

CROMWELL VARLEY FRS, ELECTRICAL DISCHARGE AND VICTORIAN SPIRITUALISM

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Cromwell Fleetwood Varley is chiefly remembered as a leading Victorian electrical engineer who was closely involved in the testing and laying of the successful transatlantic telegraph cables of the 1860s. Historians of physics principally regard him as a key figure in the ‘pre-history’ of the electron because in 1871 the *Proceedings of the Royal Society* published a paper in which he seemed to anticipate the corpuscular nature of cathode rays. For many Victorians, however, Varley was as notable for his spiritualism as his electrical researches. This paper argues that for Varley spiritualism was one of the most significant contexts of use for the 1871 paper. The latter work sought explicitly to unravel the mystery of the electrical discharge through rarefied gases but also showed the hazy boundary between the invisible and visible and material and immaterial domains. This suggested that one of the invisible powers associated with spiritualism — the ‘od’ force — might be photographed and rendered scientifically more credible, and also made it easier to understand how imponderable spirits could have apparently material attributes. Although the physical implications of Varley’s 1871 publication were not explored until the 1890s, Varley’s ‘spiritualistic’ uses of it shaped the way that some late-Victorian scientists investigated the puzzling phenomena of psychical research.

Keywords: Cromwell Fleetwood Varley; electrical discharge; spiritualism; Victorian Britain

INTRODUCTION

In early February 1896, shortly after news reached Britain of Wilhelm Conrad Röntgen’s discovery of X-rays, the eminent British scientific peer Lord Kelvin FRS grumbled to his close friend, the mathematical physicist George Gabriel Stokes FRS:

As to the true Kathodenstrom [sic], it is wonderful how the Germans have called it Kathodenstrahl, having allowed themselves to be misled by Hittorf and Goldstein. They, everyone of them that I know of except Helmholtz, have insisted with something like strong partisan spirit upon a ray of undulatory light from the Cathode and have blindly refused to accept Varley’s conclusion of a torrent of molecules, corroborated as it is by Crookes.¹

Like many physicists in early 1896 Kelvin responded to Röntgen’s discovery by returning to the controversial question of whether cathodic emanations, whose collision

with the glass walls of evacuated vessels were believed to generate X-rays, were torrents of molecules or waves in the ether of space.²

The puzzle of cathode rays began in the late 1850s when the German physicist Julius Plücker FRS observed that when electricity was discharged through a highly exhausted glass vessel, a green-yellow phosphorescence was induced in the glass walls nearest the cathode, a phosphorescence that was also deflected by a magnet. Plücker concluded from these observations that the phosphorescence was caused by some kind of electric current but offered no further physical explanation of the phenomenon.³ The nature of the mysterious glow was taken up in the late 1860s by Plücker's pupil Wilhelm Hittorf, who observed that solid bodies placed between the cathode and the glass walls of an exhausted tube cast sharp shadows, which suggested that the cathode was the source of an emanation that was not only electrically charged but travelled in straight lines like rays of light.⁴ Hittorf's work was extended by his compatriot, Eugen Goldstein, who in 1876 christened the cathodic emanations 'Kathodenstrahlen'.⁵ A major opponent of Hittorf's and Goldstein's wave interpretation was the British chemist William Crookes FRS who concluded from a spectacular series of experiments staged in the late 1870s that the current-carrying rays from the cathode were a torrent of electrified molecules, or as German physicists denoted them, 'Kathodenström'.⁶ In the subsequent decades, and especially after Röntgen's discovery of X-rays, Crookes's interpretation was challenged by Goldstein, Heinrich Hertz, Phillip Lenard, and many other German physicists, but their view of cathode rays did not dissuade J. J. Thomson FRS, Kelvin, Stokes and many other Britons that the rays were some kind of microscopic charged particle.

Kelvin's letter to Stokes shows that he was hardly above being 'partisan' in this Anglo-German controversy. What particularly annoyed him was that the Germans had overlooked the work of his former business partner, the British electrical engineer Cromwell Fleetwood Varley (1828–1883). One of the reasons why, in March 1871, Kelvin supported Varley's election to the Royal Society was because earlier that year the engineer had published in the Royal Society's *Proceedings* a short paper containing evidence for the material nature of cathodic emanations produced during electrical discharge through rarefied gases.⁷ However, Varley's paper seems quickly to have sunk into obscurity. It was overlooked in the first systematic surveys of electrical discharge research published in the 1880s and early 1890s, and more puzzlingly by Crookes who, despite collaborating with Varley on spiritualistic and other researches, remained unaware of the paper until Kelvin drew his attention to it in 1893.⁸ Kelvin's publicity work was not in vain because histories of electrical discharge written from the 1890s turned Varley into a pioneer of the emergent research programmes in electrical discharge.⁹

