Beyond Marconi: the roles of the Admiralty, the Post Office, and the Institution of Electrical Engineers in the invention and development of wireless communication up to 1908.

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The candidate confirms that the work submitted is her own and that appropriate credit has been given where reference has been made to the work of others.

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Abstract

One of the first histories of wireless communications, J.J. Fahie's *A History of Wireless Telegraphy 1838-1899* (1899), was written by a contemporary to many of the early practitioners within its pages and featured an illustrated list entitled "The Arch Builders of Wireless Telegraphy". This list stretched from key contributors to the early study of electromagnetism such as Ampère, Faraday, and Maxwell through to developers of early wireless apparatus and systems such as Branly, Lodge, Preece, and Marconi. The equal recognition recorded to these twelve men and the collective contribution of scientists, engineers, government employees, along with men of commerce, to the embryonic field of wireless communications has been mostly ignored in the existing body of scholarship on wireless telecommunications. In this thesis, I offer an early history of wireless communications deeply familiar to contemporaries but take a novel approach and study the roles of institutions rather than individuals. Traditionally institutions are presented as grateful consumers and passive users of telecommunication systems. I utilise contemporary periodicals and rich yet underused archival resources in order to map the influence, agency, and roles of three historic case studies – the Admiralty, the Post Office, and the Institution of Electrical Engineers (IEE) – in wireless communications. Furthermore I will consider how these institutions constrained the activities of the Marconi Company. This thesis begins with a consideration of the community, expertise, and practices of wireless practitioners centred about the Post Office and IEE that pre-dated the discovery of Hertzian waves and Marconi's arrival in Britain in 1896. Furthermore I will explore the technical expertise located within the Royal Navy and show how this shaped military demand for wireless communication in the early twentieth century. The final two chapters of this thesis explore the influence and agency of the Admiralty and the Post Office in domestic legislation and international regulations of wireless communications. This thesis demonstrates how and why these "institutional innovations" and activities shaped this technology during its formative years and laid the foundation stone for wireless communications and its successes in Britain and beyond.

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List of Abbreviations and Acronyms

AIEE: Associate Member of the Institution of Electrical Engineers; modern day equivalent of a member.

BT: British Telecom

FRS: Fellow of the Royal Society

GPO: General Post Office, UK

HoC: House of Commons

HoL: House of Lords

IEE: Institution of Electrical Engineers

IET: Institution of Engineering and Technology

ITU: International Telegraph Union (1865-1932) now International Telecommunication Union (1932-present)

MIEE: Member of the Institution of Electrical Engineers; modern day equivalent of a fellow.

PRO: Public Record Office, now National Archives.

RE: Royal Engineers

RN: Royal Navy

STE: Society of Telegraph Engineers

STEE: Society of Telegraph Engineers and Electricians

W/T: Wireless Telegraphy

Chapter 1: Introduction

1.1 Introduction

> ...wireless telegraphy is a free system open to the whole world. It was not patented by the Post Office; it was developed by the Post Office, and when Mr. Marconi came he only came with a new way of doing an old thing. … ...we speak of ourselves [the developers of wireless] as a body – the country, and our Post Office department and other electricians in England.[1]
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> - Evidence of Sir William Preece, former Engineer-in-Chief and Electrician of the Post Office (1892-1899), at Select Committee hearings on British ratification of the Radiotelegraphic Convention, May 1907.

In 1907 William Preece, Engineer-in-Chief and Electrician of the Post Office between 1892 and 1899, was one of many wireless pioneers giving evidence before Select Committee hearings to determine whether Britain would ratify the Radiotelegraphic Convention. The Convention, the main outcome of the 1906 International Radiotelegraph Conference held in Berlin the previous year, was the first set of international regulations on wireless communications. The witnesses called to give evidence were divided. Representatives and supporters of the Marconi Company vehemently opposed ratification, in particular the principle of obligatory intercommunication between different wireless systems during ship-to-ship communication. They also presented a distinctly commercially driven history of wireless communications, emphasising patenting and commercial competition. In contrast, most other witnesses supported ratification and argued for an early history of wireless mostly independent of commercial concerns and populated with a unified community of British wireless pioneers. Membership of this wireless community was centred around the Institution of Electrical Engineers, and was supported by powerful state-sponsored institutions such as the Admiralty and the Post Office. A closer examination of their role in early wireless developments offers, I believe, the key to unlocking an alternative, institutionally focused narrative of early wireless developments, one which studies innovation taking place beyond

