supplies carried in by all the rivers of the globe. The tendency of the operation going on upon the land is to reduce the stock of carbon and increase that of carbonic acid,

(1) by the combustion of coal and other substances used as fuel;
(2) by the destruction of carbon accumulated near the surface of the soil by natural vegetation;
(3) by the increase of man and animals.

On the other hand, there may be a corresponding increase of organic carbon in the ocean, and in this way the balance may be kept up. Dr. Frankland's various analyses of sea-water, extending to a depth of between 700 and 800 fathoms, show that even at this depth, which is less than half of the estimated average, the amount of carbon, as organic carbon, is about three times as much as the carbon, as carbonic acid, in the atmosphere resting upon an equal area of surface. When we consider the immensity of the ocean, it is evident that the operations of animal and vegetable life in it must have a vast influence upon our atmosphere, of the value of which we appear to be altogether ignorant.

XXVII. *On the Rate of the Decrease of the Light given off by a Phosphorescent Surface.* *By* Lieut. L. Darwin, R.E.*

I CARRIED out a series of experiments at Chatham with the view of determining the law of the rate of decrease of the light of a phosphorescent surface. The experiments were conducted by comparing the light given off by a surface covered with Balmain's luminous paint, with a sheet of tissue paper illuminated from the further side by a Sugg's burner regulated to give about the light of four standard candles. The surface coated with paint was one side of a thin metal vessel, which was filled with a mixture of ice and water; the object of this was to keep the temperature as uniform as possible, as any increase of temperature increases the light given off by the paint. A sheet of tissue paper, of about the same size as the painted surface, was arranged just above it so that the light of the burner illuminated the tissue paper from the further side to the observer. The whole was enclosed in a box with an opening at one side, through which the light of the burner reached the tissue paper only, and opposite to it a small hole through which the observations were made. In this way only the light from the two surfaces

* Communicated by the Physical Society. Read December 11th.

from the distance of the burner. No absolute standard was attempted, as the light of the tissue would vary with its thickness, probably with the angle at which it was observed, and with the exactness with which the colour of the paint was imitated by means of the glass and solution. The second column gives the time at which the observation was taken.

TABLE.

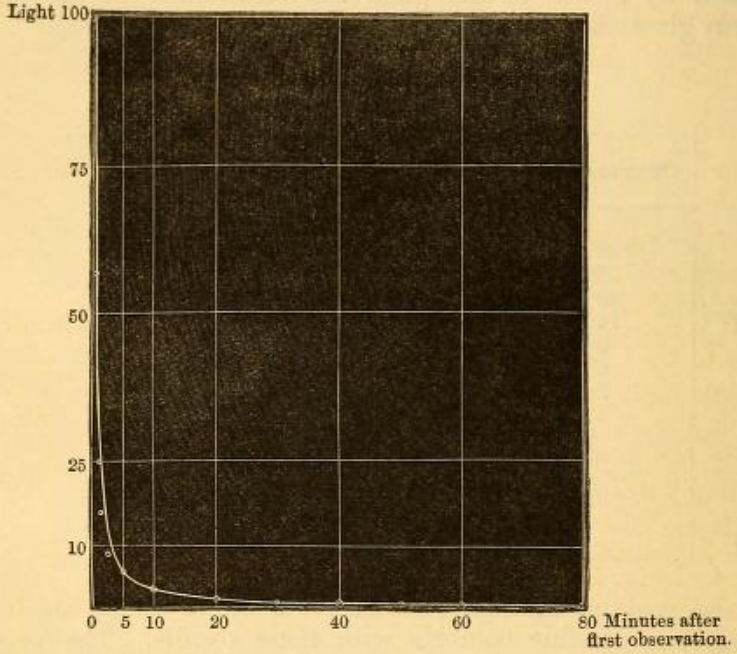
Observed Light.	Observed Time.	Calculated Time.
	m. s.	m. s.
100·	0 0	0 0*
56·5	18	19
25·1	45	1 8
14·1	1 33	2 11
9·04	2 34	3 25
6·10	5 0	5 0*
2·89	10 0	9 59
1·34	20 0	19 53
·782	30 0	31 52
·604	40 0	39 41
·433	50 0	53 0
·376	60 0	60 0*
·285	80 0	76 14

I also made an attempt to calculate a curve which should as nearly as possible coincide with these results. The form of the curve which naturally suggested itself was $\frac{A}{t+B}=l^c$; t=time, l=light, A, B, and C being constants. A curve of this form to pass through three points (*) was calculated: A=26·1, B=·498 minute, C=·86. That is to say, the rate of decrease of the light varies as the light to the power of 1·86; and at that rate the light would have been infinitely great 30 seconds before the first observation. Taking the illuminations as obtained from the observations, the time of the observations was calculated according to the above formula; and the result is given in the third column. Three of the observed times differ from the calculated times more than can be accounted for by errors of observation; and it appears that the equation does not give quite the correct curve. From this and from another series of observations, it appears that in its lower parts the curve is very nearly of the form $\frac{A}{t+B}=l$; that is to say, that the rate of decrease of the light varies as the square of the light.

By comparing several series of observations it appears to

me that the rate of decrease is quite independent of the intensity of the first illumination.

Diagram showing the Rate of Decrease of the Light given off by Phosphorescent Paint.



o Observed illumination.

—— Curve calculated from the equation $y^{86}=\frac{26\cdot1}{x+\cdot498}$.

XXVIII. *Theory of Voltaic Action.*

To the Editors of the Philosophical Magazine and Journal.

GENTLEMEN,

IN stating* that the results obtained by me† are due to a difference of potential between the metal and its oxide, chloride, or sulphide, Professors Ayrton and Perry continue to ignore the concluding phase of these experiments, though I have brought it prominently forward in the 'Electrician' for December 4, from which they give a quotation. I refer to the fact that in the copper-iron ring experiments, though after admission of the hydrogen-sulphide gas the copper side becomes strongly positive to the iron, very soon this difference

* Phil. Mag. for Jan. 1881, p. 48.

† Phil. Mag. for Aug. 1878, p. 142, and Feb. 1879, p. 109.