thus electrical variations may be produced, resembling the effects observed during the action of light on the eye.

Certain modifications taking place in the chlorous acid by exposure to light increase its sensibility, and as a general result it is found that the fluid through these alterations increases in resistance. We have thus an anomalous kind of battery where the available electromotive force increases with the resistance. The addition of neutral substances which increase the resistance without producing new decompositions improves the action of the cell.

Care has to be taken in these experiments to use the same apparatus in a series of comparative experiments, as infinitesimal differences in the contact of the active pole render it difficult to make two instruments giving exactly the same results. Cells have been constructed with two, three, and four poles, and their individual and combined action examined. Quartz surfaces have also been employed instead of glass, thus enabling the chemical opacity of different substances to be determined.

The electrical currents derived through the action of light on definite salts are strong in the case of ferro- and ferri-cyanide of potassium, but remarkably so in the case of nitroprusside of sodium.

Of organic acids the tartrate of uranium is one of the most active. A mixture of selenious acid and sulphurous acid in presence of hydrochloric acid yields strong currents when subjected to light in the form of cell described. The list of substances that may be proved to undergo chemical decomposition by the action of light is very extensive; full details will be found in the completed paper.

IV. "On the Determination of the Scale Value of a Thomson's Quadrant Electrometer used for Registering the Variations in Atmospheric Electricity at the Kew Observatory." By G. M. Whipple, B.Sc., Superintendent of the Kew Observatory. Communicated by Robert H. Scott, M.A., F.R.S. Received April 3, 1878.

The Meteorological Council, being desirous of discussing the photographic traces produced by their electrograph at the Kew Observatory some time since, requested the Kew Committee to institute a series of experiments, with the view of determining the scale value of the instrument, in order to prepare a suitable scale for measuring the curves.

The Kew Committee, at their meeting in November, entrusted the matter to me, and accordingly, having obtained the loan of a battery of 300 Bunsen cells, some preliminary experiments were made, which

showed that the greatest potential which could be obtained with them was very inadequate for the purpose.

Having named this fact to Dr. De La Rue, he very generously placed his large chloride of silver battery at the disposal of the Observatory, and by its means we have been able to test the value of the deflections of the instrument at different points of the scale throughout its entire range.

Owing to the difficulty of transporting the large battery the experiments were all made in Dr. De La Rue's laboratory, Charlotte-street, Portland-place, London.

The electrometer (Thomson's Quadrant, No. 19, White, Glasgow, maker) was dismounted from its position in the Observatory on the 3rd December, 1877, careful measurements having first been made of the distance of a mark on the instrument from the source of light and from the point of incidence of the reflected spot of light on the circumference of the cylinder of the registering apparatus.

The acid was then removed from the jar, and the needle fixed for transit.

Before moving the instrument the exact position of the quadrants, which are kept separated to some distance in ordinary use, was marked by lines drawn on the cover, so as to ensure as far as possible that the same inductive power should be acting on the needle during the experiments as there had been whilst the electrometer was in daily use at the Observatory.

The time of vibration of the needle was also carefully determined and noted, with the view of detecting any change that might occur in its sensibility from derangement of its supporting fibres during transit.

The apparatus was then conveyed to Dr. De La Rue's laboratory, and there fitted up on a bed prepared for the purpose, on which the distances as mentioned above were marked.

The jar having been refilled with acid the needle was liberated, and its time of vibration being found unaltered, it was charged positively, and the instrument left for several days in order that its interior might become thoroughly dried.

In the first experiment readings were taken on a scale divided into fortieths of an inch, which was placed in the exact position occupied by the front face of the cylinder of the registering apparatus of the electrograph.

The battery terminals were then attached to the electrodes of the instrument, and the cells joined up in series as required. The deflections produced by the different potentials were read off on the scale with the following results, the quadrants being put to earth at the beginning of each experiment with the view of obtaining a correct value of the zero.

Experiment 1. In this experiment only the potential of the positive pole was measured.

No. of Cells.	Deflection in inches.	No. of Cells.	Deflection in inches.	No. of Cells.	Deflection in inches.	No. of Cells.	Deflection in inches.
0	0·000	200	1·762	440	3·300	680	4·275
20	0·200	240	2·050	480	3·487	720	4·362
40	0·400	280	2·375	520	3·637	760	4·425
80	0·900	320	2·650	560	3·812	800	4·500
120	1·112	360	2·887	600	3·950		
160	1·450	400	3·100	640	4·087		

In the next experiment the positive deflections were read for potentials increasing by hundreds up to 800 cells, and the negative for potentials increasing by twenties up to 200 cells.

Experiment 2.

