CONSTRUCTING AN EXTINCT MONSTER FROM FOSSIL REMAINS.

BY FREDERIC A. LUCAS.

Our readers have heard much of the remarkable discoveries during the past few years of the huge dinosaurs, whose fossil remains have been found so abundantly in our western territories.

Prof. Clarke, of the U. S. Geological Survey, has long desired to show the public a restoration of a dinosaur and to display one at some of the many expositions in which during the last decade the government has been called upon to take part, and the Pan-American afforded a favorable opportunity.

There were in the U. S. National Museum some fifteen examples of a very curious reptile, called from the horns he bore triceratops, or three-horned-face, and while not a large dinosaur, so far as mere size goes, this was a good example for representation.

It was impractical to 'use the actual bones for exhibition, hence a model was prepared, which was perhaps more valuable from an educational point of view.

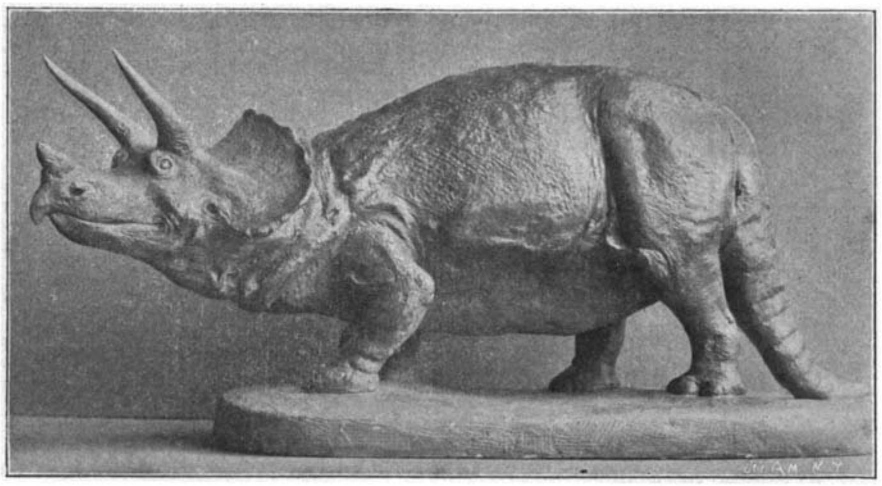
When it was decided to construct a model of a triceratops, it was decided to build it of papier mache, a mixture of paper, plaster, whiting and glue, because this is easily modeled, is harder than plaster, and when worked over a properly constructed framework will stand considerable rough handling, and if broken will merely crack across and not fly into pieces. Each bone was roughly blocked out by a framework of wood, iron rod and wire cloth, and over this was spread a coat of papier mache, which was carefully modeled into the shape of the bone, making straight all twists and turns caused by the pressure to which the original had been subjected. Some of the bones were simple enough, some were decidedly complicated, the head being one of the most difficult, the hip bones the worst of all. For in order to carry their share of the weight of a creature that in life must have weighed at least ten tons, these hip bones had need to be pretty large and very well braced. Moreover, Nature had been economical of material, and, like a good engineer, had chosen to support the weight by a series of cunningly devised struts and trusses, and the two main bones of the pelvis, which rest on the hind legs, were carried by no less than eight sections of the backbone, so that the strains were well distributed. And to reproduce all these bony processes was no easy matter.

Another difficulty was that in spite of the great size of the skull with its spreading frill and massive horns, its various parts were so thin that it was difficult to find a solid spot from which to start. The head was five and a half feet long and four and a half feet wide, and yet the only place that would admit a section of joist six inches square was just at the base of the horns; and from this, as a starting point, supporting irons were carried in every direction to form the framework of the skull.

Borrowing from the methods of the modern builder, the big frill was supported by the twisted steel rods used in the construction of concrete floors, and with the same gain in strength and rigidity. The problem of sustaining the finished skull in its proper relation to the body seemed difficult, but unlike most problems this one solved itself; for it proved that the parts were so well balanced by nature about the junction of the head with the neck that a single heavy pin firmly built into the base of the skull sufficed to carry it. The huge skull, indeed, literally dominates the body; the bones of the neck are directly adapted to its support, while the fore legs are so much shorter than the hind that the creature could readily feed from the ground without the difficulty of lowering and raising half a ton of head for every bite.

