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RESEARCH ARTICLE

Within These Four Walls: televisualizing museum spaces of science, 1950–1971

Rupert Cole

Curatorial, Science Museum, London, UK
Corresponding author: Rupert Cole, Email: rupert.cole@sciencemuseum.ac.uk

Abstract

The paper examines BBC television programmes that feature museum spaces of science and technology, contextualizing the development of this programme type in the 1950s and 1960s with science (and history-of-science) broadcasting. In 1971, the BBC televised a ten-part series devoted to UK science and technology museums. *Within These Four Walls*, the central case study, featured episodes filmed at the Natural History Museum, the National Maritime Museum, the Royal Institution and the Science Museum, among others; its televisual tour guides included prominent science broadcasters – Patrick Moore, George Porter and Eric Laithwaite – as well as curators and scholars of the history of science, such as Joseph Needham. The paper explores, using intermediality as an analytical category, how the museological conventions of curated gallery displays and tours have been adapted and transposed to television. In doing so, it reflects on the historiographies that emerge from this intermedial product (a series of televised museum tours), arguing that they should be interpreted in the cultural context of the early 1970s. It concludes that the presentation of historical authenticity through intermedial constructions of place, objects and performances conferred what Thomas Gieryn has dubbed 'truth spots' on history-of-science narratives for audiences.

In reaching mass audiences, museums and television are the most prominent examples in which general publics have encountered and engaged with science since the 1950s. While historical scholarship on both science museums and science television has been growing over the last decade, there has been little on the space in which these two media overlap.[1] The media studies scholar Roger Silverstone was perhaps the first to academically examine museums as a form of media and how they relate to television media. Writing in 1988, Silverstone reflected on the intermediality of museums and television at a time when science museums were undergoing an interactive turn, influenced by the science centre movement and, more broadly, a mass-mediated culture dominated by television and televisual forms characteristic of the late twentieth century.[2] If Silverstone was in part

[1] An exception was the 2012 Science Museum Group research project Booming Fifties, Swinging Sixties: Exploring the British Post-war Culture of Science, which resulted in the publication of Jean-Baptiste Gouyon, 'Making science at home: visual displays of space science and nuclear physics at the Science Museum and on television in postwar Britain', *History of Technology* (2014) 30(1–2), pp. 37–60.

[2] Roger Silverstone, 'Museums and the media: a theoretical and methodological exploration', *International Journal of Museum Management and Curatorship* (1988) 7, pp. 231–41, 232. While clearly concerned with the intermedial relationship between museums and television, Silverstone did not explicitly use the term 'intermediality'. This paper, in accordance with others in this special issue, follows the definition offered by Irina Rajewsky:

motivated by how museums are becoming more like television, this paper is concerned with the opposite medial angle in an earlier period: how have museums of science and technology been televised?

This paper surveys British television programmes that featured outside broadcasts of museum spaces displaying science and technology, from the earliest in the 1950s up until the first (and last) television series specifically devoted to museum collections of science and technology: *Within These Four Walls* (1971). Supplying the title of the paper and its central case study, this prime-time ten-part series featured episodes filmed at the Natural History Museum, the National Maritime Museum, the Royal Institution and the Science Museum, among others; its televisual tour guides included prominent science broadcasters of the time, such as Patrick Moore, George Porter and Eric Laithwaite. In the decades since *Within These Fours Walls*, museum spaces of science have been frequently utilized in history-of-science programming, usually involving discovery narratives.[3] While the behind-the-scenes museum documentary has had a resurgence in the twenty-first century, the museum tour format of *Within These Four Walls* remains a bit of a television relic, resurrected briefly during the COVID-19 pandemic when audiences were unable to visit museums.[4]

The paper will contextualize *Within These Four Walls*, which was also the first history-of-science documentary series on television, within the development of history-of-science programming at the BBC. It will reflect on what kind of historiography a television series concerned with material culture presented. By focusing on its intermedial form – how the museum spaces of the series have been televisualized – the paper unravels what is revealed about the public culture of science through these programmes.

Televising museums and the history of science, 1950–1970

In January 1950 the BBC's Television Service introduced a new type of programme: the museum tour. The first of this type was a series of three programmes, *Private View*, televised as outside broadcasts from the British Museum, and featuring, among others, Richard Dimbleby as tour guide/presenter.[5] Later that year, the BBC took its cameras to the Science Museum for two further museum-based outside broadcasts.[6] The second of these, *Museum Visit: Progress of Flight* (1950), took place in the Science Museum's newly opened aeronautics gallery.[7] The two galleries the BBC visited, aeronautics and telecommunciations, were typical of a 'developmental' display approach (historical technical developments arranged

'intermediality may serve foremost as a generic term for all those phenomena that … take place between media. "Intermedial" therefore designates those configurations which have to do with a crossing of borders between media'. Irina O. Rajewsky, 'Intermediality, intertextuality, and remediation: a literary perspective on intermediality' *Intermédialités/Intermediality* (2005) 6, pp. 43–64, 46.

[3] For example, the Royal Institution featured in Jim Al-Khalili's BBC series *Chemistry: A Volatile History* (2010) and Brian Cox's *Science Britannica* (2013).

[4] Such as the BBC series *Secrets of the Museum* (2020–2) and *Inside Museums* (2020–2).

[5] *Radio Times*, television edn (23 April 1950) 1384, p. 44. Dimbleby became the BBC's lead news presenter and later host of the investigatory news feature programme *Panorama*.

[6] The programmes were 'Cable to the Continent', a tour of the Science Museum's telecommunications gallery, broadcast Thursday 31 August 1950 at 20:00, and 'Museum visit: progress of flight', broadcast on Wednesday 27 September 1950 at 21:30.

[7] In June 1950, the Science Museum opened a redisplay of its aviation and aeronautics collection in the Western Galleries of the 1862 International Exhibition buildings (which became part of Imperial College London, before being demolished). Parts of this collection had been on display between 1912 and 1939, first as special exhibitions, then as a permanent gallery in the Science Museum's East Block, opening after the building's completion in 1928. Doug Millard, 'Science Museum aviation collections assessment development and recommendations – DM 16 08 16', internal Science Museum document. See also Caitlín Róisín Doherty, 'Leonardo's tomb: exhibitions

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in chronological order leading to the present) that characterized Science Museum galleries up until the 1950s.[8]

Museum Visit: Progress of Flight, departing from the single tour guide/presenter format of *Private View*, featured a dialogue-based tour between interviewer/presenter Raymond Baxter and interviewees/tour guides – Science Museum curatorial staff Phillip Lawton Sumner and William Thomas O'Dea.[9] With a background in electrical engineering, O'Dea joined the Science Museum in 1930 as an assistant keeper and developed a flair for innovative exhibition design that made dramatic use of artificial light.[10] By the time of *Museum Visit* in 1950, O'Dea headed the Aeronautics department.

The production process of *Museum Visit: Progress of Flight* gives an insight into how this new television genre, the museum tour, was rooted in deliberate intermedial practice. O'Dea produced a script, storyboard and annotated list of exhibits for Alan Chivers, a producer in the BBC's Television Outside Broadcast department. The script was not just dialogue, but resembled a shooting script, containing a sequence of numbers that cross-referenced O'Dea's exhibit list to indicate when an exhibit should be shown, as well as camera direction, e.g. 'camera tracks backward' and 'B.B.C. to blow up image'.[11] O'Dea, in a letter he sent accompanying this material to Chivers, even showed an awareness of the challenge in negotiating between the two media in the adaption of a museum gallery tour for television: 'we shall have to *modify* our selection of non-fundamental exhibits to please the eye'.[12] It would seem O'Dea understood television as operating on a different visual aesthetic to museum galleries, perhaps hinting at the temporal nature of the medium contrasted with the spatial mode of museums.

