THE 'WORLD OF THE INFINITELY LITTLE': CONNECTING PHYSICAL AND PSYCHICAL REALITIES IN BRITAIN C. 1900

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I: INTRODUCTION

In 1918 the ageing American historian Henry Adams recalled that from the 1890s he had received a smattering of a scientific education from Samuel Pierpont Langley, the eminent astrophysicist and director of the Smithsonian Institution. Langley managed to instil in Adams his 'scientific passion for doubt' which undoubtedly included Langley's sceptical view that all laws of nature were mere hypotheses and reflections of the limited and changing human perspective on the cosmos.[1] Langley also pressed into the hands of his charge several works challenging the supposedly robust laws of 'modern' physics.[2] These included the notorious critiques of mechanics, J. B. Stallo's *Concepts and Theories of Modern Physics* (1881) [AND] Karl Pearson's *Grammar of Science* (1892), and several recent numbers of the Smithsonian Institution's *Report*. The latter set of readings included 'revolutionary papers' foretelling the 'overthrow of nineteenth century dogma', including the 'famous address of Sir William Crookes on psychical research, followed by a series of papers on Röntgen and Curie'.[3] Driving the 'scientific lawgivers of Unity into the open' were not simply exposures of physicists' vague and often contradictory claims about force and mass, but X-rays, radium emanations, and scientific evidence for telepathy and the survival of the human personality following bodily death.

For Adams and Langley, the psychical research of Crookes and the physics of Röntgen and Curie were of a piece. All presented exciting new puzzles to physicists and apparent threats to the supposed unity of the sciences: X-rays seemed to behave

like longitudinal and transverse etherial waves,radium emanations were startlingly more energetic than anticipated on the basis of energy conservation, and telepathic transmissions, spiritualistic levitation, and disembodied spirits defied fundamental notions of space, time, and matter. There is no evidence that Adams developed any further interest in psychical research as it developed in the United States, Europe and Britain, but Langley's scepticism of the supposed absoluteness of natural laws was undoubtedly one reason why he joined the British Society for Psychical Research (SPR) and participated in some of its investigations.[4]

Adams and Langley were not the only ones to speak of the puzzling new physics and psychical research in the same breath. In the very address published by Langley and read by Adams, the veteran chemist and physicist Crookes explained to fellow members of the SPR how X-rays offered a possible physical explanation of telepathy, an obscure mental faculty for which leading members of the organisation believed there was very strong evidence. Owing to their extraordinary high frequency and ability to penetrate objects that were opaque to light, X-rays suggested the possibility of other, perhaps even higher frequency, rays that could be transmitted and received by structures in the brain. The focus on X-rays helped Crookes's plea for psychical research in another equally significant way. The puzzling new radiation represented 'an order of vibrations of extremest minuteness compared with the most minute waves with which we have hitherto been acquainted' and a domain highlighting the dependency of natural laws on perspective.[5] Creatures inhabiting such microscopic domains would interpret the world very differently from humans because they would regard the subtler forces of surface tension, capillarity, and Brownian motion as dominant and 'hardly believe in universal gravitation'.[6] The moral of the story was that:

is it not probable that we, in turn, though occupying, as it seems to us, the golden mean, may also by the mere virtue of our size and weight fall into misinterpretations of phenomena from which we should escape were we or the globe we inhabit either larger or smaller, heavier or lighter? May not our boasted knowledge be simply conditioned by accidental environments, andthus be liable to a large element of subjectivity hitherto unsuspected and scarcely possible to eliminate?[7]

The argument for the subjectivity of interpretations of phenomena was a warning to those who took 'too terrestrial a view' and denied the possibility of an unseen world. Crookes claimed that the unseen world to which he was referring was not the 'spiritual or immaterial world' but the 'world of the infinitely little' whose dimensions were comparable to the size of homunculi, the wavelengths of X-rays, and the mean free path length of molecules. It was at this level that 'we begin to realise how closely these sequences, or laws [of phenomena] as we call them, are hemmed round by still other laws of which we can form no notion'.[8] Earlier passages in Crookes's address suggest that this chemist, who had spent much of the 1870s producing evidence for the existence of 'spirits' who could materialise on the terrestrial plane, was trying to open a space for immaterial agencies. By recognising these strange perspectives, it was easier to admit the possibility of 'spiritual beings' that were 'untrammelled' by gravitation, space and other conditions that humans took for granted.[9]

Crookes's address spoke to perceptions held by many late-nineteenth century physicists urging for humility in the sciences [WHOSE LAWS THEY BELIEVED] which they believed more reflected human descriptions of nature than ultimate explanations.[10] It may also have been a response to someone who believed that humans' limited sense of reality was a reason why we had to be on our guard against anthropocentric notions that there existed invisible beings similar to humans. In the second (1896) edition of his *Natural Causes and Supematural Seemings*, the leading British alienist, psychologist and redoubtable critic of psychical research Henry

Maudsley denied that it was legitimate for someone to suppose that there existed a 'supernatural world peopled by supernatural people' because

> the universe, as it is within his experience, may be unlike the universe as it is within other living experience, and no more like the universe outside his experience, which he cannot think, than the universe of a mite is like his universe. To the infinitely little and great he is alike insensible.[11]

While Maudsley regarded egotism as reason why there was a 'strong antecedent improbability of a supernatural event', Crookes regarded it as equally egotistical to deny the possibility of agencies that transcended our experience.[12]

Underpinning the conflict between Crookes and Maudsley was a thorny and fifty-year old controversy about expertise in spiritualistic investigation. For British psychologists such as Maudsley, physicists may have been skilled in manipulating laboratory instruments but they were ignorant of the problems with the instruments of the spiritualistic séance, whether this meant the clever tricks played by mediums or the tricks played by the senses and the memory of the investigators themselves. One person who agreed with Maudsley was the Cambridge psychologist Ivor Tuckett. In a 1912 attack on the psychical researches conducted by the British physicists William Fletcher Barrett and Oliver Lodge, he was puzzled by 'really striking fact' that so many physicists were attracted to a subject that he believed was the sole province of 'experimental psychology'.[13] Tuckett was undoubtedly aware that the highest ranks of the leading British organisation for psychical investigation — the SPR — were occupied by a greater proportion of physicists than practitioners from other scientific disciplines: its early presidents included Crookes, Barrett, Lodge, and Balfour Stewart, its early Council members boasted the likes of Langley, Arthur Rücker, and J. J. Thomson, and other members included Daniel Comstock, E. E. Fournier D'Albe, and W. C. D. Whetham. Like other investigators of spiritualism and other psychical

phenomena, many had joined because they believed scientific evidence of mind operating without the confines of the body and the survival of personality following bodily death were weapons to wield against the materialism they deplored and provided new ways of revitalising conviction in the spiritual teachings of Christianity to which they already adhered. Thus in 1874 Lord Rayleigh spoke for many future SPR physicists when he explained to his brother-in-law and fellow spiritualistic investigator Henry Sidgwick that 'a decision of the existence of mind independent of ordinary matter must be far more important than any scientific discovery could be, or rather would be the most important possible scientific discovery'.[14] As we shall see, psychical research was also attractive because it gave access to a series of bizarre phenomena suggesting the existence of new forces and the direct interaction of mind and matter, puzzles that many physicists believed their enterprise had to tackle to make it more 'complete' and powerful.[15] One explanation of physicists' penchant for psychical research that Tuckett doubtless found unconvincing appeared in a 1908 attempt at a physical theory of psychical phenomena by E. E. Fournier D'Albe, an electrical engineer widely known for his digests, in the weekly trade paper the *Electrician*, of the latest research on X-rays, radioactivity, and other aspects of contemporary electrical science. Fournier D'Albe explained that it was not 'presumptuous for a physicist to venture an opinion' on the question of human immortality, a question 'usually associated with psychology and theology'. Since this was a question concerning the relationship between mind and matter, it required an 'extensive acquaintance with what is actually known about matter and what is not known about it' and so was relevant to the physicist who is 'permanently confronted with the problems concerning the ultimate nature of matter, more so even than the chemist, and much more than the physiologist, who usually derives his ideas concerning matter from elementary text-books of physics and chemistry'.[16] Fournier D'Albe proceeded to argue that if the chemist and

physiologist had the physicist's perspective on matter they would appreciate that it was not impossible that the vital aspect of the human body could survive bodily death and that there was a plausible physical basis of immortality.

