

and islands, by the investigations of the depths of the ocean, collections of natural history will be enlarged almost to infinity; and it will be harder and harder to place them in our museums, and to preserve them. Everywhere buildings begin to be insufficient; and if we were to stick to the old system, according to which a museum exhibits nearly all its objects, the large central depositories of natural history would grow to an enormous extent. The organization of the Cambridge museum tries to meet equally the demands of

modest existence of a learned man to a materially better-paying occupation. In this respect Europe is still far ahead. Circumstances, however, will change, together with the great development of North America; and in some of the Eastern States an alteration can already be noticed. We must therefore keep our eyes open, if we do not wish the experience of having our young cousins across the ocean outstrip us in a field the thorough culture of which, so far, has been the glory of old Europe.

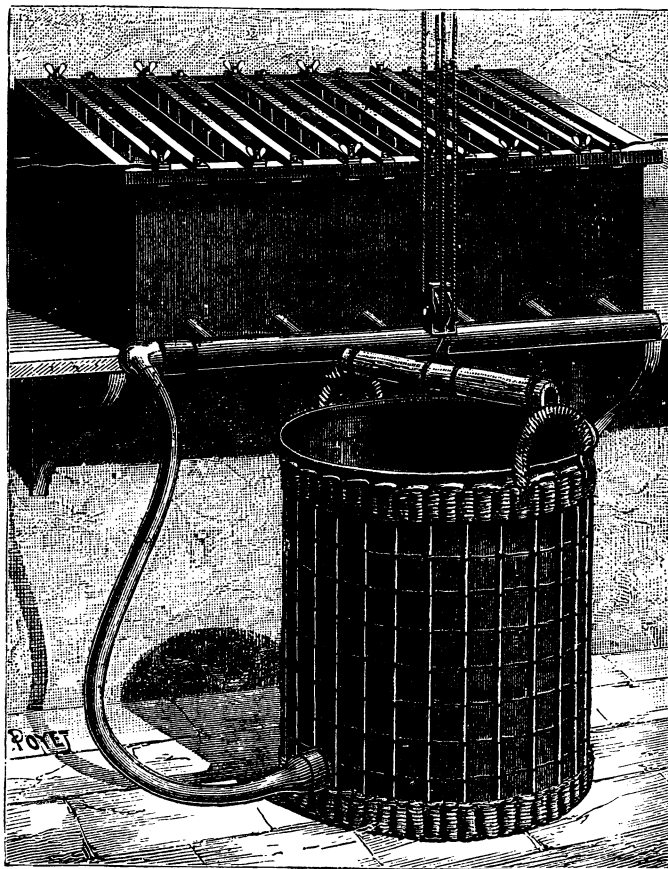


FIG. 3. — Batteries for Tissandier's balloon.

science and the wants of the public which comes for information; and in this sense I have called the Agassiz museum a model museum for the future.

Besides the institutions here mentioned, there are in many other cities of the United States — as Chicago, San Francisco, St. Louis, Cincinnati, Princeton, Baltimore, Charleston, Providence, etc. — smaller museums of natural history. They are almost all supported by societies or schools. There is, therefore, no lack of interest in scientific studies; nor is money wanting. But still the number of those is very small, who, out of pure enthusiasm for science, prefer the

TISSANDIER'S ELECTRIC BALLOON.¹—II.

As we have described our apparatus as a whole, we will now give some details concerning the various parts, and especially concerning the dynamo-electric motor and the bichromate of potassium battery, which was prepared with a view to our experiments.

The motor is a Siemens new model machine, made at Paris especially for us, consisting of a bobbin very long in proportion to its diameter, and mounted on a light wood frame. This machine weighs only fifty-

¹ Concluded from No. 53.

