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The Shocking Bag: Medical Electricity in mid-18th-Century London

The term "medical electricity" came to be used in the eighteenth century to indicate the applications of the electric fluid to the human body as a medical remedy. Although such a practice predated the introduction of the Leyden jar, it was after 1745 that the therapeutic effects of electricity became an intriguing topic of philosophical investigation. The subject was controversial, but it attracted the attention of 18th-century electricians. Despite initial scepticism, the Royal Society of London welcomed the invitation of one of its fellows, Henry Baker, not to neglect such a subject, "romantic" as it might seem.[1]

Baker addressed the Royal Society in 1747, and in the following years the fellows showed an interest in the subject and published a number of articles in the *Philosophical Transactions*.

In this paper I explore the characteristics of such an interest, focusing on the first decade of medico-electrical practice in London. I argue that the heterogeneous nature of 18th-century work on electricity provided the foundations on which the interest in medical electricity grew. At the time, understanding the nature of the electric fire, and its properties, was one of the targets of experimental investigation. Any subject related to electrical phenomena aroused the curiosity of electricians. Electricity could be found in the earth, air and water. What about the human body?

In exploring the reasons for the negative answer to the above question, I shall experiment with an approach that combines the history of scientific (electrical, in this case) instruments with historical narratives. For this purpose, I start from a real object, an electrical machine kept at the Museum of the History of Science at Oxford and, by means of the hints that it provides, I unfold a story of interactions between various branches of electrical research and their protagonists.

The instrument in question is an electrical machine, of unusual design, that can be enclosed in a box and carried. The box itself still survives. The machine is unsigned and, given the quality of the wood and of the brass, it may be easily inferred that it was designed to be a tool for some kind of practice, rather than a piece for display. Looking at the machine more closely, one realises that the

[1] See BAKER (1748), p. 271.

arrangement of the prime conductor and that of the Leyden jar was conceived so that the operations of charging and discharging the Leyden jar were simpler (for the operator) than would have been the case with other contemporary machines. Attached to the machine is a discharging electrometer. The machine is undated, but its design is by no means unknown to historians of 18th-century electricity.

In his *History and Present State of Electricity*, published in 1767, Joseph Priestley provided a description of the machine, together with the name of its maker, John Read of Knightsbridge, in London, mathematical instrument-maker. According to Priestley, the particular construction of the machine, with the prime conductor fixed to the Leyden jar, and interposed between the wheel and the glass cylinder, made it "particularly useful to physicians and apothecaries".[2]

Priestley's association of Read's machine with medico-electrical practice was not arbitrary. John Read was one of the first medico-electrical practitioners in London. Records on his early activity can be found in the work of the first author on medical electricity in the English language, Richard Lovett. In one of his pamphlets on medical electricity, Lovett published the letters of two medico-electrical practitioners in London. One of them was John Read, at the time (1758) the apprentice of a cabinet-maker. The letters recorded the beginning of medico-electrical practice in London and Read's role in the design of portable machines.

During the late 1750s and early 1760s, medical electricity was advocated by its supporters as a therapy that anyone could pursue. It was cheap, since its only cost was that of the electrical machine (that could be shared among neighbours) and it did not require medical knowledge. Directions on how to administer electric shocks or other forms of electrical therapies could be obtained from published pamphlets.

The cheapness of electrical treatments, combined with the century's fascination with electricity, fitted perfectly in the "self-help ethos" of the eighteenth century.[3] Medical electricity became a fashionable therapy in English society and it contributed to stimulating curiosity on the nature of the electric fire. By the late 1750s the fact that electricity and lightning were one and the same thing was taken for granted, and electrical machines seemed to be the tools by means of which such a tremendous power could be tamed and rendered useful for medical purposes.

The reasons for Read's interest in medical electricity are unknown, however well documented. His involvement with medical electricity was not limited to instrument-making: he also relied on electricity as a remedy for the violent pains he suffered in the back of his neck.[4] The design of Read's machine reveals the maker's knowledge of practical inconveniences that other kinds of electrical apparatus presented. Since the Leyden jar was an essential component in medico-electrical operations, it was important to simplify the operations of charging and discharging.