The foregoing analysis outlines some of the connections made by fin-de-siècle scientific practitioners and commentators between the new physics and the new science of psychic phenomena. The connection has been considered many times since the comments of the perplexed Adams, the irritated Tuckett, and the confident Fournier D'Albe. Much recent work has surveyed the ways in which wireless telegraphy, X-rays and other startling inventions and discoveries were used to support and subvert the extraordinary mental and physical feats of spiritualist mediums, theosophical adepts, and other representatives of what were loosely grouped as 'psychical' or 'occult' sciences.[17] Very few studies, however, consider the significance of the fact that many of the savants closely involved in startling discoveries and inventions in physics were also interested in psychical research. Janet Oppenheim, for example, acknowledges the involvement of Crookes, Lodge, Rayleigh and Thomson in the scientific 'revolution' but only hints that Crookes's researches on radiant matter and spiritualism were related expressions of his interest in the borderland between matter and energy and that Lodge's predilection for the ether of space and life after death were manifestations of his underlying preoccupation with 'continuity'.[18] The need for a closer analysis of psychical research *in the context* of physics arises from the fact that historians of psychical research have tended to relegate physics to a background of 'orthodox' science against which the 'unorthodox' psychical forays of physicists took place, while historians of physics, despite showing that late-Victorian physics comprised complex and troublesome enterprises, overlook this as an important context for deepening our understanding of psychical research in which the physicists of their stories participated.[19] This paper explores in a more systematic way the extent to which in the

decades around 1900 the puzzling new reality suggested by experimental and theoretical developments in physics shaped interpretations of telepathy, spiritualistic manifestations and the other puzzling phenomena of psychical research. The primary focus will be on the British physicists who engaged, to one degree or another, with psychical research but I will also consider this in relation to the way in which others types of individual — notably, spiritualists and psychologists — strengthened and undermined the supposed connection between the new physics and the occult. The following section demonstrates that there was no consensus between physicists, let alone between spiritualists, practising scientists, journalist commentators and others, on the link between the new physics and psychical research. Many physicists saw psychical research as a way of extending the authority of their enterprise and, as section IV shows, an important context for questioning the limits of physical laws that were being more explicitly articulated by physicists elsewhere. This was part of a broader attempt by physicist-psychical researchers to make physics seem convergent with major aspects of psychical research and sections IV and V explore the rhetoric they used to achieve this convergence in the domain of concept development and experimental inquiry.

III: FROM BRAIN-WAVES TO ETHEREAL SOULS

William Crookes was only the more eminent of a plethora of individuals who thought that fin-de-siècle physics had a bearing on the puzzling phenomena of spiritualism and psychical research. News of Heinrich Hertz's propagation in 1888 of electromagnetic waves in free space, Röntgen's discovery in 1895 of the existence of a 'new type of light', Henri Becquerel's discovery in 1897 of emanations from uranium salts, René Blondlot's production in 1903 of 'N-rays', Guglielmo Marconi's transmission in 1899 of wireless waves from South Foreland to Wimereux, and a host of other speculations

and theories regarding the etherealand non-material origins of matter prompted discussion in Britain, Europe and the United States of the ways in which physics had changed the boundaries of the possible and made telepathy, clairvoyance, and materialised spirit forms seem less or more plausible.

Connections between the new reality opened up by physics and 'occult' sciences were made, not always seriously, in periodicals aimed at non-specialist readers. Thus, in 1899 the eminent journalist James Knowles responded to news of Marconi's telegraphic triumph by republishing in the *Nineteenth Century* a thirty-year old speculation that since the brain was, like an electric battery, 'perpetually, while in action, decomposing its own material' then it could 'generate and emit tremors or waves of energy which sensitive 'receivers' as other human brains might catch and feel, although not conveyed to themthrough the usual channels of sensation'.[20] A few years earlier *Punch* had responded to Röntgen's discovery with a poem wittily pointing out that its readers had no desire to be seen in their 'bones' and telling the Würzburg professor to 'go away and photograph / Mahatmas, spooks, and Mrs. B[esant]'.[21] The leading British comic weekly expressed a wider perception that radiation which could penetrate our exteriors might be subtle enough to image ghosts, the invisible 'Mahatmas' of Theosophy, and Theosophical adepts such as Annie Besant during their alleged travels in the astral plane. There were no such ironic uses of physics in spiritualist and theosophical periodicals of the late-Victorian period. Typical was the sober view of the American theologian and spiritualist James Bixby who responded to news of Röntgen's discovery by suggesting that

> when we see, as in these cathode photographs, boxed-up metal and collodion film communicating through opaque envelopes, can we doubt the equal power of the mind to send its messages to neighbour [sic] minds, across similar gaps and barriers? The marvels of telepathy, of mind-cure, thought-transference, and clairvoyance have, for not a few years back, been admitted by the select circleof cautious investigators. With

such analogies from the physical realm as these recent discoveries supply, ought they not to be generally acknowledged?[22]

Like conventional photography, X-ray photography appeared to lend support to the possibility that there were some radiations — including the luminous manifestations of Karl von Reichenbach's 'od' force — which could only be sensed with certain media.

What spiritualist and theosophical journals admired most about new claims in physics was that it appeared to show physicists behaving like occultists — in particular, because they challenged such dogmas as the idea that the ultimate constituents of matter were hard and indivisible atoms. One contributor to a 1905 number of the *Theosophical Review* explained that radioactivity illustrated what Mahatmas and theosophical adepts had been teaching for years because it 'overthrew with a mighty force all current and reputable theories of the constitution of Matter and its inherent qualities' and thereby shown that the 'Mechanical Theory of Nature' rested on 'shifting sands'.[23] The electron theory of matter made physicists look especially compatible with occultists. The spiritualist weekly *Light* had a long history of upholding new views of matter — notably, William Thomson's vortex theory of the atom and Crookes's hypothesis of 'radiant matter' — as illustrations of science gradually recognising that ponderable matter was not the ultimate reality of the cosmos. In a similar vein it was gratified to read J. J. Thomson's presidential address to the 1909 meeting of the British Association because it located the ultimate seat of electrical and magnetic forces not in matter but in the imponderable ether. 'Are scientific men here pursuing a path which runs parallel with that of the Spiritualist', it wondered, 'who postulates that all force is in its ultimate nature spiritual, whether it resides latent in the ether or is manifested to the senses as matter?'[24]