This paper shows that by examining other aspects of the 1871 paper and interpreting them in the context of Varley's other writings of the period, a very different picture emerges of the significance that Varley himself attached to the work. The controversial cultures of Victorian spiritualism, I suggest, provided one of the major contexts of use that he envisaged for it. Varley's spiritualistic interests have perplexed historians since his death in 1883. Early biographers seem to have been too embarrassed to mention it although the author of his entry for the *Dictionary of National Biography* noted somewhat disdainfully that Varley was a 'rather credulous investigator of spiritualistic and other 'occult' phenomena'.¹⁰ Recent studies, however, challenge the sharp distinctions between science and 'pseudo-scientific' spiritualism implicit in these accounts.¹¹ They demonstrate the intimate relationships between the Victorian worlds of electrical engineering, physical sciences and spiritualism and

explain why it was possible for someone with Varley's scientific skills to regard spiritualism as a way of extending, not undermining, existing sciences. In publicising his own evidence for spiritualism and taking electrical instruments into séances, Varley sought to turn his mastery of the electric telegraphy into a reason for trusting him on the more troublesome question of the 'spiritual' telegraph which he and thousands of other Victorians thought connected this world and the next. As this paper shows, Varley used his expertise in probing a much wider range of electrical phenomena, notably the mysterious and often invisible phenomena of electrical discharge tubes, to invent new ways of showing that the strange and frequently unseen manifestations of spiritualism had a 'natural' basis.

CROMWELL VARLEY AND THE RISE OF ELECTRIC AND SPIRITUAL TELEGRAPHS

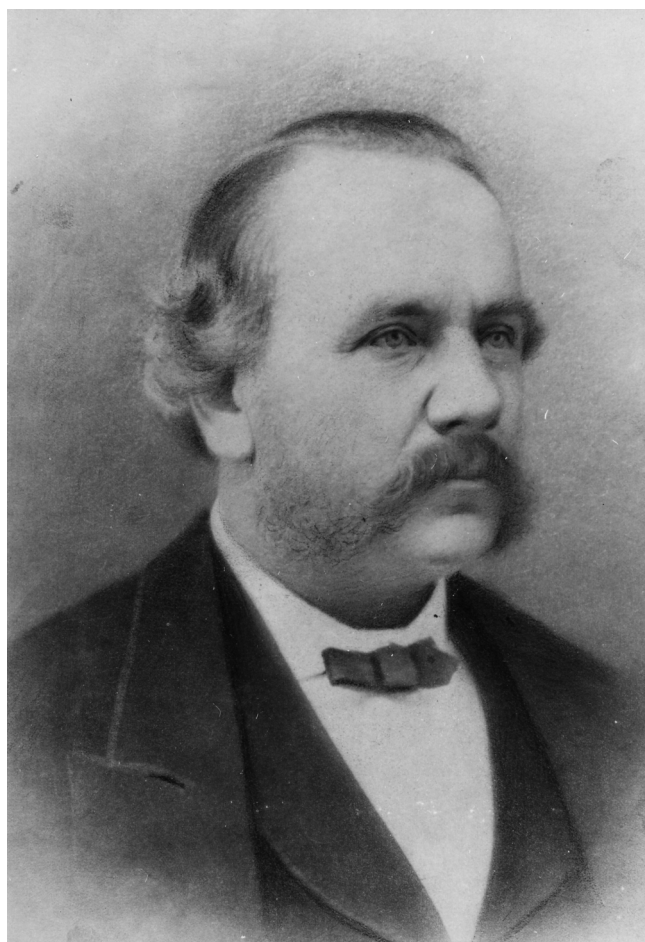


Figure 1. Cromwell Fleetwood Varley FRS circa 1880. Reproduced by permission of the IET Archives. Ref. UK0108 IMAGE 1/1/0476

By the early 1870s Cromwell Varley (figure 1) was widely recognised as one of the leading telegraph engineers of the period.¹² Born and educated in London, Varley learned scientific skills from his father, the artist and inventor Cornelius Varley, and doubtless acquired occult interests from his uncle, the astrologer and artist John Varley.

In 1846 he entered the service of the fledgling Electric Telegraph Company and his skill in maintaining and extending the firm's network of land and submarine telegraphs led to a string of promotions, culminating in his appointment in 1861 as engineer-in-chief to the Electric and International Telegraph Company (EITC). His senior position led to a close involvement in the fraught business of long distance submarine telegraphy. During the official inquiries into the costly failures of the Atlantic and Red Sea telegraphs, he strongly endorsed the view of William Thomson and other academic natural philosophers that the success of submarine telegraphy hinged on the adoption of robust new standards, protocols and instruments of electrical measurement. Thomson was so impressed with Varley's abilities that in 1865 he invited Varley to join him and Fleeming Jenkin FRS in a lucrative business partnership designing and marketing telegraphic instruments, many of which were used on the successful Atlantic telegraph cables of the late 1860s.¹³ The scientific and business skills that Varley honed in his business partnership proved invaluable after 1870 when, following the British government's purchase of the EITC and other operators of inland telegraphs, Varley embarked on a lucrative career as a private consultant engineer.