[2] PRIESTLEY (1767), p. 487.
[3] The self-help ethos of the century is effectively described in PORTER (1989).
[4] "John Reed, Cabinet-Maker in Warden Street, was for six years afflicted with violent pains in the back of his neck. In Spring 1758, he was electrified about thrice a week for a month, and quite cured" (WESLEY (1760), p. 60).

Usually, the jar would be charged by connecting its inside coating to the prime conductor of the machine and grounding the outside. Only when that was done could the shock be administered. If the practitioner was on his own, he had to turn the wheel, collect the fire from the prime conductor, and finally connect the jar to the patient's body. With Read's machine the whole process became much more practical for the practitioner: he would simply have to turn the wheel, and thanks to the particular arrangement of the Leyden jar and the conductor, the jar would receive the fire without any further operation.

Joseph Priestley admitted that part of the lack of interest towards medical electricity was due to the difficulty of its administration. He recognised that it was tedious for both patient and practitioner and he hoped that in the future the wind, water or other forces of nature could be used to operate electrical machines. He acknowledged, nonetheless, Read's efforts to render the operations of electrical therapy easier.

Being a medico-electrical practitioner himself, John Read was aware of the inconveniences that such a practice offered. He applied his practical knowledge to the improvement of the electrical machine. He could also rely on his skill as a cabinet-maker to make portable machines, whose cost could be relatively low.

> He [Read] has just invented a smaller One [electrical machine], that will take to Pieces, and pack up in a Box of about a Foot Square, and is endeavouring to reduce them to a very low Price, in order to make them as public as possible.[5]

Read's interest in electricity, however, was not limited to medical electricity and instrument-making. As was common at the time, Read was also involved in the study of the electricity of the atmosphere. The two subjects, medical and atmospheric electricity, were more closely linked than a superficial look might suggest. They both dragged electricity away from the domain of mere amusement and paved the way to the possible applications of the electric fire for the "benefit of mankind". In England, the rhetoric of medical electricity as "electricity rendered useful" started in the late 1750s and remained current throughout the century.

John Read, whose concern with the "benefit on mankind" informed the design of the machines he made, published in the *Philosophical Transactions* for 1791 and 1792 the meteorological journal he kept in Knightsbridge. For the purpose of measuring the electricity of the atmosphere, he designed an apparatus that he kept at his house. He daily recorded the results of his measurement, and concluded that weather conditions and the electrical state of the atmosphere were related.

In 1793, he published a booklet entitled *A Summary View of the Spontaneous Electricity of the Eearth and Atmosphere*. The work was dedicated to Sir Joseph Banks, President of the Royal Society. In the essay, whose original design was only for the author's own "instruction and amusement",[6] Read showed a familiarity with

[5] LOVETT (1760), p. 40.
[6] READ (1793), p. IX.

all the most recent results on electrical research and provided evidence of his collaboration with some of the FRSs:

> […] nor had I the idea of communicating part of them [his experiments] to the public. But several persons conversant in electricity, have expressed a wish, that the following Essay might be preserved.[7]

Throughout his work, Read defended Franklin's theory of a single electric fluid against the alternative notion of the two fluids. However, Read claimed that Franklin's theory called for further experiments. He likened the action of lightning to the spark between the two plates of a condenser, where the earth and the clouds above it would be represented by the two plates of the condenser. The direction of lightning (like that of the spark) could be either from the earth to the cloud or viceversa, according to the relative electric state of the two bodies. He designed experiments to show that the electric spark could be positive or negative, according to whether it struck into or issued from the earth. Accordingly, (and in this respect he differentiated himself from Franklin) lightning could be either positively or negatively charged.

Read's work on electricity was firmly grounded in experiment. His approach was pragmatical, aimed at the solution of practical problems. Although he moved in the learned world, he placed himself apart from genteel experimental philosophy. He performed experiments at the Royal Society, concerning the effect of the electric fluid on animals, however he was never elected a fellow. One of his correspondents, Mr A. Walker, a public lecturer on experimental philosophy remarked, after reading Read's essay, that his style was not "elegant enough" for natural philosophers and he confessed his regret that

> truth should want embellishment, but lace and ruffles must now ornament every production or it will not go.[8]

In his reply, Read took the opportunity to notice that this had led natural philosophers to overlook important discoveries, such as Canton's improvement of the electrical machine's rubber, in 1757, neglected for nearly twenty years afterwards.