These speculations were frequently challenged in popular scientific periodicals, lectures, and other public platforms where scientists, journalists and others sought to

control public understanding of exciting, novel and uncertain aspects of physics. Thus the *Electrician* rejected for publication a paper on the 'Physics of Thought Reading' because it questioned whether such intangible qualities as 'exaggeration' and 'mendacity' could ever be measured and thus brought within the 'domain of physical science', the *Popular Science Review* denied the suggestion that X-rays corroborated St. Paul's doctrine of the spiritual body, and *La Nature* reported on a fake spiritualist séance in Paris in which the instrument maker M. Radiguet produced ghostly forms by using X-rays generated from a hidden Crookes tube to induce phosphorescence in objects coated with zinc sulphide [FIGURES 1 AND 2].[25] Physicists themselves occupied ambiguous positions in this culture of puzzling forces and powers. They certainly shared Henry Adams's belief that there were ways in which the new physics and psychical research were of a piece. Lodge spoke for many of his colleagues when in 1909 he pointed out that psychical phenomena had the 'unfortunate knack of attracting the attention to cranks and weak headed persons all over the world — though, indeed, in this respect Röntgen rays and wireless telegraphy run it very close'.[26] While they did not agree with the uses to which spiritualists, theosophists and 'cranks' put Röntgen rays and wireless telegraphy, they also believed it was necessary to manage public speculation and show how the new physical researches could comprehend any residual truths in the otherwise disreputable mass of occult sciences. Good examples are Oliver Heaviside, the electrical engineer and physicist who thought that an X-ray or some other physical theory of telepathy would explain much in the 'bastard science' of spiritualism, and Samuel Tolver Preston, a prolific writer on theories of the ether and the kinetic theory of gases, whose 1893 manuscript on the 'Physics of Thought-reading' had been rejected by the *Electrician*.[27] Preston despised spiritualists because they seemed to be promulgating notions of the very action-at-a-distance forces he sought to vanquish with his theories of contiguous ethers: these forces were 'the last remnant of

spiritualism to be expelled from physics' he urged in 1881.[28] His 'Physics of Thought-reading' was part of this expulsion strategy.[29] Possibly inspired by William Crookes's 1891 remarks on brain waves, Preston suggested that thoughts were associated with alternating electric currents in brain cells; these currents in turn produced short wavelength electromagnetic pulses which, similar to the resonance in Hertzian wave propagation, produced exactly the same types of alternating currents in a second brain.[30] Preston's theory spoke to the interests of many leading SPR members who increasingly believed that much of what spiritualists attributed to the minds of 'spirit' intelligences were telepathic leaks from the minds of the living, and that telepathy itself might be a physical process. For this reason he sent his manuscript to J. J. Thomson who, unlike the *Electrician*, thought Preston's theory was open to testing (by exploring the effect of metal screens around telepathic agents) although he warned that Henry Sidgwick held that telepathy was already so capricious that it was difficult to see how such a physical theory could be satisfactorily verified.[31]

Doubts about physicists' 'brain wave' theories of telepathy were questioned in many quarters. Spiritualists were critical of telepathy because it reduced to the level of latent powers of terrestrial living minds so much of what they were convinced were traces of the minds of the dead.[32] The most active SPR physicists developed more complex positions on the physical basis of telepathy. In the 1880s and 1890s Barrett and Lodge produced some of the SPR's most important experimental evidence for telepathy and initially interpreted this apparent ability of a 'percipient' to sense an image in the mind of a distant 'agent' or sender as a possible mental equivalent of resonance in sensitive flames, wireless telegraphy and other physical systems in which subtle transmissions from one body induced striking effects in another body if the frequency of transmission matched the structure in the second body.[33] However, the SPR's evidence that the strength of telepathic impressions did not diminish with the

distance between telepathic agent and percipient or with the efforts of the agent prompted Barrett and Lodge to question whether telepathy could be regarded as electromagnetic or indeed, physical at all. In 1904 Barrett, then convinced of the reality of telepathy, characterised the popular 'brain wave' explanation of telepathy as 'unscientific talk' and a year earlier, in his presidential address to the SPR, Lodge, then firmly established as the most outspoken British authority on ether physics and wireless telegraphy, explained that it was likely that telepathic phenomena were purely 'spiritual and psychical events' and it was only when it was proven to be an 'etherial process' that it could 'come into the region of physics'.[34]

Barrett and Lodge saw no reason, however, why the ether, with the extraordinary physical properties it needed to sustain electromagnetic waves, could not fulifll some kind of spiritual or psychical functions. It was because the ether was 'an imperceptible, imponderable, infinitely rare and yet infinitely elastic all-pervading kind of matter', that Barrett considered it more effective than matter at being a vehicle of life and mind.[35] Similarly, in the early decades of the twentieth century, Lodge developed his notorious conception of the 'etherial body' which was part of his broader struggle to correct popular misconceptions about physics, especially the belief that it was materialistic and said nothing about deeper questions of humanity.[36] He speculated that since the ether was the cohesive force of the entire universe then everyobject had an etherial and a material counterpart, the former being at least as significant even though it evaded direct detection. In animate objects psychic activity was known to be associated with the material body, and Lodge considered this that the etheric body was even more closely associated with psychic activity: indeed, because the ether did not suffer from the imperfections of ponderable matter— for instance, decay, friction, and imperfect elasticity — then the etherial body, together with its psychic element, survived the death of the physical body and could 'lead a less abstracted and livelier

existence'.[37] Although Lodge had no evidence that the etherial body could sustain a psychic function after dissolution he believed it was within the bounds of physical speculation that the etherial body was the 'primary instrument of Mind, the vehicle of the Soul, the habitation of spirit'.[38] It was not only possible but desirable because the etherial body explained the 'obscure communications and strange movements' that from the 1890s he was convinced had been genuinely evidenced in spiritualist séances and which fulfilled his very public religious campaign to give comprehensibility to the otherwise difficult Christian conception of the soul.[39]

Somebody who shared Lodge's interest in psychical research and the way physics could give reality to the Christian conception of the soul was Edmund Fournier D'Albe, who later became a lecturer in physics at Birmingham University where Lodge was Principal.[40] We have already noted Fournier D'Albe's role as a leading reporter of the latest researches in physics and this journalistic experience shaped his first book, *The Electron Theory* (1906), one of the earliest popular expositions of the electrical theory of matter and the first of three works exploring the way new revelations concerning the inner structure of the atom shaped understanding of the entire cosmos.[41] The third and most speculative book in the series, *New Light on Immortality* (1908), used radioactivity and electron physics in a 'Physical Theory of Immortality' and to give plausibility to the materialised spirit forms and other psychical phenomena he believed rested on satisfactory evidence.[42] He explained that humans had access to three distinct material worlds each of which could be defined in terms of discrete entities of the same order of magnitude and similar general attributes: the terrene world, whose discrete entities were organised beings ranging from unicellular organisms to human beings; the supra-world of heavenly bodies; and the infra-world of atoms and electrons. Building on his mentor George Johnstone Stoney's argument that the material universe was 'really an infinite series of worlds within worlds' numerically

related to each other, he claimed that natural laws were the social laws of the entities of the inferior world. What human beings judged to be the laws of chemistry were the '*laws of life of the atomic species*', which radioactivity had shown to possess the characteristics of life, growth and decay.[43] This helped Fournier D'Albe's anti-materialist claim that it was impossible to draw the line between life and lifelessness and that what we took to be a lifeless entity was the aggregate of 'life units' of entities in an inferior world. Carrying this rule to its 'furthest limit', Fournier D'Albe concluded that vitality could be associated with small but definite material parts of the human body — 'psychomeres' — and that the aggregate of such parts constituted the soul.[44] It was also not physically impossible that the soul could leave the body. Now that physicists had suggested that the atom consisted of electrons separated by enormous empty spaces, the human body could be regarded as a 'mist' from and that it was not impossible that a finer mist — which constituted the soul — could leave the body without disrupting it, explain the shadowy forms witnessed in séances and how mediums could move objects at a distance, and provide a strong part of an argument for immortality.[45]

Fournier D'Albe not only presented a use of microphysics that most physicists would have found unconvincing, but made equally risky move of supporting his argument for the separation of the soul with what many considered inconclusive evidence for materialised spirits and other examples of the exteriorisation of human personality. The SPR still regarded such phenomena as the most problematic aspect of its enterprise and this was one of many reasons why one of its members judged Fournier D'Albe's book to be nothing better than a series of 'delightful speculations'.[46] Nevertheless, *New Light on Immortality* represents only a more radical of a long series of attempts by late-Victorian physicists to comprehend spiritualistic and psychical

phenomena, many of whom disagreed sharply on which aspects of psychical research that were worth explaining physically.

