

I. *An Account of the Experiments made by some Gentlemen of the Royal Society, in order to measure the absolute Velocity of Electricity; communicated to the Royal Society by Mr. W. Watson F.R.S.*

Read Oct. 27. 1748. **L**AID before the *Royal Society* the Beginning of last Winter an Account \* of what had been done by some Gentlemen, in order to ascertain the respective Velocities of Electricity and Sound; from which it appeared, that through a Space measuring 6732 Feet, the Electricity was perceptible in a Quantity of Time less than  $\frac{837}{10000}$  of a Second. But the Gentlemen concerned were desirous, if possible, of ascertaining the absolute Velocity of Electricity at a certain Distance; and a Method had been thought of, by which this might be determined with great Exactness.

Accordingly, *August 5. 1748.* there met at *Shooter's Hill* for this Purpose, the *President* of the *Royal Society*, the *Rev. Mr. Birch*, the *Rev. Dr. Bradley*, *Astronomer Royal*, *James Burrow Esq;* *Mr. Ellicot*, *Mr. George Graham*, *Richard Graham Esq;* the *Rev. Mr. Lawrie*, *Charles Stanhope Esq;* and myself, who were of the *Royal Society*, *Dr. Bevis*, and *Mr. Grifchow jun.* a Member of the *Royal Academy of Sciences at Berlin.*

It was agreed to make the electrical Circuit of two Miles; in the middle of which an Observer was to take in each Hand one of the Extremities of

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\* See these *Trans.* N<sup>o</sup>. 485.

a Wire, which was a Mile in Length. These Wires were to be so disposed, that this Observer being placed upon the Floor of the Room near the electrical Machine, the other Observers might be able in the same View to see the Explosion of the charged Phial, and the Observer holding the Wires; and might take notice of the Time lapsed between the discharging the Phial and the convulsive Motions of the Arms of the Observer in consequence thereof; inasmuch as this Time would shew the Velocity of Electricity, through a Space equal to the Length of the Wire between the coated Phial and this Observer.

The electrifying Machine was placed in the same House as it was last Year. We then found ourselves greatly embarrassed by the Wire's being conducted by the Side of the Road, which we were compell'd to, on account of the Space necessary for the measuring of Sound: But so great a Distance from the Machine was not now wanted, though the Circuit through the Wire was intended to be at least two Miles. We had discover'd, by our former Experiments, that the only Caution now necessary was, that the Wires conducted upon dry Sticks should not touch the Ground, each other, or any Non-electric, in a considerable Degree, in any Part of their Length: If they did not touch each other, the Returns of the Wire, be they ever so frequent, imported little, as the Wire had been found to conduct Electricity so much better than the Sticks. It was therefore thought proper to place these Sticks in a Field fifty Yards distant from the Machine. The Length of this Field being eleven Chains, or 726 Feet, eight Returns of the Wire from the Top  
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to the Bottom of the Field, made somewhat more than a Mile, and sixteen Returns more than two Miles, the Quantity of Wire intended for the Electricity to pass through to make the Experiment.

We had found last Year, that, upon discharging the electrified Phials, if two Observers made their Bodies Part of the Circuit, one of which grasped the leaden Coating of the Phial in one Hand, and held in his other one Extremity of the conducting Wire; and if the other Observer held the other Extremity of the conducting Wire in one Hand, and took in his other the short iron Rod with which the Explosion was made; upon this Explosion, I say, they were both shocked in the same Instant, which was that of the Explosion of the Phial. If therefore an Observer, making his Body Part of the Circuit, was shocked in the Instant of the Explosion of the charged Phial in the middle of the Wire, no Doubt would remain of the Velocity of Electricity being instantaneous through the Length of that whole Wire. But if, on the contrary, the Time between making the Explosion, and seeing the Convulsions in the Arms of the Observer holding the conducting Wires, was great enough to be measured, we then should be able to ascertain its Velocity to the Distance equal to half the Quantity of Wire employed only, let the Manner of the Electricity's discharging itself be what it would.