In Read's view, the electric fluid resided in the air as much as in the earth (if not more so). Its presence in the atmosphere was beneficial to animals and plants. He measured the electricity of the atmosphere in various weather conditions, and concluded that "unhealthy" winds contained but little electricity. In April 1790 an easterly wind blew in London with the force of a brisk steady gale, "which was generally deemed by the people to be unhealthy". It caused people to be "more generally sickly than at other times", and even "vegetables, during this wind, did not grow, but seemed to be in a sickly dying condition".[9] Read's measurement of the electricity of the wind revealed that the lack of electricity in the air was the responsible for such a general state of illness. His experience as a medico-electrical operator

[7] *Ibid.*
[8] *Ibid.*, p. 89.
[9] *Ibid.*, p. 24.

certainly helped him draw his conclusions on the links between the electricity of the air and human health. The same concern with human health and the electricity of the atmosphere can be found in Read's work with the doubler of electricity, which would be published in the *Philosophical Transactions* in 1794. He measured the electrical state of the air in the school and the hospital at Knightsbridge. His results reinforced his conviction that unhealthy air lacked electricity.

In the eighteenth century, atmospheric and medical electricity were related subjects. The conception of the electric fluid as a permeating ether lent itself to the conclusion that it had an effect on the human body. Experiments showed that strong electric shocks could kill animals just as lightning could kill humans. However, when properly tamed, the power of the electric fluid revealed its vivifying properties. The vegetable world offered ready demonstrations that this was the case. Plants flourished in an electrified atmosphere, as famous experiments by Nollet and Bertholon had showed. Moreover, paralytic arms could be put in motion when the electric fluid was forced through them, as Read himself witnessed in his medical practice. The problem seemed to consist in how to regulate the quantity of the electric fire that passed through the bodies. There was a need for a sort of "switch" that while turning the dangers of the electric fire off could turn its healing properties on.

Such a "switch" was invented in 1766 by a London apothecary, Timothy Lane. It was a discharging electrometer which could determine, in his inventor's words, "with any tolerable accuracy, the comparative quantity of electric fluid, with which, for any given experiment, the coated phial is impregnated".[10] The electrometer was described by Lane in a letter to Benjamin Franklin, read at the Royal Society in November 1767 and published in the *Philosophical Transactions* for the same year. The drawing that accompanies the letter shows Read's machine with Lane's electrometer (figure 1), arranged as in the case of the machine at Oxford. In the article, Lane referred to the electrical machine as one made by John Read, mathematical instrument-maker at Knightsbridge. The drawing, made by J. Mynde, is the same as the one in Priestley's *History*. Priestley published his work before Lane's article appeared in the *Philosophical Transactions*. He obtained the drawing of the machine thanks to his personal acquaintance with Lane. Thus, the apparatus (machine with electrometer) in Priestley's *History* is Lane's.

The electrometer consisted of two brass balls (*K* and *M* in figure 1) a fixed distance apart. One of the balls is attached to the prime conductor of the machine, the other is connected to the outside coating of the Leyden jar (*D*) and to a micrometric screw (*O*) that regulates the distance between the two balls. According to Lane, once it is fixed, the distance between the two knobs is proportional to the quantity of electric fluid that the Leyden jar can receive from the glass cylinder.

The electrometer simplified the operations of medical electricity. Normally, when electric shocks were required, the operator would charge the jar and subsequently connect its inside and outside to the parts of the body that had to be treated. For certain

[10] LANE (1767).

disorders, several hundreds of shocks were required, with the obvious consequence that treatment was long and tiring for both the patient and the practitioner. Lane's electrometer solved the problem, since once the distance between the two knobs was fixed, the only operation that was required was the turning of the wheel: the electrometer guaranteed that the intensity of the shocks would always be the same. Moreover, with Read's machine the operator did not even have to change posture.