It is unclear to what extent O'Dea's role in scripting and storyboarding the programme was the product of prior discussion between himself and BBC staff. But in substance, his script differed little from the final production script, indicating that the BBC were impressed with his work. O'Dea had no prior experience of working on television programmes, although, as mentioned, he had a keen sense of how visual effects could be created in museum displays. His willingness and ability to produce this television script is perhaps indicative of his engagement with an emerging trend in 1950s museum display: the deliberate borrowing of techniques and methods from other media – in this case, scripting and storyboarding from cinema and television.[13]

At the time of *Museum Visit*, Television Outside Broadcasts was a young department, seen as producing the most exciting kind of programmes for the BBC's rapidly expanding television audiences: early outside broadcasts included televised live events such as the 1947 wedding of Princess Elizabeth and Prince Philip, the 1948 London Olympics, and

of early flight technology at the Deutsches Museum, Science Museum and Smithsonian, 1903–2003′, unpublished PhD thesis, University of Cambridge, 2018, pp. 140–2.

[8] Tim Boon, 'Presidential Address. "Some years of cudgelling my brains about the nature and function of science museums": Frank Sherwood Taylor and the public role of the history of science', *BJHS* (2023) 56, pp. 283–307.

[9] The programme would mark the television debut of Raymond Baxter, a former RAF pilot who would later present BBC science programmes *Eye on Research* and *Tomorrow's World.*

[10] David Rooney, '"A worthy and suitable house": the Science Museum's buildings and the temporality of space', in Peter Morris (ed.), *Science for the Nation*, London: Palgrave MacMillan, 2010, pp. 157–75.

[11] William O'Dea, 'Science Museum aeronautical collection – draft script', 20 August 1950, BBC Written Archives Centre (hereafter BBC WAC), T14/1117.

[12] O'Dea to Chivers, 21 August 1950, BBC WAC, T14/1117, added emphasis.

[13] Following Sophie Forgan's work on the Festival of Britain, Tim Boon has observed this trend of intermedial transfer, where language and grammars from advertising, cartoon strips, radio, cinema and television were consciously incorporated into museum display methods at the Science Museum and elsewhere from the early 1950s onwards. Tim Boon, 'Scripting the postwar museum', unpublished paper for BSHS annual conference 2017, dated 8 June 2019.

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FA Cup finals.[14] Besides a few exceptions – such as the aforementioned Science Museum tours, coverage of British Association meetings, and adaptations of the Royal Institution Christmas Lectures – television science programming in this period was largely the domain of the studio-based Talks department.[15] This began to change in 1957, following the success of the hugely ambitious programme *The Restless Sphere*, which covered the International Geophysical Year through both live and telecined footage of scientific experiments from around the world. The most expensive programme the BBC had produced to that date, *The Restless Sphere* demonstrated the exciting potential of science outside broadcast programmes. Its chief architect, Aubrey Singer, became a key figure in their development at the BBC, in 1957 launching *Eye on Research*, a series which 'visited laboratories and saw scientists in action', as Singer described it.[16] Spaces of scientific research thereby became temporary television studios.

Towards the end of the 1950s, BBC producers, fuelled by competition between the Outside Broadcasts and Talks departments, experimented with new genres and formats in science television.[17] The period's most prevalent genre, with the greatest diversity of formats, was the topical reporting of contemporary science and technology. This could take the form of live studio-based programmes showcasing current scientific research, such as *Science Review* (1952–6), *Frontiers of Science* (1956–69) and *Sky at Night* (1957–) or live outside broadcast programmes such as *Eye on Research* (1957–61) and *Science International* (1959). The 'magazine' format – live reporting mixed with film sections held together by an anchor or voice-over – became the dominant style in the 1960s, exemplified by *Horizon* (1964–), developed for the arrival of BBC2, and *Tomorrow's World* (1965–2003), for the more mainstream audiences of BBC1. By this time, the majority of BBC science television programming had become the output of a specialist department, Science and Features, headed by Aubrey Singer, within the Outside Broadcasts section of a restructured Television division.[18]

Television programmes on the history of science were virtually non-existent until the 1960s. The handful of examples before then were all products of a west London-based institutional network between the BBC, the Science Museum, and the Royal Institution (RI). Aside from the two outside broadcasts at the Science Museum, the BBC staged television lectures from the Royal Institution's lecture theatre on history-of-science topics.[19] RI scientific director Edward Andrade's 1951 lecture, 'Pioneers of discovery at the Royal Institution', was described by the *Radio Times* as featuring 'famous experiments first made *within its walls*, and ... historic equipment the early scientists used'.[20] The RI's historic lecture theatre had been cast as a time machine, with Andrade's lecture connecting viewers to the RI's past through the re-enactment of experiments associated with former RI professors Humphry Davy, Michael Faraday, John Tyndall, and William Bragg, with the same apparatus they used,

[14] In 1948 Outside Broadcasts gained autonomy as its own television department, having been sharing that status with Film facilities since 1947 when the television workforce was first divided into departments. See Timothy Boon, *Films of Fact: A History of Science in Documentary Films and Television*, London: Wallflower Press, 2008, pp. 229, 238. For the early popularity of television outside broadcasts and the increasing television audience in the period see Asa Briggs, *The History of Broadcasting in the United Kingdom*, vol. 4: *Sound and Vision*, Oxford: Oxford University Press, 1979, pp. 208, 239–42; John Swift, *Adventures in Vision: The First Twenty-Five Years of Television*, London: John Lehmann, 1950, p. 126.

[15] Boon, op. cit. (14), p. 199.

[16] Interview with Aubrey Singer by Frank Gillard, 1986, BBC Oral History Collection.

[17] This competition between Talks and Outside Broadcasts had its origins in the divide between two professional traditions in early BBC television: the spoken-word culture from radio broadcasting and a visual storytelling one from film and documentary making. See Gouyon, op. cit. (1), pp. 40–1.

[18] See Boon, op. cit. (14), p. 209–32.

[19] Dating back to 1799, the RI was seen by the BBC, as well as the Festival of Britain organizers, as a place of historical interest, unusual at the time for a scientific institution.

[20] *Radio Times*, television edn (6 July 1951) 1443, p. 42, added emphasis.