IV: THE PSYCHICAL BOUNDARY OF PHYSICS

For many late-nineteenth century commentators on physics the interest shown by Barrett, Crookes, Stewart and others in spiritualism was symptomatic of a more general and worrying drift of physicists towards metaphysics. In his notorious critique of 'modern physics', J. B. Stallo derided in the same breath British preoccupations with etherealising matter and their habit of introducing supernatural elements into physics. He noted how the 'intellects of men of science are haunted by pre-scientific survivals, not the least of which is the inveterate fancy that the mystery by which a fact is surrounded many be got rid of by minimising the fact and banishing it to the regions of the Extra-sensible'. William Thomson's theory that atom were vortices in a frictionless and incompressible fluid ether was not much better than the 'sorting demon' that James Clerk Maxwell had introduced to illustrate the statistical nature of heat dissipation or Balfour Stewart and Peter Guthrie Tait's speculation in their anonymous *The Unseen Universe[;] [Or] or Physical Speculations on a Future State* (1875) that there existed an eternal invisible universe, connected to the transient visible one via the imponderable ether of space, and which was a possible abode of the immortal souls of human beings. The 'scientific literature of the day', he concluded:

> teems with theories in the nature of attempts to convert facts into ideas by a process of dwindling or subtilization. All such attempts are nugatory; the intangible specter proves more troublesome in the end than the tangible presence. Faith in spooks (with due respect be it said for Maxwell's thermodynamical "demons" and for the population of the "Unseen Universe") is unwisdom in physics no less than in pneumatology.[47]

As we saw in the last section, in contrast to Stallo, spiritualists, theosophists, and practitioners of 'occult' sciences generally welcomed physicists' embracement of metaphysics and apparent recognition of the limits to mechanical and materialistic models of the universe. For some British physicists the interest in the 'extra-sensible' was desirable not because they wanted to ally themselves with occultists but because they wanted to protect the image of physics. At a 1903 meeting of the exclusive philosophical debating club, the Synthetic Society, Lodge criticised Stallo for misrepresenting the 'teachings of the great physicists' and for giving those who were 'disinclined or unable to acquiesce' in the claim that physics excluded the possibility of 'free-will action, of guidance, or the self-determined action of mind of living things' reasons for thinking that 'much-vaunted' laws of physics rested upon 'a hollow foundation'.[48] By this time Lodge was actively engaged in showing how the action of life and mind in the material universe did not violate energy conservation and that this cornerstone of physics did not therefore lead to determinism. Indeed, much of Lodge's work from the turn of the twentieth century was as an attempt to persuade an intelligent lay section of the British public that newer developments in physics were even more compatible with fundamental Christian teachings on mind and spirit. The electrical theory of matter developed by Joseph Larmor, J. J. Thomson and others was useful to Lodge because it showed physicists' increasing recognition of the limits of cherished physical principles and tolerance of the way in which physics could embrace broader questions of the cosmos. 'The really fundamental dynamics', he explained in a 1901 article, 'must have an ethereal and not a material basis' and it was quite possible that Newtonian laws of dynamics 'may no longer be fundamental or ultimate'.[49] The new dynamics was not only better than Newtonian dynamics at explaining electricity and magnetism but was more likely to enable life to be included in the 'general scheme of physical science', and by calling for such a possibility to be 'strenuously' investigated

Lodge was implicitly reiterating his 1891 call for physics to be made more 'complete' via psychical research.[50] The 'tendency' of leading physicists at the turn of the century, Lodge sanguinely concluded, was toward the 'devout' rather than the 'materialistic' because they 'seek to elevate matter and all existence to the level of mind and spirit'.[51]

[LOUIS T. MORE'S CRITIQUE AND THEOLOGICAL ARTICLE]

Lodge's 1901 view of the 'tendency' of leading physicists represents one of many instances in which British physicists actively involved in psychical research used the context of this problematic new scientific enterprise to make some of their most profound contributions to the fin-de-siècle debate on the limits of cherished physical principles. We have already seen that in his SPR address Crookes implicitly suggested that dismissing the possibility of telepathy reflected a lamentable blindness to the possibility that natural might look very different from different perspectives, and that in his SPR address of 1903 Lodge rebuked physicists for dismissing telepathy simply because they could not conceive of an event that fell outside the ethereal or physical. Lodge was partly inspired by Crookes when in his 1913 address to the British Association he cited J. J. Thomson's 1909 observation that new methods of detecting electified molecules — notably, C. T. R. Wilson's cloud chamber — were enormously more sensitive than those, such as spectroscopy, operating on unelectrified molecules: the smallest number of molecules of neon that could be detected by spectroscopy was 10^{12} which was still so much larger (7,000 times) than the population of earth that 'if we had no better test for the existence of man than we have for that of an unelecrified molecule we should come to the conclusion that the earth is uninhabited'. For Lodge, this 'parable' of modern physics was a reason why we had 'no right to say positively that even space is uninhabited', possibly by 'immaterial dwellers'.[52]

In many ways, Crookes's and Lodge's recognition of the perspectivism in natural laws echoed remarks made in 1886 by the Manchester meteorologist and

physicist Balfour Stewart who by this time was increasingly convinced by the the SPR's evidence for telepathy which, like the *Unseen Universe*, fuelled his campaign to show that empirical evidence and what he considered legitimate physical speculation supported the notion of mind existing independently of the body and thus Christian teachings on the spiritual body.[53] In 1886 Stewart replied to William Fletcher Barrett's SPR paper describing his experiences of intelligent raps and movements at spiritualist séances which led him to conclude that '*mind occasionally and unconsciously can exert a direct influence upon lifeless matter*'.[54] Stewart immediately saw the threat that this seemed to pose to the scientific principle that he had spent much of his career propounding in technical and popular scientific texts: the conservation of energy.[55] However, Stewart explained that he did not regard the principle as 'anything else than a scientific assertion' albeit a 'very sagacious one'. This had not been borne in mind by scientists, whose 'limited application of physical laws' precluded the possibility of free-will, miracles and telepathy, and their clerical opponents, who insisted that miracles were abrogations of ordinary laws. For Stewart, it was possible to reconcile these positions by viewing miracles as 'phenomena embracing a higher law'; moreover, there was no reason why telepathy and the physical phenomena of spiritualism should not be manifestations of some such law because in the 'the very different conditions of things contemplated by the Psychical Society' there might be 'at least an apparent and *primâ facie* breakdown of [energy] laws'.[56] Energy conservation and dissipation did not therefore provide legitimate grounds for dismissing the psychical evidence amassed by the SPR.

