grammes. The little engine, which developed a motive power of about 2 kilogrammeters per second, weighed 300 grammes. Finally, the total weight of the apparatus, mounted upon rollers, was 1·75 kilogrammes. This entire affair (Fig. 2) left the earth at a velocity of 8 meters per second, although the resistances were almost equal to those due to the opening of the angle formed by the planes above the horizon. The experiment was performed in 1879 at the Chalais-Meudon Military Establishment. The aeroplane, which was attached by a cord to the center of a circular flooring, revolved around the track, rose from the ground, and once, even, passed over the head of a spectator (Fig. 3). We can only renew here the thanks that we have already addressed to Messrs. Renard and Krebs for their extreme obligingness and the interest which they appeared to take in our experiments.

After this result we formed a project of studying with this apparatus the advantages or disadvantages connected with the use of more or less extended planes, of more or less open angles, and of different velocities in the two cases; but our resources, which were then more than exhausted by these long and costly labors, did not permit it, and, to our great regret, we have since had to content ourself with indicating the programme of our experiment, without carrying it out ourself.

The experiment which we have just described confirmed our previsions, however, and we think that we are now able to trace the principal lines of an aeroplane without fear of committing a grave error. In an aeroplane, as in a balloon, the resistance to a forward motion increases as the square of the velocity. The motive power, then, will here also have to increase as the cube of such velocity; but since, for a given angle that is supposed invariable, the sustaining thrust and the resistance to motion will always be in the same ratio, the disposable weight will increase with the square of the velocity, so that, as regards this point, we will be more favored than by the use of balloons.

It must be remarked, per contra, that, with the aeroplane system, large constructions will merely offer the advantage of permitting us to obtain motors that are relatively lighter and more economical.

It is very evident that the first essays made with aeroplanes would be only of short duration. Let us at first have modest views. Let an aerial machine work only an hour, half an hour even, at a velocity of 15 meters per second, and the progress made will be immense; one may even say that the problem will be entirely solved. After this first step will rapidly come the improvements that experience will indicate. New motors will become an object of researches that will soon prove fecund, and humanity will finally find itself in possession of the most powerful engine that it has ever imagined.—*La Nature.*

CHOLERA has prevailed in this country in 1832, 1848–49, 1854, 1865–66, and 1873.

DINOSAURS.

The first naturalists who described reptiles as crawling animals would certainly have modified the opinion that they expressed had they known the strange creatures whose history we are about to sketch.

These animals, which are designated as ornithoscelians or dinosaurians, partake, by certain characteristics of their organization, of the nature of mammals, birds, and reptiles properly so called, while at the same time exhibiting characters that are proper to themselves. They seem to bridge over the gap which in present nature separates the most perfect of the reptiles, the crocodiles and the tortoises, from the lower mammals—the marsupials—and from such birds as the ostrich, emu, and cassowary. They are so far removed from the reptiles that we have to form a distinct subclass for them equal in value to that which is admitted for reptiles of the present time.