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inside the same physical space – the walls of the RI's Mayfair premises, with its occupation there dating back to 1799. This notion of creating a sense of historical place, situating artefacts and experiments in their original setting, was a new one for television broadcasting, and would become a key intermedial feature in the 1971 television series *Within These Four Walls*, explored in the next section of this paper.[21]

The BBC returned to the RI the following year for another history-of-science television lecture, this time a thirty-minute adaptation of Science Museum director Frank Sherwood Taylor's Christmas Lectures, How Science Has Grown, which again included performances of historical scientific experiments.[22] Demonstrations of historical apparatus were also employed in a new Schools Lecture service at the Science Museum devoted to the 'historical development of science and engineering', which Sherwood Taylor (1897–1956) established in 1954 after discussions with the RI, who launched a complementary scheme.[23] As the sole member of Science Museum staff with an academic background in the history of science, Sherwood Taylor had limited success during his directorship (1950–6) in promoting its study among his curatorial staff and the museum's activity.[24] He did have one protégé, however, in fellow Oxford-trained chemist Frank Greenaway (1917–2013), who joined the Science Museum as an assistant keeper in the Chemistry Department in 1949. Like Sherwood Taylor, Greenaway was another early participant in history-of-science television programming, contributing a regular item called 'Science has a history' on a children's television series, *Jigsaw*, in 1955.[25] Greenaway was encouraged by Sherwood Taylor to pursue the academic study of the history of science.[26]

[21] The idea for the programme had come from Seymour de Lotbinière, a pioneer of outside broadcasts at the BBC and its departmental head (rather than a science producer). Lotbinière was specifically attracted to the RI's historic spaces and artefacts: 'we might be able to show the original apparatus in action … the broadcast could conceivably take place in one of the laboratories … or in a lecture hall already used for the famous Friday night Discourses and for the Christmas series of children's lectures'. S. J. de Lotbinière to C.Tel.P [Cecil McGivern], 16 January 1951, BBC WAC T14/1018/2.

[22] 'Publicity week 2', 15 December 1952, BBC WAC, T14/1018/2. Sherwood Taylor's Christmas Lectures series was published in book form as *An Illustrated History of Science* in 1955. The BBC had produced single-lecture versions of the RI's six-part Christmas Lectures series each year since 1948. Michael Henderson was the producer of these, as well as Andrade's 'Pioneers of discovery' programme. The BBC were keen on using the RI as an OB venue, with George Barnes, the BBC's first director of television, telling the OB department in 1951 he was 'most anxious [to] make the most of any opportunities offered from there'. Peter Dimmock to Michael Henderson, 9 November 1951, BBC WAC, T14/1018/2. However, when controversy around Andrade's position at the RI surfaced in 1952, they refrained from working with the RI for several years. See Rupert Cole, 'The common culture: promoting science at the Royal Institution in postwar Britain', PhD thesis, UCL, 2017, pp. 61–8; Frank A.J.L. James and Viviane Quirke, 'L'affaire Andrade or how not to modernise a traditional institution', in Frank A.J.L. James (ed.), *'The Common Purposes of Life': Science and Society at the Royal Institution of Great Britain*, Aldershot: Ashgate, 2002, pp. 273–304, 288–301.

[23] Gouyon, op. cit. (1), p. 40.

[24] See Frank Greenaway, 'Taylor, Frank Sherwood', *Oxford Dictionary of National Biography*, 2004, at https://doi.org/10.1093/ref:odnb/36430 (accessed 10 March 2022).

[25] Greenaway later judged this sole television appearance as a 'hopeless failure', admitting that his nerves and lack of rehearsal meant he 'fluffed it' when he 'had to talk live to a camera'. See Frank Greenaway, 'Early years at the Science Museum', in R.G.W. Anderson, P.J.T. Morris and D.A. Robinson (eds.), *Chymica Acta: An Autobiographical Memoir*, Huddersfield: Jeremy Mills, 2007, pp. 91–106, 98.

[26] Greenaway cited his experience of working with Sherwood Taylor as formative in his research career in his book *A History of Industrial Chemistry* (1957). Having contributed a chapter, he ended up completing the book for publication, after Sherwood Taylor died in post at the Science Museum in 1956. Around this time, Greenaway undertook an MSc degree in the history of science at University College London (awarded 1957), and in 1971 he gained a PhD for his work on John Dalton. He was the first curator at the Science Museum to hold academic qualifications in the history of science. See Frank Greenaway, 'The Science Museum: later days', in Anderson, Morris and Robinson, op. cit. (25), pp. 141–50.

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Over the following decades, Greenaway did much to embed the history and heritage of science at both the Science Museum and the RI.[27] He would be among a number of figures who utilized the popular currency of C.P. Snow's rhetoric of 'two cultures' to promote the academic discipline's expansion in the 1960s, presenting it as a subject to bridge the supposed gulf between science and the arts within cultural and public institutions.[28] This 'bridging' notion was embedded in Greenaway's curation of a new suite of chemistry galleries at the Science Museum (opened in 1964), which included re-created historical spaces such as workshops and laboratories – then a novel display method at the museum – that situated scientific activity in a practical, craft tradition.[29] However, it was at the RI, while he was serving on its Committee of Visitors (1963–5), that Greenaway most explicitly pushed this two-cultures bridging agenda, at a time when the institution was internally debating its future role while selecting a new director. The RI appointed the photochemist George Porter (1920–2002), who advertised himself as a candidate by making a deliberate intervention in the two-cultures debate and stressing the importance of the RI's history and heritage to its future.[30]

From his position as RI director (1966–85), Porter became a prominent science broadcaster, and a 'very firm ally' to BBC Science and Features, as Philip Daly, a leading producer in the department, described him to the controller of BBC2, David Attenborough.[31] It was through broadcasting that Porter promoted the RI's history. This began with a *Horizon* programme, 'A candle to nature' (1964), which featured a dramatized version of Faraday's 1861 Christmas Lectures, The Chemical History of a Candle, with re-enactments of historic experiments, followed by a lecture by Porter on the same subject, updated with contemporary scientific and industrial developments.[32] Launched in 1964 as BBC2's flagship science series, *Horizon* predominantly covered contemporary scientific topics, with its early intent to focus on those that 'have philosophical impact on other fields of the arts and the humanities'.[33]

[27] For Greenaway's promotion of the history of science at the Science Museum see Peter Morris and Robert Bud, 'Obituary: Frank Greenaway', *Science Museum Group Journal* (2 March 2014) 1, at http://dx.doi.org/10.15180/140111 (accessed 1 March 2022). At the RI, in 1967 Greenaway initiated a long-running series of academic history-of-science discussion groups, and in 1970 he became the RI's first honorary reader in the history of science, which he held until 1985. He remained influential at the RI in his later years, serving as vice president of the RI's Council (1992–3). Managers' Minutes, RI MS AD/02/B/02/A25, p. 41.

[28] For the influence of the two-cultures rhetoric on the growth of the history of science in Britain see D. Graham Burnett, 'A view from the bridge: the two cultures debate, its legacy, and the history of science', *Daedalus* (1999) 128, pp. 193–218; Frank A.J.L. James, 'Alfred Rupert Hall, 1920–2009; Marie Boas Hall, 1919–2009′, *Biographical Memoirs of Fellows of the British Academy* (2012) 11, pp. 388–9.

[29] For one of these historical spaces, a re-creation of a sixteenth-century assaying workshop of Lazarus Ercker, involved collaborating with craftsmen and National Gallery experts, which led Greenaway to consider the exhibit to represent 'the unity of the world of learning'. Greenaway, op. cit. (25), p. 46. More broadly, Peter Morris described Greenaway's vision for these galleries as displaying 'chemistry within a wide scientific and humanistic context'. Peter J.T. Morris, 'A history of the chemistry galleries at the Science Museum in the twentieth century', in Anderson, Morris and Robinson, op. cit. (25), pp. 151–68.

[30] Rupert Cole, 'The importance of picking Porter: the Royal Institution, George Porter and the two cultures, 1959–64′, *Notes and Records: The Royal Society Journal of the History of Science* (2015) 69, pp. 191–216. Greenaway, as the RI's secretary and then chair of the Committee of Visitors, argued from the early 1960s for the RI to establish a professorship in the history of science, culminating in a 1963 memorandum entitled 'The Royal Institution and the study of the history of science', influencing the RI's managers in their selection of Porter. While the professorship was not established until 2004, a reader position was created (for Greenaway) in 1970.