1 *Report from the Select Committee on Radiotelegraphic Convention; Together with the Proceedings of the Committee, Minutes of Evidence, and Appendix*. Vol. 246, House of Commons Reports of Committees. London: Printed for His Majesty's Stationery Office, 1907, 226, 233.

traditional locations such as commerce and the laboratory. It is for these reasons and more that I have selected these three institutions – the Admiralty, the Post Office, and the Institution of Electrical Engineers – as the case studies for this thesis.

The evidence put forward before the Select Committee by these early wireless pioneers, including that of William Preece, served a purpose secondary to ratification of the Convention. It granted this community of early wireless pioneers and institutional witnesses the opportunity to publicly express the roles and agency they and their institutions had in early wireless and to provide evidence of state-sponsored expertise and innovation in wireless communications. Their evidence moved beyond mere technical and scientific advances to a more detailed précis of the development of institutional wireless policy that embraced early demands for wireless systems, wireless legislation and regulations, along with technical innovations. In the short-term the arguments put forward by institutional witnesses and other early wireless pioneers were successful with the outcome being the British ratification of the Convention. However, in the long-term, it was the commercially driven narrative of wireless invention established by Marconi and his supporters which formed the basis for the established narrative of wireless history. Hitherto, institutional contributions to wireless communication have only received fragmentary treatment. Most often these institutional innovations have been considered – in a Whiggish fashion – as being the product of a key figure in each respective institution, exemplary cases in this context being William Preece at the Post Office and Henry Jackson in the Royal Navy.[2] Thus a consideration of the roles of state and technical institutions in the early history of British wireless and the influence of these institutional actions on wireless technology and the activities of the Marconi Company is absent from the standard historiography of wireless communications. It is this absence of scholarship on institutional-level innovations in wireless communications which has motivated this thesis and informed its methodological approach.

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2 For example, see Baker (1976); Constable, Anthony Robert. "William Preece - the Engineer Whose Failed Quest for Wireless Telegraphy Set the Scene for Its Eventual Arrival." *The Journal of the Communications Network* 5, no. 1 (2006): 51-58; Pocock, R. F. "Captain Henry Jackson and the Early Development of Radio." *Journal of the Royal Naval Scientific Society* 20, no. 1 (January 1965); Pocock, Rowland F. "The Radio Experiments of Sir William Henry Preece." *The Society of Engineers Journal* 56 (1965): 141-47; Rawles, Alan T. "Jackson of the "Defiance"." *Journal of the Institution of Electrical Engineers* 1, no. 12 (1955): 743-45; Tucker, D.G. "Sir William Preece (1834-1913)." *Transactions of the Newcomen Society* 53 (1981): 119-36.

Traditional scholarship on wireless communications emphasises its heroic origins, drawing a clear narrative from the creative genius of a few isolated pioneers to the later successes of wireless broadcasting.[3] In doing so, the significant influence and contribution of institutions to the embryonic history of wireless communications is marginalised. An excellent example is provided by the events surrounding the 1907 Select Committee which, despite being well-documented and well-publicised at the time, have been side-lined in the canon of wireless historiography.[4] More generally in the history of technology, institutions are typically considered to be limited by their traditions and hence a hindrance to invention and innovation.[5] The nature of institutions, particularly state-sponsored institutions including government departments, is typically placed in distinct contrast to the free and progressive nature of technological innovation. Scholars in the field of economic history, such as North, have argued that the essence of an institution is constraint according to state or societal norms in order to shape economic interactions and activities.[6] I will further develop this definition and argue that institutional constraint stems from these essential properties and not from their perceived conservative nature. I will further argue that institutions are capable of both supporting and constraining innovation and invention and, more importantly, institutions can be sources of innovation and innovations themselves.

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3 Examples of traditional wireless scholarship include Appleyard (1930), Coe (1943), Garratt (1994), Geddes (1974), Jacot de Boinod and Collier (1935), Jolly (1974), Rowlands (1994), and Weightman (2004).

For a wider discussion of the development of the 'heroic' identity of the inventor, see MacLeod (2007).