Probably the mechanical difficulties in the making of such a restoration as this do not occur to the average observer. To him the modeling of the bones and the correct pose of the various parts seem the serious questions, when, as a matter of fact, these are comparatively simple. The real problem is to so construct the mimic skeleton that it will stand up in good shape with as few visible supports and braces as possible. The sections of the backbone with their various processes might seem much more difficult to reproduce than the ribs attached to them, but quite the reverse is true. To make a rib five feet long, no thicker than one's finger and thrice as wide, curving three different ways, is not an easy matter. It would take a skillful carver to fashion such a bone, and were it done in wood there would be too many weak places where the grain ran crosswise.

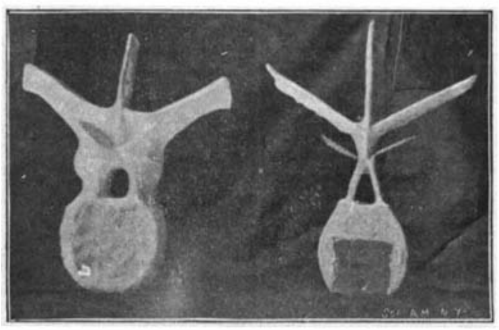
The reclaimed Potomac Flats with their flourishing groves of willows suggested the solution of the rib question, for each rib was outlined with a quarter-inch iron rod and this outline filled with willow withes. The flat body thus formed was wrapped with wire, then with Manila fiber, and lastly given a coat of papier mache in which the little details were modeled, the result being a strong and accurate facsimile of the original. There were twenty-six pairs of ribs in the framework of triceratops. Each vertebra was modeled over such a wood and wire cloth frame as shown in the engraving, but while there were twenty-eight of these sections in the body, and as many more in the tail, no two were alike; each vertebra required a separate form, and each had to fit accurately with the one before and the one behind, and all had to accommodate themselves to the curves of the backbone as a whole.



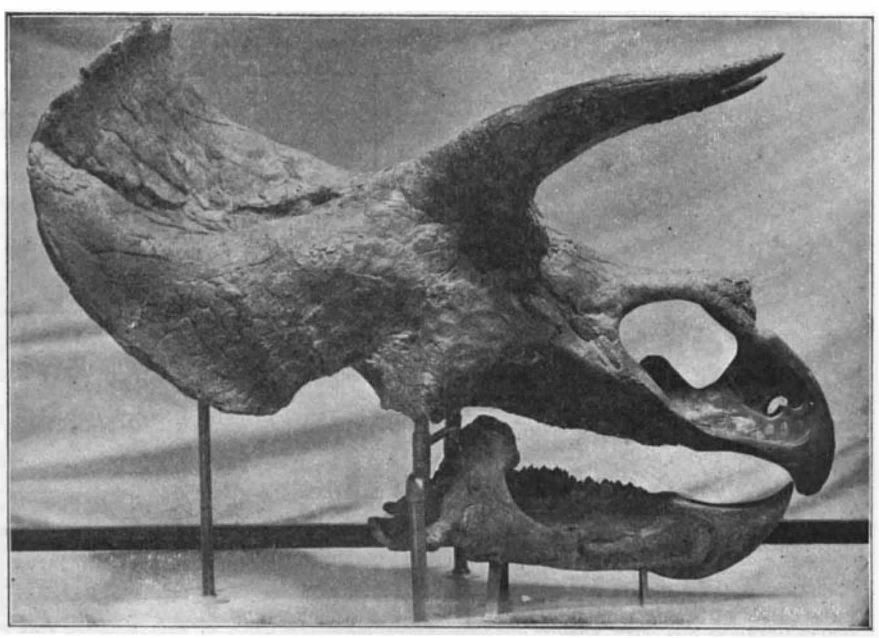
MODEL OF TRICERATOPS EXHIBITED AT THE PAN-AMERICAN EXPOSITION.

The shape of the leg bones made them easy subjects, both as to internal structure and external modeling. They were made hollow, not only for lightness, but to admit the passage of a heavy pipe that sustained the weight of each leg, while additional strength was gained by running a cross-bar to one of the main supports of the body.

