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SPOTLIGHT ARTICLE

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"A many-sided crystal": Understanding the manifold legacy of Silvanus Phillips Thompson (1851–1916)

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SPOTLIGHT SECTION
Silvanus P. Thompson: Quaker polymath and public scientist-engineer

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Abstract

Was Silvanus Phillips Thompson primarily a physicist, electrical engineer, biographer, or teacher? His obituarists could not agree. I argue Thompson was in fact a polymathic generalist who, as a philanthropic Quaker, worked not to promote his own expertise but rather to ensure the public was swiftly informed of the most important techno-scientific research and applications of his contemporaries. I illustrate this in a comparison of Thompson and his longer-lived friend Oliver Lodge: working in closely-related areas, they had contrasting profiles and commitments. After inspecting Thompson's work as textbook author and bibliophile, I resolve his apparently paradoxical status as both radical critic and figurehead of multiple institutions. Finally, to flesh out his friends' representation of him as a "many-sided crystal," I analyse Thompson's multi-facetted posthumous reputation, especially in reviews of the *Life and Letters* written by his widow Jane and daughter Helen exactly 100 years ago.

KEYWORDS
legacy, polymath, public benefit, Quaker, specialisation, Silvanus P. Thompson, textbooks

> "… an all-round physicist, of a type that is certainly not increasing in numbers"
> *The Times* June 1916 obituary of S. P. Thompson.[1]
> "… a high authority on electrical engineering, and his Cantor lectures in 1883 were a revelation to the engineering world as to the construction, theory, and mode of working dynamo-electric machinery."
> Royal Astronomical Society obituary of S. P. Thompson.[2]
> "His Life of Lord Kelvin, 1910, has taken its place as one of the few really great English biographies"
> Royal Society obituary of S. P. Thompson.[3]

In an era of global crises exacerbated by populist questions concerning the trustworthiness of techno-scientific expertise, what can we learn about how public trust in scientific authority was accomplished in the past? Trust in the leadership of scientists has evidently been secured not just by citation of their esoteric research results, but by qualities of public performance.[4] In this regard, the posthumous transnational legacy of the British Quaker Silvanus Phillips Thompson deserves extensive re-examination. As Hannah Gay and Anne Barrett have shown, Thompson's unusually broad-ranging career in late 19th- and early 20th-century techno-science actively eschewed the research specialisation and unworldly abstraction once taken for granted as core issues by historians of science; indeed, no specific accomplishment by Thompson appears in textbooks today. Instead, Gay and Barrett astutely focus on how Thompson's importance for his *fin-de-siecle* contemporaries related less to any stereotype of the heroic scientific discoverer or inventor, but rather to him as a unifying figure who served the needs of various public constituencies—albeit with some idiosyncratic bibliophile interests. While Gay and Barrett rightly stress that much of Thompson's public-minded imperatives came from his Quakerism, they still refer to him specifically as a "scientist"—a term that he rarely, if ever, used for himself.[5] There is thus a deeper set of questions to explore about both how to capture Thompson's self-identity and—since Gay and Barrett do not explicitly discuss Thompson's posthumous legacy—the significance of his career for the present day.

Building on the insights of Gay and Barrett's study, in this paper I suggest that Thompson's interest for the 21st century is his focus on public service rather than personal fame, or any putative role as a "scientist." As a committed if somewhat liberal Quaker, Thompson set out to follow a different model to his contemporary and friend Oliver Lodge—a role that, for Thompson, involved shunning self-glorification and the competitive race for priority. This mode of public-centred life is thoroughly documented by his widow Jane and daughter Helen in writing their wide-ranging but unsentimental *Silvanus Phillips Thompson: Life and Letters*. Published 4 years after his death, it reveals both their commitment to supporting Silvanus in the public life of useful and earnest techno-science, and also the international scope of his trustworthy reputation, greatly facilitated by his fluent command of no fewer than five languages: English, French, German, Italian, and Latin.[6] Since this 1920 family biography also covers in detail Thompson's record of published research, ranging across sound, light, electromagnetism, and machinery—these topics so well discussed by Gay and Barrett and by Arapostathis and Guagnini in this volume—such topics do not need detailed attention here.[7]

Instead, this paper develops for the first time a deeper account of his reputation in terms of the public identity in posthumous legacy suggested in the *Life and Letters* but not examined by Gay and Barrett. This account can explain how and why, in the decade after his death, Thompson's public role as "a many-sided crystal" (a term acknowledged but not developed by Gay and Barrett) was so deeply cherished and in what ways it was sustained in constituencies much more committed to specialisation than was Thompson. Ironically, at the time of his passing

[1]Anonymous (1916, p. 8).
[2]Anonymous (1917, p. 305).
[3]Perry (1919, p. xvii).
[4]Huber, Barnidge, Gil de Zúñiga, & Liu (2019).
[5]Gay & Barrett (2002).
[6]J. S. Thompson & H. G. Thompson (1920). These points of family life and internationalism are not covered extensively in Gay and Barrett's piece.
[7]See Arapostathis & Guagnini (2021).

in 1916, the techno-scientific imperative to specialisation reinforced by the Great War's many challenges is reflected in obituarists' focus on particularised facets of Thompson's rich, multi-dimensional career.

For the London *Times*, Thompson belonged to a vanishing breed of all-round, genteel physicist. By contrast, the Royal Astronomical Society saw him primarily as a "high" authority on electrical engineering, especially in public communications. Then again, the Royal Society chose to highlight his skill in writing biographies of Michael Faraday and (especially) Lord Kelvin. Certainly the obituary representations cited above give us pause when we consider that the only book-length study of Thompson in the last century is barely more than a pamphlet in length, and casts him largely as an educator.[8] Fortunately in this century, Gay and Barrett have valuably explained why and how Thompson was represented in manifold other ways by his contemporaries.[9] For them, he was a cultured humanitarian with a career trajectory embracing many more obligations than either his personal research or the teaching—from 1885 until his death three decades later—of the industrially focused technicians that filled Thompson's classrooms at Finsbury Technical College.

