

- IV. "On the Disintegration of Urinary Calculi by the Lateral Disruptive Force of the Electrical Discharge." By GEORGE ROBINSON, M.D., Licentiate of the Royal College of Physicians of London, and Lecturer on Medicine in the Newcastle-upon-Tyne College of Practical Science. Communicated by Dr. SHARPEY, Sec. R.S. Received June 13th, 1854.

The great and diversified powers of electricity have long suggested the possibility of its being employed as a means of effecting the destruction of calculi in the human bladder, and thus obviating the necessity for the painful and dangerous operation of lithotomy. But the attempts hitherto made in this direction have contemplated the solution of the stone through electrolytic action rather than its disintegration by the mechanical force of the electrical discharge. A moment's reflection will however suffice to convince us that the force which shatters a steeple or cleaves an oak, is also capable of reducing to fragments the largest urinary concretion. Nor can I imagine any other than the following sources of objection to the practicability of employing this force for the purpose of breaking down vesical calculi *in situ*, namely, 1. the danger to the living structures from the necessity of using a powerful discharge; 2. the difficulty of conveying the force to the required spot, or in other words, causing the discharge to pass through the calculus. The first objection is in a great measure met by the fact of our being enabled to regulate with the utmost precision the degree of intensity of the discharge, and it would be almost entirely removed were it possible to apply the disruptive force of electricity without any portion of the body being included within the circuit traversed by the electrical current. The second objection rests upon the mechanical difficulty of bringing the calculus within the direct route of the electrical discharge, but would scarcely apply were it demonstrated that the disruptive effects of electricity can be obtained without any such direct transmission of the current.

My own attention was some years since directed to the subject by reading an account of the following experiment first performed by Mr. Crosse. "Two platinum wires one-thirtieth of an inch in

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diameter were secured to a slip of window glass half an inch wide and four inches long, so that they rested upon the flat surface of the glass, leaving an interval between their points of one-twentieth of an inch. The wires were connected, one with the negative conductor of a powerful machine, the other with a ball to receive sparks from the prime conductor. On placing the glass in a flat dish filled with water and turning the machine, the glass between the points soon became fractured, and after 100 revolutions the fracture enlarged and two small cracks appeared. After 200 revolutions an excavation was formed, but on the side *opposite* to that on which the wires were tied. After 250 revolutions the glass was completely perforated. Many variations of this experiment were made, in all of which the same kind of mechanical effect was obtained. Even quartz was excavated*.”

It being thus shown that a lateral disruptive action takes place within a certain distance of the seat of discharge, the idea at once suggested itself to me, that by using two parallel wires separated at their extremities like those in Mr. Crosse’s experiment, and similarly connected with an electrical machine or Leyden jar, bringing their ends in contact with the surface of a calculus, and then allowing a series of moderate discharges to take place between the extremities of the wires, a disintegrating effect would be produced upon urinary calculi of the same nature as that witnessed in glass and quartz. And short of the actual disintegration of a calculus in the bladder of a living person, the following experiments will, I trust, be deemed conclusive on this point.

Two copper wires, one-twentieth of an inch in diameter, were connected, one with the external, the other with the internal surface of a Leyden jar, having about 400 square inches of internal metallic coating. These copper wires were soldered to platinum wires half an inch long and one-thirtieth of an inch in diameter. Each wire was drawn through a fine gutta percha tube, and the tubes, having first been placed perfectly parallel, were warmed and gently pressed together so as to assume somewhat of the appearance of a flexible bougie; the platinum wires projecting beyond the gutta percha to

* Described by Mr. Walker in Lardner’s Cabinet Cyclopædia, vol. ii. pages 218–220.

the extent of one-eighth of an inch, and their free extremities being slightly everted and separated from each other by an interval of one-tenth of an inch. In experimenting, the united gutta percha tubes were grasped and the projecting platinum points pressed against the surface of the calculus: the jar was then discharged by another person, and a series of such discharges thus passed between the free extremities of the parallel platinum wires while resting upon the surface of the stone.

With this simple arrangement, fragments a quarter of an inch long were broken off flints immersed in water, and the same force was applied to urinary calculi with the following results:—

Exp. 1. June 7th.—A piece of a large lithic acid calculus was placed in a bladder, nearly filled with water, into which the gutta percha bougie containing the wires was then introduced and the neck of the bladder tied round the instrument. The bladder with its contents being placed on a wet board, the projecting platinum wires were then kept in contact with the surface of the calculus and the jar discharged. On opening the bladder and examining the stone, it was found to be broken into numerous fragments by the single discharge.

Exp. 2.—A small phosphatic calculus, very smooth and hard, was experimented upon in a similar manner. The first five discharges produced no perceptible effect, but the sixth split it into at least twenty fragments, and many of these, on being slightly pressed between the finger and thumb, readily broke down.

Exp. 3.—A very large oxalate of lime or mulberry calculus with projecting tubercles was similarly tested, and the first discharge produced a small cavity in the surface to which the wires were applied, separating a considerable quantity of fine sand; but subsequent discharges did not act so efficiently on this very large stone.

Exp. 4.—On the following day, June 8th, the experiment was repeated in the presence of Messrs. Potter, Rayne and Furness, surgeons in Newcastle, and a small calculus, removed a few months since by the gentleman last mentioned from a young boy, was, after a few trials, split through the centre, one-half being reduced to fragments, and the other exhibiting in its interior a dark-coloured nucleus of lithic acid.

These experiments appear to demonstrate the practicability of

applying the lateral disruptive force of the electrical discharge to the disintegration of calculi in the bladder. There can be no difficulty in bringing the end of a gutta percha catheter, conveying two copper wires, in contact with the surface of a stone in the bladder, and a very simple mechanical contrivance will enable the extremities of the platinum wires to be protruded when the end of the catheter touches the calculus. By employing two wires, one connected with the positive, the other with the negative, portion of the jar or machine, not only is the intensity of the discharge increased, but the body is also prevented from forming any part of the circuit, and the risk of injury thereby materially diminished. The bladder used in the above-mentioned experiments was not at all injured, and on retaining a portion of it between the platinum wires so that the discharge passed through it, no perforation or other destructive effect took place. The gutta percha tubes, having the projecting platinum wires, were placed in the mouth without being in contact with the lips, and a discharge sent through the wires, but there was no perceptible shock. When, however, the bladder containing the stone rested upon the hand, during the act of disintegration a smart impulse was felt.

On the whole, I am of opinion that the electrical force applied in the manner indicated, will be found quite as efficient for the disintegration of calculi in the bladder as the more formidable analogous operation of lithotripsy, occasionally practised. And, as regards simplicity and security, the electrical apparatus certainly appears preferable to the instruments used for crushing the stone by ordinary mechanical force.

Communications also were read from Mr. Forrester, Mr. Huxley, Mr. Joule and Prof. Thomson, Dr. Hassall, Dr. Hooker, Dr. Marcet, Mr. Brooke, Dr. Scoresby, Sir J. C. Ross, Mr. Wheatstone, Dr. Williamson and Mr. Collins*.

* Notices of these will appear in succeeding Numbers.