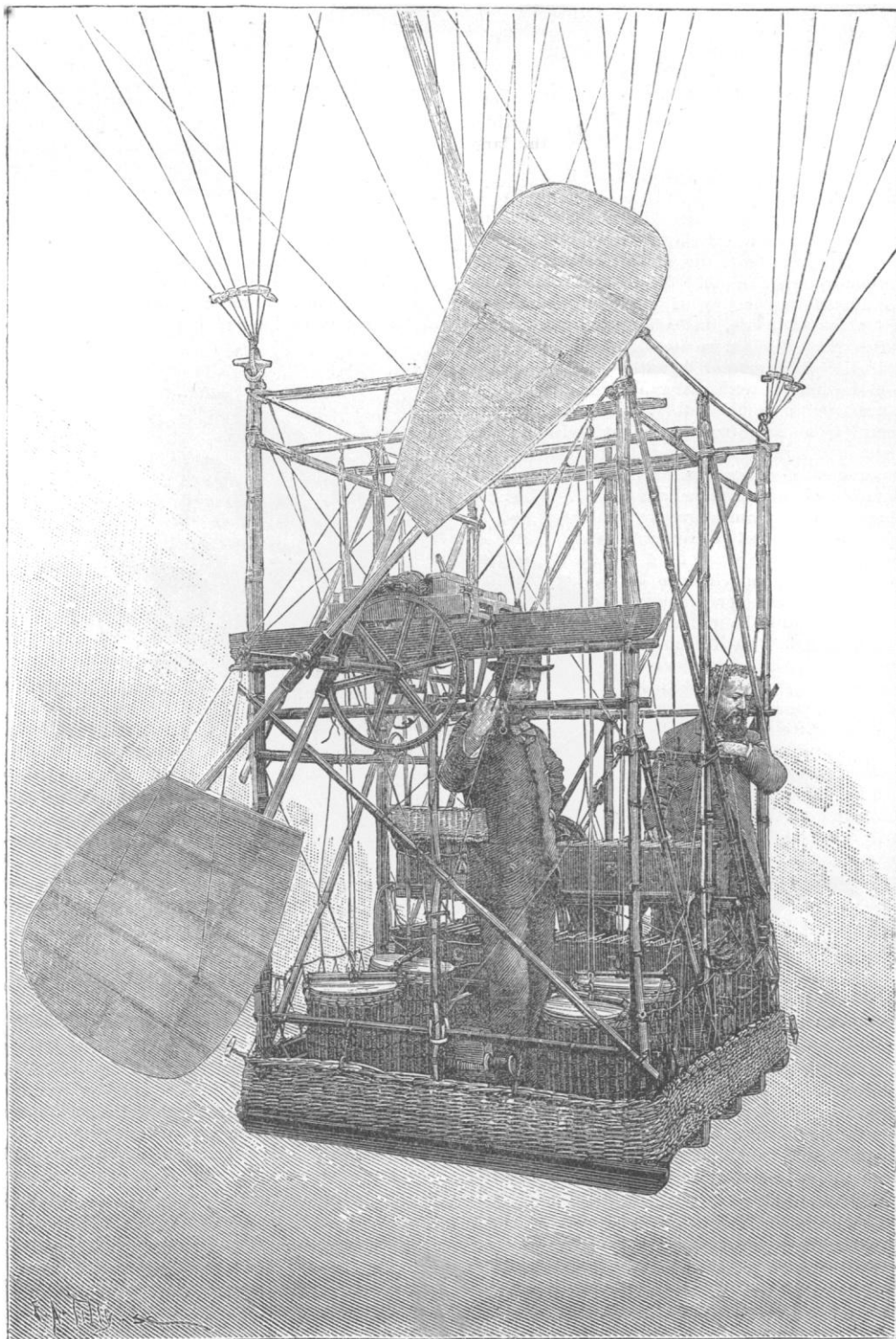


FIG. 4.—BASKET OF TISSANDIER'S FLYING-BALLOON.

four kilograms. The screw consists of two helicoidal pallets covered with varnished silk, the deformation of which is guarded against by the action of coils of steel wire. This screw is 2.85 metres in diameter: it is attached to the machine by a transfer and by gearing, and makes a hundred and eighty revolutions per minute, while the bobbin makes eighteen hundred.