To clarify the scope of Thompson's polymathic public activities—captured neither in Greig's depictions of him as an educator nor in Gay and Barrett's titular reference to his "scientific career"—let us compare two major episodes in public communication in the 1890s in which Thompson features very prominently: the physics of music and the launch of radiology as a clinical subject. Neither episode has been addressed previously in less-inclusive narratives of Thompson's life, nor have previous historians (including Gay and Barrett) noted his interest in patenting as one trigger in his move to the history of science.[10]

In June 1890, Thompson introduced to large-scale British audiences the works of the reclusive, German-born and Paris-based acoustician and instrument-maker, Rudolph Koenig. Lecturing "On the Physical Foundation of Music" at the prestigious Royal Institution of Great Britain in London, Thompson showed with numerous practical demonstrations how Koenig's intensive quarter-century of researches on tuning forks and allied sonic apparatus facilitated a highly accessible fundamental account of how music was generated and perceived by the ear.[11] As a physicist, amateur musician, and patentee of telephonic apparatus, Thompson was very well-placed to present this material to the world. And when Wilhelm Roentgen produced his first evidence of the shadows created of living-body bone tissue 5 years later, it was Thompson again who took on the task of delivering an experiment-based explanation to the wider British public in another Royal Institution Lecture in May 1896, followed by a full series of Christmas lectures there later that year. Generalising beyond immediate epistemic novelties, Thompson's widely-read publication of this lecture series, *Light Visible and Invisible* of 1897, ranged across the electromagnetic spectrum with lucid narratives in optics, theories of light, experimental demonstrations, and potential applications of what were soon named X-rays.[12] While revealing his skills in the inter-related areas of physics, physiology, and photography, this was not Thompson's self-promotion, but rather a judicious exegesis of major fellow-experimenters in those fields.

In the late 19th-century British context, Thompson was, to say the least, unusual in demonstrating such an apparently selfless determination to promote the physics and engineering work of others to the public; even while Gay and Barrett address his Quaker imperatives, they do not discuss this specific feature of Thompson's determination to bring the benefits of science to the widest possible audience. It would be anachronistic, however, to analyse directly the extraordinary breadth of Thompson's work within the 21st-century framework of "interdisciplinarity." That category, after all, had to be invented to heal the fragmentation and narrowing of academic scholarship once it had lost the kind of breadth that Thompson had manifested more than a century ago. Nevertheless, to effectually explore Thompson's extraordinary array of activities with due sympathy, we can follow Gay and Barrett by drawing

[8]Greig (1979).

[9]Gay & Barrett (2002).

[10]In response to a referee's helpful mention of other polymathic figures in the 19th-century physical sciences—Thomas Young, Fleeming Jenkin, and Hermann von Helmholtz—I do not claim that Thompson was necessarily unique in his breadth of interests. But after Helmholtz's death in 1894, Thompson was one of the few remaining practitioners in the field who resisted the trend toward narrow specialisation in specific areas of the physical sciences.

[11]S. P. Thompson (1890); J. S. Thompson & H. G. Thompson (1920, p. 159).

[12]S. P. Thompson (1897); J. S. Thompson & H. G. Thompson (1920, pp. 184–198).

inspiration from the kind of extensive interdisciplinary treatment recently given to his friend and regular correspondent Oliver Lodge—one needing historians, theologians, and literary scholars to unravel.[13] From a comparative perspective it is useful to show how Thompson's work can be re-inserted productively into contemporary historiography of science, just as Lodge's has been—uncoupled from the latter's somewhat selective and self-vindicating autobiography *Past Years*, and re-acquainted with Thompson's more utilitarian practices as public authority figure.[14]

In what follows the extension of Gay and Barrett's comparative discussion of Lodge and Thompson will be a springboard, premised on their close working relationship and friendship. Augmenting Gay and Barrett's survey of Thompson's work as an accomplished textbook author and bibliophile, I then look at the apparently paradoxical status he had as both radical and figurehead of multiple institutions – a topic that no previous historian has noted. Then exploring in greater depth Thompson's representation as a 'many-sided crystal' by fellow members of the Odde Sette of Volumes (a major bibliophile group) in 1904, I look at how Thompson's reputation was dealt with in the immediate aftermath of his death. That way we can see more easily both how Thompson's multi-facetted reputation was both challenging to capture by those who survived him, not least his obituarists and how that inflected reviews of the *Life and Letters* written by his widow Jane and daughter Helen a hundred years ago.

1 | THE THOMPSON-LODGE-CONNECTION AND COMPARISON

A comparison between Silvanus P. Thompson and Oliver Lodge (that is partly developed by Gay and Barrett) is very revealing, since in many respects they had much in common and were both good friends and professional allies.[15] Yet there were crucial differences in their career goals and deportment, which perhaps goes some way to explaining the differences in their longer-term reputations. Both were born in the year of the Great Exhibition, and both were educated in physics and chemistry in 1870s London. While Thompson learned rather more than Lodge did from attending classes of the experimental-chemist-turned-physicist Frederick Guthrie, only recently recognised is that Thompson's and Lodge's first major encounters were in the meetings of the Physical Society of London launched in Guthrie's South Kensington laboratory in 1874.[16] Each became eminent early as provincial professors of physics with strong public-speaking profiles, Thompson in Bristol (1876–1884) and Lodge in Liverpool (1881–1900). Part of their eminence came from applying their expertise in electromagnetism to explain the new communications technologies of the day, telephony for Thompson and telegraphy for Lodge (both submarine cable and wireless varieties).[17] Each had significant family or paternal responsibilities, and took out patents and published best-selling books to help to pay for their children's education.[18] It is clear in turn that the families (spouses and some offspring) respectively helped Thompson and Lodge to achieve their multifarious successes in writing and other endeavours. Yet Oliver Lodge has been remembered and written about more substantially, and only in part because he lived 24 years longer than Thompson, dying in 1940 with a separately published bibliography numbering over 1100 items—almost 10 times the scale of Thompson's output.[19]

While neither was born in conventionally privileged metropolitan elites, one critical difference lay in Thompson's Quaker roots, as emphasised by Gay and Barrett. Whereas Lodge was born into a large, liberal, Anglican dynasty in the Midlands, and always sought to show how his all-encompassing ecumenical vision of science and spiritualism

[13]Mussell & Gooday (2020); Gay & Barrett (2002, pp. 153–154, 157, 159, 174–176).
[14]On Lodge's selective construction of his identity in *Past Years*, see Mussell & Gooday (2020, pp. 21–38); Amigoni (2020). It should added that *Past Years* makes very little reference to the extensive letters concerning Lodge's commercial patenting activities with Alexander Muirhead documented in MS ADD 89, UCL Archives, London, England, and Arapostathis & Gooday (2013, pp. 147–149).
[15]Thompson's middle name "Phillips" differentiated him from his father, Silvanus Thompson.
[16]Gooday (2020). See Lodge's reminiscences in Lodge (1897).
[17]Noakes (2013).
[18]Gay & Barrett (2002, p. 169).
[19]Besterman (1935).