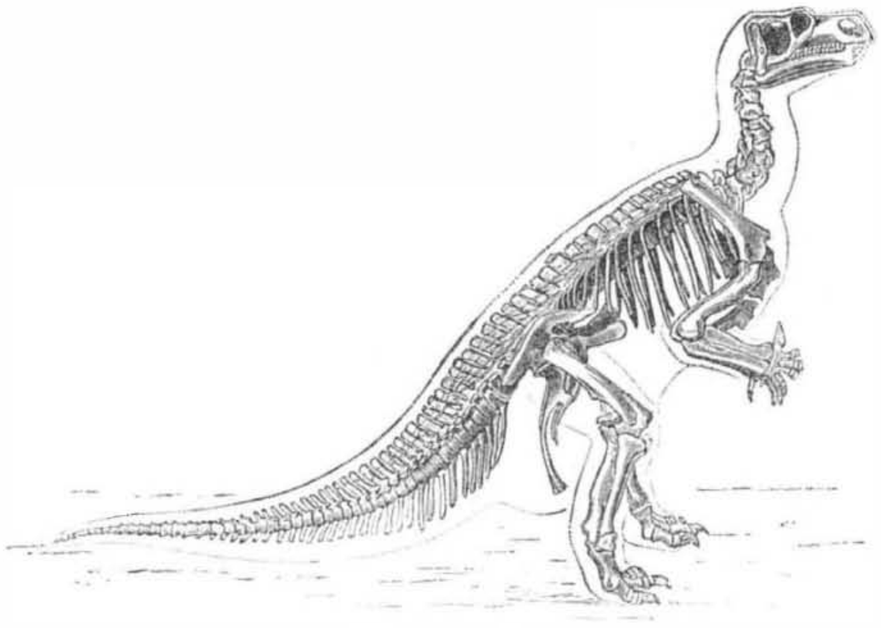


Fig. 5.—SKELETON OF IGUANODON.

The differences that they present from our reptiles are much greater than those that we find between tortoises and serpents, for example, to merely cite the two extreme terms of the series. We know nothing of the dinosaurs except their skeleton. It is probable that if it were permitted us to know what their organization was, how their circulation was effected, and what their mode of development was, we should not hesitate to put them into a class intermediate between that of the mammals and birds and that of the reptiles properly so called. It was along toward 1820 that Gideon Mantell found the first bones of dinosaurians in the midst of Tilgate forest, on the Isle of Wight, in strata which are referred to the lower portion of the Cretaceous formation, and which are terrestrial and fresh water ones that mark a transition from the Jurassic to the Cretaceous. These bones, which were very incomplete, were referred by Mantell to an animal of great size, which he called an *iguanodon*, as the teeth offered certain analogies, as regards form, with those of a lizard of the present time called the iguana. Since that epoch, and especially since a few years back, our knowledge concerning the dinosaurs has peculiarly increased, and we are beginning to get a glimpse, among these animals, of very different types, which indicate orders just as distinct as are those of the pachyderms, ruminants, and carnivora among mammals.

Upon the sides of the Rocky Mountains, in the United States, we find strata which can be followed for several hundred miles in extent, and which have yielded for the investigation of paleontologists a small marsupial, remains of fishes, remains of pterodactyls, crocodiles, and tortoises, and especially an enormous quantity of bones of gigantic dinosaurs. We have here a true bone yard in which lie buried, pellmell, the most curious and strange forms of all the animals that the ancient ages have bequeathed to us. It is to the admirable researches of Marsh and Cope that we owe our knowledge of a fauna that has entirely disappeared.

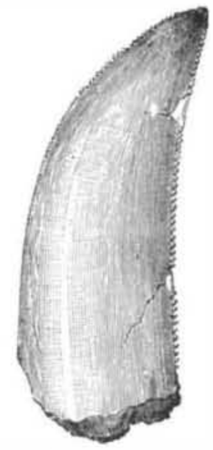


Fig. 1.—TOOTH OF MEGALOSAURUS.

Fig. 2.—TOOTH OF IGUANODON.

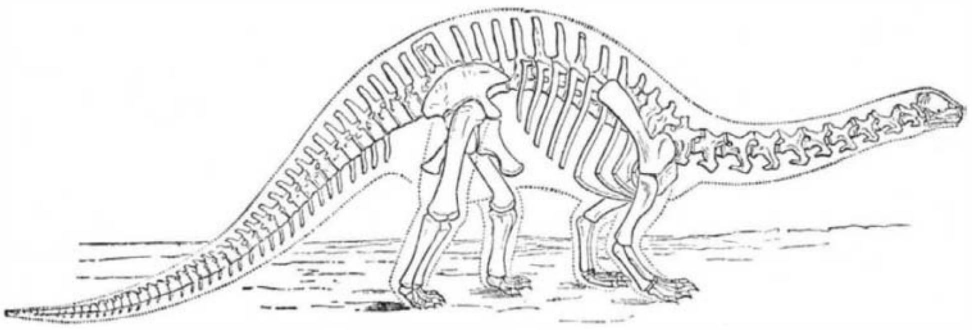


Fig. 4.—SKELETON OF BRONTOSAURUS (× 1-125).