It has been a Question with some, who have consider'd this Subject, whether the Electricity, in completing the Circuit from the Matter contained in the Glass, passed either by the Wire in the Mouth to the Coating of the Glass, the contrary Way by

the Coating to the Wire in the Mouth, or otherwise directed itself both Ways at once? That the Electricity must pass off one of these three Ways, was certain, as the Explosion would not be complete, unless in the Instant thereof some Matter very non-electric communicated between the Wire in the Mouth, and the Coating of the Glass. Unless therefore the Observer was placed in the Centre of the conducting Wires, it might be objected, that the Experiment was not made with the Exactness necessary; because any Person, who was of Opinion that the Electricity directed itself from the Mouth of the Glass to the Coating, might object, if the Wire from the short iron Rod to the Observer was only half the Length of that between the Observer and the Coating of the Glass, that the Electricity, in the Time found, passed only through the short Wire, and *vice versa*. But if, as it was here thought proper, the Observer was placed in the Centre of the conducting Wire, let the Direction of the Electricity be what it would, no Difference could happen in the Result of the Experiments, if made with the necessary Caution; because, if the Effects in the middle and both Ends of the Wires were instantaneous, the Conclusion therefrom would be very obvious. To make the Experiment, the same Phial filled with Filings of Iron, and coated with Sheet-Lead, which was used last Year, was placed in the Window of the Room near the Machine, and was connected to the prime Conductor by a Piece of Wire. To the Coating of this Phial a Wire was fastened; which, being conducted upon dry Sticks to the before-mentioned Field, was carried in like manner to the Bottom;

tom; and being conducted thus from the Bottom of the Field to the Top, and from the Top to the Bottom seven other times, returned again into the Room and was held in one Hand of an Observer near the Machine. From the other Hand of this Observer, another Wire, of the same Length with the former, was conducted in the same manner, and returned into the Room, and was fasten'd to the iron Rod with which the Explosion was made. The whole Length of the Wires, allowing ten Yards for their Turns round the Sticks, amounted to two Miles a Quarter and six Chains, or 12276 Feet.

As the Night preceding these Experiments had been very rainy, Care was taken, by silk Lines properly disposed, that the Wires in their Passage from the Window of the House might not touch the Wood thereof; lest from the Moisture of this Wood, the electrical Circuit might be shortened.

When all Parts of the Apparatus were properly disposed, several Explosions of the charged Phial were made; and it was invariably seen, that the Observer holding in each Hand one of the Extremities of these Wires was convulsed in both his Arms in the Instant of making the Explosions.

Instead of one, four Men were then placed holding each other by the Hand near the Machine, the first of which held in his right Hand one Extremity of the Wire, and the last Man the other in his left. They were all seen convulsed in the Instant of the Explosion. Every one who felt it, complained of the Severity of the Shock.

It was then desired, by one of the Gentlemen concerned, that an Explosion should be made with the Observer holding only one of the Wires. This

was done accordingly; but the Observer felt nothing, the Phial discharging itself in a different manner to what it did before, on account of the Circuit's not being completed.

It was then tried, whether an Observer would be shocked upon the Discharge of the Phial, if the two Wires at their Extremities slightly touched each other, whilst an Observer at the same time held one of these about a Foot from their Ends in each of his Hands. Upon Trial he felt nothing, though the Phial exploded very quick, because the iron Wire conducted the Electricity better than the Body of the Observer.

It was then tried, whether or no, as the Ground was wet, if the Explosion was made with the Observer holding the Extremity of each Wire standing upon the Ground near the Window of the House, any Difference would arise in the Success of the Experiment. No Difference was found, the Observer being shocked in the Instant of the Explosion, as before, in both his Arms, and across his Breast.

Upon these Considerations we were fully satisfied, that through the whole Length of this Wire, being, as I mentioned before, twelve thousand two hundred and seventy-six Feet, the Velocity of Electricity was instantaneous.

As it was found last Year, we observed again, that although the electrical Commotions were very severe to those who held the Wires, the Report of the Explosion at the prime Conductor was little, in comparison of that which is heard when the Circuit is short. From whence it was conjectured, that the very loud Report, in the Experiment of *Leyden* is confined to a very short Circuit.