The electric battery, which may be called the generator of the screw balloon, has the same surface of zinc and carbon as our trial batteries, the measurement of which has already been given elsewhere (*La Nature*, May 20, 1882), the same number of cells, the same volume of liquid. We are able to considerably reduce its capacity by using four ebonite troughs with six compartments, instead of twenty-four separate receivers. Besides, we use slightly higher vessels, which also gives greater breadth. Fig. 3 presents one of the four batteries used in the electric balloon as it was tried in the laboratory. It consists, as may be seen, of one large trough with six divisions; each compartment forming an element of the pile, enclosed and mounted on copper legs, having eleven thin carbons and ten zincs arranged alternately. The zincs are held in place from above by flexible pincers, and may easily be renewed after each experiment: they are .15 of a centimetre thick, sufficient to work the battery for three hours. They must be perfectly amalgamated. Each compartment is provided at its lower part with a slender ebonite tube, which communicates to a lateral conduit connected by a caoutchouc tube with a large and very light ebonite vessel containing the acid solution of bichromate of potassium. If the pail is raised by means of a string passing into the blocks above the level of the battery, the latter is filled by the chief communicating vessel, the liquid acts on the zincs, and the current passes: if the pail is lowered, so that it occupies the position seen in fig. 3, the liquid enters by the caoutchouc tube, the battery becomes empty, and ceases to act. By this system it is apparent that the piles communicate with each other solely by the narrow conduits. The resistance of the liquid is great enough for this communication to have no effect on the current, although the elements are in series. In the car there are four batteries like that shown in the figure, of twenty-four elements, in series, and fed by four pails of ebonite, each containing thirty litres of the bichromate of potassium solution. The batteries are stowed away in the car (which is 1.9 metres long and 1.45 metres broad) so as to occupy the least possible room. Two ebonite troughs of twelve elements are placed cross-wise about .35 of a metre from the bottom of the car, and there are two more .15 of a metre higher. The ebonite reservoirs at the two back corners of the car feed the upper piles; and the other two reservoirs, nearer the battery, feed the lower piles (fig 4). A

vacant space is left between the four pails for the operator, who controls every thing, having at hand the cords to raise the pails, the hooks to hold the cords at the desired height, the commutator with the cup of mercury to start the current, and the cords the rudder.

The bichromate of potassium used to work the battery is concentrated and very acid: it is turned into the pails at a temperature of about 40°, which permits of a considerable increase in the quantity of dissolved salt. The commutator is so arranged that a current of six, twelve, eighteen, or twenty-four elements may pass; and thus the screw has four velocities. The four pails are covered with a sheet of caoutchouc, pierced with one small hole, which allows the air to pass when the liquid is flowing, and is bound

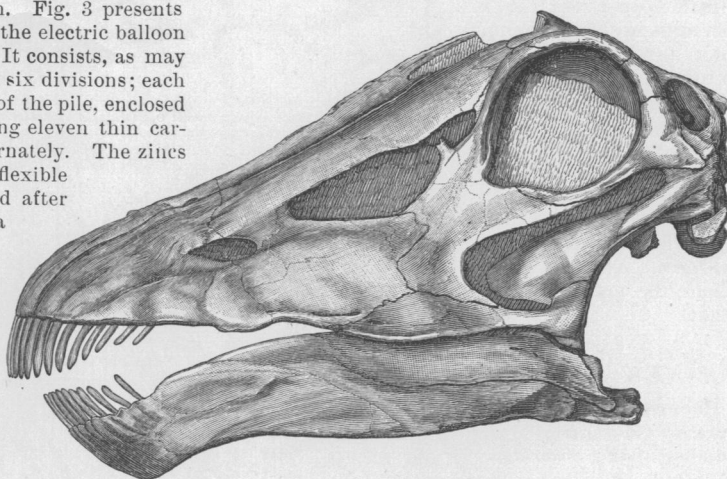


FIG. 1. — Skull of *Diplodocus longus* Marsh, side view.

around the pail by a copper thread sheathed in gutta-percha. This manner of closing is very secure; and, in case of a shock, not a drop of the liquid can escape. The pails, when empty, weigh only three kilograms each: they are strengthened by basket-work, which also serves as a support. Cords passing into the pulleys raise them above the piles in order to fill them, and lower them to empty them. The bottom of the car holds a caoutchouc cistern to receive the liquid in case of accident. The pile with the liquid weighs about a hundred and eighty kilograms. A little willow basket—easily seen in our illustration—is placed under the motor. It contains an oil-can for the motor, a little bottle of mercury to supply the cups of the commutator sunk into a block of box-wood, and also the tools necessary to discharge the pile in case of accident. All this occupies the back of the car. In the front, space is reserved for the ballast-bags and for the implements used in the descent.

Our illustration was made with great exactness: it presents all the details of the arrangement of the car, and shows the attachment of the motor. The

Siemens machine, and the spring which it works, are arranged on a walnut cross-piece. In addition, it is held by stretched ropes, which may be tightened at pleasure by tension, and which connect the four extremities of the framework with the upper and lower cross-pieces of the car. When rotating with great velocity, the vibrations are avoided by this method of attachment.