Not long before the EITC was dissolved Varley declared publicly that he was convinced of the evidence for spiritualism.¹⁴ In the early 1850s he had joined the thousands of other people in Britain, Europe and the United States who were enquiring into table-turning, spirit-rapping and other early manifestations of what became known as 'Modern Spiritualism'.¹⁵ He agreed with Michael Faraday FRS that the supposedly new force that turned tables was not, as many supposed, electricity, but he was not convinced by the claim, made by Faraday and many others, that most phenomena of spiritualism could be put down to known forces and was therefore unworthy of further investigation. Indeed, far from agreeing with Faraday that enquiring into the so-called 'spirits' of séances was scientifically worthless and morally perilous, Varley joined many others, including Augustus de Morgan FRS and Alfred Russel Wallace FRS, in regarding spiritualism as an empirical way of elucidating new laws of nature and a potentially more satisfactory way of answering spiritual questions unanswered by established religions.¹⁶

Varley did not have to go very far to gain his most important experiences of spiritualism. In the late 1850s he claimed to have developed mesmeric powers which he used to entrance his wife Ada who, in this state, displayed the apparent ability to perceive distant objects and scenes (clairvoyance) and to communicate with others by thought alone.¹⁷ Ada was one of many Victorian mesmeric subjects whose extraordinary mental skills helped her cultivate apparent powers of spiritual mediumship in which capacity she became the channel through which invisible intelligent agencies manifested themselves to the living, typically via a 'telegraphic' code of raps on furniture. Séances with Ada convinced Cromwell Varley that the invisible agents were genuine spirits of the dead, and sittings with the notable Scottish-American medium D. D. Home persuaded him that Home had the ability to move objects at a distance by some unknown force.¹⁸ Convinced that he was the victim of neither self-delusion nor trickery, Varley proclaimed in 1869 that he was a spiritualist because he had distinctly seen 'spirits', because 'spirits' had relayed information known only to him and deceased persons allegedly communicating from beyond the grave, and because 'spirits' had correctly predicted the time and nature of future events unanticipated by all present in séances.¹⁹

Varley's approach to testing mediums and their 'spirits' illustrates his belief that the expertise and resources that he had used in constructing successful electric telegraphs would also help him understand the 'spiritual' telegraph. In his view he had

exactly the kind of knowledge and skills needed to determine the veracity and nature of distant beings trying to communicate via some kind of telegraph, and the knowledge to appreciate how different the world may look from the perspective of the imponderable agents sending the signal or constituting the channel of communication.²⁰ For instance, in 1869 he explained how his knowledge of electricity made it easier to accept claims that immaterial or spiritual entities could have material attributes, such as the enormously puzzling observation that spirits of the dead were clothed:

An iron wire is to an electrician simply a hole bored through a solid rock of air so that the electricity may pass freely. Glass is opaque to electricity, but transparent to magnetism. Therefore we infer that everything is solid in respect to something, and that nothing is solid in respect to all things, and therefore thought, which is power, may be in some sort solid, so that if you take an old English farmer, for instance, he would be ashamed to be seen without his top boots, his coat with the buttons, and his hat. They are part of his identity, he cannot think of himself without them; they form part of his nature, and the moment he leaves his body and becomes a thought man, the thought boots, the thought coat and the thought hat form part of his individuality.²¹

Two years earlier Varley had used the material tools of the electrician's trade to extend the work of Faraday, William Robert Grove FRS and others on the correlation of forces in a radical new, spiritual, direction.²² In séances held in New York with the famous American medium Kate Fox, Varley was given permission to use electrical apparatus in an attempt to establish the 'analogies existing between the forces [he] was dealing with, and those which [the spirits] employ'. He was impressed with the ability of the 'spirits' accurately and repeatedly to determine when he touched an electrical circuit, in which direction the current flowed through his body, and when he placed a magnetised coil of wire over his head. Since the séance was conducted in the 'dark', Varley was satisfied that no mortals in the room (including himself) knew exactly what he was doing and could not therefore have faked the effects of intelligent spirits. Varley also concluded that the spirits were not able to see what he was doing by sensing 'electric and magnetic streams' because he established from dialogue with them that they regarded magnets *and* crystals as magnetic. The 'spirits' seemed clearly to be mistaking 'other powers' accompanying electricity and magnetism for the forces themselves.²³

What made the existence of other such powers plausible was the work of the early nineteenth century German industrial chemist Karl von Reichenbach. From the late 1840s Reichenbach had published experimental evidence of a new universal force, christened 'od', which was imperceptible to all but certain 'sensitive' individuals whose reaction to the force including seeing a multi-coloured luminous aura or 'flames' around magnets, crystals, and other objects (figure 3).²⁴