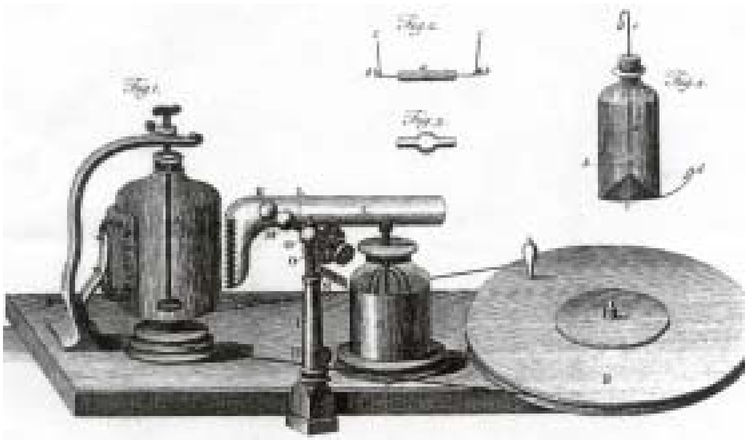

Figure 1 Read's machine and Lane's electrometer.

During the late 1760s and the early 1770s, Read's machine with Lane's electrometer became almost inextricably connected with the medical administration of the electric fluid. However, in Lane's article there is only a passing mention of the medical applications of electricity: the electrometer is presented as a useful tool to increase the accuracy of electrical experiments rather than as an instrument for therapeutic purposes.

Despite Lane's silence on medical electricity, the electrometer was commonly regarded as an essential component of medico-electrical apparatus. Priestley noticed that it allowed the administration of as many shocks as were needed in any therapy, all of precisely the same "degree of force".[11] He remarked that together with Read's machine the electrometer was particularly useful to physicians and apothecaries. Franklin himself in a letter to Giambattista Beccaria referred to Lane's electrometer as an instrument for medical purposes,[12] and Tiberius Cavallo included the instrument among the essential components for medico-electrical practitioners.[13] The instrument became so important for this purpose that it modified the original design of the Leyden jar: the so-called "medical bottle" (figure 2), especially

[11] PRIESTLEY (1767), p. 530.
[12] See FRANKLIN (1970), IV, p. 439.
[13] See CAVALLO (1780), p. 26.

designed for electrical treatments, was a Leyden jar with a simplified version of Lane's electrometer attached to it.

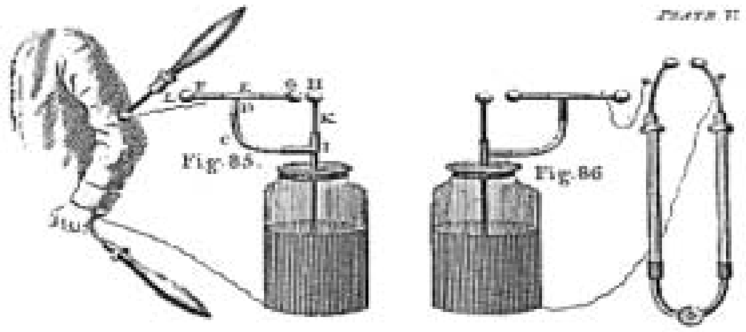

Figure 2 The medical bottle from Cavallo's *Essay on the Theory and Practice of Medical Electricity*.

Lane worked closely with William Watson, FRS, an apothecary whose work in electrical research was widely known. Watson was an advocate of medical electrical treatments and in 1763 he published an article in the *Philosophical Transactions* in which he described the results of the electric treatment of a case of muscular rigidity. He claimed that the powers of the electric fluid as a healing agent could be employed beyond the usual treatments of palsies. In 1770 he proposed Lane as a suitable member of the Royal Society and signed, first in the list, in support of Lane's candidature.

At the time of Lane's paper, the supporters of medical electricity stressed the importance of carefully administering the electric fluid, emphasising that the operator ought to be familiar with electrical apparatus. They also invited practitioners to avoid strong shocks that were of no benefit to any disorder and could even prove dangerous. Lane's electrometer could be used to limit the strength of the shock, since it allowed a quantitative determination of its intensity. Priestley referred his readers to Lane's article in the *Philosophical Transactions* for further details of how the electrometer should be employed. However, in the article no such directions can be found. In his paper, Lane described the instrument together with four experiments as examples of its use. The experiments consisted in forcing the electric fluid through a piece of dry or wet clay, and through some water contained in a glass bottle (figures 2, 3, 4 in figure 1). The role of the electrometer in the experiments was to measure the quantity of electricity needed for the shock to happen. Rather than medical electricity, his conclusions concerned the effect of lightning when it struck various substances.