The use of such a machine in the car of a balloon is comparatively simple. When every thing has been prepared on the ground, there is nothing to do but to plunge a little copper fork into the mercury-cup of the commutator, and the screw begins to turn.

From fear of fire, and from the change of position, which affects the altitude of the balloon when once poised in the air, the operator must have no manual work to do: electricity alone supplies all the fundamental conditions of the aerostatic motor-force. After the winter, when favorable weather comes, the first electric balloon will again take its flight.

GASTON TISSANDIER.

A NEW AND STRANGE DINOSAUR.

PROFESSOR MARSH continues his studies of the Jurassic dinosaurs of America by giving, in the last number of the *American journal of science*, an account of a new family of Sauropoda founded upon the genus *Diplodocus*, which he places between the Atlantosauridae and the Morosauridae. The chevrons of the caudal vertebrae, which have both anterior and posterior branches, have suggested the name *Diplodocus*; and the ischia of the pelvic girdle are intermediate in form and position between the families heretofore recognized, the shaft being straight, and not twisted nor apically expanded.



FIG. 2. — The same skull, front view.

But the best preserved portion is the skull, of which we reproduce Professor Marsh's excellent figures. It was of moderate size, the figures being one-

sixth the natural size, and showing clearly the characteristic features. It has two pairs of ante-orbital openings, the small front pair not having been seen before in dinosaurs. The brain inclines backward, and has a very large pituitary body, enclosed in a

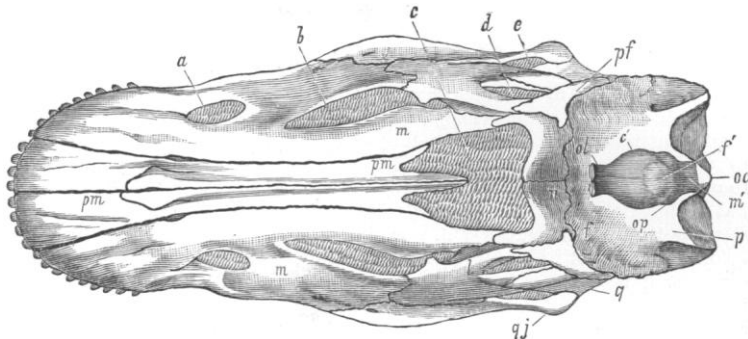


FIG. 3. — Skull and brain cast of the same, seen from above. *a*, aperture in maxillary; *b*, ante-orbital opening; *c*, nasal opening; *c'*, cerebral hemispheres; *d*, orbit; *e*, lower temporal fossa; *f*, frontal bone; *f'*, fontanelle; *m*, maxillary bone; *m'*, medulla; *n*, nasal opening; *oc*, occipital condyle; *ol*, olfactory lobes; *op*, optic lobe; *p*, parietal bone; *pf*, pre-frontal bone; *pm*, pre-maxillary bone; *q*, quadrate bone; *qj*, quadrato-jugal bone.

capacious fossa below the main brain-case, — a very different condition from that holding in the other families of Sauropoda. The size of the skull indicates an animal probably forty or fifty feet long: the weak dentition shows that it was herbivorous, and its food was probably such succulent vegetation as an aquatic life would enable it to procure.

In looking at these figures, and noting their strange resemblance to a horse's skull, one finds it hard at first to recall the fact that the nearest living allies of *Diplodocus* are the crocodiles.

THE FALSE PROPHET OF THE SUDAN.

THE religious movement in the Sudan has a special interest for ethnologists on account of its parallelism with the events by which the faith of Islam was originally propagated. A recent letter from Khartum informs us that Mohamed Ahmed, the Mahdi, was born at Dongola in the year 1260 of the hegira. His parents, Abdellahi and Amina, were poor, and had two older sons. From the age of seven he was taught in a Mussulman school to read, write, and commit to memory the Koran. At the age of twelve he knew the latter perfectly. In the same year his father died; but his brothers continued his education while he pursued studies of the Mussulman law, foreseeing eminence in store for him. After the death of his mother, having completed his studies, he repaired to the Isle of Aba on the White Nile, to be near his brothers, who were boat-builders. For nearly fifteen years he inhabited the isle, venerated as a holy man by all who knew him, before making claim to the title of Mahdi or Mussulman Messiah. He then wrote to all sheiks and grand dervishes of the region, that the prophet