4 Standard modern narratives of wireless history which have omitted or downplayed the 1907 Select Committee hearings include Aitken (1976), Burns (2004), Constable (1980), Garratt (1994), Hong (2001), Pocock (1988), Rowlands and Wilson (1994), and Sarkar, Mailloux, Oliner, and Sengupta (2006).

5 More generally, see Fogel, Kathy, Ashton Hawk, Randall Morck, and Bernard Yeung. "Institutional Obstacles to Entrepreneurship." In *The Oxford Handbook of Entrepreneurship*, edited by Mark Casson, Bernard Yeung, Anuradha Basu and Nigel Wadeson, 540-79. Oxford: Oxford University Press, 2006; Mohnen, Pierre, and Lars-Hendrik Röller. "Complementarities in Innovation Policy." *European Economic Review* 49, no. 6 (2005), 1433; and Wiener (1981). In relation to history of radio, see Lochte, Robert Henry. "Invention and Innovation of Early Radio Technology." *Journal of Radio Studies* 7, no. 1 (2000), 111.

6 North (1990), 3-4. See also **footnote number 8**.

This is not to ignore the importance of the commercial development of wireless but rather to show it was not the sole model for invention and innovation in the field, especially during its formative history. Further to this, I will argue that institutional needs and demands, which mostly differed from those of the commercial world, laid the groundwork for wireless communications in Britain. Issues of ownership, competition, litigation, patenting, and profit were of marginal importance in institutions but are generally considered of vital importance in the world of commerce. However, this is not always as straight-forward as it is seems – these matters do not always motivate and direct the activities of the commercial company to the degree often presented. Marconi's Wireless Signal and Telegraph Company (the Marconi Company), the most successful wireless company during this period and the most inclined to patent, did not pay out dividends on company shares nor litigate until 1911, fourteen years after the company was first established.[7]

Returning to the key question informing this thesis, we must ask: what was the role of these state and technical institutions in the early history of British wireless? Furthermore how did these institutions influence the early development of wireless technology and how did they constrain the activities of the Marconi Company? These questions can be broken down into three interconnected questions. First, what was the role of state and technical institutions in the early history of British wireless communications? Secondly, which institutions were the key institutions? Thirdly, how did these key institutions influence wireless technology and constrain the activities of the Marconi Company? In pursuing these questions, I will challenge key aspects of the traditional narrative of wireless history which credits the Marconi Company as being the main, indeed sometimes the sole, source of invention and innovation during its formative period. Instead I will extend and reinterpret the contribution of Marconi and his company in terms of the institutional affiliations of his supporters and allies. I will also argue that much of Marconi's early commercial successes was achieved with the assistance and support of these institutions in combination with Marconi's distinctive access to key aspects of

7 For further details of the first dividend issue of the Marconi Company, see "The Marconi Meeting." *The Times*, 21 July 1911, 22.

For further details on Marconi vs. British Radio Telegraph and Telephone Company Ltd. (1911), see Marconi Collection MS. Marconi 535 – Correspondence and papers concerning an action against the British Radio Telegraph and Telephone Company Ltd (1910-11).

these institutions including organisational expertise, technical resources, and administrative structures.

Before describing the selection of institutional case studies, first I will consider the concept of an institution and relatedly "institutional innovation", these being important considerations in my proposed revisionist history of wireless. The key considerations of institutions discussed generally in this section and more specifically throughout this thesis raise a number of different questions about the nature of institutions and hence an understanding of "institutional innovation" for the purposes of this thesis. For example, what is an institution? Is it merely the sum of the individuals employed by the institution or does an institution also incorporate the structure, practices, strategy, and identity of the institution itself? But can these properties be defined independently of the individual involved? And so we return to the key question: where, if at all, is the delineation between the individual and the institution? This is a key consideration in this thesis with prominent examples considered being the delineation (if at all) between Henry Jackson and the Royal Navy and William Preece and the Post Office.