The preparation of this great model was the work of a year, and there were times when it seemed doubtful if it would be done by the time agreed upon; but when the first of May came and the gates of the Pan-American Exposition were formally opened to the public, the model of a triceratops stood complete upon its pedestal just within the north entrance of the Government building. It stood at the highest part ten and one-half feet high, measuring from the tip of the nose to the end of the tail twenty-five feet. The model is now on view at the Charleston Exposition.



SECTIONS OF THE BACKBONE.



FRILL, HORNS AND JAWS.

There are about 7,000 coin-controlled telephones in China.

The Artesian Well Water Supply of Australia.

At the Royal Colonial Institute of London Mr. W. Gibbons Cox, C.E., delivered an interesting lecture upon the supply of water by means of artesian wells in Australia. Australia, despite its national wealth and resources, has always been subject to one great drawback: that of occasional droughts of greater or lesser severity, due to the peculiar physical character and conditions of the country. Owing to the comparatively low altitude of the existing ranges, the watersheds of Australia are less effective than those in countries possessing high mountain chains. Another condition which militates against the formation of a river system is the absorptive nature of the soil. At flood times there are long stretches of navigable waters in the interior; but in time of drought those rivers and creeks exist in name only, because soakage and evaporation reduce them to a mere chain of waterholes. The natural sources of the water supply are those from the rainfalls, the rivers, the creeks, lagoons and waterholes in the interior, and the subterranean stores, the latter having been utilized only within the last few years. A very large portion of the rain, the source of supply, sinks out of sight into the earth in so imperceptible a manner that the quantity of it fails to impress itself on the mind. Even the hardest rocks are to some extent porous, and granite itself has a percentage of water in its composition. All the softer rocks are water bearing and the dense, compact limestones frequently hold great quantities of water in cavities and cavernous galleries. The cretaceous formation is freely developed in Western Australia, South Australia, New South Wales, and Queensland. In Victoria, so far as is known, are artesian wells to a lesser extent. Considerable work has been done in the various States in drawing the water supply from these artesian wells, both by the government and by private landholders. The largest number of these bores is to be found in Queensland, owing to the territory being in an exceptionally favorable position for the fulfillment of the conditions required for a supply of water. The rainfall is caught on the western slope of the dividing range, from which almost the whole country to the border slopes downward. In Queensland the water-bearing sandstones have been proved to be over 700 feet in thickness. The depth of the bores varies from 300 to 5,000 feet. The total number of bores in Queensland is 839, of which 6 per cent only have been made by the government. There are 60 flows of over 1,500,000 gallons per day, ranging as high, at Cunnamulla, as 4,500,000 gallons, and at Coongola to 6,000,000 gallons a day. The continuous yield from 515 flowing bores is 321,653,629 gallons per day. Some of the water issues at a high pressure of which use is made in various ways. In a few of the bores the temperature of the water is high, in one case being 196 deg. Fahrenheit. This artesian water has been the salvation of stock to the value of millions of dollars, and when the immense water-bearing areas hitherto subject to drought have been further tapped the saving in future years would be enormous. In connection with the irrigation from rivers, the Darling-Murray system, which never runs dry, has proved the best.

Influence of Hydrogen on Iron.

The influence of hydrogen upon iron forms the subject of a series of experiments made in the Charlottenburg technical laboratory by E. Heyn. The gas is allowed to act upon iron at red heat, and it is found that the latter is considerably affected. In the first experiments he found that iron heated to redness and plunged in an atmosphere of hydrogen, then tempered in water, became brittle, and that this brittleness is especially remarked in the trials of cold bending. On the other hand, if the iron is again heated at a rather low temperature in a water or oil-bath it becomes much less brittle or even regains its original state. The same phenomenon is observed when the pieces are allowed to remain in the open air at the ordinary temperature. The time required for the iron to come back to the normal state varies with its constitution. For instance, samples of Martin steel of 0.05 carbon took fifteen days to come back. In the case of steel wire one-eighth inch in diameter and very poor in carbon the time is much longer.

The Lehigh University will offer a new and extended course in electro-metallurgy, beginning next fall. This is the first of its kind in the country.