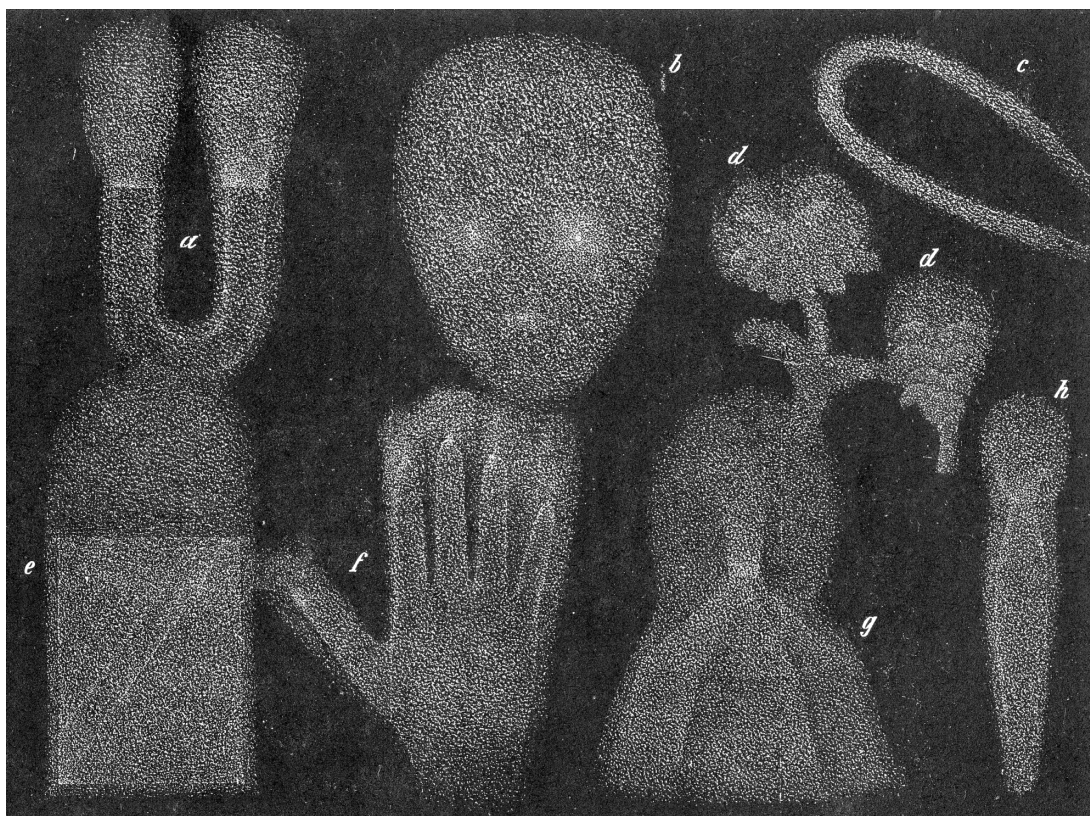


Figure 3. The luminous manifestations of 'od'. Karl von Reichenbach claimed that though invisible to most people, these mysterious lights were seen by his 'sensitive' human subjects surrounding various bodies including magnets (a and c), the human head and hand (b and f), and plants (d, g and h). Reproduced by permission of the author.

Much to Reichenbach's chagrin, mesmerists identified 'od' as source of the 'magnetic fluid' involved in mesmeric healing and clairvoyance, and spiritualists often claimed 'od' as the physical channel through which spirits of the dead interacted with the living.²⁵ Reichenbach's proposed association between magnetism and light seemed plausible to many readers of his work given Faraday's 1845 evidence of the magnetic rotation of the plane of polarised light and by works by Grove and the physiologist William Benjamin Carpenter FRS on the correlation of physical forces.²⁶ While Reichenbach's claims failed to convince the leading Berlin physicists whom he invited in the early 1860s to witness his experiments on photographing 'od' luminosity, he gained notable champions elsewhere, including the Scottish chemist and writer on mesmerism William Gregory who produced one of the two English translations of Reichenbach's major treatise and supplemented it with his own evidence illustrating the 'truth and exactitude' of his fellow chemist's claims.²⁷ Varley's sympathetic attitude to Reichenbach doubtless owed something to Gregory's efforts but probably more to experiences of his wife's alleged sensitivity to 'od'. Indeed, it was her perception of 'od' that prompted Varley's speculation that 'spirits' also had this faculty and used it to tell what he was doing with the electrical circuit.²⁸

From the late 1860s Varley's published evidence of the genuineness of 'spirits' and 'od' was used by spiritualists to raise their public profile and scientific credibility, but his reputation as an electrical expert did little to persuade scientific colleagues and others that he, along with many other Victorians, had become the likely victims of self-

delusion or mediumistic trickery. His business partner Kelvin, for example, never swayed from the view, tersely expressed in 1893, that ‘nearly everything in hypnotism and clairvoyance is imposture and the rest bad observation’, although he did not think Varley’s interests in these subjects were ‘fatal’ to his case for election to the Royal Society in 1871.²⁹ The troubled status of spiritualism deeply concerned Varley who regarded it as his scientific duty to persuade the public that it rested on a ‘natural basis’. On 6 October 1870 he outlined one strategy to the leading British spiritualist Benjamin Coleman:

It has for some time past been my intention to bring together in a lecture those portions of scientific research with material or physical questions which indicate the existence of spiritual bodies, or rather show that the limits to matter as indicated by the eye and touch are not the only limits.

