An account of a large Electro-Magnet, made for the Laboratory of Yale College ;* by JOSEPH HENRY and Dr. TEN EYCK.

(Extract of a letter to Prof. Silliman, accompanying the Magnet.)

THE magnet is constructed on precisely the same principles as that described in the last number of the Journal. It weighs 59½ lbs. avoirdupois, (exclusive of the copper wire which surrounds it,) and

* This magnet is now arranged in its frame, in the laboratory of Yale College. Being myself out of town when the instrument arrived, the necessary experiments and fixtures were satisfactorily made by Mr. C. U. Shepard, (Chem. Assis.) and Dr. Titus W. Powers, of Albany, who was so obliging as to bring the magnet to New Haven. There has not been time (as the magnet came just as this No. was finishing) to do any thing more than make a few trials, which have however fully substantiated the statements of Prof. Henry.† He has the honor of having constructed by far, the most powerful magnets that have ever been known, and his last, weighing, armature and all, but 82½ lbs., sustains over a ton. It is eight times more powerful than any magnet hitherto known in Europe, and between six and seven times more powerful than the great magnet in Philadelphia. We understand that the experiments described in the last No. of this Journal, (except those ascribed to Dr. Ten Eyck) were devised by Professor Henry alone, who (except forging the iron) constructed the magnet with his own hand. The plan of the frame, and the fixtures, and the drawing in the last No., were done by Dr. Ten Eyck. In the Yale College magnet, the plan was drawn by Professor Henry, and the iron forged under his direction. The length of the wires being agreed upon, the winding was done by Dr. Ten Eyck, and the experiments were mutually performed.—*Ed.*

† It may be worth while to state a single experiment, which I made with a view to learn the chemical effects of this instrument. As its magnetic flow was so powerful, I had strong hopes of being able to accomplish the decomposition of water by its means. My experiment, however, which was made as follows, proved unsuccessful. The battery being immersed, to the extremities of the magnet were applied two broad, polished plates of iron, terminating in flattened wires, which were united with the wires of the ordinary apparatus for decomposing water, and the contact heightened by the use of cups of mercury: not the slightest decomposition was, however, observable. Aware, that had any chemical effect been produced, this arrangement could have decided nothing, (except perhaps from the degree of energy in the decomposition) as respects the point whether simple magnetism is adequate to decompose water, since it might under these circumstances be attributed to the electricity from the battery, I had determined in a second experiment, had the first proved successful, to have interrupted the galvanic flow by a non-conductor; in which case, had the decomposition ensued, pure magnetism might have been considered as the decomposing agent. But as my preliminary experiment was unsuccessful, I proceeded no farther; I hope, however, to resume the research hereafter, under more favorable circumstances. C. U. SHEPARD.

was formed from a bar of Swede's iron three inches square and thirty inches long. Before bending the bar into the shape of a horse-shoe, it was flattened on the edges, so as to form an octagonal prism, having a perimeter of $10\frac{3}{4}$ inches. The other dimensions of the magnet, as measured before winding it with wire, are as follows:—perpendicular height of the exterior arch of the horse-shoe $11\frac{3}{4}$ inches—around the outside from one pole to the other $29\frac{9}{10}$ inches—internal distance between the poles $3\frac{1}{2}$ inches.

The armature or lifter is formed from a piece of iron from the same bar, not flattened on the edges; it is nearly 3 inches square, $9\frac{1}{2}$ inches long, and weighs 23 lbs. The upper surface is made perfectly flat, except about an inch in the middle where the angles are rounded off so as to form a groove, into which the upper part of a strong iron stirrup, surrounding the armature, fits somewhat loosely. The weight to be supported is fastened to the lower part of the stirrup, and by means of the groove is made to bear directly on the center of the armature.

For the purpose of suspending the magnet, a piece of round iron with an eye on one end, is firmly screwed into the crown of the arch and is attached to the cross beam of a frame, similar to that figured in the last number of the Journal.

The magnet is wound with 26 strands of copper bell wire, covered with cotton thread 31 feet long; about 18 inches of the ends are left projecting, so that only 28 feet actually surround the iron; the aggregate length of the coils is therefore 728 feet. Each strand is wound on a little less than an inch; in the middle of the horse-shoe it forms three thicknesses of wire, and on the ends or near the poles it is wound so as to form six thicknesses.

Two small galvanic batteries are soldered to the wires of the magnet, one on each side of the supporting frame, in such a manner as to cause the poles to be instantaneously reversed, by merely dipping the batteries alternately into acid. To render these as compact as possible, they are formed of concentric copper cylinders with cylinders of zinc plates interposed and so united as to form but one galvanic pair. Each of these batteries presents to the action of the acid, measuring both surfaces of the plate, $4\frac{7}{9}$ square feet—they are 12 inches high and about 5 inches in diameter.

In experimenting with this magnet, a battery containing $\frac{2}{5}$ of a square foot of zinc surface was first attached to the wires; with this the magnet could not be made to support more than 500 lbs. An-

other battery was then substituted for the above, containing about three times the same quantity of zinc surface; with this, at the first instant of immersion, the magnet sustained 1600 lbs.; after the acid was removed, it continued to support, for a few minutes, 450 lbs.; and in one experiment, three days after the battery had been excited, more than 150 lbs. were added to the armature* before it fell. It was evident from these experiments, that this magnet required a considerably larger quantity of zinc surface in proportion to its weight, to magnetize it to saturation, than that described in the former paper. Accordingly the two batteries, before mentioned as containing $4\frac{1}{9}$ square feet, were prepared. With one of them, at the first immersion, the magnet readily supported 2000 lbs. A sliding weight was then attached to the bar; the battery was suffered to become perfectly dry, and on immersing it again, the magnet supported 2063 lbs. The effect of a larger battery was not tried.

To test its power of inducing magnetism on soft iron, two pieces of round iron $1\frac{1}{4}$ inches in diameter and 12 inches long, were interposed between the extremities of the magnet and the armature—with this arrangement, when one of the batteries was immersed, the pieces of iron became so powerfully magnetic as to support 155 lbs.

To exhibit the effects produced by instantaneously reversing the poles, the armature was loaded with 56 lbs. which added to its own weight made 89 lbs.; one of the batteries was then dipped into the acid and immediately withdrawn, when the weight of course continued to adhere to the magnet; the other battery was then suddenly immersed, when the poles were changed so instantaneously, that the weight did not fall. That the poles were actually reversed in this experiment, was clearly shown by a change in the position of a large needle placed at a small distance from the side of one extremity of the horse-shoe.

P. S. Last autumn, I commenced a series of observations on the magnetic intensity of the earth at Albany, and intend to begin a new series next month; the apparatus used was that sent by Capt. Sabine to Prof. Renwick, and was mentioned in the Journal, Vol. XVII, p. 145. I have constructed a similar apparatus for myself, and intend to pay considerable attention to the subject.

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* The armature of 23 lbs. applied when the battery is immersed, only for an inch and an instant, remains, day after day, without falling, although the galvanic coils are perfectly dry.—*Ed.*

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