was compatible with many ideologies and walks of life, Thompson's career was dedicated more specifically to cultivating the open and earnest principles of the Society of Friends. Born on June 19, 1851 to a Quaker family in York, Thompson followed his father early into a teaching career at the (Quaker) Bootham School in that northern city; thereafter for much of his life, the Quaker environment was the centre of his universe. Nevertheless, as Greig and Cantor both point out, Thompson was not a conventional Quaker—attending evensong at York Minster, performing music domestically, painting extensively, and seeking a career in teaching the physical sciences. In the early 1870s, physics was not the obvious discipline to pursue Quaker prerogatives for benevolent humanitarian endeavours, just as it was not the self-evident environment for Lodge to nurture his developing socialist commitments. As Cantor emphasises, Thompson was the only 19th-century Quaker other than Joseph Dalton to become an experimental physicist and engineer: all his contemporaries focused on the botanical or medical sciences or—most unusually—became theoretical physicists like Arthur Eddington.[20]

Even as Thompson left for a lectureship in physics at University College, Bristol in 1876, Lodge and Thompson continued to collaborate on practically useful apparatus for demonstrations as encouraged by the recently launched Physical Society, also publishing together in the *Philosophical Magazine* on tourmaline crystals.[21] As their careers developed, the electrical telecommunications industry grew; Thompson took up telephony and binaural audition as practically oriented research topics, while Lodge pursued telegraphy. In relating the motion of electricity to Hertzian waves and its relation to the electromagnetic ether in a theoretical fashion, Lodge created the kind of large metaphysical overview that Thompson never attempted. As a Quaker, Thompson's primary commitment was not to abstract metaphysical speculation, but to work of immediate practical human value, especially in communicating the work of others.[22] Thus from 1885, Thompson devoted himself less to physics and more to electrical engineering as principal and professor of electrical engineering at the (City- and Guilds-sponsored) Finsbury Technical College in London, as is covered well by Greig and Gay and Barrett, so no further discussion is needed here.[23]

Such was his eminence, both in electrical engineering and in his Quaker life, that in 1899 Thompson was elected president of the Institution of Electrical Engineers (IEE, now the IET) and in 1903 became a minister of the Society of Friends, working to persuade Quakers of the need to embrace science.[24] Correlatively, although Lodge never served as president of the IEE, he did rise to serve as Principal of the newly constituted University of Birmingham in 1900 until retiring in 1919. Thus each lived in comparative eminence and comfort in their later years. At the peak of their careers, both Thompson and Lodge had very strong public profiles, giving lectures and writing many books both on technological matters (also taking out numerous patents—see Arapostathis and Guagnini in this volume) and on the deeper questions of human existence as informed by their researches.[25] Lodge's writing on the ether presented it as the route to all human and epistemic issues, including the afterlife; seeking no similar celebrity nor promotion of a personal metaphysics, Thompson busied himself both with addressing the core issue of reconciling Quakerism to a secularising techno-scientific world, and with presenting to non-Quakers the results of others' research.

Lodge latterly (in the 1920s and 1930s) cultivated a celebrity status by integrating his ether theories, with wireless communication and spiritualist discussions of the afterlife in the new medium of radio further supported by the publication of a self-vindicating autobiography, *Past Years*, in 1931 to reclaim his role in the invention of wireless telegraphy.[26] By contrast, Thompson's Quakerist project shunned celebrity in favour of dedicating his skills to whichever of a very wide range of issues of justice or public benefit he was called upon to apply his interrogative and or leadership skills.[27] Thompson thus held the presidencies of the Institution of Junior Engineers (1890), the Roentgen

[20]Cantor (2005, p. 237); Stanley (2007).
[21]S. P. Thompson & Lodge (1879); S. P. Thompson (1880).
[22]In this regard, Arthur Eddington was most unusual as a Quaker in pursuing a career as theoretical physicist. See Stanley (2007).
[23]Greig (1979); Gay & Barrett (2002).
[24]Cantor (2005, pp. 262–263).
[25]See Arapostathis & Guagnini (2021).
[26]Lodge (1931). On Lodge's construction of his autobiography, see Mussell & Gooday (2020, pp. 21–38).
[27]Thompson was unusual among Quakers in dedicating himself to the physical sciences; botanical or medical studies were much more common: Cantor (2005, pp. 94–95).

Society (1897), the Institution of Electrical Engineers (1899), the Physical Society of London (1901–1902), the Optical Society (1905), and the Society of Illuminating Engineering (1909).[28] While his London residency made such a breadth of representation logistically easier than for Lodge in Liverpool and Birmingham, few among the *fin-de-siècle* practitioners of any kind of science or engineering based in Britain's capital ever took on such diverse roles. Thompson chose to prioritise public duty over his personal research interests.[29]

In the midst of this, Thompson's pursuit of critical historical writing on technology and technologists (informed by his huge historic book collection and leadership of the Odde Sette of Volumes from 1905) enabled him in 1912 to support Lodge's successful claims to extend his wireless tuning patent of 1897, for which Lodge had been insufficiently rewarded in the multi-person invention of wireless telegraphy.[30] That episode illustrates the significance of the Lodge–Thompson symbiosis, with Lodge's fame enabled by Thompson's righteous and meticulous historical documenting of priority in invention.[31]

By coincidence, each died during a period of major national crisis: Thompson in the First World War (1916) and Lodge in the Second World War (1940). Lodge was very active in World War I as a member of the Royal Society committee, and afterward in the spiritualist consolation of the millions bereaved by the 1914–1918 conflict.[32] By contrast, Thompson, as a Quaker, was committed to non-participatory pacifism, attempting to prevent the conscription of his students and staff once war contributions ceased to be voluntary for young British men in 1916. Thompson's early death that year led to much formal commemoration of him, both at the time and once the hostilities of the First World War had ceased. By contrast, Lodge's death at the age of 89 did not prompt similar commemoration, although his name was kept in the public domain by a cultish legacy of spiritualism and multiple eponymous companies run by his children.[33] For the case of Thompson, I next explore his legacy of very readable textbooks in electrical engineering (see Arapostathis and Guagnini's paper on this as his adopted field of expertise), which were celebrated both in his lifetime and afterwards, exemplifying his commitment to communicating useful knowledge as widely and efficaciously as possible.[34]