You have my whole sympathy in your present movement, and I should be very happy to occupy one or more evenings on some occasion to demonstrate by actual experiment that there is no hard and fast boundary between the material and the spiritual existences.³⁰

Only a few days before Varley wrote this he submitted to the Royal Society his paper on electrical discharge through rarefied gases. The close proximity of the events suggests that he probably had aspects of the paper in mind when alluding to research on ‘material or physical questions’. As far as Varley was concerned, there were already a range of phenomena known to natural philosophers and electrical experimenters that resembled some of the manifestations of spiritualism and which could therefore be used to make spiritualism more scientific. The ‘scientific research’ in the 1871 paper was concerned with just such phenomena. These were phenomena that, like the luminous forms of ‘od’ and furniture moving under the will power of invisible intelligences, were often invisible, difficult to replicate and which appeared to challenge hard and fast distinctions between conceptions of the material and immaterial.

PERSPECTIVES ON RAREFIED MEDIA: THE 1871 PAPER

In exploring electrical discharge through rarefied gases Varley was entering a field dominated by savants considerably more distinguished than him.³¹ Accordingly, his paper began with a strategic nod to John Peter Gassiot FRS and Grove who in the 1850s had published papers on the puzzling dark bands, striae and stratifications in this kind of electrical discharge. Via the work of Gassiot and Grove, Varley would also have been familiar with Faraday’s pioneering explorations of the phenomena including his identification of a dark space between the negative electrode and the luminosity occasioned by discharge.³² Despite his deference to these eminent natural philosophers, the telegraph engineer boldly insisted that the question of the ‘nature of the action’ inside electrical discharge tubes remained a ‘considerable mystery’.³³ Unlike Faraday, Grove, and Gassiot in his early researches, those studying the electrical discharge in rarefied gases from the early 1860s had a powerful new tool at their disposal — electrical discharge tubes designed by the Bonn instrument maker, Heinrich Geissler. Capable of withstanding much lower pressures (produced by Geissler’s powerful new mercury air pump) and of producing much brighter discharges, ‘Geissler tubes’ had

been used by Geissler's Bonn colleague, Julius Plücker, in the late 1850s to explore the dramatic effect of magnetism on the size and shape of the luminous form arching between the electrodes of the tube.³⁴ By the early 1860s, the immensely colourful effects made possible by the Geissler tubes were also proving immensely attractive to scientific showmen who were always on the look out for new ways of drawing crowds. The tubes were used, for example, by one of London's most conspicuous scientific lecturers, 'Professor' John Henry Pepper, and by the celebrated Parisian stage magician Henri Robin.³⁵ Pepper and Robin often used Geissler tubes to emphasise the differences between the sublime mysteries of science and the apparently bogus mysteries of the séance room but as we shall see, Varley sought to collapse this distinction.

Varley owned and was familiar with Geissler tubes at least as early as 1867 because by this time he was using them to indicate current strength in an apparatus simulating the electrical characteristics of long telegraph cables.³⁶ Months before he sent his electrical discharge paper to the Royal Society he was already playing a significant role in exhibitions of Geissler tube phenomena to leading British scientific audiences: he supplied John Tyndall FRS with a powerful battery for one such display at the Royal Institution and at a soirée of the Royal Society he gave Fellows a taste of his forthcoming paper by showing the stratifications and magnetic deflection of the luminous discharge.³⁷ Not content simply to regard the Geissler tube as an unproblematic technology of display, he devised two new strategies for probing the 'action inside the tube', in particular the faint luminosity stretching between the electrodes.³⁸ Crucially, both strategies involved extending the range of the human senses of sight and touch. The first was to photograph the tube in a 'perfectly dark room' (figure 3).



Figure 3. Photography of electrical discharge in a Geissler tube. This sequence of images represents the changes in the visual and/or photographic appearance of electrical discharge as the resistance in the circuit is changed. In images 1 to 5 the eye and photographic plate tell approximately the same tale. '1.' shows the Geissler tube with its circular electrodes in plan view; '2.' shows that with a high resistance in the circuit there was luminosity around the right-hand or positive pole only; '3.' and '4.' show that with lower resistance luminosity was seen projecting from the positive to the negative pole which was itself beginning to emit light; and '5.' shows that at lower resistance still, the luminosity around the positive pole was extinguished. Image '6.', however, shows that according to the photographic plate, when the resistance was removed altogether the positive pole was surrounded by a luminous white hour-glass shape. To the eye, however, this pole was shrouded in a 'bright blue envelope'. Reproduced by permission of the President and Fellows of the Royal Society of London.

Having connected a 'very well-exhausted' tube of 'Geissler's manufacture' (containing trace amounts of hydrogen and ring-shaped electrodes) to a circuit containing a powerful Daniell battery, a galvanometer and a variable resistance, he proceeded to observe the colour, position and shape of the luminosity as the resistance was increased and decreased.³⁹ At high resistance Varley reported seeing faint light only around the positive electrode, a light 'so feeble' that it was difficult to tell 'whether the current was passing or not'. Although the light was 'too feeble for the eye', a wet collodion

photographic plate exposed to the light for thirty minutes provided ‘a very good photographic record of what was taking place’. Photography revealed important differences with what the eye perceived. For instance, after removing the circuit resistance altogether, Varley reported that while a ten-second exposure photograph showed ‘a white flattened hour-glass, apparently detached from the [negative] wire’, the eye saw the wire only ‘surrounded by a bright blue envelope ¼-inch in diameter, which did not possess sufficient photographic power to leave a record of itself’.⁴⁰