Guided by the two great laws of correlation of forms and subordination of characters—laws which we owe to the incomparable genius of Cuvier, and which, like Ariadne's thread, permit us to find our way in the inextricable labyrinth that is presented by the forms of extinct animals—these two learned American paleontologists have evoked an entirely new world, and brought up before us the evidences of a fauna of which nothing in existing nature could have given us the least notion.

During the secondary epoch the dinosaurs lived also in Europe and in Southern Africa, where they were represented by very diverse types, as has been shown us by the learned researches of Mantell, Owen, Phillips, Huxley, Seeley, Hulke, Dollo, and Matheron.

Very recent researches have thrown an entirely new light upon the organization of these animals, and permitted of as complete a study of their skeletons as could have been made of those of animals now living. We can grasp the general features that connect them with other reptiles, and the peculiar ones that distinguish them from each other.

What essentially separates the dinosaurs from all other reptiles is that the sacrum is always composed of more than two vertebræ, which form a very solid, single bone like that of mammals. These vertebræ, which exceed the normal number of two, are caudal ones that are modified so as to serve as a support of the pel-

Fig. 3.—AMERICAN LANDSCAPE OF THE JURASSIC EPOCH WITH REPTILES AND PLANTS OF THE PERIOD.

vis, which is considerably enlarged, in order to be able to support the usually robust hind limbs. To judge by the great width presented by the medullary canal, the spinal marrow must have been much swollen in the sacral region, and have furnished very large nerves to a limb that was strongly developed and moved by extremely powerful muscles.

The ribs are highly developed, and their size shows that the thoracic region was very ample, and that consequently the lungs must have been large.

As the food of the dinosaurs was very varied, the form of their teeth is, as may be seen, entirely different according to the types examined. The flesh eaters, such as the megalosaurus (Fig. 1), had strong, cutting teeth, which were crenulate at the edges. The maxillaries, as well as the intermaxillaries, were armed with such teeth, and these must have been formidable. The herbivora, such as the iguanodon (Fig. 2), the vectisaurus, the laosaurus, and the hypsilophodon, had maxillaries that were provided with teeth admirably arranged for cutting and grinding. These teeth became worn out, like those of existing herbivorous mammals, and were indefinitely replaced, that is to say, as soon as one of them was worn out, another one succeeded it. What is not found in existing reptiles was a motion of the jaws, as in the ruminants of our epoch, in order to allow the teeth to grind food. The size of the apertures and channels through which the nerves passed shows that there existed soft lips and cheeks, without which the mastication of food would have been entirely impossible.

The hadrosauri, which were herbivora, had their teeth arranged in several rows that formed, through wear, a grinding surface in the form of a checker board. In the herbivora which have been grouped under the name of ornithopodia the intermaxillaries were not provided with teeth, and the same was the case with the extremity of the lower jaw, which was very likely armed during life with a horny beak; by means of which the animal cut off the buds and leaves that constituted its food.

Many dinosaurs had naked skin. In others, that are designated as stegosauri, the body was protected by bony shields and by spines.

We are acquainted with dinosaurs of all sizes, from the gigantic atlantosaurus of the Rocky Mountains, which attained a length of at least 80 feet, down to the nanosaurus, which was scarcely as large as a cat.