[31] Philip Daly to C.A.O.B.F.S [William Cave], 25 February 1966, BBC WAC, T14/2795/2.

[32] Broadcast on BBC2 at 9.55 p.m. on 27 June 1964, 'A candle to nature' was the third *Horizon* of its first series. Porter had been invited by Philip Daly, the series' first editor, who he had previously worked with on *Eye on Research*. Philip Daly to George Porter, 3 May 1964, BBC WAC, T14/1610/5.

[33] Quoted in Timothy Boon, '"The televising of science is a process of television": establishing *Horizon*, 1962–1967′, *BJHS* (2015) 48(1), pp. 1–16, 4–8. As Boon shows, definitions of *Horizon*'s purpose and style were often revised and did not always align with practice.

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Horizon did occasionally cover historical topics, including another dramatized portrayal of Faraday in a biographical portrait of his life, 'Dynamo: the life of Michael Faraday' (1967). As a documentary drama, 'Dynamo' was a departure from the lecture format of earlier history-of-science programming. Starring Ian Richardson (well known later for his role in the BBC's political drama *House of Cards*) as Faraday, the programme was mostly filmed at the RI, with scenes taking place in one of Faraday's basement laboratories, allegedly left unchanged since he last used it.[34] The *Horizon* programme served as publicity for the RI's 1967 fundraising appeal (organized around the centenary of Faraday's death) to renovate its historic premises, which included restoring the Faraday basement laboratory and constructing a museum. As the appeal campaign made clear, the RI was moving away from a member's club towards a public institution with 'national-heritage' status.[35]

The idea of a *scientific* heritage was, towards the end of the 1960s, becoming more commonplace in cultural discourse, influenced perhaps by the opening of historic sites of science as museums, such as the RI and the Old Royal Observatory buildings at Greenwich, as well as the professionalization and popular dissemination of the history of science. Within the BBC, history-of-science programming began to receive greater attention in internal discussions. In a 1968 meeting of the BBC's Science Consultative Group (SCG), George Porter raised the point that 'there was a tendency for "Horizon" to deal with topical issues in the news [and] an opportunity was perhaps being missed to show the work of physicists in historical perspective'.[36] Two other committee members agreed, with John Mason (director general of the Met Office) arguing for a 'less topical approach, with greater emphasis on showing how scientific advance was achieved'. Robert Reid, editor of *Horizon*, accepted the need to incorporate historical perspective, but felt that programmes had already been successful in doing so.[37]

However, the neglect of science from the BBC's big-budget documentary series on the history of human culture, *Civilisation: A Personal View by Kenneth Clark* (1969), sparked 'fury' in Reid's departmental head, Aubrey Singer, who then successfully petitioned David Attenborough to commission a scientific version of *Civilisation*.[38] The conceptual development of this history-of-science documentary series, which became *Ascent of Man* (1973), was discussed in several meetings of the SCG under the agenda item 'presentation of scientific achievement' – a continuation of the discussions about the need for greater historical perspective in *Horizon*.[39] But *Ascent of Man* did not end up being the first documentary series on the history of science; this distinction went to *Within These Four Walls* (1971), which took a very different approach to the big-budget, chronological, 'history-of-ideas' concept of *Ascent of Man*.[40] Instead, as we shall see, *Within These Fours Walls* had as its starting point the material culture of the history of science and technology.

[34] *Radio Times*, 23 February 1967, p. 41.

[35] 'The Royal Institution of Great Britain', [undated], RI MS GP/C375, p. 3.

[36] SCG minutes, 8 November 1968, BBC WAC, R78/76/1, pp. 4-5. The Science Consultative Group was set up in 1964 to provide a dialogue between prominent scientists and BBC personnel involved in science broadcasting. For the context of its formation see Allan Jones, 'Elite science and the BBC: a 1950s contest of ownership', *BJHS* (2014) 47(4), pp. 701–23. Porter joined the committee in 1967.

[37] SCG minutes, 8 November 1968, BBC WAC, R78/76/1, p 5.

[38] Interview with Aubrey Singer by Frank Gillard, 1986, BBC Oral History Collection.

[39] SCG minutes, various dates, BBC WAC, R78/76/1.

[40] While not a documentary series, there had been a BBC educational series for schools on the history of science and technology in 1960, *Science and Life*, presented by Arthur Garratt and produced by John Braybon and Donald Grattan. Grattan would become the BBC's first head of the Further Education television department.

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Within These Four Walls: production origins and format

As the Science Consultative Group were informed, *Within These Four Walls* (*WTFW*) 'had the aim of enabling scientists and scholars to give their own interpretation of some of the landmarks in the history of science and technology preserved in museum collections'.[41]

The series was a product of BBC Further Education, a television department that had been producing educational television programmes intended for adult audiences since 1963.[42] It followed a standard ten-programme length for Further Education productions.[43] The production team included director Peter R. Smith, who previously worked on *Horizon* and *Tomorrow's World*, and producer Brenda Horsfield (1926–2014), a former RAF pilot and prolific producer of television programmes since she had joined the BBC in 1956.[44]

Horsfield came to specialize in programmes with scientific subjects, including a life sciences series for the Royal Society tercentenary year in 1960 and, for Further Education, series on oceanography (1966), the weather (1966), engineering design (1967), the history of mechanical engineering (1968) and sailing (1969). The series she produced immediately before *WTFW* was *Heritage*, on 'the threatened natural environment of Britain and its chances of survival', which featured subjects such as land development, intensive farming, the ecological consequences of pesticides and water pollution.[45] For Horsfield, *WTFW* was a continuation of her interest in national heritage. At a time when producers had much greater autonomy at the BBC, Horsfield was likely responsible for choosing her series' subject. Described by her BBC colleagues as a 'force of nature', she invested intellectually in the programmes she produced, and co-authored several spin-off books.[46]

WTFW aired in a prime-time BBC2 slot on Friday evenings at 7.05 p.m., between January and March 1971. Other programmes in this same slot over 1971 included cricket test matches, drama and music concerts. The series was repeated on BBC1 the same year at a late evening slot and again in 1973, indicating that it was likely well received internally and scored well in the BBC's audience reaction index; however, it doesn't seem to have been reviewed by the national press. In what may be the only published review, beyond extended descriptions in newspaper television listings, an anonymous writer in the journal of the London Underground Railway Society judged the opening programme on the British Railways Museum to be 'a little affected in parts, but an interesting idea'.[47]

The 'idea', or format, of the series was essentially the same as the earliest outside broadcasts from museums in 1950 – the *Museum Visit* programmes from the Science Museum – where an interviewer/presenter was in dialogue with an interviewee/tour guide within a gallery space, following a route of pre-planned exhibits and demonstrations. There were occasional departures from this basic format, such as filmed sequences with voice-over in one programme, and an extra contributor appearing part way through to assist with a demonstration in another. Dialogue, it seems, was unscripted but sometimes rehearsed.[48] The music that featured in the series during title and credits was playfully subject-specific

[41] SCG minutes, 17 November 1972, BBC WAC, R78/76/2, p. 7.

[42] See Asa Briggs, *The History of Broadcasting in the United Kingdom*, vol. 5: *Competition*, Oxford: Oxford University Press, 1995, p. 479.

[43] Scientific programmes had featured from the beginning, including a series of outside broadcast talks on relativity, $E = mc^2$ (1963), by Hermann Bondi; molecular biology, *The Thread of Life* (1965), by John Kendrew; and a series on thermodynamics, *The Laws of Disorder* (1965), by George Porter.