Varley’s second strategy was remotely to probe the luminous discharge within the Geissler tube itself. He agreed with Plücker that when an electromagnet was held near the tube, the luminous discharge followed the lines of magnetic force. He may also have been aware of the Bonn physicist’s argument that the luminosity was due to trace gases in the tube, but he clearly believed such a claim required more satisfactory evidence.⁴¹ To achieve his goal he constructed a delicate ‘tell-tale’ consisting of a small strip of talc affixed to a silk fibre which itself spanned the diameter of a U-shaped piece of talc. The entire tell-tale was somehow attached to the inside of the Geissler tube so that the centre of the talc strip was aligned with the centres of the circular electrodes. After re-exhausting and reconnecting the tube, Varley reported that when an activated electromagnet was used to make the luminous arch ‘play’ on the lower part of the talc strip, the tell-tale was repelled irrespective of the direction of the electric current and by an amount that increased with the concentration of luminosity near the tell-tale. For this reason, Varley concluded that the arch was ‘composed of *attenuated particles of matter projected* from the negative pole by electricity in all directions, but that the magnet controls their course’.⁴²

The tell-tale and the photographic plate were Varley’s key tools for changing the perspective on the Geissler tube and for highlighting the limitations of the human senses. Just as the photographic plate had revealed features of the electrical discharge that were hidden from human vision, so the tell-tale showed that what appeared to be a luminous immaterial form could deliver material blows.

SPIRITUALISTIC USES OF ELECTRICAL DISCHARGE

In what ways did Varley think that his new perspectives on electrical discharge could give spiritualism a ‘natural basis’ and thus boost its popularity? It is not clear whether Varley alluded to the ‘limits to matter as indicated by the eye and touch’ or to the hazy boundary between the ‘material and spiritual existences’ during the first exhibition of his experiments at a Royal Society soirée in early March 1871, but the final paper in the *Proceedings* contained the important claim that his technique for ‘viewing light too feeble for the eye may receive other applications’.⁴³ It is tempting to think that Varley was hinting at the photography of the invisible spirits of séances, but there is no evidence that Varley was interested in or convinced by this most controversial of all spiritualist practices.⁴⁴ A more likely ‘application’ was the photographic detection of something else that emitted light too feeble for most people to see: the alleged manifestations of Reichenbach’s ‘od’ force.

In the late 1890s many spiritualists, Theosophists and writers on occult subjects upheld the discovery of X-rays as a vindication of ‘od’ and the other invisible radiations that they believed were involved in clairvoyance, the photography of unseen spirits, and other aspects of spiritualism.⁴⁵ Varley never made such a strong connection between the phenomena of electrical discharge in rarefied gases and spiritualism. He

may well have contemplated some link between the luminosity of the Geissler tube and that associated with 'od': from his reading of Reichenbach's major treatise he would have known that the German chemist had attributed one of the most dramatic forms of electrical discharge — the aurora borealis — to 'od', and shown that the flames of 'od' were, like Geissler tube luminosity, in some sense material and increased in brightness with the rarefaction of the surrounding air. But unlike Geissler tube luminosity, 'od' luminosity did not follow the lines of magnetic force and manifested independently of magnetism and electricity.⁴⁶ Irrespective of Varley's position on this question, we know that not long after he completed his electrical discharge paper he was actively involved in attempts to photograph the luminous manifestations of 'od' allegedly seen near magnetic sources.

Although spiritualists such as Varley were convinced of the objective existence of 'od' from their study of living human 'sensitives' and from Reichenbach's works, they also realised the need to confront serious criticisms of Reichenbach's work. From the mid-1850s medical practitioners such as W. B. Carpenter and the pioneer of hypnotism James Braid argued that the human subjects in whom Reichenbach placed so much trust were unreliable because, possibly in response to cues unconsciously supplied by Reichenbach himself, they may well have seen only what they expected to see rather than an objectively existing luminous manifestations of 'od'.⁴⁷ One person who captured the way photography could meet some of these difficulties was William Henry Harrison, a photographic expert, spiritualist and one of Varley's closest friends. Writing in an 1875 issue of his own periodical, the *Spiritualist*, he described his recent collaboration with Varley on photographing 'od' and emphasised that, if successful, the experiment would enable spiritualists to show the 'scientific world' that 'od' was not a purely subjective and doubtful phenomenon and could be "photographed at any time by the process which is now laid before you".⁴⁸ In other words, photography would help shift the burden of proof from potentially untrustworthy human observers to machines that could not be influenced by unconscious signals from experimenters. While recognising that Reichenbach himself had attempted to photograph 'od' in the 1860s, Harrison and Varley were satisfied that with technological innovations made since that time, including more sensitive photographic plates and more powerful electromagnets, better evidence of the objective reality of 'od' could be produced. After several experiments, however, Harrison reported that the experimenters found 'no action' of magnetism on plates exposed in the darkness or exposed to white light, even with exposure times of twelve hours. Reichenbach's apparently positive results, they concluded, were probably due to fogging of photographic plates.⁴⁹