The concept of an institution has been the subject of scholarly interrogation by individuals from the fields of philosophy, anthropology, economics, and social science, amongst others; this remains a much-debated and unresolved topic to this day with little consensus or clarity to be found.[8] The *Oxford English Dictionary* characterises eight different use of the term "institution" and I have selected the definition which best shed light on the notion of an "institution" as it applies for the purposes of this thesis: "**institution, n.** 7a. An establishment, organization, or association, instituted for the promotion of some object, esp. one of public or general utility, religious, charitable, educational, etc. ..."[9]

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8 For discussions of the ongoing debate about the nature of institutions, see de Pina-Cabral, Joao. "Afterword: What Is an Institution?" *Social Anthropology* 19, no. 4 (2011): 477-94 and Miller, Seumas. "Social Institutions." The Stanford Encyclopedia of Philosophy, http://plato.stanford.edu/archives/fall2012/entries/social-institutions/. Date accessed: 15 November 2011. See also Searle, John R. "What Is an Institution?" *Journal of Institutional Economics* 1, no. 1 (2005): 1-22.

9 "institution, n.". OED Online. September 2012. Oxford University Press. 15 November 2012 <http://0-www.oed.com.wam.leeds.ac.uk/view/Entry/97110?redirectedFrom=institution>.

This was an accepted usage in the English language by the late nineteenth century and so formed part of how the historical figures considered in this thesis would have understood an "institution" or rather how specific instances such as the Admiralty, Post Office, the Royal Navy, and the Institution of Electrical Engineers were understood. Furthermore, this usage supports the notion of a conceptual framework of an institution which incorporates usage, practice, organisation, and the integral structure of the institution itself. This definition also supports the notion of an "institution" which incorporates social elements and utility. For the purpose of this thesis, this usage supports the notion of an "institution" as being the collective action of a group of individuals towards some common purpose and incorporating, I will argue, the organisational expertise, technical resources, and administrative structures of the institution itself. Thus, institutions are, I will argue, more than the sum of their individuals.

Further to this, the notion of "innovation" is also worthy of further consideration and, again, the *Oxford English Dictionary* (*OED*) provides multiple examples about which there is plenty of scope for debate and discussion. As per the above discussion of "institution", I have identified the particular usage that offers a better understanding of the notion of "innovation" as it applies to this body of research. To this end, the *OED* offers "**innovation, n.** 1a. The action of innovating; the introduction of novelties; the alteration of what is established by the introduction of new elements or forms. … 5. *Comm*. The action of introducing a new product into the market; a product newly brought on to the market."[10] To this end, we can understand innovation as being something which is novel: either something truly original such as an invention or something which has been significantly improved as so to offer novelty, such as the incremental improvement of an invention. It is worth highlighting that, independent of later claims, all of Marconi's early British patents between 1896 and 1904 were all improvements rather than inventions and were titled as such.[11] This definition was in usage

10 "innovation, n.". OED Online. March 2013. Oxford University Press. 3 May 2013 <http://0-www.oed.com.wam.leeds.ac.uk/view/Entry/96311?redirectedFrom=innovation>.

11 Examples include British patent No. 12,039 (1897) "Improvements in Transmitting Electrical impulses and Signals, and in Apparatus therefor [sic]"; British patent No. 7,777 (1900) "Improvements in Apparatus for Wireless Telegraphy"; British patent No. 5113 (1904) "Improvements in Transmitters suitable for Wireless Telegraphy"; British patent No. 21640 (1904) "Improvements in Apparatus for Wireless Telegraphy"; and British patent No. 14788 (1904)

from the sixteenth century and so would have been part of the vocabulary used by the actors in this thesis. However, the current definition of "innovation" offered by the *OED* also includes a more recent definition dating from the mid-twentieth century, definition five listed above. This usage of "innovation" points towards a commercially focused understanding of innovation: something which creates value in the commercial market. However, this definition did not enter common usage until the mid-twentieth century and so would not have been part of the understanding of "innovation" according to the historical actors featured herein. It also, to some degree, contradicts the notion of "institutional innovation", using commercial development as an important and sometimes sole arbiter for the notion of "innovation", a lacuna in the understanding of "innovation" which I challenge within this thesis.

Having briefly analysed the character of both institutions and inventions, I will synthesize these two concepts in a way that might be thought to be oxymoronic by some scholars in the history of telecommunications, for example critics of the conservatism of Government bureaucracy such as Charles Perry.[12] So next, I will consider "institutional innovation", the novel methodological concept of this work. Put quite simply, "institutional innovation" is innovation which takes place within institutions and outside of, although not entirely independent from, traditional spheres of innovation such as commerce and scientific research. In order to construct this concept, I have utilised theories from history of technology and economic studies. From history of technology, I have synthesised elements from three distinct approaches: "collective invention", social shaping of technology, and social construction of technology (SCOT).[13] In its original conception, "collective invention" describes the process whereby different commercial companies working in the same field share what might be

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"Improvements in or relating to Wireless Telegraphy".