Positive.				Negative.			
No. of Cells.	Deflection in inches.	No. of Cells.	Deflection in inches.	No. of Cells.	Deflection in inches.	No. of Cells.	Deflection in inches.
0	0·000	600	3·725	0	0·000	120	1·200
100	0·900	700	3·951	20	0·125	140	1·450
200	1·701	800	4·051	40	0·287	160	1·575
300	2·387			60	0·525	180	1·850
400	2·951			80	0·725	200	2·100
500	3·401			100	0·975		

The negative deflections in the next experiment were obtained for potentials diminishing from 200 cells. The positive again increased by hundreds.

Experiment 3.

Positive.				Negative.			
No. of Cells.	Deflection in inches.	No. of Cells.	Deflection in inches.	No. of Cells.	Deflection in inches.	No. of Cells.	Deflection in inches.
0	0·000	600	3·750	200	2·250	80	0·825
100	0·950	700	3·975	180	2·000	60	0·612
200	1·750	800	4·100	160	1·725	40	0·400
300	2·400			140	1·512	20	0·200
400	2·950			120	1·287	0	0·000
500	3·450			100	1·050		

The scale was then dismounted, and a frame substituted for it con-

taining a sensitized sheet of paper (such as is used in the self-registering photographic instrument at Kew), and having a sliding shutter.

The image of the illuminated slit reflected from the mirror of the electrometer, falling on this paper made a photographic impression of each deflection of the needle with various numbers of cells in circuit. The time of exposure of the paper was two minutes.

After the sheets had been developed and fixed the deflections were measured with a tabulating instrument, and the following results obtained.

Experiment 4. Experiment 5.

Experiment 4. Positive.		Experiment 4. Negative.		Experiment 5. Positive.		Experiment 5. Negative.	
No. of Cells.	Deflection in inches.	No. of Cells.	Deflection in inches.	No. of Cells.	Deflection in inches.	No. of Cells.	Deflection in inches.
0	0·000	0	0·000	0	0·000	0	0·000
100	0·949	40	0·410	100	0·918	40	0·410
200	1·764	80	0·880	200	1·725	100	1·135
300	2·412	120	1·323	300	2·406	160	1·701
400	3·013	160	1·805	400	3·003		
500	3·452			500	3·454		
600	3·806			600	3·784		
700	4·049			700	4·052		

After these experiments the quadrants were put to earth, and the instrument left until the following morning, when observations were again made of a similar nature.

It was however observed that the deflections noted were found generally to be somewhat larger than those of the previous day for the same number of cells joined up.

Experiment 6.

Positive.			
No. of Cells.	Deflection in inches.	No. of Cells.	Deflection in inches.
100	0·937	500	3·662
200	1·837	600	4·125
300	2·625	700	4·337
400	3·125	800	4·525

In the next experiment the deflections were measured for every twenty cells added on from 200 negative to 800 positive.

Experiment 7.

Positive.						Negative.	
No. of Cells.	Deflection in inches.	No. of Cells.	Deflection in inches.	No. of Cells.	Deflection in inches.	No. of Cells.	Deflection in inches.
0	0·000	320	2·475	600	3·925	0	0·000
40	0·525	340	2·600	620	4·000	20	0·100
80	0·650	360	2·750	640	4·075	40	0·275
100	(0·700)	380	2·875	660	4·125	60	0·500
120	0·900	400	3·000	680	4·175	80	0·725
140	1·075	420	3·075	700	4·225	100	0·950
160	1·250	440	3·175	720	4·275	120	1·175
180	1·425	460	3·300	740	4·325	140	1·425
200	1·600	480	3·400	760	4·350	160	1·675
220	1·775	500	3·525	780	4·375	180	1·925
240	1·950	520	3·625	800	4·400	200	2·175
260	2·100	540	3·700				
280	2·200	560	3·775				
300	2·350	580	3·850				

After this the photographic slides were again mounted in the place of the scale and the deflections registered, which on the sheets being measured gave results as follow:

Experiment 8.

Positive.				Negative.	
No. of Cells.	Deflection in inches.	No. of Cells.	Deflection in inches.	No. of Cells.	Deflection in inches.
100	1·058	500	3·942	100	1·108
200	1·943	600	4·358	200	2·323
300	2·686	700	4·625	300	3·663
400	3·488	800	4·810		

Experiment 9.

Positive.				Negative.	
No. of Cells.	Deflection in inches.	No. of Cells.	Deflection in inches.	No. of Cells.	Deflection in inches.
100	0·976	600	4·097	100	1·149
200	1·843	700	4·359	200	2·429
300	2·591	800	4·561	300	3·853
400	3·203	900	4·686		
500	3·708				