Like other SPR physicists, Stewart's writings display occasional tensions between an acceptance that physical laws might not be applicable to the psychical domain and a hope that their expertise was still relevant to understanding the nature of psychical phenomena. One of the ways in which they did this was to urge the

importance of such 'physical phenomena' as the movement of objects without apparent means of support, ectoplasm and materialised spirit forms, topics that Eleanor and Henry Sidgwick, F. W. H. Myers and other leading non-physicist SPR investigators considered less profitable than the 'mental' aspects of psychical research because of stronger associations with fraudulence. Thus in 1894 Barrett upheld physical phenomena because they 'belong essentially to the region of experiment with which as a physicist I am more familiar' and were 'of primary importance from a scientific point of view', while Lodge was so keen to make physical phenomena the aspect of psychical research by which physics could be extended that he was the first to publicly call for the foundation of a 'psychical laboratory' where a self-registering balance, automatic photographic cameras, ultra-violet lamps and other instruments could detect, measure and verify what had largely rested on the dubious testimony of spiritualists.[57]

Another way in which SPR physicists made their enterprise seem convergent with that of psychical research was to make new reality suggested by physics look increasingly psychical or 'occult', a strategy that they shared with spiritualists and theosophists. Lodge was not the only one to insist on this when he anticipated the new ether-based dynamics being able to embrace life, mind and domains radically different from that of ponderable matter. In his *Recent Development of Physical Science* (1904) the Cambridge experimental physicist W. C. D. Whetham summed up Larmor's, Lorentz's, J. J. Thomson's, and Stoney's subtly different views on the microstructure of matter by insisting that matter 'is an electrical manifestation; and electricity is a state of intrinsic strain in a universal medium. It is prior to matter, and therefore not expressible in terms of matter; it is sub-natural if not super-natural'.[58] Unsurprisingly, the second sentence was seized on by theosophists as a sign that physicists shared their sense of the ultimate intangibility of the universe.[59] A permeable boundary between physics and the occult was even more strongly tolerated by Whetham's mentor, the Cavendish

Laboratory's director J. J. Thomson who, by the early 1900s, had helped the SPR with investigations the alleged abilities of mediums (including the theosophist Madame Blavatsky) to move objects at a distance and despite the attitude of many SPR colleagues, considered telepathy to be wanting in conclusive proof.[60] Thomson's interest in occult subjects seems to have shaped the way he chose to communicate abstruse new ideas in physics. In a public lecture of 1908 he discussed the ways in which the electrical theory of matter had transformed understanding of the relationship between matter and ether. To convey the prediction of the theory that an electric charge gained mass owing to its motion, he appealed to a hydrodynamical analogy that was typical of a Cambridge-trained physicist such as Thomson and a concept drawn from the theosophical practices in which he seems to have taken an interest [MAKE STRONGER]. He explained that when an electrified charge moved its lines of force gripped and dragged portions of the ether or the 'invisible universe' around it, and it was 'for exactly the same reason' that a body moving through water was heavier owing to the need to move a portion of the water around it; but when an electrified charge moved it was also possible to think of it as having 'an etherial or astral body' which increased its apparent mass.[61] Indeed, just as theosophists thought that the astral body was more important than its counterpart in the material plane, so Thomson concluded from Walter Kaufmann's measurement of the mass of β-rays emitted by radium that at the subatomic level all mass was due to electric charge — that the etherial or astral body was the most significant. Thomson was notorious for exploiting working hypotheses and illustrative analogies and it is possible that his implicit theosophical analogy was merely intended as a heuristic device; nevertheless, Thomson's example forces us to be more sensitive to the exotic range of resources that late-Victorian physicists were prepared to use in comprehending new aspects of physics, as well as their sense of the possible convergences between physical and psychical domains.[62]

V: THE PSYCHICAL INSTRUMENTS OF PHYSICS

When, in 1936, Thomson recalled his experiences in psychical research he made some of his profoundest statements on the ways of dealing with the 'delicate instruments used in physical laboratories'. In his opinion such instruments had failed to detect physical effects produced by mediums, but he still thought they illustrated the danger of impatience when investigating mediums who were so 'psychic and impressionable' that 'it may be as unreasonable to expect them to produce their effects when surrounded by men of science armed with delicate instruments, as it would for a poet to be expected to produce a poem while in the presence of a Committee of the British Academy'. Psychical researchers had to remember that mediums were only more complex versions of delicate laboratory instruments which, until their 'technique has been mastered', gave contradictory results, and which for Thomson illustrated the truth of a famous saying of the Cambridge don Coutts Trotter that 'the law of constancy of the Nature was never learned in a physical laboratory'.[63]

Thomson expressed the dilemna that we have already encountered with his colleagues Barrett and Lodge: they agreed that there were many ways in which physical and psychical investigation were incommensurably different, but maintained that in some areas of psychical research physicists had the appropriate investigative and manipulative skills that practitioners from other scientific disciplines lacked. In many ways, this was a response to an argument made by Maudsley, Tuckett and other psychologists and medical practitioners that physicists were way out of their depth in investigations where the physical and psychical were mingled. These redoubtable critics agreed that physicists' greatest blunder was treating spiritualist mediums, automatists, and other subjects of psychical investigation like the inanimate instruments of the physical laboratory. A good example of this occurred in 1876 when the leading

psychologist William Benjamin Carpenter criticised Barrett's evidence that certain human subjects, when sent into a trance state by mesmeric passes, were able to perceive, without using normal sensory channels, thoughts in the mind of a distant person. Carpenter was not convinced that the physicist had proved the existence of a direct mind-to-mind communication because he did not appear to have guarded against 'certain little unconscious revelations […] made in [his] tone, gesture, [and] expression of face' that supposedly mesmerised subjects surreptitiously used in their apparent feats of 'thought-reading'.[64] Barrett's evidence was especially problematic because he, like many of the physicists and chemists whom Carpenter had attacked for incompetent spiritualitic investigation, failed to understand '*the nature of their instruments of research*, putting as much faith in tricky girls or women, as they do in their thermometers or electroscopes'.[65] In other words, Barrett understood neither his own mind and body, nor those of his instruments who had a notoreity for conscious and unconscious deception. Lodge came under similar attack some forty years later. In 1916 he published *Raymond or Life and Death* (1916) an immensely popular exposition of the evidence he had received of the discarnate intelligence of his son who had been killed in the Western Front and then appeared to communicate through a spiritualist medium. Few were more scathing about this work than Charles Mercier, a London physician and expert on criminal insanity, who in an attempted exposé of Lodge's séance blunders warned that one of the reasons why this 'professor of electricity' had erred in his evidence for telepathy and discarnate spirits was because he had spent his life studying 'matter destitute of life, of intelligence, of intention, of volition, of desire, of feeling' and was as fitted to the task of investigating humans in a hypnotic condition as a conjuror was for the task of solving 'some abstruse problem in electricity'.[66]

We saw in the last section that one of the ways in which physicists defended the place of their expertise in psychical research was by emphasising that it concerned a

range of *physical* puzzles which physicists were best equipped to tackle. A common strategy was for physical scientists to insist that since they were skilled at detecting and measuring very small forces then they were in the best position to determine whether mediums exerted the more substantial forces involved in levitation. Thus in his 1870 manifesto of spiritualistic investigation, Crookes boasted that since the 'scientific chemist' could measure weights of one thousandth of a grain he was 'justified in asking [spiritualists] that a power professing to be guided by intelligence, which will toss a heavy body up to the ceiling, shall also cause his delicately-poised balance to move under test conditions'.[67] Barrett agreed that scientists trained in accurate measurement were unlikely to be fooled by mediums using crude mechanical devices to fabricate 'spiritualistic' manifestations. In 1908 he considered it

> absurd to suppose that the resources of science are so far exhausted that highly-trained investigators, such as Mr. Crookes or Professor Lodge, cannot determine, with reasonable precision, whether certain physical movements are due to a known or an unknown cause without resort to the aid of clumsy and possibly hazardous police expedients.[68]

Barrett's warning reflected his awareness that aggressive behaviour in séances, especially towards the medium, was 'unscientific' because it upset the very conditions that were considered necessary for the apperance of the phenomena under investigation, and posed a threat to the mental and physical health of the medium. Barrett, Lodge and as we have seen, Thomson, implicitly held that physicists were in the best position to tolerate this investigative requirement, and were thus more scientific and moral, because their laboratory practices exposed them to the problems of delicate and sensitive instruments. Thus in 1894 Lodge urged investigators of the highly controversial Italian medium Eusapia Palladino to treat her like a 'delicate piece of apparatus […] whose ways and idiosyncrasies much be learnt, and to a certain extent humoured, just as one studies and humours the ways of some much less delicate piece

of physical apparatus turned out by a skilled instrument-maker'.[69] In the same year, Barrett represented physicists as especially adept at considering the effect of their very presence in experimental spaces on the behaviour of sensitive instruments. 'If, for example, Professor S. P. Langley of Washington', he told an audience of spiritualists,