Given Lane's involvement with medical electricity, his silence on the subject is revealing of the complexity of interactions between the various areas of electrical research. Clearly his concern with medical matters informed the design of his electrometer, possibly to the point that the use of the instrument in medical practice was so obvious as not to need further advocacy. His paper, one should not forget, was a letter to Benjamin Franklin. The choice of Franklin seems to place Lane well beyond the boundaries of medical practice. It is true that Franklin showed an interest in the effect of electricity in the treatment of palsies, but it is also true that he was manifestly sceptical about the actual results of the therapy. In his letter to the illustrious electrician, Lane stated that he had been involved in electrical experiments since 1762. What kind of experiments did Lane mean?

In a letter to Giovanbattista Beccaria (dated 29 May 1766), the American electrician referred to Lane as the inventor of "a fine method […] to give shocks exactly equal […] for medical purposes" and also as the discoverer of a new electrical effect concerning the fluorescence of certain bodies induced by electrical sparks.[14] Lane also worked on chemical phenomena, publishing, in 1769, another paper ("On the solubility of iron in simple water by the intervention of fixed air") in the *Philosophical Transactions*. As in the case of the one on his electrometer, the article was in the form of a letter, this time addressed to Henry Cavendish.

Like Watson and Franklin, Cavendish approved of Lane's election as a Fellow of the Royal Society and signed the certificate of election. He was well acquainted with the work of the apothecary and invited him to his house in Great Marlborough Street to work on the experiments with the artificial torpedo. Lane's concern with accuracy in measurements was congenial to Cavendish. In his experimental notes, Cavendish compared Lane's electrometer with other ones in use at the time (such as Henley's and the simple straw-electrometer), compiling tables with measurements taken with the various instruments. He also described a version of Lane's electrometer that he used for his own electrical experiments.

Lane's concern with accurate measurements was a long-lasting one that informed all the areas of natural knowledge he was involved with. In 1801 he obtained a patent from the king George III for his invention of "Measuring glasses for compounding medicines". In the specification, Lane stated that to distinguish the measures made under the patent, the name of "Lane" was to be affixed to them.[15]

Apart from the concern with accuracy, Cavendish and Lane shared the appointment by the Board of Ordnance to serve on the committee investigating the most appropriate shape of lightning-rods to protect buildings during thunderstorms. The committee included, among others, the President and Secretary of the Royal Society, i.e. John Pringle and Joseph Planta, William Henley, the inventor of the electrometer named after him, Edward Nairne who, in 1782 patented an electrical machine for medical purposes, and Joseph Priestley. The committee had a tormented life, going through various changes in its composition. The main reason was Benjamin Wilson's attack on pointed rods (as opposed to rounded ones) as effective means of protecting buildings. Without going into the details of the controversy, it is

[14] See FRANKLIN (1970), IV, pp. 458-9.

[15] The apparatus was regarded as an effective means of preventing vendors and purchasers from being deceived by fallacious measures of the kind that were detected by the Censors of the Royal College of Physicians in the years 1800 and 1801.

worth noticing that most of the people who sat in the committee had, at least at a certain stage, an interest in medical electricity. Benjamin Wilson himself, as early as 1746, practised electrical treatments. His correspondence provides evidence that he maintained an interest in such treatments at least until 1760.[16]

Lane's electrometer embodies the connections between atmospheric and medical electricity. In his advocacy of pointed rods as effective means of securing buildings from lightning, Franklin made use of Lane's electrometer as a model of the phenomenon of lightning. In the paper that he delivered to the committee, Franklin outlined his view on the imbalance of the electric fluid as responsible for the phenomena of atmospheric electricity. He likened the distance between the earth and the electrified cloud to that between the two knobs in Lane's electrometer and the subsequent atmospheric discharge to the spark in the electrometer.[17] The interactions between atmospheric and medical electricity unveil the complexity of 18th-century work on electricity. Far from being structured into separated disciplines, electrical research was an area of natural investigation that lent itself to various approaches.

The elusive nature of the electric matter aroused the curiosity of the gentleman as well as that of the apothecary. Those who called themselves electricians came from a wide diversity of backgrounds and they all employed their skills to answer the same question on the nature of the electric fluid and its role in the economy of nature, including the human body.

