



# XXX. On electro-pulsations and electro-momentum

William Sturgeon

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gradually improving facilities of internal and external communication, our American brethren may look forward to the attainment of a state of greatness and prosperity that may not readily lie within the compass of human calculation.

XXX. *On Electro-pulsations and Electro-momentum.* By WILLIAM STURGEON, *Lecturer on Experimental Philosophy at the Honourable East India Company's Military Academy, Addiscombe, &c.\**

IT is very well known to the readers of the Philosophical Magazine, that I have long considered electric currents, when transmitted through inferior conductors between the poles of a voltaic battery, as the effect of a series of distinct discharges, in such rapid succession as not to be individually distinguished by the senses. Such currents I have called electro-pulsatory. See my theory of magnetic electricity in the London and Edinburgh Philosophical Magazine, vol. ii. p. 202.

By following up these views of electro-pulsations, I was about two years ago enabled to dispense with all acid or saline liquids, in the employment of galvanic batteries, for the purpose of galvanizing, as it is called, either to satisfy the curiosity or as a medical process; and my plan, which answers very well, I have found to be productive of a considerable saving in the expense necessarily attendant on the use of voltaic batteries when excited by acid solutions.

It is well known that a Cruickshank battery of about a hundred pairs will, by employing water alone in the cells, charge to a certain degree of intensity almost any extent of coated surface of glass that we please; and that the same degree of charge is given to it by a single contact of the conductors, however short its duration. This being understood, and understanding also that the shock produced by any discharge from a given intensity would be proportional to the quantity of fluid transmitted in a given time, it was easy to foresee that a series of shocks in rapid succession might be produced by some mechanical contrivance, and that the degree of force might be regulated by varying the extent of coated surface.

My first experiments were made with a hundred and fifty pairs of three-inch plates, and about seven feet on each side of coated glass; and my apparatus for producing a rapid succession of shocks was one of Mr. Barlow's stellated electro-

\* Communicated by the Author.

**Mr. Sturgeon on *Electro-pulsations and Electro-momentum*. 133**

magnetic wheels\* which was soldered to an iron spindle and put into rotatory motion by a wheel and band; the points of the wheel touching in succession a copper spring in connexion with the positive surface, and thus producing a discharge at every contact of the wheel and copper spring.

When the two surfaces are connected by wires with two basins of salt water, and the hands immersed one in each basin, the effect experienced is precisely that of the discharge of a voltaic battery. The discharges can be made in such rapid succession as to prevent the sensation of distinct shocks; and if the process were to be concealed it would require some experience to distinguish between the effects on the animal economy from this apparatus and those from a voltaic battery charged with acid and water.

My views being so far verified, the next attempt was to simplify the apparatus and make it more portable; and as it was readily seen that if one hundred pairs would charge glass of considerable thickness, thinner glass might be charged by fewer pairs; this was done; and eventually the glass entirely dismissed, and its place supplied with well-varnished Bristol-board. These boards answer exceedingly well as a reservoir for low intensities; they may be coated to within an inch of the edge all round, and placed upon their edges either on a piece of glass or on a board properly prepared, and arranged to any required extent like the plates of a voltaic battery, but when considerable intensity is wanted, it is better to use thin glass.

From these facts we learn that metallic surfaces of many acres of extent may possibly be charged to a low intensity in the interior of the earth, by having a thin intervening stratum of inferior conducting matter sufficient to insulate from each other their dissimilar electric surfaces.

It may now be understood that the slightest accident which would suddenly break through the insulation, such as the sinking of a mass of metalline matter from one stratum to the other, would cause a sudden rush of an immense ocean of the electric fluid, which might be productive of subterranean lightnings and tremendous explosions sufficient to shake an extensive range of country on every side.

Connected with the preceding facts there are others which may be conveniently mentioned in this place, and which would lead us to similar explanations of the causes of subterraneous convulsions. Electric currents of considerable magnitude when suddenly checked, or diverted to a new channel, produce a

\* [See *Phil. Mag.*, First Series, vol. lix. p. 241.—*EDIT.*]

momentum not very generally understood ; but which I will endeavour to explain. A coil of copper wire excited by magnetic action will become a channel for an electric current ; and whilst the whole circuit is metallic, the velocity of that current would be considerably greater than if any, even a small part of the circuit were of worse conducting materials : and if the current were suddenly transferred from a channel of the former character to one of the latter, by any contrivance whatever, it would meet a resistance on entering the new channel, which the momentum it had previously required would have to overcome ; and a sudden disturbance of the electric fluid, previously at rest, would take place, and a violent rush of the current would as suddenly follow.

It is in this manner that shocks and sparks are produced by magnetic electric machines, where the current, previously in rapid motion, is suddenly transferred to a new channel of inferior conducting character ; and all the fluid in the revolving coil rushes through a person properly situated for the new route, and who experiences the electric shock, or else through a thin stratum of air at an interruption in the metallic circuit where the spark is produced.

These, then, are some of the effects of electric currents, or of the momentum of the electric fluid in a state of motion, after the exciting cause is entirely cut off. The shock thus produced may very conveniently be compared to the blow given by Montgolfier's hydraulic ram. Electro-momenta may be produced by any mode of excitation whatever, and the effects will be proportional to the velocity and quantity of the electric fluid first put into motion ; and the length of the original channel is also to be taken into account. If then electro-momenta, capable of producing violent shocks and vivid sparks, can be produced by a few hundreds of feet of thin copper wire, what is it that might not be expected from the electro-momenta of nature, arising from currents of many miles in extent, kept in motion either by heat, saline solutions, or by other causes, amongst the metalline strata below the surface of the earth ? A sudden disruption in the circuit would insure the blow, and an earthquake might be the result.

Artillery Place, Woolwich, July 4, 1836.