> in the delicate experiments he is now conducting — exploring the ultra red radiation of the sun — had allowed the thermal radiation of himself of his assistants to fall on his sensitive thermoscopes [bolometers], his results would have been confused and unintelligible. We know that similar confused results are obtained in psychical research, especially by those who fancy the sole function of a scientific investigator is to play the part of an amateur detective; and accordingly what they detect is merely their own incompetency to deal with problems the very elements of which they do not understand and seem incapable of learning.[70]

New and extraordinarily sensitive instruments of the physics laboratory did not just provide analogies for justifying [a] respectful experimental approach towards mediums but constituted some of the means by which psychical researchers tried, and in Thomson's opinion failed, to detect physical effects apparently caused by subtle emanations from the bodies of mediums. In late-Victorian Britain the most elaborate importation of physical instruments into the séance took place in the 1870s when Crookes invented torsion balances (in vacuo) to determine whether the gravity-defying 'psychic force' of mediums was possessed by everybody, and then used a sensitive mirror galvanometer to determine whether female media, connected to electric circuits, broke the current to masquerade as materialised 'spirit' forms.[71] Although Crookes later attributed the motion of his torsion balances to a new effect of radiation, his example seems to have inspired a whole series of attempts by mainly continental physicians and psychologists to evidence the existence of effluvia flowing from all bodies, not just those of mediums: Abbé Fortin's magnetometer, Hippolyte Baraduc's 'bioscope' and Paul Joire's 'sthenometer' (both comprising a needle suspended within a glass case that apparently moved in response to radiation from human beings but no other source), and the 'fluid motors' of Comte de Tromelin (comprising paper cylinders balanced on

needle points that revolved on the approach of the human hand).[72] These [IN TURN] were part of [AN EVEN] a much broader movement, particularly among French, Italian and German medical practitioners, to explore the extent to which X-rays and radium emanations were part of a much broader range of new subtle emanations, some of which might be emitted by the human body and be detectable by photographic plates, phosphorescent screens, electroscopes, and other instruments. Thus Baraduc, Louis Darget, Jules Luys and others caused a sensation in British and Continental spiritualist journals during the 1890s with [ALLEGED] photographs of thoughts, dreams, the soul at the time of death, and the subtle effluvia believed to be responsible for mesmeric effects.[73] Although this research was intended to deepen understanding of human psychology rather than lend support to spiritualism, spiritualists welcomed such evidence because, like spirit photography, it shifted the burden of proof of 'spirits' away from the subjective judgement of séance goers to the more 'objective' inscriptions of inanimate instruments that were not thought to be susceptible to the hypnotising powers of mediums. For many British psychical researchers, however, many of the new instruments were no more conclusive than spirit photography because they held that it was more likely that known causes had produced the same effects.[74]

This did not stop psychical researchers from exploring the possibility that the new instruments of the physics laboratory could fulfill other functions in the séance. Many mediums disliked working in strong lighting and in sight of laboratory hardware because it upset their concentration and it was for this reason that psychical researchers believed, as Lodge put it, that 'psychic laboratories' should feature detection instruments positioned so discreetly as to give the space the 'comfort and ordinary homeliness' in which mediums worked best.[75] This was exactly the problem that the American optics expert and famous debunker of scientific and spiritualistic frauds, Robert W. Wood tried to achieve in his use of an X-ray tube during tests of the medium

Eusapia Palladino held at Colombia University in 1910.[76] Eusapia arrived having been claimed as a fraud by some scientific experts and vindicated as genuine by others, and Wood believed that the puzzle of her mediumship could be conclusively settled by one of the most extraordinary features of fin-de-siècle physics laboratories. By inviting Eusapia to sit between a carefully hidden X-ray apparatus and a fluorescent screen he reckoned he could determine, by inspection of the shadows cast on the screen, whether the objects that 'levitated' around a darkened cabinet near Eusapia were moved by the medium herself or a third 'supernormal' arm extending from her body. Frustratingly for Wood, when Eusapia arrived at the séance she refused to participate owing to poor health. Wood never managed to use his apparatus on Eusapia or any other medium but he maintained that '[i]f the phenomena are genuine it can be proved by the X-rays' and encouraged other investigators to adopt his ultimate 'proof against any fraud'.[77]

VI: CONCLUSION

Wood's projected experiment is a fitting image with which to end this paper. It represents a very different use of X-rays from the one envisioned by Crookes in his SPR address of 1897, and by M. Radiguet in his fake Parisian séance of the same year: Wood's sought to demonstrate that mediumistic trickery could not escape from the gaze of a new tool of experimental physics, Crooke[S]'s aimed to show that new physical reality created by the same tool made it rash to dismiss the possibility of the psychic and spiritual reality produced by mediumistic instruments, and Radiguet's sought to show that X-rays were more magical and spiritualistic than spiritualism. The juxtaposition of Eusapia Palladino and the X-ray tube in 1910 symbolises much more than the new physics being pitted against the old occult. It illustrates the extraordinary possibilities, puzzles and tensions within physics around the turn of the twentieth century when many physicists accepted the possibility that their claims about the nature

of ether and matter and their experimental practices could embrace the claims and practices of more exotic scientific cultures.

This paper causes problems for distinctions made between 'modern' and 'classical' physics, an issue that Richard Staley has masterly analysed his contribution to this volume. In his best-selling *Tao of Physics* (1975) the physicist Fritjof Capra insisted on striking parallels between 'modern' physics and Eastern mysticism. Capra's argument depends on a sharp contrast between the 'mechanistic world view of classical physics' that confined itself to 'physical phenomena we encounter in our everyday life' and modern physics, which focused on the 'more fundamental' subatomic level and taught that the observer and observed were no longer independent but connected in an organic whole. Modern physics and eastern mysticism were similar because they emerged 'when one enquires into the essential nature of things — into the deeper realms of matter in physics; into the deeper realms of consciousness in mysticism' and thus showed the inadequacy of mechanistic world view.[78] Capra's argument has been criticised for and overly simplistic view of the development of physics, not least a lack of sensitivity to the statistical and non-mechanistic aspects of pre-1900 physics and the 'classical' elements of post-1930 physics.[79] This paper shows that leading late-Victorian physicists were much more tolerant of the limits of physical laws and 'classical physics' than hitherto supposed, and frequently made such arguments challenge the putative barrier between the physical and the psychical. Their physics was certainly not confined to the objects of 'everyday life' and it was precisely their struggles to comprehend the 'infinitely little' worlds of electron and ether physics that shaped their tolerance of the possibility that physics might be able to address questions of life, mind and religion.

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[1] S. P. Langley, 'The Laws of Nature', *Annual Report of the Board of Regents of the Smithsonian Institution for the Year Ending June 30, 1901* (Washington: Government Printing Office, 1902), 545–552, 545. For Adams and Langley see Albert E. Moyer, *American Physics in Transition: A History of Conceptual Change in the Late Nineteenth Century* (Los Angeles: Tomash Publishers, 1986), 106–113, 167–172.

[2] Henry Adams, *The Education of Henry Adams* [1918] (Harmondsworth: Penguin Books, 1995), 359.

[3] Adams, *Education*, 426.

[4] [Anon.], 'Obituary. Dr. Samuel Pierpont Langley', *Journal of the Society for Psychical Research* (hereafter *JSPR*) **12** (1906), 232.

[5] William Crookes, 'Address by the President', *Proceedings of the Society for Psychical Research* (hereafter '*PSPR*') **13** (1897–98), 338–355, 352

[6] Crookes, 'Address', 344.

[7] Crookes, 'Address', 348.