The secondary epoch, in which the dinosaurs lived, has justly been entitled the reign of reptiles. It was then that this group reached its maximum development. The mammals were very puny during this epoch, and were represented solely by the most inferior kinds. The dinosaurs seem to have then played upon the surface of the globe the role that the large carnivora and herbivora do now; but, while mammals have always gone on improving until they already offered at the end of the Tertiary epoch the magnificent development which we now see, reptiles have gone on continuously diminishing in importance. The higher animals have gradually excelled beings of a less perfect organization.

Dating from the Triassic epoch, the dinosaurs were already represented by so diverse types that it seems as if these were the descendants of animals that existed at a more remote epoch. It was at the end of the secondary epoch that these animals disappeared forever without leaving any descendants. They were unable to adapt themselves to the new conditions of existence that were imposed upon them, and they died, while the mammals, on the contrary, daily proceeded more toward the highest types.

The temperature was high during the Jurassic epoch, and uniform throughout the earth, as demonstrated by the existence in the north of Europe of corals comparable with those of the Gulf of Mexico or the South Sea. During the upper Jurassic epoch our country must have been cut up into lagoons, marshes, and frequently inundated estuaries. These privileged localities had a richer and more varied vegetation than the mountainous portions. Here grew large ferns with leathery fronds, while the declivities and uplands were covered with plants that approached the pandani, araucariæ, and cycads, and having almond-like seeds that formed the food of the herbivorous dinosaurs of the epoch.

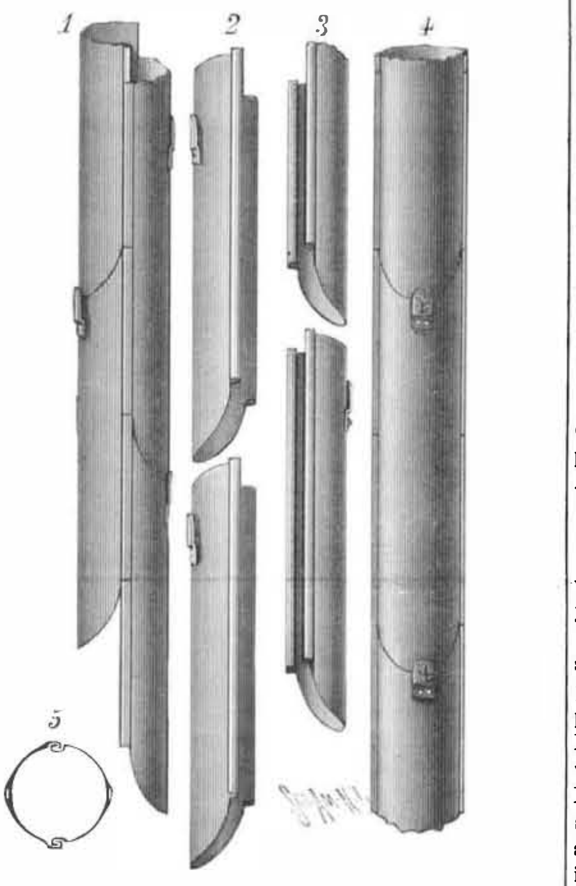
If, through the admirable discoveries that have been made in recent years, we endeavor to bring to life again the fauna of the upper Jurassic period in the United States, we shall find one that is no less rich and strange than that of the Old World. Here we have, amid araucariæ and cycads, the gigantic stegosaurus, with a body clothed with bony plates and spines, that formed a powerful armor for it, and with fore legs much shorter than the hind ones; the compsonotus, with fore paws equally as well developed as the hind ones; and the strange flying reptiles, the pterodactyls (Fig. 3).

Among the animals found in the Rocky Mountains, the strangest beast is doubtless the brontosaurus, of whose skeleton we give a restoration according to Prof. Marsh (Fig. 4). This animal reached a gigantic size; living, it must have weighed at least thirty tons! The head is remarkably small for an animal of such a size. The brain, which is extremely small, indicates a slow and stupid beast. The neck is long, flexible, strong, and very mobile, the legs are massive, and the bones solid. The animal walked after the manner of our present bears, its body was entirely naked, its habits more or less aquatic, and it must have frequented muddy swamps pretty much as the hippopotamus does. Its food consisted of plants that grew in the water or near the banks.