The discovery that the electric matter and the matter of lightning were one and the same thing had demonstrated that electricity was one of the forces of nature, one that had power over life and death. Its permeating nature assimilated it to a substance of its own, perhaps deeply connected to the principle of life. This conceptual framework found expression in the experimental work of 18th-century electricians. Whether designed to entertain or to investigate, electrical experiments gave material form to underlying conceptions of the electric fluid. Within this work, the healing powers of electricity were obvious consequences of its relation to the principle of life.

From this perspective, the experiments that Lane included in his paper on the electrometer become more revealing about the extent of 18th-century electrical research. It was a received notion that the quantity of electric fluid in the atmosphere had an influence on health, and that it was also responsible for weather conditions. What about earth and water? Was there any natural phenomenon that could be explained by the motion of the electric fluid in the bowels of the earth or in the depths of the oceans?

Lane's experiments answered in the affirmative. If the earth was a great reservoir of the electric fluid, electrical unbalance ought to occur quite frequently in its bowels. Just as in the case of dry clay that broke into pieces when the electric shocks struck through it, volcanoes erupted sulphuric matter. Earthquakes were also the result of electrical imbalance under the surface, though in this case, as for wet clay, the effect of the motion

[16] *British Library*, Add. Mss, 30094, f. 31.
[17] FRANKLIN (1970), IV, p. 429.

of the fluid would be a swelling of the soil. In the waters, whirlpools and gigantic waves were also due to the natural tendency of the electric fluid to rectify imbalance.

In 1783, Giovanni Vivenzio, physician to the king of Naples, published a book on the earthquakes that had occurred in Calabria and Sicily a few years earlier. In the work, he referred to Lane's experiments to give further strength to his theory on the electrical nature of earthquakes.[18] His work did not stand on its own, it rather summed up various theories on the subject published throughout the 1770s, in England as well as elsewhere.

From the perspective of such a composite field of investigation, medical electricity might simply have been received as one of the many wonders of electricity. One, however, that could demonstrate the usefulness of electrical research. In this respect, Read's work as a maker of medico-electrical apparatus, with his emphasis on its cheapness, is quite telling.

As I have shown, however, that the framework in which medical electricity came to fit in was much more complex than that of polite entertainment. During the 1750s and 1760s medical electricity intrigued electricians belonging to different areas of practical or philosophical knowledge: natural philosophers, physicians, apothecaries and instrument makers, all came to share an interest in medical electricity. Probably they addressed different audiences, different slices of market. But they put their different areas of competence at work with a view to grasp the nature of the electric matter and its role in nature. The heterogeneity of their interests and skills enriched 18th-century electrical research. Philosophical questions intermingled with practical needs, in a dialectic mediated by electrical instruments. The case of Read's machine and Lane's electrometer proves this point. It demonstrates that medico-electrical instruments surpassed the borders of the particular area for which they were originally designed, contributing to the work carried out in related areas, in particular atmospheric electricity.

In this paper, I have underlined the range of interests of some of those who were involved in medical electricity. I have also showed that medical electricity was a starting point for other kinds of electrical research which partook of the same concern on the role of the electric fluid in nature. Starting from a real object, I have woven together the hints that it offered. The result shows that the history of scientific instruments can contribute to the construction of historical

[18] "Lo sperimento del Cel. LANE Membro della Società Regale di *Londra*, col quale dimostrasi, che per l'esplosione elettrica si gonfia la creta umida allorché vi è interruzione di circuito, e che è spezzata, ed i frammenti sparsi per qualunque direzione, se è la medesima un poco asciutta, par che confermino il fin qui detto; e lo sperimento, col quale vien dispersa tutta l'acqua, è un bicchiere rotto, che contenevala, avvenendo ciò con una violenza sorprendente, allorché situansi in esso due fili metallici con palle all'estremità, immerse nell'acqua ad una picciola distanza tra loro, e messe nel circuito di una molto grande carica Boccia, o di una picciola Batteria, è una chiara dimostrazione di ciò che succede dell'inondazione del mare in molti forti Tremuoti" (VIVENZIO (1783), pp. 94-5).

narratives, providing essential insights on the interaction between experimental practice and the construction of theoretical explanations.

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