2 | THOMPSON AS TEXTBOOK WRITER AND BIBLIOPHILE

As Gay and Barrett have noted, one of Thompson's most obvious legacies are the books that he wrote himself, and those of others that he collected in his stupendously large personal library.[35] Both have endured to keep his name in the consciousness of different sections of the reading public. According to his Royal Astronomical Society obituarist, the total sales of Thompson's books numbered over 100,000.[36] His own monographs fall mostly into two categories: textbooks and biographies, with a later focus in a third category on the reconciliation of Quaker principles with the natural sciences. Since the biographies are addressed by Geoffrey Cantor, and the latter by Matt Stanley, I will focus mostly on Thompson's textbooks, not least because it is yet another contrast with Oliver Lodge whose treatises were not generally written to meet curricular needs (with the exception of Lodge's *Elementary Mechanics* [1879]). [37] Again in contrast to Lodge, Thompson's famed fluency in French, Italian, and German (and in Latin) enabled him not only to

[28]By contrast, Lodge took only the presidency of the Liverpool Physical Society in 1889–1893, of the Physical Society of London in 1897, and of the British Association for the Advancement of Science in 1912–1913: Lodge (1931).
[29]The most widely appointed institutional head in engineering and the physical sciences was probably Lord Kelvin, who held presidencies of the British Association for the Advancement of Science, the Royal Society of Edinburgh, the Royal Society of London, Mathematical Society of London, the Institution of Electrical Engineers, the Physical Society of London, the Institution of Marine Engineers, and the Faraday Society of (London). See S. P. Thompson (1910, Vol. 2, pp. 1216–1222).
[30]S. P. Thompson (1911).
[31]Arapostathis & Gooday (2013).
[32]Arapostathis & Gooday (2013, pp. 202–211).
[33]Mussell & Gooday (2020).
[34]See Arapostathis & Guagnini (2021).
[35]Gay & Barrett (2002, pp. 154, 166, 170, 175, 182–185).
[36]Anonymous (1917).
[37]Lodge (1879).

read more widely than many, but also as an internationalist to translate and publicise works of meritorious scholars outside Britain. As his friend and Royal Society obituarist observed, Thompson "was probably, in his time, the very best expositor of the work of others"—a key observation at the heart of this paper's interpretation.[38]

Substantial support for educational endeavours was a mainstream public role for Quakers, who as a group were dedicated to public beneficence. The educational focus of much of Thompson's writing reflected a pattern in his original research: of his 166 "important" original papers, many concerned "the discovery of new experimental illustrations of physical laws."[39] Notably, this focus on useful pedagogical apparatus and its deployment was also the focus of the Physical Society of London, of which Thompson was an early participant and president in 1902.[40] Thus we can see why, when not writing biography or Quaker reflections, his books were written for students or about their educational needs:

Thompson's Commercially Published Books (excluding those published privately—see below)
1879 *Technical Education* (Bristol: T. Kerslake, 1879; London, England: Hamilton, Adams, 1879)
1881 *Elementary Lessons in Electricity and Magnetism* (7 eds.; London, England: Macmillan, 1881)
1883 *Life of Philipp Reis, Inventor of the Telephone* (London, England: E. & F. N. Spon, 1883)
1884 *Dynamo-electric Machinery* (7 eds.; London, England: E. & F. Spon, 1884)
1890/91 Translation of Guillemin's Physique (*Electricity*) (London, England & New York, NY: Macmillan 1891)
1891 *The Electromagnet and Electromagnetic Mechanisms* (London, England: E. & F. N. Spon, 1891)
1895 *Polyphase Electric Currents* (London, England: Spon; New York, NY: Spon & Chamberlain, 1895)
1896 *Light Visible and Invisible* (London, England: Macmillan, 1897)
1898 *Life of Faraday* (London, England & New York, NY: Cassell, 1898)
1900 *Photographic Optics* (From the German of Otto Lummer) (London, England: Macmillan, 1900)
1900 *Notes on the Translation of Gilbert's De Magnete* (London, England: privately printed, 1901)
1903 *Design of Dynamos* (London, England: Spon, 1903)
1906 *The Manufacture of Light* (London, England & New York, NY: Macmillan, 1906)
1910 *Life of Lord Kelvin* (2 Vols.; London, England: Macmillan, 1910)
1910 *Calculus made Easy* ("by F.R.S.") (London, England: Macmillan & Co, 1910)
1912 *Translation of Huyghens' Treatise on Light* (London, England: Macmillan, 1912)
1915 *The Quest for Truth* (London, England: Headley Brothers, 1915)
1918 *A Not Impossible Religion* (posthumous) (London, England: John Lane, The Bodley Head, 1918)

In his obituary, Perry notes that *Elementary Lessons in Electricity and Magnetism* was particularly successful, running to 40 international editions in translation and reprints.[41] The preface to the 1915 edition reveals the role of Helen Thompson (who had studied natural sciences at the University of Cambridge) as one of several who helped Thompson to keep the *Lessons* up to date as electron-based interpretations brought new interpretations of how to teach the subject. Revealingly, *Elementary Lessons* was so valued by its publisher, Macmillan, that a posthumous edition was produced in 1921.[42]

Thompson's longest-lasting work, still in print today—but mentioned only in a footnote by Gay and Barrett—was characteristically not in his predominant areas of electromagnetism or acoustics, but a pedagogical treatise on the mathematics of calculus. According to Helen and Jane Thompson, Thompson initially invented a "new" and cheerfully irreverent way of presenting the subject to meet the needs of Finsbury Technical College's electrical and mechanical engineering students, who were in want of a speedy and efficient method to grasp calculus as a ready tool in their future professional work. He did so at a time of controversy concerning attempts by reformist Irish engineer John Perry to

[38]Perry (1919, p. xvii).
[39]See listing in J. S. Thompson & H. G. Thompson (1920, pp. 358–366), including addresses to institutional gatherings.
[40]For the Physical Society of London, see Gooday (2020, pp. 257–261).
[41]Translations: German—S. P. Thompson (1887); French—S. P. Thompson (1898a); Italian—S. P. Thompson (1891).
[42]S. P. Thompson (1881), with a final edition in 1921. See the comment below from Elihu Thomson on the canonical nature of this textbook.