This was not the last time that Varley would be frustrated in his attempts to bolster the scientific credibility of Reichenbach's claims. Sometime in the early 1870s he and Lord Lindsay FRS, the aristocratic astronomer, bibliophile and electrical inventor, explored the possibility that a large magnetic field might induce physiological responses akin to those experienced by Reichenbach's 'sensitives'.⁵⁰ Lindsay had been interested in occult subjects long before this period and in 1869 he testified publicly to the genuineness of D. D. Home's powers of levitation, apparitions of the deceased, and cases of 'second sight' in his own family.⁵¹ Two years later he conducted 'experiments' in his private London laboratory in which D. D. Home successfully located a magnet in the dark and thereby seemed to display sensitivity to the luminous forms of 'od'.⁵² Varley was a 'frequent' visitor to Lindsay's laboratory where the two men undoubtedly discussed electrical and spiritualistic subjects and may well have realised their mutual interests in photographing transient phenomena such as electrical discharge, solar eclipses and 'od'.⁵³ It was in Lindsay's laboratory that Varley helped

the aristocrat construct a giant electromagnet for testing magnetic sensitivity.⁵⁴ In a rare account of the resulting experiment, Kelvin explained in 1883 that the experimenters found no effect although he was optimistic that with an ‘exceedingly powerful magnetic force’ evidence of a ‘magnetic sense’ might be produced.⁵⁵

The giant electromagnet proved much more successful in another strategy devised by Varley and Lindsay to explore a scientific subject in which spiritualists took particular interest: the capacity of imponderable agents and powers to act like material bodies. In exactly the period when Varley was exploring this question with the magnetic deflection of the rarefied luminous ‘arch’ in Geissler tubes, he and Lindsay staged public exhibitions of the power of an electromagnet to levitate a heavy copper ring between its poles and to deflect a mercury-filled indiarubber tube through which an electric current was passing.⁵⁶ Varley’s commentary on the copper ring experiment reflected his 1869 view that the imponderable power of thought was in ‘some sort solid’. He told a reporter for William Crookes’s *Quarterly Journal of Science*, that the capacity of the imponderable power of electricity to counteract the imponderable power of gravity showed that “‘a current of electricity is as solid and material to a magnetic field as is a plate of iron to a bar of copper’”.⁵⁷ Unsurprisingly, he jumped at his friend Harrison’s invitation to contribute to the *Spiritualist* a similar commentary on the experiment involving the mercury-filled tube. For this audience Varley placed greater emphasis on the word ‘imponderable’ because this could also be interpreted as spiritual agency. ‘The magnetism has no action upon the mercury’, he explained,

but has upon the electric current, therefore the tube must be suspended by the electric current, and the electric current suspended by the powerful magnetic rays. In other words, a heavy material object (mercury) is supported upon an imponderable electricity which, in its turn, is supported by an imponderable magnetism.⁵⁸

Varley’s preoccupations with the action of imponderables on material objects casts important new light on the Royal Society *Proceedings* paper of 1871 that is now only remembered as an early anticipation of the electron. When we interpret this paper in the context of its Varley’s contemporary views on propagating spiritualism and the conclusions he drew from other electrical experiments, his uses of the phenomena of the Geissler tube more resemble yet another strategy to show that the boundaries between the material and non-material or spiritual existences are purely a matter of perspective.

THE LEGACY OF THE 1871 PAPER

Varley’s paper of 1871 hardly generated the excitement, bewilderment and scorn provoked by Crookes’s papers on the same subject eight years later. Apart from Varley’s allusion to it in an 1876 meeting of spiritualists and citations in an 1878 paper on electrical discharge by British chemists Warren De la Rue and Hugo Müller, it remained largely unknown until Kelvin resurrected it in the early 1890s.⁵⁹ However, many of the lessons that Varley drew from the research shaped the way that many British scientists engaged with the question of psychical phenomena from the late 1870s until the early twentieth century.

William Crookes may have been unaware of Varley’s paper until 1893 but in the 1870s he copied his fellow spiritualistic investigator’s example of using a delicate

‘tell-tale’ to probe the mechanical effects of electrified molecules in rarefied gases and to use this work in showing that, from a different perspective, ‘hard and fast’ distinctions between the material and non-material domains become more difficult to sustain.⁶⁰ In his famous lecture ‘On Radiant Matter’ delivered at the 1879 meeting of the British Association for the Advancement of Science, he explained that molecules in this state seemed to behave more like rays of light or pure energy and so revealed a ‘borderland where Matter and Force seem to merge into one another’.⁶¹ More provocatively, in 1897, during his presidential address to the Society for Psychical Research (SPR), Crookes considered how different the world would appear when viewed from the domain of ‘extremest minuteness’ represented by the wavelength of the recently discovered X-rays produced in ‘radiant matter’ or ‘Crookes’ tubes.’⁶² Since creatures inhabiting this microscopic scale would not share our perceptions of natural law — they would, for example, consider surface tension to be a ‘dominant’ force and ‘hardly believe’ in the ‘universality of gravitation’ — then it was plausible that our laws of nature were inevitably reflections of our ‘materialistic’ and ‘too terrestrial’ a view of the world. Contemplating the ‘unseen world’ of the ‘infinitely little’ made it easier to comprehend such spiritualistic claims as ‘spiritual beings’ being able to manifest themselves with material bodies and ‘intelligence, thought, and will, existing without form or matter, and untrammelled by gravitation or space’.⁶³