[44] Bernard Adams, 'Brenda Horsfield obituary', *The Independent*, 10 December 2014.

[45] *Radio Times*, 25 April 1970, 2424.

[46] Quoted in Giles Oakley, 'Brenda Horsfield obituary', *The Guardian*, 18 December 2014.

[47] Anon., 'Television', *Journal of the London Underground Railway Society* (1971) 10(5), p. 75.

[48] Post-production scripts, transcribed from transmission, exist as a record of the programmes. These also contain camera and direction notes.

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until Episode 5, when the title and credits music remained the same for the rest of the series – Armand Migiani's jazz rendition of Bach's 'Prelude and fugue no. 16'.[49]

The *WTFW* titles introduced the scientist or scholar as giving a 'personal view' of the museum. The BBC had used the trope of the personal view since the early 1950s, initially in current-affairs programming on radio and television, to indicate that the authorial 'voice' of the programme was not that of the BBC, allowing the corporation to maintain its commitment to impartiality. Regularly employed in *Radio Times* listings, its use expanded to all types of factual programming but became particularly associated with documentary. *Civilisation: A Personal View by Kenneth Clark* (1969) became a blueprint for personal-view documentary series. The first to follow this blueprint, *The Ascent of Man: A Personal View by Jacob Bronowski* (1973), sparked several debates during its development (1969–72) within the Science Consultative Group on applying the personal-view format to history-of-science programmes. UCL space scientist Robert Boyd argued 'an arrangement should be made for balancing the programme', to which a producer retorted, 'it was not possible to combine a personal view and balanced opinion in the same format'.[50] Aubrey Singer stressed the need for presentism, remarking that 'he would have no objection to an idiosyncratic view of science in history, so long as it was based on an up-to-date synthesis'.[51] With a different authorial voice for each programme, *WTFW* had the potential for a much greater diversity of personal views than *Civilisation* or *Ascent of Man*, yet, as we shall see, commonalities between how history of science was being presented did emerge across the series.

Among the ten *WTFW* personal-view authors, all were male. Just under half were curators or museum staff associated with the museum collection featured in the programme, and the rest were scientific figures with expertise in a discipline related to the collection.[52] They included George Porter at the Royal Institution; Patrick Moore, long-time presenter of BBC's *Sky at Night*, at the Old Royal Observatory; Science Museum curator John van Riemsdijk at the British Transport Museum; Joseph Needham, biochemist and historian of Chinese science, at the Science Museum's time measurement galleries; and engineer Eric Laithwaite, who held professorships at Imperial College and the RI, at the Science Museum's electrical-engineering galleries. Peter Bennett Stone, a former *Sky at Night* director who had previously collaborated with Brenda Horsfield as a presenter on Further Education series, was the interviewer/presenter throughout *WTFW*.

The collections that *WTFW* covered were varied, though by no means comprehensive of science and technology. They were transport (locomotives and aeroplanes), natural history, time measurement, astronomy, navigation, physics, electrical engineering, George III's scientific instruments and military technology. Collections relating to communications technology, chemistry and the earth and social sciences were absent.

'Within these four walls', as a phrase chosen for the series name, figuratively connotes a space in which secrecy is to be maintained, similar to 'behind closed doors'. It subtly invokes

[49] For example, the first programme from the British Transport Museum featured the railway-inspired piece 'Coronation Scot' by Vivian Ellis, and the second programme from the Shuttleworth collection featured Ron Goodwin's title song from the 1965 comedy film *Those Magnificent Men in Their Flying Machines* – one of the aircraft from the collection that the programme mentioned (just before titles) had been built for the film.

[50] SCG minutes, 5 November 1971, BBC WAC, R78/76/2, p. 7.

[51] SCG minutes, 16 May 1969, BBC WAC, R78/76/1, p. 7.

[52] The full list of contributors and museum collections for each programme: *WTFW* 1: the Museum of British Transport (John van Riemsdijk); *WTFW* 2: the Shuttleworth Collection (David Keith-Lucas); *WTFW* 3: the Natural History Museum (Alan Cherig); *WTFW* 4: the Time Measurement Gallery at the Science Museum (Joseph Needham); *WTFW* 5: the Old Royal Observatory, Greenwich (Patrick Moore); *WTFW* 6: the National Maritime Museum, Greenwich (D. W. Waters); *WTFW* 7: the Royal Institution (George Porter); *WTFW* 8: the Electrical Engineering Gallery at the Science Museum (Eric Laithwaite); *WTFW* 9: the George III Collection at the Science Museum (K.W. Keohane); *WTFW* 10: the Armouries of the Tower of London (H. Russell Robinson).

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the popular trope of archives and museum collections being hidden or secret, (much) later employed in the titles of 'behind-the-scenes' documentary series, such as the BBC's *Secrets of the Museum* (2020). Above all, the phrase draws attention to the spatial dimension of its subject matter: physical places of (scientific) history, either a museum space housing historic objects, such as the Science Museum, or museums that incorporate both historic buildings and objects, such as the RI and the Old Royal Observatory. If we are to accept that museums are a form of medium, functioning as a mediating interface between visitors and the history contained in their physical spaces, then it follows that there is an intermedial entanglement when the sites of this medium are being used by another medium – broadcast television – that again functions as an interface between viewers and the museum-contingent history.

Before attempting to unravel these entanglements in *WTFW*, I shall briefly introduce a framework for applying intermediality as an analytical category. The literary theorist Irina O. Rajewsky has put forward three subcategories of intermediality that capture differing 'medial configurations and their specific intermedial qualities':

1 *Medial transposition* – the process of transposing a given media product (e.g. a text, a film and so on) into another medium. The 'original' text, film and so on is the 'source' of the newly formed media product. In the case of *WTFW* programmes, it is a transposition of a guided tour of a curated museum or gallery space (the original source) to a personal-view television documentary.
2 *Media combination* – the process of combining at least two conventionally distinct media or medial forms of articulation. *WTFW* combines a television programme with the experience of a museum visit. Going beyond Rajewksy's subcategory description, it is worth noting that there is in *WTFW* a hierarchical structure in the way the two media are combined: given that the media product of *WTFW* is a television programme, the 'primary' medium is therefore television and the 'secondary' medium is the museum; the reverse might be a museum display (primary) that contains a broadcast of a television programme (secondary).
3 *Intermedial references* – the medium makes references to techniques specific to another medium. In *WTFW*, this might be references in the television programmes to museological techniques and terms, such as curation or label writing.

As Rajewsky observes, 'a single medial configuration may certainly fulfil the criteria of two or even of all three of the intermedial categories outlined above'.[53] This paper will utilize these subcategories, with the italicized terminology serving as shorthand, to analyse the intermedial aspects of *WTFW*.

Within These Four Walls: mediations of place, objects and performances

The two *WTFW* programmes at the Old Royal Observatory (ORO) and the RI, which both feature collections housed within historic buildings, exemplify the series' title motif more than the other programmes by drawing attention to the physical place in which the tour is taking place.[54] In the pre-titles sequence of the ORO programme, the camera is behind Patrick Moore (tour guide) and Peter Bennet Stone (presenter) as they walk into an atmospherically lit Flamsteed House in the evening light. The shot then slowly zooms out, revealing the exterior of building from the front. The dialogue during this shot runs,

[53] Rajewsky, op. cit. (2), pp. 51–3.