reject traditional formal mathematics education in order to make the subject more accessible to the masses. Such was the interest that in 1910 Thompson was persuaded to publish his technique in the wryly colloquial *Calculus Made Easy: Being a Very Simplest Introduction to Those Beautiful Methods of Reckoning Which Are Generally Called by the Terrifying Names of the Differential Calculus*[43] *and the Integral Calculus*. One reviewer believed that this book was worth buying "for the jokes alone"; for example, the prefatory epigraph, "What one fool can do, another can (Ancient Simian proverb)," which was as obviously factitious as it was beguilingly self-deprecating. Thompson avoided controversy on his own part by writing under the pseudonym "F. R. S."; hence many, including Lodge, at first believed Perry to be the author. Thompson's students knew perfectly well who the author was, but generally kept the secret; only after Thompson's death was the second 1914 edition published bearing Thompson's authorship, and it has stayed in print thus ever since.[44] It is symptomatic of Thompson's posthumous career that, although never claiming to be a specialist in mathematics, his most visible legacy was his contribution to making a branch of it accessible to novices across the world.

In understanding Thompson as a public servant rather than a narrow specialist in his authorship practices, it might seem paradoxical that he was also a committed bibliophile regarding books that were neither educational nor up to date, but rather rare historical volumes.[45] But Jane and Helen Thompson highlight the strong literary orientation at the core of his genteel liberality and broad cultural authority: these books were his "friends"—a companionable part of his off-duty life. More than that, his research on techniques for magnetisation naturally took Thompson back to medieval and Tudor treatises on magnet-making. Thus, as a member of in the private book club "The Sette of Odde Volumes," Thompson produced his translations of William Gilbert's *De Magnete* and Peter Peregrinus on the lodestone. His correlative pursuit of Renaissance treatises in magnetism and electricity greatly added to Thompson's personal library.[46] Far from being inconsistent with his Quaker practice, senior Quaker physician Sir George Newman's obituary for *The Friends' Quarterly Examiner* mused: "it was this unique collection which oftentimes furnished Prof. Thompson with the material for those delightful papers and brochures, biographical or other, with which he regaled first this learned society and then that."[47] This library was thus the resource that underpinned Thompson's polymathic authority to multiple institutional audiences. We shall see below, therefore, that the ultimate fate of Thompson's extraordinary personal library was a major issue in his posthumous commemoration. But before that, let us consider how institutional leadership was a major part of Thompson's commitment to public service.

3 | THE PARADOX OF THOMPSON AS RADICAL AND INSTITUTIONAL FIGUREHEAD

While harder for the historian to reconstruct than the resilient legacy of his books, during the latter part of his career, markers of Thompson's public service and broad-ranging authority in the sciences and engineering can be found in the diversity of organisations for which he was elected or appointed president. His eligibility for these roles was enhanced by election as a Fellow of the Royal Society in 1891 in recognition of his electrical researches. Excluding literary, artistic, and religious organisations, these were the bodies for which he was president:

Institution of Junior Engineers, 1890
Roentgen Society (founding President), 1897
Institution of Electrical Engineers, 1899
Physical Society of London, 1901–1902
Optical Society, 1905

[43]Thompson, S. P. ['F.R.S.']. (1912).
[44]J. S. Thompson & H. G. Thompson (1920, pp. 138–141).
[45]Lodge instead wrote and collected according to his spiritualist interests: Besterman (1935).
[46]Thompson & Thompson (1920, p. 358). Gay & Barrett (2002, pp. 177–178), but note that the first word of the quaintly idiosyncratic "Odde Sette of Volumes" is erroneously given by Gay and Barrett as "Odd."
[47]Quoted in Perry (1919, p. xviii).

Society of Illuminating Engineering (founding president), 1909[48]

Of course, a handful of Thompson's most eminent contemporaries took on a great number of institutional presidencies for national bodies in the latter part of their carer, notably including Lord Kelvin.[49]

Yet no other contemporary scientist or engineer—certainly not Lodge—was willing to take on the exhausting work of leading such a *variety* of technical organisations. The most significant of these for Thompson's long-term legacy, but least discussed by previous historians (such as Greig), was his founding presidency of the Roentgen Society.[50] In the period 1895–1897, Thompson was in fact one of the leading early publicists in Britain for the invisible rays discovered by Roentgen, later dubbed X-rays by Roentgen himself. In his Quaker commitment to maximising the broader benefit of science, Thompson often took it on himself to turn any new knowledge to public utility. Thus, he and his Finsbury assistants from an early stage were intensively involved in researching the nature of these rays with a view to communicating their effects both for medical application and for explanatory display to a general audience. By 1896, Thompson was the leading British authority on X-rays and was invited to give the Royal Institution Christmas Lectures on this topic in 1896 under the title *Light Visible and Invisible*. Soon thereafter these hugely popular lectures were published under that title by Macmillan.[51] Concurrently, a number of London physicians set up a "Roentgen Society" to dedicate research and publicity to the therapeutic and diagnostic powers of X-rays; they unsurprisingly turned to the polymathic Thompson to serve as their founding president in the same year. As we shall see below, the Roentgen Society's appreciation of Thompson continued after his death with a series of eponymous memorial lectures—a form of posthumous identity curiously overlooked by all previous historians of Thompson's career.

In another seeming paradox, Thompson held such major diplomatic roles while also being very outspoken in his public criticism of "Establishment" figures in both commerce and the judiciary. Like Lodge, he took out patents in order (among other reasons) to secure income to support his daughters' education.[52] Passed over largely in silence by Thompson's obituarists, despite being unusual for a Quaker to undertake, his pursuit of intellectual property rights took him to securing 63 sole and joint patents across the whole range of electrical technology.[53] Indeed, Thompson's posthumous wealth was substantial, even after his expenditure on his enormous library and the very public invalidation of his own telephone patent by the aggressive United Telephone Company in 1884.[54] After that unhappy experience and the associated liquidation of the company he set up, Thompson was quick to identify the remarkable (that is, corrupt) alignment of decisions by judges (and lawyers) with the financial interests of the largest commercial telephone companies.[55] Greatly sensitised to priority issues in invention, 10 years later Thompson defended his friend Lodge against Guglielmo Marconi's appropriation of Lodge's 1894 work on the transmission of Hertzian waves.[56] It was thus that Thompson's Quaker pursuit of justice was conjoined both with his historical sensibilities and with the public interest campaign against dangerously monopolistic private enterprise.

