounding weight held its gigantic frame together. There is no evidence that it was web-footed. Its great posterior skeleton enabled it to stand firmly on the bottom, seize a passing fish, feed on the plant life at the bottom, raise its head to a great height, stand on its hind feet and tail, and browse on the overhanging branches. A saurian in structure, it was everything in habits. It swept the territory in which it moved of animal and vegetable life. Of the wonderful fauna of the Jurassic it was one of the tallest, of hugest dimensions, of the greatest mass in proportion to height.

The giant dinosaur would be an appropriate name for another reptile—the camarasaur. The *Amphicælius altus*, just described, was amphibious in the sense that it fed upon everything it could reach and capture, in or out of water, while wading.

The type now to be described was similar in appearance in many respects, except that it waded or swam in the water indifferently. This type was purely herbivorous, and its great bulk suggests that it required at least an acre of plants, grass, and leaves to satisfy its appetite for a meal. Almost identical types of these saurians are *Brontosaurus excelsus* (Marsh) and *Camarasaurus supremus* (Cope), of the wonderful fauna of the Jurassic. The camarasaur was præminent in general proportions, and also the tallest; the *Amphicælius altus* was next in height. The camarasaur was also remarkable for the light construction of the vertebræ anterior to the



THE ARMORED DINOSAUR.

Stegosaurus unguatus. Professor O. C. Marsh of Yale University first discovered the wonderful stegosaur genus. The *Stegosaurus unguatus* (Marsh) and the *Stegosaurus latus* (Cope) differ only in the number of erect spinal plates. The animal was herbivorous and inoffensive, but so terribly armed as to maintain its peaceful pursuits. Length twenty-five feet.

tail; they were hollow, including two large separated chambers, which communicated with the cavity of the body by a foramen on each side. The ribs had an unusually elevated basis. On the other hand, the bones of the tail and hind limbs were nearly solid. Because of the greater length of the hind limbs, this dinosaur could progress on land, while *Amphicælius altus*, because of a shorter femur, had to remain in water to insure its support in holding its parts together. As it could roam about at will, the camarasaur ate only vegetation, while the other, confined to wading, had to eat whatever it could seize or reach. The camarasaur may have lightened its weight in walking by filling the cavities in its upper backbones with air

from the lungs. Because of the solidity of its tail, the animal was enabled to use it as a walking-stick, presenting the appearance of a tripod in motion. Thus, while browsing on tree-tops with a bird-like beak, its fore limbs resting on the trunks or branches, it presented something of the appearance of the giraffe.

Not even remotely related to the dinosaurs, but with a different ancestry and history, were the great sea lizards. These animals, which suggest the fabled sea-serpent, were the long and terrible mosasaurs; in fact, they possessed eight technical characteristics of serpents of the same period. *Mosasaurus Dekayi* (Mitchell) is a fair type. The teeth, without fangs, are those of serpents, and they differ from the teeth of any of the lizards. The vertebral column resembles that of a serpent in many features, having numerous joints. The ribs are cylindrical, as in lizards and serpents. Science must regard the mosasaurs and their allies as a race of gigantic marine serpent-like reptiles, with powers of swimming and running like the modern snakes. As they had posterior and anterior paddles, they are not unlike Pontopidan's figure of the sea-serpent. That the mosasaurs had the habit of devouring their prey whole is evident. The extension of the lower jaw exceeded that of other reptiles in this capacity, allowing the passage of large objects. The carnivorous lizards, on the contrary, tore their prey in pieces, as do mammals of the present day. For the most part they lived in the ocean. Professor S. W. Williston has recently secured complete skeletons, with perfect fore and hind paddles, having five digits each, with preserved skin and scales.

According to the fossil skeletons at hand, the mosasaurs ranged from thirty to fifty feet in length. Maximus was the longest (fifty feet), and possessed the largest and most terrible head. Princeps and Missouriensis were next in size, and may have attained the same length. Oarthrus was doubtless the smallest, though an animal thirty feet long may be considered reasonably large.

Allied to these saurians was the ram-nosed mosasaur, *Nectoportheus proriger* (Cope). It was the ram-ship of the naval fleet of saurians. While the mosasaurs in general had muzzles, the beak of proriger was much prolonged beyond the teeth, and in shape was very obtuse. With this weapon it punched or pounded its foes, and perhaps used it to turn over rocks and objects in its

search for food. It also had a very long tail, which it used to good advantage while swimming at terrific speed in the ocean.

Another entirely distinct type of sea lizard was the great plesiosaur, *Elasmosaurus platyurus* (Cope). These elasmosaurs, as Professor Cope called them, were the most elongated sea saurians yet discovered, not excepting the mosasaurs last described. They are found all over Europe as well as North America. Their fossil skeletons were found on the Missouri River, three hundred miles west of Leavenworth, and elsewhere. The tail was a powerful swimming-organ, more or less compressed in life, and hence the animals' specific name means «flat-tailed.» The habits of this animal, like those of its newest known allies, were rapacious, as is evinced by the numerous dog-like teeth, and the remains of fish found beneath the skeletons. The general form of this reptile was that of a serpent with relatively shorter, more robust, and more backwardly placed body than is characteristic of the true serpents. Underneath the Fort Wallace skeleton the remains of six species of fishes new to science were found, which had been the food of the elasmosaur. It is evident that half the length of the animal was a neck so elongated as to enable it to seize fishes with ease while skimming along the water with great rapidity. Its whole form shows a construction best adapted to running after its prey and away from its foes, which were presumably the cimoliasaurs, and of a speed ample to catch up with contemporaneous fishes on which it lived. It was probably a diver as well as swimmer.

An animal similar to this flat-tailed plesiosaur was the cimoliasaur (Leidy), with a shorter and stouter neck and a larger body. It was a robust and powerful serpent-like lizard, in which bulk was more developed than length. The elasmosaur, with the longer neck and tail, was fortunate in being a swifter swimmer, since in a contest the animal with stout, short neck and great bulk would have the advantage of larger powers. The *Cimoliasaurus magnus* (Cope) must have been the lion of the ocean, easily able to whip any monster of the deep which came within reach. Its paddles were short, thick, and stout, its head large, massive, and round.

During the age of reptilian life the inoffensive mammals were slowly evolving upon land—at first extremely small, like the oldest and smallest reptiles, and then increasing gradually in size until the present reign of man.