[54] There are six surviving programmes (1, 2, 3, 5, 7, 8 – see note 52 above), as well as some post-production scripts of missing programmes (4, 10). The paper focuses its analysis on the surviving programmes, and particularly 3, 5, 7 and 8.

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MOORE: There is plenty of history around; of course it is a Wren building too and a very well preserved one.
STONE: I think this bit we are going to now – this is the oldest part?
MOORE: It is the oldest part of the observatory, now known as Flamsteed House.[55]

The mention of the building's historic significance (Christopher Wren and John Flamsteed associations) and it being old (Flamsteed House was completed in 1676) is used to entice us in, both intellectually and literally – it gives us the sense of physically entering the building, as we follow behind the tour guide (and presenter) while they walk and speak in front. The camera technique that helps create this impression is used throughout *WTFW* but is especially present in the ORO and RI tours, which span multiple locations and rooms within a building (rather than a single gallery space in other programmes). The point-of-view (POV) camera direction, in simulating the experience of being physically present, transposes the museum tour into a television tour. There is a similar sequence in the RI programme where the camera slowly zooms in on George Porter and Stone from behind as they walk down a corridor between rooms. Again, the dialogue alludes to the heritage of the building, as well as its contents, but with an additional reflexivity that refers to the 'secondary' medium of the museum:

PORTER: the whole place is a wonderful museum of science over the last nearly two hundred years. We want to make it possible for everyone to see this.
STONE: You're open to the public?
PORTER: It will be open to the public next year. And Faraday's Museum – Faraday's Laboratory downstairs ... is untouched since Faraday left it. And this will be available for everyone to see, as well as all the other treasures which we have here in the Royal Institution.[56]

Through *WTFW*, the first public visit to the RI in its function as a museum was a televisual one. The intermedial construction of experiencing the RI's historical spaces was achieved through other televisual methods beyond the POV camera technique, such as the use of perspective shots that simulated experiences suggested by the dialogue: for example, watching a lecturer (Porter) make a 'dramatic entrance' into the RI's lecture theatre from the perspective of a seated member of the audience; and, in the same segment, Porter's perspective of lecturing from the floor, as he describes the experience of 'standing in the shoes of Michael Faraday'.[57] The combined-media product is enhanced realism: a transposed museum tour without the spatial or temporal boundaries of physically being there.

Alongside camera and direction, linguistic techniques of medial transposition are employed to create the sense of being inside a room during a tour, with frequent use of 'this' or 'these' as pronouns to emphasize where we (viewers and guides) are or what we are looking at. In a particularly prominent example during the ORO programme, Patrick Moore repeatedly uses this grammatical construction to give the impression of being somewhere historically significant, before Peter Stone playfully and reflexively alludes to the series title:

MOORE: Well *this* is really where it all began and you know I always think *this* is the most fascinating room in the entire building. *This* is the famous Octagon Room ...
STONE: Why are we within these eight walls?

[55] *WTFW* 5: 3:14–3:24, BBC Television Archive.
[56] *WTFW* 7: 5:30–5:57, BBC Television Archive.
[57] *WTFW* 7: 6:00–6:10, BBC Television Archive.

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MOORE: Well, it's a convenient shape architecturally and of course it does mean you have windows in every possible direction, which is useful when you are using telescopes from inside as they were.[58]

As the camera pans 360 degrees around the eight-sided room, showing telescopes at each of the windows, the connection made in the dialogue between the room's unusual architectural form and its scientific function is reinforced visually. We then hear the room's historical credentials:

MOORE: And after all it was designed by Sir Christopher Wren and he certainly knew what he was doing ... One of the very few remaining Wren interiors and absolutely as it was in Wren's time.[59]

This reference to the room's authenticity is followed by a discussion of the authenticity of the telescopes in the room – a theme that continues throughout the rest of the programme in relation to the ORO's scientific instruments. The reveal by Moore that none of the Octagon Room telescopes are 'originals' – that is, instruments associated with John Flamsteed – provokes a diversion into (an absent) object provenance. As Moore explains, in gendered language, when 'Flamsteed died ... along came Mrs Flamsteed and took away all the telescopes, which were legally hers'.[60] Each *WTFW* programme has at least one object in which its authenticity becomes a discussion point: reproduction fossils and aircraft, demonstration models of apparatus and 'originals', such as Davy's miner's lamp at the RI, Tesla's induction motor at the Science Museum and a Flamsteed-associated clock at the ORO.

This engagement with the authenticity of objects speaks to a distinctive medial trope of museums: the presentation of 'the Real' through authentic objects, which Roger Silverstone problematized as a medial feature distinguishing museums from television, arguing that both media navigate the 'fuzzy' 'boundary between reality and fantasy'.[61] The authenticity of objects, how their materiality connects us to a particular person, place, use and history, is what, Walter Benjamin influentially argued, gives them their unique 'aura'.[62] If Benjamin's thesis that a reproduction of an object jeopardizes its authenticity is to be believed, how can an object's aura be (re)produced for television?

In *WTFW*, moments of encountering authentic objects vary depending on how they are presented – both physically, such as behind glass in a showcase or out on open display, and conceptually, in terms of how important they are in the historical narrative. A showcase example comes at the Natural History Museum (NHM), when Alan Charig (1927–97), NHM curator and principal scientific officer (1964–87), shows Stone a wall-mounted frame containing a fossilized specimen: 'now this is Mary Anning's original plesiosaur, the one she found in 1823. The first articulated plesiosaur ever found'. While the camera zooms in on the object, its 'aura' of being the real thing is undermined by Stone's unimpressed response: 'it's a bit of a mangle'. Its historical significance is then played down by Charig for the reason that Anning's fossil discovery was in a pre-Darwinian era of natural history when 'they

[58] *WTFW* 5: 3:56–4:18, BBC Television Archive, added emphasis.

[59] *WTFW* 5: 4:18–4:37, BBC Television Archive.

[60] *WTFW* 5: 7:30–7:39, BBC Television Archive. The address 'Mrs Flamsteed' (referring to Margaret Flamsteed, *c.*1670–1730) becomes a recurring explanation as to why 'originals' are absent, in increasingly sexist tones: at one point, when it's asserted an object was taken by her, Moore exclaims with derision, 'that woman!'

[61] Silverstone, op. cit. (2), p. 233.

[62] Walter Benjamin, *Illuminations*, London: Fontana, 1992, p. 216. At the time of *WTFW*, Benjamin's essay, first translated into English in 1968, was becoming increasingly influential in cultural discourse, finding a wider audience when it featured as the focus of John Berger's first programme of his 1972 BBC television series *Ways of Seeing*.

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classified them [fossils] but nothing more than that'.[63] Behind museum glass, and in turn the glass of a television screen, the aura of Anning's plesiosaur has been lost in the media combination of a televisual museum tour; lost by reproduction.