As previous historians of Thompson's career have not considered this part of his public profile, it is important to emphasise that he thus became committed to fastidiously checking historical priority claims in innovative electro-technology; this is arguably a more important point for posterity than Thompson's own work in electro-technology. His historical expertise in narrating details of invention was honed again in supporting Lodge's claim in 1910–1912 for compensation for insufficient royalties earned on his tuning patents for wireless telegraphy. The skilful and scholarly historical narrative that Thompson produced to document Lodge's priority against Marconi won Lodge and Thompson a rare victory against that large telecommunications company.[57] Thompson was no nepotist, however. As

[48]J. S. Thompson & H. G. Thompson (1920, p. 248).
[49]See discussion above in regards to S. P. Thompson (1910, pp. 1216–1222).
[50]Rutherford (1918, pp. 75–76), cited in J. S. Thompson & H. G. Thompson (1920, pp. 200–201).
[51]J. S. Thompson & H. G. Thompson (1920, pp. 184–200).
[52]J. S. Thompson & H. G. Thompson (1920, p. 115).
[53]Arapostathis & Gooday (2013). See further discussion in Arapostathis & Guagnini (2021).
[54]Thompson's probate was £8444 5*s*. 7*d*. on July 31, 1916, approximately half a million pounds sterling in today's currency, according to the National Archives currency converter. Gooday & Smithells (2004).
[55]Arapostathis & Gooday (2013, p. 74).
[56]Arapostathis & Gooday (2013, p. 158).
[57]S. P. Thompson (1911); Arapostathis & Gooday (2013, pp. 170–171).

Greig notes, after this favourable judicial judgement, as a true Quaker Thompson was also unsparingly candid in criticising Lodge's writings on patent law reforms and the Great War.[58] While inconvenient for his targets, Thompson's refusal to allow untruths or injustices to pass without comment won him much public trust—a characteristic by no means so prominent in other public authority figures.

Similarly, with a Quaker commitment to combating manifest injustice, Thompson was earnestly engaged in the cultivation of equal rights for women, especially equal participation in science and engineering. Gay and Barrett note that Thompson supported two daughters through higher education: a University of London Bachelor of Science for Dorothea (sanitary inspector), while Helen went on to study natural sciences at the University of Cambridge.[59] While Gay and Barrett also note that Hertha Ayrton's research on the electric arc helped Thompson to campaign for women to be allowed to join committees of the British Association for the Advancement of Science, we surely need to add that Thompson's support for gender meritocracy extended to him acting decisively, as President of the Institution of Electrical Engineers in 1899, to facilitate Hertha Ayrton's election to full IEE membership—the first woman to be granted that status. At the same time, he promoted the published research of Hertha Ayrton's friend, Marie Sklodowska-Curie, on which magnetic steels were the best for making "permanent" magnets.[60] While not explicitly acknowledging this feminist activity in Thompson's lifetime, his systematic Quaker commitment to meritocracy is perhaps implicit in the most famous affectionately satirical representation of him as a "many-sided crystal." Since Gay and Barrett's reproduction of this illustration does not extend to exploring the significance of its metaphorical power, the next section explores the value of this representation in capturing both how his contemporaries saw him and also how his posthumous representation was constructed.[61]

4 | THE "MANY-SIDED CRYSTAL": THOMPSON'S POSTHUMOUS REPUTATION

A key theme underpinning this collective volume (as already observed also by Barrett and Gay, Cantor, and Greig) is Thompson's broad expertise across many domains. This quality stemmed not only from his liberally broad interests, but also his imperative to engage with whatever important new topic needed public explication. Thus, to a degree unusual even for a Quaker, Thompson was a polymath in an era when disciplinary specialisation was manifest in greater specificity in both university courses and technical journals.[62] Arguably, Thompson's public authority rested on his sheer breadth of knowledge, rather than on any deep specialisation. So when Thompson was elected in 1904 to the "Oddship" (presidency) of the "Odde Sette of Volumes," his fellow artist John Hassall amiably caricatured the magnetic expert, "Brother Magnetizer" Thompson, as a "Many-Sided Crystal—Very Rare."[63] This representation wryly captured his manifold facets of achievement, embedded elegantly into a tourmaline crystal of the kind that he and Lodge had researched in 1878 (Figure 1).

Thompson had published several times on tourmaline in preceding decades, including early on with Lodge in 1878–1879, and had become associated with this and other demonstrations of evocative optical and electrical and/or magnetic properties in the meantime. Suffice to say that, whereas Lodge's multi-facetted activities were united by common substantive themes of the ether, spiritualism, and communication, Thompson's endeavours appeared more miscellaneous and less connected to at least some of his contemporaries.[64] They were united, of course, in Thompson's ability to communicate almost any topic in the physical and engineering sciences more effectively than any of his contemporaries. While this crystalline caricature remained a private joke among members of

[58]Greig (1979, pp. 54–55).
[59]J. S. Thompson & H. G. Thompson (1920, pp. 195, 206–207, 214, 341–343); Gay & Barrett (2002, p. 178).
[60]Gooday (2009, pp. 67–80).
[61]Gay & Barrett (2002, p. 182).
[62]For discussion of the shifting dynamics of celebrity in engineering and the natural sciences in the early 20th century, see MacLeod (2007).
[63]J. S. Thompson & H. G. Thompson (1920, pp. 249–252).
[64]Mussell & Gooday (2020).