Not far from the French frontier, between Mons and Tournay, in Belgium, is located the Bernissart coal mine. In order to reach the bed of coal it is necessary in that country to excavate the earth to a certain depth, and traverse strata which were deposited subsequent to the formation of the valuable combustible. In making researches at Bernissart for extracting coal, some wealden strata were encountered in a valley that dated from the beginning of the Cretaceous epoch, and that was afterward filled through the movements of the earth. Fishes by hundreds, crocodiles of unknown types, and gigantic reptiles here lay buried at a depth of almost 1,150 feet, nearly in the spot where they formerly lived. They were buried in mud, and lay pellmell along with the plants that grew upon the ground that they had trod at an epoch so remote as to exceed all imagination. These gigantic animals thus brought to light, thanks to the persevering researches of De Paux and Sohier, were dinosaurs belonging to the genus iguanodon, the first remains of which were found by Mantell in 1822.

It is to the labors of Boulenger and Van Beneden, and especially to those of Dollo, that we owe our knowledge of one of the strangest beings that ever existed in olden times. The discovery of the Bernissart iguanodon—an animal whose entire skeleton is now known—has thrown an absolutely new light upon the structure of a whole group of herbivorous dinosaurs.

Everything, in fact, is strange in the iguanodon (Fig. 5). Its stature, as well as its gait, is well calculated to astonish



HIRSCHMANN'S IMPROVED STOVE AND OTHER PIPES.

the naturalist who is acquainted with existing reptiles only —beings which are very puny as compared with animals that lived in former times.

The Bernissart iguanodon measures nearly thirty-three feet from the end of the nose to the tip of the tail, and, when standing upright upon its hind legs (the attitude that it assumed in walking), it rose to more that thirteen feet above the level of the ground. The head is relatively small and much compressed, and the nostrils are spacious and as if partitioned. The temporal fossa is limited by a bony arch, above as well as below—a character entirely exceptional in existing reptiles. The extremity of the jaws must likely have been provided with a beak designed for cutting the large ferns and the cycadaceæ that grew upon the margins of the lagoons and marshes into which the earth was cut up. The teeth, which are crenulate at the edges, indicate an essentially herbivorous diet, and they were replaced as soon as worn out. The neck must have been very mobile. The ribs, which are strong, indicate vast lungs. The fore limbs, shorter than the hind ones, terminate in a five fingered hand. The thumb is provided with a large spur, which must have been a formidable weapon. The hind limb, which is digitigrade, is provided with but three fingers, which were probably connected by a web. The pelvis more closely resembles that of birds than that of existing reptiles. The tail, a little longer than the rest of the body, is about sixteen feet in length, and consists of nearly fifty vertebræ. It is much compressed laterally, like that of the crocodiles, and must have served as a rapid and powerful means of propulsion.

"The circumstances under which the Bernissart iguanodons were found show, as Mr. Dupont has pointed out, that these animals must have lived in the midst of marshes and upon the banks of a river. It is consequently not surprising that they had aquatic habits.

"Granting that the iguanodons passed a portion of their existence in water, we can imagine, by the aid of observations made upon the crocodile and *amblyrrhyncus* (a large marine lizard of the Galapagos Islands), two very different modes of progression of our dinosaur in the liquid element.

"When it was swimming slowly, it made use of its four limbs and its tail. If, on the contrary, it wished to move forward rapidly in order to escape its enemies, it placed its fore limbs against its body, and made exclusive use of its hind ones and of its caudal appendage. In this mode of progression, it is clear that the smaller the fore paws are the more they are hidden, and consequently the less resistance they offer to the movement of the animal in the water. In confirmation of this, we observe that, among the forms that swim in the manner just stated, the fore limbs are so much the smaller in proportion as the beast is the more aquatic.

