III. "On certain Points in the Theory of the Magneto-electric Machines of Wilde, Wheatstone, and Siemens." By C. F. Varley, Esq. In a Letter to Professor Stokes, Sec. R.S. Received February 26, 1867.

Fleetwood House, Beckenham, S.E.,
February 23, 1867.

My dear Sir,—Professor Wheatstone showed that a shunt put into the circuit of the electromagnet increased the power greatly, but the explanation that it increased the power by equalizing the resistance of the armature and that of the electromagnet is either wholly incorrect, or very nearly so.

Yesterday I had an opportunity afforded me by Mr. C. Siemens of experimenting with his machine, in which the electromagnets have each a resistance of about 250 Ohms = 500 Ohms, the armature 400 Ohms.

On adding a shunt to the electromagnet the flame was greatly increased.

The two electromagnets when connected in series had a resistance of about 500 Ohms. I then connected them in a double circuit, the resistance in this case being about 125 Ohms. By this means the same result as regards resistance could be obtained as by a shunt, with the difference that the power expended in the shunt is lost in heat; while reducing the resistance by the double circuit caused the whole force to be expended on the electromagnet.

The results of the experiment were—

1st. The shunt invariably *increased* the power.

2ndly. When the magnets were joined in double circuit the power was greatly *reduced*.

The explanation is to me obvious. In a Ruhmkorff's coil, where the iron core is divided into fine wire, so that the dying magnetism cannot set up currents in the iron core to prolong its existence, the magnetism is very rapidly lost, and the make-and-break hammer works very rapidly, sometimes as fast as sixty beats per second.

If the secondary circuit be closed so that the currents can flow, the make-and-break hammer works very slowly, indeed one or two beats per second; and in 1856 I published a description of electromagnets whose action was very slow, and which were rendered sluggish by a copper cylinder around them.

Wilde's armature, when revolving, sends intermittent currents around the electromagnet, whose circuit is broken at every half revolution of the armature.

Were the magnets composed of fine iron wire, the magnetism would die away rapidly, producing a violent current by its efforts to maintain itself, as in the Ruhmkorff's coils. (This current is called by foreigners the extra-current.)

The shunt which Wheatstone inserted carries this current across, and so maintains the magnetism of the electromagnets until the armature gives a

second impulse. The current in this shunt will be found to travel in alternate directions; not so that on the electromagnet.

When the armature is discharging its current into the electromagnets, the current in the shunt is in the direction it would have if the shunt were in circuit solely with the armature.

When the armature is changing poles and is disconnected, the secondary current is in full play, and the current in the shunt is in the direction of the current prolonged in the electromagnet, that is, of the extra current.

The force expended in the shunt is wasted in heat; but a secondary wire on the electromagnet or a copper cylinder would very greatly add to the power by maintaining the magnetism, and not consume uselessly the force now wasted in the shunt.

The overlapping of the armature and the solid mass of the electromagnets tends to maintain imperfectly the magnetism during the intervals of *no* current from the armature; and but for this the machines, whether they be Wilde's, Wheatstone's, or Siemens's, would none of them work.

In 1860 I published a description of two machines I had constructed, and in 1862, at the Universal Exhibition, I exhibited a machine for adding mechanical force to static electricity without friction. A machine similar in principle, but a little different in construction, has been exhibited recently under the name of Holtz.

One of my machines bears to the other precisely the same relation that Siemens's or Wheatstone's does to Wilde's.

If these be of sufficient interest to the Royal Society, I shall be happy to exhibit them.

I am, my dear Sir,

Very truly yours,

C. F. Varley.

IV. "On a Magneto-electric Machine." By William Ladd, F.R.M.S. Communicated by Professor Stokes, Sec. R.S. Received March 14, 1867.

In June 1864 I received from Mr. Wilde a small magneto-electric machine, consisting of a Siemens's armature and six magnets. This I endeavoured to improve upon, my object being to get a cheap machine for blasting with Abel's fusees. This was done by making one of circular magnets, and a Siemens's armature revolving directly between the poles, the armature forming the circles; with this I could send a very considerable power into an electro-magnet, &c. It was then suggested to me by my assistant, that if the armature had two wires instead of one, the current from one being sent through a wire surrounding the magnets, their power would be augmented, and a considerable current might be obtained from the other wire available for external work; or there might be two armatures, one to