The SPR was also the means by which the more substantial, photographic, legacy of Varley’s 1871 paper was explored. In April 1883, only a few months before Varley’s death, the fledgling society heard the results of an investigation undertaken by leading members into Reichenbach’s claims. Reichenbach was a perfect subject for an organisation seeking new scientific methods of assessing claims regarding mesmerism, thought-reading, spiritualism and related ‘psychical’ phenomena.⁶⁴ Although Varley never joined the SPR, his friend, the electrician and spiritualistic investigator Walter Coffin did, and seems to have transmitted Varley’s work to the society as Honorary Secretary of the SPR’s “Reichenbach” Committee’.⁶⁵ Like Varley, Coffin recognised that if the magnetic luminosity associated with ‘od’ could be shown to be ‘an actual physical phenomenon, and demonstrable as such’ then it would raise the credibility of Reichenbach’s claims and have independent scientific importance.⁶⁶ The Reichenbach committee tried two methods of gauging the objectivity of magnetic luminosity: first, following a procedure devised by W. H. Stone, the medical electrician and Reichenbach committee member, it tested whether a human observer allegedly sensitive to magnetic luminosity could determine, more frequently than what chance coincidence predicted, when an electromagnet hidden in a dark room was rapidly activated and deactivated; second, following the Varley and Harrison example, it invited the distinguished instrument maker Howard Grubb FRS to try to photograph the effect.⁶⁷ The committee reported that the first experiment yielded only ‘slight’ evidence in favour of magnetic sensitivity while the second trial, like the Varley and Harrison experiments of 1875, produced negative results, but it prompted the suggestion that with better apparatus (notably the photographic plates designed by William Abney FRS that were sensitive to infra-red radiation) an effect might be detected.⁶⁸

The Reichenbach committee’s conclusion that they had made a ‘*primâ facie* case’ in favour of *some* effect was challenged a few years later by experiments made by American experimental psychologists highlighting the difficulty of excluding normal sensory ways in which ‘sensitives’ could have determined the state of the electromagnet.⁶⁹ This did not dissuade the British physicist and electrical engineer Silvanus Thompson FRS in a new attempt to succeed where Varley and Lindsay had failed. Thompson took some interest in the SPR’s work and was close friends with

three of the leading physicist members of the Society: Crookes, Oliver Lodge FRS, and the Reichenbach Committee member, William Fletcher Barrett FRS. In the early 1900s Thompson began following up his hero Kelvin's suggestion that magnetic sensitivity might one day be detected.⁷⁰ In a paper accepted for the *Philosophical Transactions* he explained that when placing their heads within a powerful alternating magnetic field he and other experimental participants had experienced a flickering bluish illumination superimposed on ordinary vision (figure 4).⁷¹



Figure 4. Silvanus Thompson FRS testing the physiological effect of a large alternating magnetic field. Photograph accompanies letter, J. Crichton-Browne to S. P. Thompson, 4 Apr. 1910, Thompson Papers, Imperial College London Archives, 63a. Reproduced by permission of Imperial College London Archives.

Unlike Varley, Lindsay and Reichenbach, Thompson regarded this as a purely 'subjective' impression but he had still achieved what many spiritualistic investigators and early psychical researchers had long desired — to win the sanction of the Royal Society for research showing that some 'spiritualistic' phenomena could be experienced independently of mediums and had a 'natural basis'.

ACKNOWLEDGEMENTS

For permission to quote from manuscript material held in their collections I would like to thank the Institution of Engineering and Technology and the President and Fellows of the Royal Society of London.

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⁴ W. Hittorf, ‘Über die Electricitätsleitung der Gase. Erste Mittheilung’, Ann. Physik und Chemie **136**, 1–31 (1869).

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⁷ W. Thomson to E. Sabine, 23 March 1871, R. Soc. Archives, MC.9.182; C. F. Varley, ‘Some experiments on the discharge of electricity through rarefied media and the atmosphere’, Proc. R. Soc. Lond. **19**, 236–242 (1871). Varley was elected on 8 June 1871.

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- ¹⁷ Varley, op. cit. (note 14), pp. 157–159.
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- ²¹ Varley, op. cit. (note 14), p. 172.
- ²² Faraday's and Grove's work on the correlation of forces is summarised in Morus, op. cit. (note 9), pp. 71–77.
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- ²⁹ W. Thomson cited in [W. T. Stead], 'The response to the appeal', Borderland 1, 10–23 (1893); Thomson to Sabine, op. cit. (note 7).
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- ³¹ Although most of the 1871 paper was devoted to electrical discharge in rarefied gases, a short concluding section (which falls outside the scope of this paper) emphasised the similarities between the forms of electrical discharges in rarefied gases and in air at normal pressure.
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