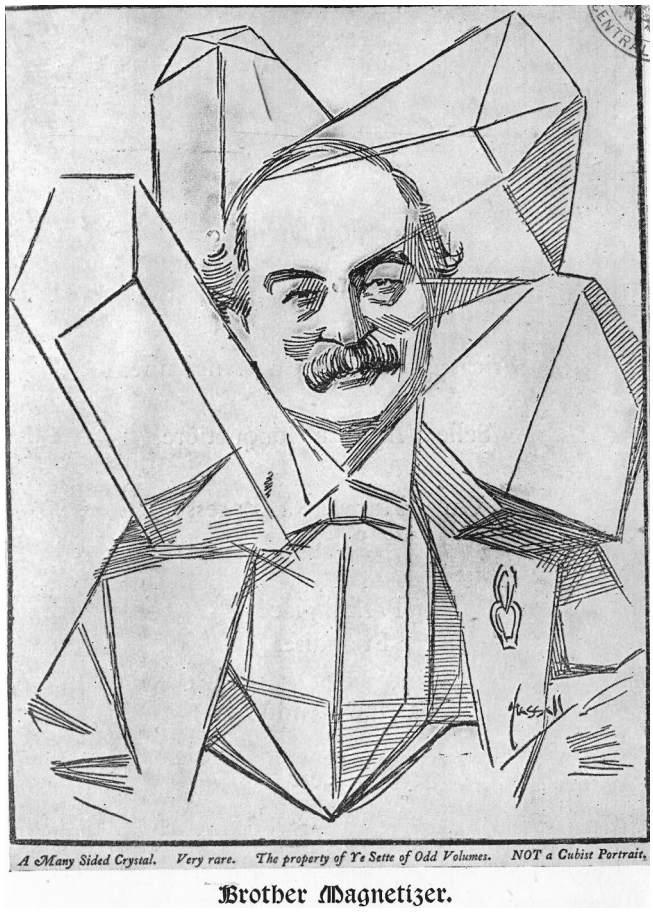

FIGURE 1 "Brother Magnetizer: A Many-Sided Crystal Very Rare…" by John Hassall (1868–1948). From *Silvanus Phillips Thompson: His Life and Letters* (p. 252) by J. S. Thompson & H. G. Thompson, 1920, London, England: T. Fisher Unwin. Artwork is in the public domain

the Odde Sette of Volumes for the remainder of Thompson's life, his widow and daughter saw it as a helpful diagnostic tool in understanding the complexity of his legacy. I next discuss why, following his premature death in June 1916, Thompson's contemporaries wrote obituaries that drew highlights from his achievements in such different ways.

The First World War brought the greatest challenges of Thompson's career, in part owing to the intense anti-German animosity that generated tensions for the scientific community as well as for him personally. Moreover, as a devout Quaker, his opposition to any participation in warfare propelled him to protect his own students at Finsbury from any prospect of military service. Following the tragic demise of the brilliant physicist and physical chemist Henry Moseley in 1915, research chemists had won at least a reprieve from battlefront duties.[65] When compulsory conscription of young men to the armed forces began the following year, Thompson was thus able to prevent some Finsbury chemistry students from being dragooned into combat. But he was distressed at being unable to save students and valued assistants in engineering from military service. As Jane and Helen Thompson wrote of his final months in 1916, "grief and worry and overwork told on him severely." After another unsuccessful attempt one

[65]MacLeod, Egdell, & Bruton (2019).

Saturday he returned home, disappointed and exhausted. Early the following morning he suffered a brain haemorrhage and died on Monday, June 12, a few weeks before his 65th birthday.[66]

It was an indication of Thompson's high standing in the scientific community, as well as literary and artistic circles, that even in the middle of the harshest phase of conflict, many attended the memorial meeting held for him at the Quaker Westminster Meeting House.[67] Representatives attended from all the societies for which Thompson had worked. When we look at the 1916 obituaries—see the epigraph for this paper—we see the multi-facetted categorisation that epitomises Thompson's multi-dimensional persona as a "distinguished physicist … of the 'all-round' type," as an authority in electrical engineering, and as a skilled biographer. Each obituarist privileged a different facet of the rare crystal of Thompson's reputation.

This diversity of views was echoed in 1920 in response to *Silvanus Thompson: His Life and Letters*, produced by Jane and Helen Thompson from 4 years of work. But written more in the style of a conventional "Life and Letters" than a strict Quaker analysis, it more revealed the affection in which Thompson was held by his family than it offered any criticisms of his flaws. This appealed to the *Physical Review* reviewer who, describing him as "one of the pioneers in electrical engineering and applied physics," praised the narrative "full of personal touches" that would appeal especially to those who "had the good fortune to know Professor Thompson."[68] It was also reviewed positively by *The Bookman*, which assessed his Faraday and Kelvin volumes as "two examples of the very best kind of biography."[69] In *The Times*, we read instead that Thompson's "principal service to science was his wonderful aptitude for teaching and popular exposition." However, *The Times* also critically noted his outspoken public disagreements on educational matters, which he pursued with "perhaps more ardour than prudence, especially his vision that London University would become a teaching body rather than merely serving to examine.[70]

A somewhat harsher critic for *The Athenaeum* in March 1920 revealingly downgraded Thompson's significance to being just "A Popularizer of Science." While clearly Thompson had "exceptional abilities" in many respects, this reviewer claimed he had "no predominant ability" in any of the sciences. When compared to the publications of Lord Kelvin, Lord Rayleigh, and Sir George Stokes, it was not obvious that Thompson's research counted even as "second rate." Revealingly, this reviewer's deflationary view captured an important point about the audience-specific nature of Thompson's authority as a communicator of expertise: "In the public mind he was classed as a 'scientist' among other scientists." Among scientists, however, he was regarded instead as an "authority on Technology, particularly the technology of dynamo-electric-machinery." Somewhat in tension with that evaluation, the reviewer more charitably noted that among top-ranking scientists Thompson served as an encyclopaedically useful correspondent: Kelvin often consulted him on phosphorescence, and his hints on lecture technique were found useful "even by experimenters of the calibre of Sir Oliver Lodge." In the best sense, this reviewer archly concluded, Thompson was a "popularizer of science, who brought together scientific, literary and artistic worlds in a diplomatic way," also enthusing youth in his teaching. This *Athenaeum* reviewer concluded that probably "none" of Thompson's work was "destined to immortality."[71]

Yet this was not a view shared by the organisations with which Thompson had been associated. It is salutary to note that 3 years before this condescending *Athenaeum* review appeared, the Roentgen Society had endowed a posthumous Memorial on Thompson. The first of its annual "Silvanus P. Thompson Memorial Lectures" was given in April 1918 by the eminent Manchester University physicist Ernest Rutherford. He tactfully hailed the Society's "very fortunate" choice of Thompson as its first president, as he had been "not only distinguished as a teacher, investigator and writer on technical science," but also greatly interested in "the advance of pure science, especially in the domain

[66] J. S. Thompson & H. G. Thompson (1920, pp. 347–355).

[67] Among those who attended were Sir J. J. Thomson, Sir William Crookes, Sir William Fletcher Barrett, Sir George Newman, and Professor Arthur Schuster (on behalf of the BAAS), along with representatives of the Institution of Civil Engineers, Royal Astronomical Society, and British Science Guild: "Deaths" (1916).

[68] Anonymous (1921, p. 440).