[8] Crookes, 'Address', 338.

[9] Crookes, 'Address', 342.

[10] J. L. Heilbron, 'Fin-de-Siècle Physics' in C. G. Bernhard, E. Crawford and P. Sörbrom, *Science, Technology and Society in the Time of Alfred Nobel* (Oxford: Pergammon Press, 1983), 51–73, 52–57.

[11] Citations from Henry Maudsley, *Natural Causes and Supernatural Seemings* (London: Watts & Co., 1939), 3. This is an abridged reprint of the 1896 edition.

[12] Maudsley, *Natural Causes*, 37.

[13] Ivor Tuckett, 'Psychical Researchers and "the Will to Believe"', *Bedrock* **1** (1912–13), 180–204, 192.

[14] Lord Rayleigh to Henry Sidgwick, 7 June 1874, cited in Robert John Strutt Fourth Baron Rayleigh, *John William Strutt Third Baron Rayleigh* (London: Edward Arnold, 1923), 66–67, 67.

[15] Oliver Lodge, 'Address', *Report of the Sixty-First Meeting of the British Association for the Advancement of Science* (London: John Murray, 1892), 547–557, 554.

[16] E. E. Fournier D'Albe, *New Light on Immortality* (London: Longmans, Green and Co., 1908), vii.

[17] Clément Chéroux, 'La photographie des fluides: un alphabet de rayons invisible', in Clément Chéroux et al. (eds), *Le Troisième Oeil: La photographie et l'occulte* (Paris: Gallimard, 2004), 114–125; Roger Luckhurst, *The Invention of Telepathy* (Oxford: Oxford University Press, 2002), 135–140; Arne Hessenbruch, 'Science as Public Sphere: X-Rays Between Spiritualism and Physics', in Contantin Goschler (ed.), *Wissenschaft und Öffenlichtkeit in Berlin, 1870–1930* (Stuttgart: Franz Steiner, 2000), 89–126; Allen W. Grove, 'Röntgen's Ghosts: Photography, X-Rays and the Victorian Imagination', *Literature and Medicine* **16** (1997), 141–173; Carolyn Marvin, *When Old Technologies Were New: Thinking About Electric Communication in the Late Nineteenth Century* (Oxford: Oxford University Press, 1988), 56–62; Mary Jo Nye, 'N-Rays: An Episode in the History and Psychology of Science', *Historical Studies in the Physical Sciences* **11** (1980), 125–156, 145–147. For a use of 'occult' sciences see A. P. Sinnett, *The Occult World* (London: Trübner and Co., 1881).

[18] Janet Oppenheim, *The Other World: Spiritualism and Psychical Research in Britain 1850–1914* (Cambridge: Cambridge University Press, 1985), 326–390, 327.

[19] Example of histories of psychical research include Oppenheim, *Other World*, Ruth Brandon, *The Spiritualists: The Passion for the Occult in the Nineteenth and Twentieth* Centuries (London: Weidenfield and Nicolson, 1983), Brian Inglis, *Natural and Supernatural: A History of the Paranormal from Earliest Times to 1914* (London: Hodder and Stoughton, 1977). Examples of histories of physics include Per F. Dahl, *Flash of the Cathode Rays: A History of J. J. Thomson's Electron* (Bristol: Institute of Physics Publishing, 1997), Hugh G. Aitken, *Syntony and Spark: The Origins of Radio* (Princeton: Princeton University Press, 1985) and P. M. Harman, *Energy, Force, and Matter: The Conceptual Development of Nineteenth Century Physics* (Cambridge: Cambridge University Press, 1982).

[20] James Knowles, 'Wireless Telegraphy and 'Brain-Waves'', *Nineteenth Century* **45** (1899), 857–864, 857–858.

[21] [Anon.], 'The New Photography', *Punch* **110** (1896), 45.

[22] James Bixby cited in [W. T. Stead], 'From the Roentgen Rays to the Existence of the Soul', *Borderland* **3** (1896), 319–321, 320.

[23] Fio Hara, 'The Advance of Science Towards Occult Teachings', *Theosophical Review* **37** (1905–1906), 548–554, 550.

[24] [Anon.], 'The British Association', *Light* **29** (1909), 427.

[25] [Anon.], 'Notes', *Electrician* **30** (1892–93), 588; *Popular Science Monthly* cited in Otto Glasser, *Wilhelm Conrad Röntgen and the Early History of Roentgen Rays* (San Francisco: Norman Publishing, 1993), 206; 'Flamel', 'Apparitions lumineuses', *La Nature* **25** (1897), 302–303.

[26] Oliver Lodge, 'The Attitude of Science to the Unusual. A Reply to Simon Newcomb', *Nineteenth Century* **65** (1909), 206–222, 207.

[27] Oliver Heaviside to Oliver Lodge, 11 January 1895 and 26 August 1896, Oliver Lodge Papers, University College London, Add MS. 89/91 and 100.

[28] S. Tolver Preston, 'On the Importance of Experiments in Relation to the Mechanical Theory of Gravitation', *Philosophical Magazine* **3** (Ser. 5) (1881), 391–393, 391.

[29] S. Tolver Preston, 'On the Physics of Thought-reading [1893]', J. J. Thomson Papers, Cambridge University Library, Add 7654 (hereafter 'JJT-CUL'), P45a.

[30] William Crookes, 'Some Possibilities of Electricity', *Fortnightly Review* **51** (1892), 173–185, 176.

[31] S. Tolver Preston to J. J. Thomson, 18 May and 12 June 1893, JJT-CUL, P47–P48. For Thomson's positive views on telepathy see Thomson, *Recollections and Reflections* (London: G. Bell and Sons, 1936), 154.

[32] John J. Cerullo, *The Secularisation of the Soul: Psychical Research in Modern* Britain (Philadelphia: Institute for the Study of Human Issues, 1982), 57–87.

[33] W. F. Barrett et al., 'First Report on Thought-Reading', *PSPR* **1** (1882–83), 13–46, 33; Oliver Lodge, 'Some Recent Thought-Transference Experiments', *PSPR* **7** (1892), 374–382, 376. For Barrett see Richard Noakes, ''The Bridge which is Between Physical and Psychical Research': William Fletcher Barrett, Sensitive Flames, and Spiritualism, *History of Science* **42** (2004), 419–464.

[34] W. F. Barrett, 'Address by the President', *PSPR* **18** (1903–4), 323–350, 333; Oliver Lodge, 'Presidential Address', *PSPR* **17** (1901–3), 1–21, 20.

[35] W. F. Barrett, 'Science and Spiritualism', *Light* **13** (1894), 539–540, 559–561, 571–572, 583–585, 595–597, 572.

[36] For Lodge's psychic uses of the ether see David B. Wilson, 'The Thought of Late Victorian Physicists: Oliver Lodge's 'Ethereal Body'', *Victorian Studies* **15**(1971), 29–45, Peter Bowler, *Reconciling Science and Religion: The Debate in Early Twentieth Century Britain* (Chicago: Chicago University Press, 2001), 95–101 and Richard Noakes, 'Reworking the Wynne Thesis: Ethers, Religion and Politics in Late-Victorian Britain', (forthcoming).

[37] Oliver Lodge, 'Ether, Matter, and Soul', *Hibbert Journal* **17** (1918–1919), 252–260, 258.

[38] Oliver Lodge, *Ether and Reality: A Series of Discourses on the Many Functions of the Ether of Space* (London: Hodder and Stoughton, 1930), 179.

[39] Lodge, 'Ether, Matter, and the Soul', 260.

[40] [Anon.], 'Dr. Fournier D'Albe. Reading by Sound', *Times*, 8 July 1933, 14.

