

ART. VIII.—*Experiments in Electro-Magnetism*; by Dr. CHARLES G. PAGE, of Salem, Mass.

TO PROFESSOR SILLIMAN.

Dear Sir—I notice in the July No. of the Franklin Institute Journal, an announcement of the discovery of the thermo-electric spark by an Italian philosopher, and also the subsequent exhibition of the spark by Prof. Wheatstone to Faraday and others; the date of the discovery is not given. On referring to my notes I find that I obtained the spark in August last, but not the shock. The spark and shock were both obtained Dec. 2d, 1836, and exhibited to a number of friends, and announced in your last No. It appears that the European philosophers have not yet obtained a current of sufficient magnitude to afford a shock by the multiplier, although they use in the experiment a great number of pairs. In my experiment only a single pair is used either of bismuth and iron, bismuth and zinc, or bismuth and antimony, and yet the induced or lateral shock given by the multiplier is very distinct by acupuncture. The particular arrangement of the thermo-electric elements to produce such powerful effects, I do not wish to describe at present, as I hope ere long to announce it as a substitute for galvanic batteries in many experiments.

On the disturbance of Molecular forces by Magnetism.

A short article on this subject appeared in the last No. of this Journal, under the caption *Galvanic Music*. The following experiment, (as witnessed by yourself and others not long since,) affords a striking illustration of the curious fact, that a ringing sound accompanies the disturbance of the magnetic forces of a steel bar, provided that bar is so poised or suspended as to exhibit acoustic vibrations. An electro-magnetic bar four and a half inches in length, making five or six thousand revolutions per minute near the poles of two horse shoe magnets properly suspended, produces such a rapid succession of disturbances, that the sound becomes continuous, and much more audible than in the former experiment, where only a single vibration was produced at a time.

On the application of Electro-Magnetism as a moving power.

Late in the fall of last year, (November,) I commenced the investigation of this subject, not knowing that any thing more had ever

been effected than what appeared in an instrument before me at that time, viz. Ritchie's revolving galvanic magnet, which consists of a horizontal bar of soft iron covered with copper wire, the ends of the wire descending into mercury cells. This instrument was the basis of my pursuit. Finding that this bar never attained its maximum velocity, from the occasional union of the battery poles, I soon remedied this defect by a contrivance, wherein the bar moved vertically, and the mercury cells were entirely independent of each other. The instrument thus improved became an interesting and useful piece of apparatus, and is in fact the revolving interruptor described and figured in the last No. of the Journal. The stationary magnets, instead of being single contrary poles, at opposite sides of the circle described by the bar, were multiplied so as to form an entire circle of poles, with the exception of an inch on each side between the opposite poles. The magnets were short bars arranged in the form of a cylinder, somewhat like the staves of a barrel, and the poles not in use were united by armatures of soft iron. The velocity of this model was very great, but I found the scattering and oxidation of the mercury a great inconvenience and soon substituted for it solid conductors. The wires on the bar had their similar ends united by single wires, which were brought down and soldered by cylindrical segments of metal, firmly fixed upon, but insulated from the axis. These segments, representing the ends of the wires covering the revolving bars, were insulated from each other by pieces of horn or ivory. Two wires connected with the poles of the battery pressing against these segments with a spring, furnished sufficient metallic contact to ensure the passage of the galvanic current through the wires from end to end. As the segments revolved, they presented opposite ends of the wires to the fixed battery wires and thus the poles were changed.* But the most important discovery in relation to the application of this power, is the following, viz. the admissibility of oil between the solid conducting surfaces. After the ma-

* Before the appearance of the April No. of this Journal, in which Davenport's machine was partly described, I addressed a letter to Prof. Silliman, to learn if he was aware of any experiments of the kind hitherto made. His answer was, "the best information you can have on this subject, will be embodied in the coming No. of the Journal." The Journal appeared with a description of Davenport's machine, but the mode of making battery connection and changing poles was reserved, and until within a short time since, I supposed that mercury was the medium. Finding lately that he used dragging wires upon semizones of metal, I have secured the above arrangement to myself by patent.

chine had revolved for a time, I found it necessary to free the revolving segments, (or discs they may be called,) from oxide, even when it was made of silver, gold or platinum. Amalgamating the surfaces, the oxide collected with still greater rapidity. It occurred to me that if the interposition of oil or naphtha would not interrupt the current, the oxidation of the rubbing surfaces might be entirely prevented. On trying oil I was agreeably surprised to find that the current was not only not interrupted when the pressure of the metals was very slight, but that it passed with greater certainty, and enhanced the operation of the machine six fold. It appears that oil more than compensates for its non-conducting property, by keeping the surfaces free from oxide.

This discovery will prove of vast importance in the laboratory, as it will dispense with the use of mercury in many experiments, and prevent the constant necessity of amalgamating and cleaning conductors. Having attained such an advantage in small models, I proceeded to the construction of a large one. The revolving bars are a foot in length and weigh together ten pounds. They are disposed at right angles on the same axis, but revolving in opposite ends of the cylinder of magnets. With steel magnets its power is very great; but with galvanic magnets its power is sufficient to carry a machine for covering copper wire with cotton; and with the addition of more coils of wire, might doubtless be made to turn a large lathe. Now although it is certain that machines of this description may be applied to a considerable extent, yet it is evident that their power is limited. These and all other similar machines must be liable to the objection, that their magnetic forces cannot be made commensurate with their size and weight. This objection I have surmounted, (as far as theory and a small model afford proof,) by the following arrangement. Instead of extending large bar magnets through the whole diameter of the circle, I have horse shoe magnets carried near to the circumference of the circle. They are arranged on arms or radii like the spokes of a wheel, and both poles of each horse shoe are in operation at once. They each change their poles four times in each revolution, and the change is effected as before by revolving segments or discs. From the great success of a small model on this plan, I have commenced and now nearly finished an engine on a grand scale; from which I expect great power. The revolving apparatus weighs nearly a hundred pounds. If its power should be in proportion to that of the small model, it must exceed one horse.

Salem, August 15, 1837.