[69] Anonymous (1920c, p. 44).

[70] Anonymous (1920a).

[71] Anonymous (1920b, p. 372).

of optics." Although, as a Quaker broadly committed to publicly useful research, Thompson himself rarely ever pursued science for its own sake, Rutherford shrewdly analysed Thompson's uniquely great posthumous value as a multi-facetted, emblematic authority for early radiology: he was interested in all types of radiation, and had been the first Briton to demonstrate publicly X-ray photographs and to show how to increase the power of X-ray tubes.[72] Last of all, Thompson had shown "the physiological effect on the head" of a powerful alternating magnetic field—Thompson's characteristically adventurous experiment—illustrating for Rutherford the "catholicity" of Thompson's "scientific interest and his versatility."[73]

The Roentgen Society and its successor bodies (now known as the British Society for Radiology) were dedicated to both the physics of X-ray generation and the clinical benefits of their application; so it is revealing of such multi-facetted practice that Silvanus Thompson Lectures have traditionally alternated between practitioners of the physical and clinical sciences.[74] The International Congress on Radiology hosted by the Society in 1925 thus covered radiology, physics, electrotherapy, and physiotherapy, with Sir William Bragg as a physicist involved in discussions on standardisation of dosage, and Louis de Broglie presenting the eighth Silvanus Thompson Memorial Lecture. The eminent Berkeley Moynihan was just one of a number of eminent physicians working with the physicists on this new hybrid discipline.[75]

It was not just in radiology that Thompson's life was annually commemorated in memoriam. On February 1, 1923, Finsbury Technical College's Old Students' Association also launched its own Silvanus Thompson Memorial Lecture. Sir Oliver Lodge gave the first of these to an audience of over 1000, including many "eminent past students." Of Thompson he said, "The breadth of his outlook and width of his interests" were "almost proverbial." Most distinctive for Lodge was Thompson's "love of discoveries in their nascent stages," helping to promote both expert and public understanding, and his "recognised" position as a historian of science. Lodge lamented that, given Thompson's cosmopolitan and pacific sensibilities, he too had been a victim of the "war and its atrocities."[76] To ensure that Thompson's legacy did not just remain locally celebrated at Finsbury, the Old Students' Association donated a bust of Thompson to another major organisation with which he had been closely associated, the IEE.

On May 31, 1923, the IEE's annual general meeting saw no fewer than three major donations to commemorate Silvanus Thompson. In addition to the Finsbury bust of Thompson, an oil painting of him was presented by his widow, to be hung in the IEE Library. As Jane Thompson observed:

> It was painted in 1891, the year in which he was elected a Fellow of the Royal Society and about the time when he made his best contributions to electrical science in connection with dynamos and magnetos, which were then just coming into general use throughout Europe. It was really the time of greatest activity during his life.[77]

Then Thompson's substantial library, which had been purchased from the family by colleagues and friends, was formally donated to the IEE, with all the lengthy fundraising and legal procedures having finally been completed. The eminent electrical engineer William Mordey (not a past Finsbury student) described this library as "a very important and well-known collection." He and fellow subscribers agreed that there "could be no better memorial of Thompson" than for it to be hosted the IEE. Finally, Elihu Thomson, visiting from the US where he was acting president of MIT, addressed the meeting to note Silvanus Thompson's educational legacy: *Elementary Lessons in Electricity and Magnetism* was still "the best that can be recommended for anybody beginning the study of electricity."[78]

[72]On science for its own sake, Gooday (2012).
[73]Rutherford (1918).
[74]The British Institute of Radiology was later incorporated with the Roentgen Society: British Institute of Radiology (n.d.)
[75]Anonymous (1925); de Broglie (1927).
[76]Anonymous (1923a); Anonymous (1923b).
[77]Anonymous (1923c, p. 1146).
[78]Anonymous (1923c, p. 1147).

Thus, the identity of Thompson as a rare multi-facetted crystal persisted in the world of interwar techno-science. Strikingly, though, in all of these big celebrations, barely any mention was made of the two other major books that he wrote for the public good, both of which have thrived posthumously and are still read today. His jocular *Calculus Made Easy* was only published under Thompson's own name posthumously.[43] Another was Thompson's final serious religious discourse, *A Not Impossible Religion*, which was also intended to be anonymous. It was his plea for the wider world to adopt some lessons from the Quaker community. Although incomplete (lacking its final chapter) when Thompson died, this book was edited by his son in law, T. Edmund Harvey, and published by the Friends in 1918 to promote the integration of dogma-free advances in religious thought with the fearless (if still reverential) quest for truth.[79] Appearing in print under Thompson's name in the last months of the Great War, it too was widely read beyond the Quaker community and was well received among those needing answers to the existential questions raised by the war. *A Not Impossible Religion* was so popular and well-reviewed that a second edition quickly appeared, and has lasted longer in print (and far less controversially) than Oliver Lodge's spiritualist attempt in *Raymond* to console those who had lost sons in the brutal conflict of 1914–1918.[80]

While the contributions of other authors in this special volume are summarised elsewhere (see the special issue introduction) in this conspectus of Thompson and his legacy, we can see good reason for why we should follow them in pursuing some of the many rich veins of his career.[81] In exploring some of the deeper connections—and a few surprising disconnects—in Thompson's kaleidoscopic career, which embodied arts, humanities, and sciences, we see that far from being just a "Popularizer of Science," as per *The Athenaeum*'s arch posthumous analysis of him, Thompson's life and work were cherished by a range of audiences for reasons that went far beyond either "popularisation" or disciplinarily specialist research. Instead, his candidness in challenging unfairness and his public-oriented endeavours in communication should make us think instead of how roles like Thompson's are not necessarily incidental or trivial in the public relations of science. There are surely lessons there for a 21st-century audience that is willing to consider how trust in science might be rebuilt and sustained by pursuing projects that are directed to public need and enacted both with due regard to inclusive meritocracy and a commitment to critiquing mere profiteering or disinformation.

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[79]By contrast, Gay & Barrett (2002, p. 181) discuss this final work by Thompson in generic terms as a "Christian" work without exploring its Quaker context; notably, this final work by Thompson is not discussed in Cantor (2005).

[80]Thompson & Thompson (2002, pp. 335–337). For Lodge and Raymond, see Gay & Barrett (2002, p. 181); Mussell & Gooday (2020, pp. 152–182, 210–213).

[81]For the introduction, see Gooday (2021).

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