[41] E. E. Fournier D'Albe, *The Electron Theory: A Popular Introduction to the New Theory of Electricity and Magnetism* (London: Longmans, Green, and Co., 1906). For discussion see Graeme Gooday, 'The Questionable Matter of Electricity: The Reception of J. J. Thomson's "Corpuscle" Among Electrical Theorists and Technologists', in Jed Z. Buchwald and Andrew Warwick (eds.), *Histories of the Electron: The Birth of Microphysics* (Cambridge MA: The MIT Press, 2001), 101–134, 120–121.

[42] Fournier D'Albe, *New Light*, viii.

[43] Fournier D'Albe, *New Light*, 87, 90. Fournier D'Albe's emphasis.

[44] Fournier D'Albe, *New Light*, 322.

[45] Fournier D'Albe, *New Light*, 110.

[46] F. J. M. Stratton, 'Review', *JSPR* **14** (1909), 78–79, 79. For the SPR and 'physical phenomena' see Alan Gauld, *The Founders of Psychical* Research (London: Routledge and Kegan Paul, 1968), 200–245.

[47] J. B. Stallo, *The Concepts and Theories of Modern Physics* [1881] (Cambridge MA: Harvard University Press, 1960), 151. For discussion see Moyer, *American Physics*, 3–32.

[48] Oliver Lodge, untitled paper presented on 23 February 1903, published in *Papers Read Before the Synthetic Society 1896–1908* (London: [Synthetic Society], 1909), 385–392, 386.

[49] Oliver Lodge, 'Scope and Tendencies of Physics' in A. G. Sedgwick et al., *The 19th Century: A Review of Progress* (London: G. P. Putnam's Sons, 1901), 348–357, 352, 355.

[50] Lodge, 'Scope and Tendencies', 354; Lodge, 'Address', 554

[51] Lodge, 'Scope and Tendencies', 355.

[52] Oliver Lodge, 'Continuity', *Report of the Eighty-Third Meeting of the British Association for the Advancement of Science* (Lonon: John Murray, 1914), 3–42, 28. A version of Thomson's 'parable' appears in J. J. Thomson, 'Address', *Report of the Seventy-Ninth Meeting of the British Association for the Advancement of Science* (London: John Murray, 1910), 3–29, 11.

[53] Balfour Stewart, 'Address', *PSPR* **4** (1886–87), 262–267, 262; [Balfour Stewart and Peter Guthrie Tait], *The Unseen Universe or Physical Speculations on a Future State* (London: Macmillan and Co., 1875).

[54] W. F. Barrett, 'On Some Physical Phenomena, Commonly Called Spiritualistic, Witnessed by the Author', *PSPR* **4** (1886–87), 25–44, 40. Barrett's emphasis.

[55] For Stewart see Graeme Gooday, 'Sunspots, Weather and the *Unseen Universe*: Balfour Stewart's Anti-Materialist Representations of "Energy" in British Periodicals' in Geoffrey Cantor and Sally Shuttleworth (eds.), *Science Serialised: Representations of the Sciences in Nineteenth-Century Periodicals* (Cambridge: The MIT Press, 2004), 111–148.

[56] Balfour Stewart, 'Note on the Above Paper', *PSPR* **4** (1886–87), 42–44.

[57] W. F. Barrett, 'The Evidence for Spirit Identity', *Light* **13** (1895), 62–64, 74–75, 64; Oliver Lodge, 'Experience of Unusual Physical Phenomena Occurring in the Presence of an Entranced Person (Eusapia Palladino)', *JSPR* **6** (1893–94), 306–360, 357–360.

[58] W. C. D. Whetham, *The Recent Development of Physical Science* (London: John Murray, 1904), 280.

[59] Hara, 'Advance of Science', 552.

[60] Thomson, *Recollections and Reflections*, 147–163.

[61] J. J. Thomson, *On the Light Thrown by Recent Investigations on Electricity on the Relationship between Ether and Matter* (Manchester: Manchester University Press, 1908), 8–10.

[62] George E. Smith, 'J. J. Thomson and the Electron', 1897–1899', in Buchwald and Warwick (eds.), *Histories of the Electron*, 21–76, 55–60. Cf. Jeff Hughes who explains that in 1913 Aston used the term 'meta-neon' to describe a neon-like element for which he had produced evidence in positive ray researches. Aston revealed that his source for the term was Annie Besant and Charles Leadbeater's *Occult Chemistry* (1909), a work embodying the authors' 'astral' means of discerning the inner structure of atoms: Jeff Hughes, 'Occultism and the Atom: The Curious Story of Isotopes', *Physics World* **16** (2003), 31–35.

[63] Thomson, *Recollections and Reflections*, 153.

[64] W. B. Carpenter to Barrett, 2 November 1876, Barrett Papers, Society for Psychical Research Archive, Cambridge University Library, SPR.MS.3, A2/12. On Carpenter see Alison Winter, *Mesmerised: Powers of Mind in Victorian Britain* (Chicago: Chicago University Press, 1998), 276–305.

[65] W. B. Carpenter, 'Spiritualism', *Spectator*, 14 October 1878, 1282–1283, 1283. Carpenter's emphasis.

[66] Charles A. Mercier, *Spiritualism and Sir Oliver* Lodge (London: The Mental Culture Enterprise, 1917), 69–70.

[67] William Crookes, 'Spiritualism Viewed by the Light of Modern Science', *Quarterly Journal of Science* **7** (1870), 316–321, 319.

[68] W. F. Barrett, *On the Threshold of a New World of Thought* (London: Routledge and Kegan Paul, 1908), 91.

[69] Lodge, 'Experience of Unusual Physical Phenomena', 324.

[70] Barrett, 'Science and Spiritualism', 585.

[71] Richard Noakes, '"Instruments to Lay Hold of Spirits": Technologizing the Bodies of Victorian Spiritualism', in Iwan Rhys Morus (ed.), *Bodies/Machines* (Oxford: Berg, 2002), 125–163.

[72] Docteur Bonnaymé, *La Force Psychique: L'Agent Magnétique at les Instruments servant à les mesurer* (Paris: Libraire du Magnétisme, 1908); Hereward Carrington, *Laboratory Investigations into Psychic Phenomena* (London: Rider & Co., 1939), 25–111. For discussion see Sophie Lachapelle, 'A world outside science: French attitudes toward mediumistic phenomena, 1853–1931' (unpublished PhD dissertation, University of Notre Dame, 2002, AAT 3059400), pp. 122–153.

[73] [Anon.], 'New Photographs of Psychic Radiations', *Light* **17** (1897), 283–285. For discussion see Chéroux, 'La photographie des fluides'.

[74] See, for example, William Crookes, 'On the Supposed "New Force" of M. J. Thore', *Philosophical Transactions of the Royal Society of London* **178** (1888), 451–469; F. J. M. Stratton and P. Phillips, 'Some Experiments with the Sthenometer', *JSPR* **12** (1906), 335–339.

[75] Lodge, 'Experience of Unusual Phenomena', 359.

[76] On Wood see William Seabrook, *Doctor Wood: Modern Wizard of the Laboratory* (New York: Harcourt, Brace and Company, 1941) and Nye, 'N-Rays', 141–143.

[77] R. W. Wood et al, 'Report of an Investigation of the Phenomena Connected with Eusapia Palladino', *Science* **31** (1910), 776–780, 779–780. See also Seabrook, *Doctor Wood*, 246 and Hereward Carrington, *Personal Experiences in Spiritualism* (London: T. Werner Laurie, [1914]), 218–219.

[78] Fritjof Capra, *The Tao of Modern Physics: An Exploration of the Parallels Between Modern Physicss and Eastern Mysticism* (London: Fontana Paperbacks, Revised Edition, 1983), 336–337.

[79] John Brooke and Geoffrey Cantor, Reconstructing *Nature: The Engagement of Science and Religion* (Edinburgh: T. & T. Clark, 1998), 75–94.