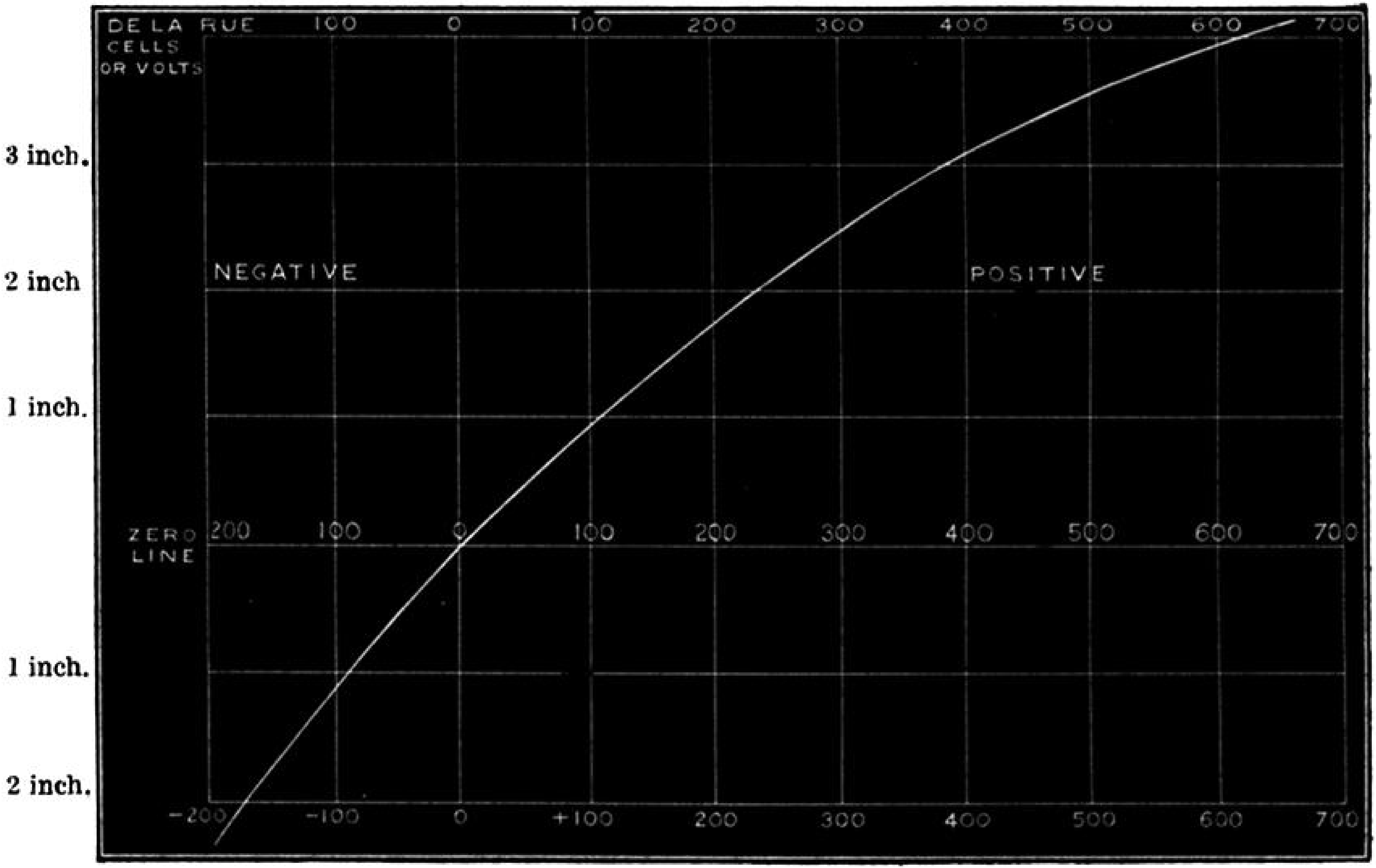
By combining the results of all the above experiments, and taking the means for every hundred cells, we have the following table:

Positive.				Negative.	
No. of Cells.	Deflection in inches.	No. of Cells.	Deflection in inches.	No. of Cells.	Deflection in inches.
100	0·93	600	3·95	100	1·04
200	1·77	700	4·20	200	2·34
300	2·48	800	4·42	300	3·75
400	3·09	900	4·69		
500	3·57				

On laying down these values in a curve, making use only of those between the limits of − 200 cells and + 700 cells, as the others are beyond the capability of correct registration by the electrograph, we find a regular smooth curve is produced, which being projected upon one of the ordinates gives a scale by means of which the electrograms are now easily tabulated.

The value of the electromotive force of one De La Rue chloride of silver cell being 1·03 volt, as determined by Messrs. De La Rue and Müller (Proc. Roy. Soc., vol. xxvi, p. 324), the scale thus formed has been assumed to represent volts with sufficient accuracy for the required purpose.

My best thanks are due to Mr. Seaton and Mr. R. W. F. Harrison for assistance rendered me in the prosecution of the experiments.


DE LA RUE CELLS OR VOLTS
100
0
100
200
300
400
500
600
700
3 inch.
2 inch
1 inch.
NEGATIVE
POSITIVE
ZERO LINE
200
100
0
100
200
300
400
500
600
700
1 inch.
2 inch.
−200
−100
0
+100
200
300
400
500
600
700