

5. Laboratory Notes. By Professor Tait.

(1.) Measurements of the Electromotive Force of the Gramme Machine at Different Speeds.

The following measurements were made by means of a Gramme machine, recently procured for the University. I desired to make use of it, not only for electric light, but for electrolysis, the exciting of electromagnets, and various other purposes for which we have hitherto used from 4 to 40 or so Bunsen cells. I therefore arranged the driving-gear so that with the same motor (a $3\frac{1}{2}$ h.p. gas-engine) it was easy to use either of three speeds. These are, approximately, 800, 533, and 320 turns per minute. The electromotive force varies, of course, not only with the speed but with the resistance of the whole circuit—falling off at first rapidly and then more slowly for any one speed, as the resistance is increased. As I had no means of measuring the speed *directly*, I was somewhat puzzled at first to find the electromotive force at any one speed rise to a maximum, and then rapidly fall off as the whole resistance was gradually diminished. But I soon found that this was due in great part to the slipping of the driving-belts (though they were very tight), whenever the intensity of the current exceeded a certain amount. A liberal use of rosin almost removed this anomaly, though there is reason to believe there is still considerable slipping.

The following table gives the average of a number of experiments which accord fairly with one another. The resistance of the conductor of the Gramme machine is about 1.16 B. A. units. For the added resistance I used coils of stout covered copper wire which were in the laboratory, having resistances 0.054, 1.844, and 3.63, respectively. The first was always in circuit, and a portion of it, of resistance 0.0015, was introduced into the circuit of a galvanometer having a resistance 23. The deflections of the galvanometer were observed with the first coil alone in the circuit of the Gramme, then with the addition of the second or third, and finally with all the coils.

The explosions in the gas-engine occur only at every *second* stroke of the piston. This and other causes render the driving power not absolutely steady, but the *average* deflection of the galvanometer was very easily observed.

From the graphic representation of the results the following numbers were taken :—

Nominal Speed.	Whole Resistance.	Electromotive Force in terms of a Bunsen cell.
800	1·5	38*
...	3·	38
...	4·5	36
...	6	31
533	1·5	24
...	3·	23
...	4·5	17·5
...	6·	9·
320	1·5	13
...	3·	5
...	4·5	2·5
...	6	2·

Next, instead of the second or third coils above mentioned, a Duboscq's lamp was included in the circuit, the other arrangements being as before, and the speed being 800 nominal. The deflection corresponded to an electromotive force of about 39 Bunsen cells, and a resistance of 2·66. As the lamp itself was sometimes found to have a resistance of as much as 0·6, and as the carbons have a resistance of from 0·115 to 0·045, per 4 inches, it appears that, approximately, the resistance of the electric arc, under these conditions, is at least 0·8.

Subsequent experiments, in which the lamp was not used, gave resistances varying from 0·75 to 1·2, according to the length of the arc—and when a little sodium was introduced, it fell to 0·25. These estimates, of course, include the effect due to heating and pointing the carbons.

The want of accurate speed determinations, of course, deprives these results of scientific value, but they are very useful as an expression of the electromotive force practically to be obtained from the Gramme machine under different circumstances of its ordinary working,—showing, as they do, what adjustments to make for the purposes of a particular experiment.

* This particular number must be over-estimated, for about 5 h.p. is required to maintain an electromotive force of 38 Bunsens in a resistance 1·5.

The very rapid increase of electromotive force with diminished resistance at the lowest speed, seems to show that the speed is very considerably overrated when stated as 800 or 533, with the resistance between 1 and 2 B. A. units. I hope soon to have the means of accurately measuring the speed realised, and shall then repeat these experiments for a scientific, and not a mere practical purpose.

(2.) On the Law of Extension of India-rubber at
Different Temperatures.

To fill the vacancies in Foreign Honorary Fellowships caused by the deaths of Claude Bernard, Elias Magnus Fries, Henri Victor Regnault, Angelo Secchi, the following Gentlemen were elected:—

FRANK CORNELIUS DONDERS, Utrecht.

ASA GRAY, Cambridge, U.S.

JULES JANSSEN, Paris.

JOHANN BENEDICT LISTING, Gottingen.

The following Gentlemen were duly elected Fellows of the Society:—

THOMAS H. COCKBURN HOOD, F.G.S., Junior Carlton Club, Pall Mall.

THOMAS GILRAY, M.A., 6 Carlung Place, Edinburgh.

ALEX. BENNETT M'GRIGOR, LL.D., 19 Woodside Terrace, Glasgow.

JAMES BLAIKIE, M.A., 14 Viewforth Place, Edinburgh.

Monday, 17th March 1879.

Professor KELLAND, President, in the Chair.

The following Communications were read:—

1. On Gravitational Oscillations of Rotating Water.

By Sir William Thomson.

(*Abstract.*)

This is really Laplace's subject in his Dynamical Theory of the Tides; where it is dealt with in its utmost generality except one important restriction,—the motion of each particle to be infinitely nearly horizontal, and the velocity to be always equal for all par-