A contrasting example of an encounter with 'original' objects occurs in the RI programme. Porter 'picked' a selection of electrical machines from the RI's collections and displayed them on the table of the RI's lecture theatre. But the objects are not intended as inert exhibits; they've been curated with performance in mind, as Porter proceeds to demonstrate how they work. Chronologically going through them, he generates electricity from a range of eighteenth- and nineteenth-century original apparatus, including Nairne electrostatic machines used by Davy and Faraday, an electrostatic generator made by Wimhurst and electrochemical battery piles associated with Volta and Davy. These original objects are primarily employed for their demonstration value, for the shocks and sparks that Porter generates:

PORTER: [*shouting while turning the Wimhurst machine to loud fuzz and bright sparks*] This gives a very satisfactory spark, you see.
STONE: I think it's not doing the television cameras any good at all. It's quite dramatic.
PORTER: I'll short it out for the sake of the television people.[64]

With this self-conscious reference to the primary medium, television, the programme signalled to its viewers that this was a televisual moment pushing the technical limits of its medium, adding to the excitement of witnessing it. The dynamism of these original objects in working demonstrations, arranged with the television cameras in mind (and before a time of stricter conservation practice), gave them a televisual aura, specific to this media combination. However, the main 'aura' moment in the programme was still to come, reserved for an object associated with the 'greatest experimentalist of them all, Michael Faraday', as Porter described him at the programme's conclusion. Before we see the object – Faraday's electromagnetic generator of 1831 – Porter contextualizes it in a historical narrative of electrical discoveries, from electrostatics through to electrochemistry, direct current and Faraday's electromagnetic research. His voice then slows: 'And *this* little bit of apparatus really is a historic piece of scientific apparatus … because in a sense it is the first dynamo.'[65] The camera zooms in on Porter as he speaks. Then there is a cutaway to a close-up of the object (our first glimpse after much build-up), with Porter's hands demonstrating how Faraday used it to generate an alternating electric current and measure it on a galvanometer (another original piece of apparatus): we see the galvanometer's needle move as Porter pulls the magnet in and out of the electrical coil. At this, Stone remarks, in astonished tones, 'this was the demonstration he made, well, 140 years ago!' Temporal emphasis is then married to spatial, as we are told by Porter that Faraday's 'discovery happened here' inside the RI.[66]

In this moment, *WTFW* presents a performance of the real thing (Faraday's apparatus) in a real place (the RI's lecture theatre where Faraday demonstrated it), situated in a temporal narrative of technological progress in the history of electricity generation.[67] On the one hand, the viewer cannot physically be in the presence of the object's aura, yet, through

[63] *WTFW* 3: 5:25–5:50, BBC Television Archive.
[64] *WTFW* 7: 12:02–12:10, BBC Television Archive.
[65] *WTFW* 7: 14:16–14:25, BBC Television Archive.
[66] *WTFW* 7: 14:50–16:20, BBC Television Archive.
[67] For contemporary museological accounts of the 'magic' and 'power' of displaying 'the real thing in the real place' see Alison Boyle and Harry Cliff, 'Curating the collider: using place to engage museum visitors with particle physics', *Science Museum Group Journal* (10 September 2014) 2, at http://journal.sciencemuseum.ac.uk/browse/issue-02/curating-the-collider (accessed 2 April 2022); Kevin Moore, *Museums and Popular Culture: Contemporary Issues in Museum Culture*, Washington, DC and London: Cassell, 1997.

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this medial combination, the object comes alive: we have 'behind-the-scenes' access to the object and its working operation that would be unavailable to a museum visitor – when the RI's museum opened the following year, the apparatus was inert behind glass in a showcase.[68]

Performances of historical experiments and apparatus, a lecturing tradition at the RI and the Science Museum since the 1950s, were a key intermedial feature of *WTFW*, combining dialogue, direction, camera and museological sites and apparatus. Unlike the RI programme, usually they were done with reproductions of original objects, like the copy of a Flamsteed equatorial sextant in a notable example at the ORO: 'we had to take Flamsteed's description of it ... and two engravings, and from that made a full-size working model', curator Derek Howse, head of astronomy at the ORO, explained as he joined Moore and Stone for a demonstration.[69] The three men then proceed to re-enact, with historical sensibility, how Flamsteed and his assistants measured angular distance, between the star Pollux and Jupiter for their demonstration, with the instrument:

HOWSE:	Imagine that the roof is open.
STONE:	It's perishing cold, presumably.
MOORE:	[*lying under a viewing telescope*] And cramped too, if I may say.
HOWSE TO STONE:	You are what Flamsteed called 'the silly surly labourer'. The man actually is Cuthbert, Cuthbert Denton. So [addressing Stone], 'Cuthbert, excuse me, what I want you to do ...'[70]

The dialogue continues in this jocular fashion, with Moore and Howse continuing to address Stone as 'Cuthbert' in mock authoritative tones. Stone eventually complains 'Cuthbert must have had a jolly boring job, doing this for two other people while seeing nothing'.[71] The performance conveys to the viewer a flavour of the physical and social conditions of working at the ORO, including from a technician's perspective. In another ORO performance, the three men operate the Airy transit circle, which is connected in the dialogue to a big narrative point: the ORO provided 'the world's time service'.[72] Through carefully staged televisual re-enactment, these performances of scientific operations inside the ORO building give us access to the real thing; the tacit knowledge involved in astronomy work, televised intangible heritage.[73]

While these demonstrations and re-enactments were constructed out of televisual documentary grammar, they were not fundamentally contingent on the intermedial format of the television museum tour. There was, however, an example of activity in *WTFW* that was: curatorial intervention. This occurs at the Science Museum's Electrical Engineering Gallery, which had opened in 1957.[74] The programme's tour guide author was Eric Laithwaite, professor of heavy electrical engineering at Imperial College. He was a familiar face to BBC television audiences, having appeared on the popular programmes *Tomorrow's World* and *Science Fair*. He had close ties to the RI, where he held a professorial post and gave the 1966–7 Christmas Lectures, which were the first series televised live in their entirety by the BBC. His pet subject was the linear motor, which he developed in his research, and advocated for its

[68] For inert and 'living' objects in museological display see Fiona Candlin, 'Keeping objects alive' in Michelle Henning (ed.), *Museum Media*, Oxford: Wiley-Blackwell, 2020, pp. 279–302.

[69] *WTFW* 5: 11:53–12:06, BBC Television Archive.

[70] *WTFW* 5: 12:40–13:16, BBC Television Archive.

[71] *WTFW* 5: 13:48–13:52, BBC Television Archive.

[72] *WTFW* 5 25:25–25:30, BBC Television Archive.

[73] See Sarah Kenderdine, 'Reenactment and intangible heritage strategies for embodiment and transmission in museums', *Volkskunde* (2020) 121(3), pp. 415–28.

[74] Its curator (assistant keeper) was Margaret Weston, who later became director of the Science Museum.

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adoption in high-speed hovertrain transport.[75] He was well known at the Science Museum, regularly bringing his Imperial students to the Electrical Engineering Gallery. He would also donate, shortly after *WTFW* was broadcast, several of his linear-motor prototypes to the museum's collection.[76]

In *WTFW* Laithwaite presented a history of electricity generation, from Faraday onwards, through electrical machines. The first in this series is a reproduction of Hippolyte Pixii's alternating-current generator of 1832.[77] Laithwaite opens the object showcase it is in, demonstrating how it works. He then makes an intermedial reference to its label text:

LAITHWAITE: But read what it says on this label, 'A year later, at Ampere's suggestion, a simple commutator was also added', which means they connected a small rotary switch … so you got direct current as you get from a battery, and one could add after that sentence, 'thereby retarding the progress of electrical machines by 50 years' … Now everything that happened after that for a time was a step backwards. Look at this machine …

STONE: You're a bit hard on them, aren't you, because direct current was all the rage then, because they were discovering new elements by electrolysis.[78]

The intermediality of the televisual museum tour has afforded Laithwaite the opportunity of adding text to a museum label, altering the historical narrative of the gallery section. He reinterprets the narrative positioning of the object from the standpoint of modern AC power generation, arguing all the gallery's DC electrical machines after Pixii's modified generator are a 'step backward' from technological progress. Stone counters Laithwaite's curatorial revisionism with a plea to consider DC machines in the context of their time, but in fact from an alternative presentist standpoint, of scientific rather than technological progress: the importance of DC in the history of experimental research, such as Davy's isolation of chemical elements by electrolysis (a narrative that came from Porter in the previous programme when he discussed Pixii's generator).

