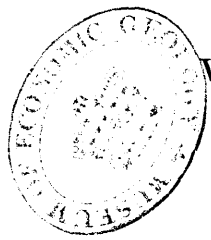
PROCEEDINGS

OF THE

ROYAL SOCIETY OF LONDON.

From June 6, 1867, *to June* 18, 1868, *inclusive.*



VOL. XVI.

LONDON:
PRINTED BY TAYLOR AND FRANCIS,
RED LION COURT, FLEET STREET.
MDCCCLXVIII.

February 6, 1868.

Lieut.-General SABINE, President, in the Chair.

The following communication was read :—

"Comparison of Magnetic Disturbances recorded by the Self-registering Magnetometers at the Royal Observatory, Greenwich, with Magnetic Disturbances deduced from the corresponding Terrestrial Galvanic Currents recorded by the Self-registering Galvanometers of the Royal Observatory." By GEORGE BIDDELL AIRY, Astronomer Royal. Received December 20, 1867.

(Abstract.)

The author, after adverting to the origin of this branch of science, as commencing (with himself) in communications with Messrs. Edwin and Latimer Clark, but more particularly with Mr. Charles V. Walker, and alluding to the important labours of Mr. W. H. Barlow, Mr. Walker, and Dr. Lamont, proceeds to give the official history of the establishment of the wires and other apparatus necessary for its prosecution at the Royal Observatory. In 1860 and 1861, the author submitted to the Board of Visitors of the Royal Observatory proposals for extending wires from the Royal Observatory in two directions nearly at right angles,—on the second occasion, specifying Croydon and Dartford as terminal points. The Board in 1861 recommended this to the Admiralty, who immediately gave their sanction. The author then applied to the Directors of the South-Eastern Railway for permission to place his wires on their poles, which was granted, at a merely nominal rent. All the wires and labour in mounting them were provided by the Railway Company at cost price, and the insulators were furnished by Messrs. Silver without profit. The wires communicate with the earth at both ends of each by solder-attachment to water-pipes.

The author then describes the apparatus made by Mr. Simms for the record of the currents. For each wire the current acts on a galvanometer whose needle-carrier also supports a small plane mirror; and, by proper adjustment of cylindrical lenses, neat spots of light are formed upon a rotating ebonite cylinder, covered with photographic paper and made to revolve (by clockwork) in twenty-four hours. With angular motion of the galvanometer, the spot of light moves. The zero of measure is obtained by interrupting the wire-circuit. The zero of time is obtained by interrupting the light and observing the corresponding clock-time. Other adjustments have received great attention.

Many delays occurred in the establishment of the apparatus, and finally from the discovery that the earth-currents were very much stronger than

had been anticipated. From 1865, April 18, it has been continuously in use, in the same form as at present.

The author then gives the theory, algebraical and numerical, for inferring, from the magnitude of the galvanic currents observed in two known directions, the magnitude of the galvanic currents in the north and west directions. And, proceeding from these by the known law, that when a current from the graphite or copper pole of a battery passes under a needle, it forces the austral element to the right (as referred to the current-course), he infers the magnitude of the magnetic force in the north and west directions.

The numerical expression contains four unequal constant factors, by which the photographic ordinates must be multiplied. The author explains that, for his own preliminary examination, he used four proportional compasses, constructed expressly for this purpose by Mr. Simms, and thus formed the ordinates of the new Magnetic-Force Curves without any use of numbers whatever. But for the more detailed work to be done by young assistants, he judged it better to measure the ordinates by scales with graduations of different value, and to add the results, thus forming numerical values of the magnetic ordinates.

The resulting scale being arbitrary, it was so adapted that the largest ordinates were not very different from the largest ordinates of the curves given by the Horizontal-Force Magnetometer. The curves given by the Declination Magnetometer were adapted to the scale of the Horizontal-Force Magnetometer.

In the large diagrams exhibited to the Society, the curves representing the North Force as shown by the Horizontal-Force Magnetometer, and the North Force as inferred from the Galvanometers, are brought into juxtaposition, and the curves representing the West Force as shown by the Declination Magnetometer, and as inferred from the Galvanometers, are brought into juxtaposition, for seventeen days in 1865, 1866, and 1867. And the general agreement between the curves of the two classes, especially for the North Force, is so remarkable that the author expresses his undoubting belief that the irregularities of magnetic force are caused by the galvanic currents. At the same time he indicates some discordances which require further examination. One of these is, that the disturbance inferred from the galvanic currents usually (but not always) precedes that recorded by the magnetometers. Another is, that the North Force appears, from the galvanic currents, to be increased (whereas, in magnetic storms, it is usually found to be diminished). There are other points of smaller importance.

The author suggests as possible that these discordances may arise from the circumstance that the Observatory is at the end of each of the wires; and therefore the galvanic current which is recorded, being that which covers a space whose centre is several miles from the Observatory, may not correspond to the magnetic forces which are observed at the Observatory.

And he submits for consideration whether it may not be desirable to try two shorter wires, the two ends of each wire making connexion with the earth on opposite sides of the Observatory, and the register of each being made, at the Observatory, near the middle of its length.

February 13, 1868.

Lieut.-General SABINE, President, in the Chair.

The following communications were read:—

I. "On the Mysteries of Numbers alluded to by Fermat."—Second Communication. By the Right Hon. Sir FREDERICK POLLOCK, Bart., F.R.S. Received January 14, 1868.

(Abstract.)

This paper is not adapted to be read *in extenso*; so much of it is connected with mere calculation, so much more of it requires continual reference to diagrams, that no adequate knowledge of its contents would be acquired by merely hearing it read aloud; but a statement has been prepared of what it contains which will give a general view of the result.

The properties ascribed to all odd numbers, in addition to those contained in Fermat's theorem, are these:—1st. The algebraic sum of the roots in some form of the 4 squares which compose the number will equal 1, 3, 5, 7, &c. (every odd number which it is large enough to produce); 2ndly, the difference between some 2 of the roots will be any odd or even number whatever, subject to the same limitation.

The series $\overset{1\ 3\ 5\ 7\ 9}{1, 3, 7, 13,}$ &c. $(n, n, n, n+l)$ will give 1, 3, 5, &c. as the sum $\overset{2\ 4\ 6\ 8}{\ }$ of the roots of its terms; and each term is the smallest that will give that amount. So $\overset{1\ 3\ 5\ 7}{1, 5, 13, 25,}$ &c. is the series whose terms are the smallest that $\overset{4\ 8\ 12\ 16}{\ }$ give the odd numbers as a difference of the roots, and $\overset{2\ 6\ 10}{1, 3, 9, 19,}$ &c. that give the even numbers. And these are the three series that compose *The Square* (the subject of the *last* paper) when the 1st term is 1; and they are the cause of its properties. A portion of the paper is devoted to an investigation of the change effected in the sum of the squares, by a change in the roots. If 2 roots differ by n, they may be represented by a and $a+n$; and if the smaller be diminished by 1, and the larger increased by 1, the sum of the squares is increased by $2n+2$; if $n=0$, the difference is 2; and it becomes 4, 6, 8, &c. as n becomes 1, 2, 3, 4, &c. On the other hand, if the smaller root be increased and the larger diminished by 1, the sum of the squares becomes less by $2n-2$.