"The iguanodons walked on the ground by the aid of their hind legs only; in other words, they were bipeds after the manner of man and of a large number of birds, and were not jumpers like the kangaroo; moreover, they did not rest upon the tail, but allowed it simply to drag.

"But, it will be said, just now, in speaking of aquatic life, you compared the iguanodon with the crocodiles; yet the latter are not adapted for an erect attitude. What need, then, had the iguanodons of a bipedal walk if they had analogous habits? It appears to us, on the contrary, that standing upright must have been a great progress, and for the following reason:

"These animals, being herbivorous, had to serve as prey to the carnivora of their epoch; and, on another hand, they remained in the midst of marshes. Among the ferns by which they were surrounded they would have observed the approach of their enemies with difficulty, or not at all; but, standing upright, they were enabled to look about them to a considerable distance. Upright, too, it was in their power to seize their aggressor between their short, but powerful arms, and to bury their two enormous spurs into its body. These spurs, it is probable, were provided with a cutting edge.

"The difficult progression of the crocodile upon the ground has been described by all travelers, and there can be no doubt that the long tail of this animal contributes not a little to its awkward gait. The transformation of this cumbersome organ out of water into a balance was, it seems to us, a happy modification.

"Finally, the bipedal walk must certainly have allowed the iguanodon to more quickly regain the river or lake in which it disported than would a quadrupedal walk that was continually interfered with by numerous aquatic plants that played, after a manner, the role of brushwood."*—*Science et Nature.*

IMPROVED STOVE AND OTHER PIPES.

The pipe shown in the accompanying engraving is made up of sections fitting together by longitudinally sliding lock-joints, the ends of the sections being formed with projections for overlapping. By this method of construction a very strong pipe is obtained, time and labor are economized in putting it up, and space saved when storing or transporting it. Fig. 1 is a side view, showing the lock-joint. Figs. 2 and 3 show the sections detached. Fig. 4 is a front view, showing the transverse joints and metal catches; and Fig. 5 is a cross section. The longitudinal edges of each section are bent to form a half-lap folding or sliding joint, as very clearly indicated in Fig. 5. One end of each section is cut square across, and the other end is extended, so that when two sections are united, end to end, this projection will pass under a sheet or cast metal catch, upon the squared end of the adjoining section; if considered desirable, the catches can be made ornamental. Elbows for such a pipe may be similarly constructed, or the pipe may be fitted with the common elbow. The parts are so assembled that the transverse joints will be in the middle of each section. The sliding longitudinal joints readily fit one within the other, and give the pipe increased strength, so that it may be connected for a longer distance than a riveted pipe without the necessity of holding it to the ceiling or elsewhere by wire.

This invention has been patented by F. L. Hirschmann, M.D., of Norway, Mich.

Training of the Young.

A remark made in one of the papers read before the recent Woman's Congress in Baltimore suggests an interesting argument in favor of the kindergarten. It is well known that, in its development, each new born being passes through very much the same stages that his ancestors have been through before him. Even after birth the growth of the child's intelligence simulates the progress of the human race from the savage condition to that of civilization. It has been shown by Preyer, and others who have studied infant development, that a faculty which has been acquired by the race at a late stage is late in making its appearance in the child. Now, reading and writing are arts of comparatively recent achievement. Savage man could reap and sow, and weave, and build houses, long before he could communicate his thoughts to a person at a distance by means of written speech. There is, then, reason to believe that a child's general intelligence would be best trained by making him skillful in many kinds of manual labor before beginning to torture him with letters; and the moral to be derived is, that primary instruction should be instruction in manual dexterity, and that reading and writing could be learned with pleasure and with ease by a child who had been fitted for taking them up by the right kind of preparation. The argument is a novel one, and it certainly seems plausible.—*Science.*

* L. Dollo, Les Iguanodons de Bernissart.