Later in the programme, Laithwaite makes a second curatorial intervention of a different kind: he inserts his own invention, the linear induction motor, into the gallery. Displayed (for the purpose of the programme) on a table next to Tesla's induction motor, Laithwaite puts his work (and object) in direct dialogue with Tesla.[79] These curatorial interventions rely on the combination of televisual and museological media, whereby the authority, narrative and content of a permanent gallery space can be temporarily modified during a television broadcast, giving Laithwaite both a spatial platform (the Science Museum) and a temporal platform (the *WTFW* television slot) from which he can construct his own material history of electrical engineering, which leads up to his own work on linear induction motors.

[75] Rupert Cole, 'Laithwaite, Eric Roberts', *Oxford Dictionary of National Biography*, 12 July 2018, https://doi.org/10.1093/ref:odnb/68432 (accessed 17 January 2022).

[76] For Laithwaite's linear motors at the Science Museum, the object numbers are 1977-702, 1977-703 and 2000-429.

[77] The object was a reproduction (Science Museum inventory number 1937-625) based on drawings of Pixii's electromagnetic generator. The Science Museum disposed of it in 1987. A superior reproduction (Science Museum inventory number 1972-332) had been made in 1972 with reference to the original apparatus, held by the Smithsonian Institution.

[78] *WTFW* 8: 7:26–8:46, BBC Television Archive.

[79] Tesla's induction motor was an original (Science Museum inventory number 1927-157), which Laithwaite operated. Since the year 2000 it has been on display in the Science Museum's Making the Modern World gallery. Two of Laithwaite's earliest linear induction motors, one of which featured in *WTFW*, were acquired by the Science Museum in 1977 (Science Museum inventory numbers 1977-702, 1977-703).

Beyond these four walls: historiography and the public culture of science

How does *WTFW* present the history of science and technology? At the level of generalities, there are historiographical traits across the series common to scientists' accounts of their subject's history in the period: internalist, presentist, Whiggish, 'great man', lone-genius tropes, nationalistic emphasis, technological progress and so on. Some of these historiographical traits were also typical of gallery displays at the museums featured, such as the Science Museum, curated before academic history of science came to influence its curatorial staff. However, there were a few moments in the series when we witness inversions. John van Riemsdijk, a Science Museum curator, was responsible for most of these. In the first *WTFW* programme from the British Transport Museum in Clapham, Riemsdijk argued that European engineering design of locomotives in the twentieth century was superior to British; and that when prompted by Peter Stone to reassess a nineteenth-century British locomotive designer, William Adams, in light of this, Riemsdijk refused, and instead argued that Adams was innovative in the context of his time. Unlike other *WTFW* authors, Riemsdijk also provided social and cultural context to his historical account of locomotive development.

At times, *WTFW* authors were led into alternative historiographies by the subject matter of the series that privileged the material over the documentary history of science. For example, Porter departed from a discovery-led narrative of former Royal Institution figures when describing Faraday's notebooks; instead, he remarked on the practice and process of science that these artefacts invite. More generally, we find an instrumental-led progress narrative that emphasized the role of applied science and the linear model, e.g. Faraday cast as the 'father of electricity' in the context of power generation.[80] This material-culture historiography was no more evident than during a format feature of the series where at the end of each programme the camera zooms in on a final object as a concluding historical point is made by the author. When this happened at the end of the Electrical Engineering Gallery programme, Laithwaite reflected what 'people like us' wandering around the museum in a hundred years' time might think of 'that modern 1970 machine' and judge it as technologically naive.[81] This sense of relative technological progress from a historical perspective unravels Laithwaite's presentist, Whiggish account of electrical engineering that he had constructed up until that point.

But rather than ascribe these Whiggish tendencies to a lack of historical sophistication, a key concern of the post-1960s generation of historians of science, I think there were ideological motivations for scientists to promote this mode of history.[82] For example, the context in which history-of-science programming was discussed within the Science Consultative Group was often in terms of the 'presentation of scientific *achievement*'.[83] It was this topic that Porter had complained about in a 1968 meeting to the BBC's Aubrey Singer with respect to contemporary science programmes, which he argued showed the 'bad rather than the good effects of science and technology on everyday life'. Singer retorted that 'he did not see the BBC's role as a propagandist', adding that 'his intention was to bear witness to the times'.[84] By the end of the 1960s, BBC producers of series such as *Horizon* and *Towards Tomorrow* (1967–9) had begun questioning the direction science was taking, engaging with controversial issues of science and technology, such as industrial pollution, organ

[80] See Frank A.J.L. James, 'The Janus face of modernity: Michael Faraday in the twentieth century', *BJHS* (2008) 41, pp. 477–516.

[81] *WTFW* 8: 26:10–26:20, BBC Television Archive.

[82] See Geoffrey Cantor, 'Presidential Address. Charles Singer and the early years of the British Society for the History of Science', *BJHS* (1997) 30(1), 5–23.

[83] SCG minutes, various dates, BBC WAC, R78/76, added emphasis.

[84] SCG minutes, 24 May 1968, BBC WAC, R78/76/1, pp. 7–8.

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transplantation and chemical and biological warfare, prominent in public debate in these years.[85] History-of-science broadcasting in its internalist and presentist form could be a refuge for establishment scientists like Porter, who wanted to disassociate the social and political aspects from science in order to promote it as a progressive force.[86]

WTFW presented an opportunity to achieve this in powerful new ways, engaging with ideas of national heritage through intermedial constructions of historic place and object performances. These moments – such as George Porter demonstrating Faraday's original 'dynamo' in the RI's lecture theatre – created what Thomas Gieryn has dubbed a 'truth spot':

> historical museums trade on the authenticity of their collection of objects, and when those objects are presented not in halls filled in glass cases but in a place … their authenticity becomes unassailable, and the story itself becomes that much more believable.[87]

With combined televisual and museological techniques, the objects and place impress upon viewers not just historic authenticity but also the truth of the scientific narrative that they have been linked to: Faraday's electromagnet work at the RI as the origin of modern electrical power generation, for example. In this way, in *WTFW*, the material culture of science and technology is connected as tangible and convincing origin points in a narrative of modern living, spanning transport, electricity and time.

This usage of historic place and material culture as 'truth spots' to reinforce progressive, discovery-led historiography became a feature of history-of-science programming on the BBC in the following decades. *The Ascent of Man*, for example, even deployed some of the same places and objects as *WTFW*, such as the Airy transit circle at the ORO, to similar effect. By employing intermediality as an analytical tool, it is possible to deconstruct how historiographic narratives are being presented as factual truths through scientific heritage.

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[85] See Timothy Boon and Jean-Baptiste Gouyon, 'The origins and practice of science on British television', in Martin Conboy and John Steel (eds.), *The Routledge Companion to British Media History*, London: Bloomsbury, 2014, pp. 470–83, 477; Cole, op. cit. (22), pp. 121–3.

[86] Cole, op. cit. (22).

[87] Thomas F. Gieryn, *Truth-Spots: How Places Make People Believe*, Chicago: University of Chicago Press, 2018, p. 60.

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