12 Perry (1992).

13 Publications featuring "collective invention" include Allen, Robert C. "Collective Invention." *Journal of Economic Behavior & Organization* 4, no. 1 (March 1983): 1-24; Cowan, R., and N. Jonard. "The Dynamics of Collective Invention." *Journal of Economic Behavior & Organization* 52, no. 4 (December 2003): 513-32; Hall and Rosenberg (2010), and Nuvolari, Alessandro. "Collective Invention During the British Industrial Revolution: The Case of the Cornish Pumping Engine." *Cambridge Journal of Economics* 28, no. 3 (1 May 2004): 347-63. Publications on social shaping and construction of technology include Bijker, Hughes, and Pinch (1987), Bijker and Law (1992), Bijker (1995), Fox (1996), MacKenzie and Wajcman (1999), and Oudshoorn and Pinch (2003).

traditionally understood as “trade secrets” openly and unpatented for the collective benefit of all involved. Social shaping and construction of technology argued that the success and failure of technologies could be best understood in terms of the social context, support, and development. Building on these theories, I will argue that “institutional innovation” borrows from the collective contributions of “collective invention” but with the different individuals working for the same institutional body rather than different commercial companies. In terms of SCOT, I will argue that the innovations developed within the institutions examined in this thesis were influenced by their development and production within non-commercial bodies devoted to the public good where certain commercial practices such as patenting were not a priority. Thus the “ownership” of these innovations does not lie with individuals and/or patent-holders but rather the overall institutional body. This provides a distinct contrast to the case of the Marconi Company and their practices, commercial and patenting.

I have also considered studies of institutions from the wider field of economic history.[14] “Institutional innovation” uses different elements of institutions in order to more fully understand the notion of innovation within the institutional context. The elements I have selected for consideration are research, expertise, agendas, resources, publicity, and need/demand. I will explore these in order to compare and contrast my three case studies, and to show how these institutional differences contribute to an explanation of their different roles in and responses to wireless telegraphy. I will also utilise the concept of “institutional innovation” to consider how it diverges from more familiar modes of invention and innovation such as commercial development and scientific invention. In doing so, I will challenge the notion that commercial development and scientific invention are the sole locations of

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14 See Acemoglu, Daron, and James Robinson. "The Role of Institutions in Growth and Development." *Review of Economics and Institutions* 1, no. 2 (2010): Article 1; Meisenzahl, Ralf R., and Joel Mokyr. "The Rate and Direction of Invention in the British Industrial Revolution: Incentives and Institutions." In *The Rate and Direction of Inventive Activity Revisited*, edited by Josh Lerner and Scott Stern, 443-79. Chicago: University of Chicago Press, 2012; Mokyr, Joel. "The Institutional Origins of the Industrial Revolution." In *Institutions and Economic Performance*, edited by Elhanan Helpman, 64–119. Cambridge, Massachusetts: Harvard University Press, 2008; and North, Douglass C., and Barry R. Weingast. "Constitutions and Commitment: The Evolution of Institutional Governing Public Choice in Seventeenth-Century England." *The Journal of Economic History* 49, no. 4 (1989): 803-32.

invention and innovation and furthermore revise and reinterpret the role of the Marconi Company in the formative history of wireless communications in Britain.[15]

In terms of the case studies engaged with in this thesis, I will show that the "institutional innovations" conducted by the Post Office were conducted in the context of a clear public need for a wireless communications system for lighthouses, lifeboats, and additional locations incapable of cable telegraphy. This demand for innovation resulted in the Post Office being the first institution, British or otherwise, to conduct formal investigation and experimentation in the field of wireless communications. These innovations also took place within the institutional structure of the Post Office and external to commercial demands such as patenting and related claims of historical priority. Beyond this, the Post Office as an institution was a true pioneer and innovator in the field of wireless and remained deeply influential throughout the period covered by this thesis. In the early twentieth century their "institutional innovations" continued and were extended beyond the technological. Instead the Post Office extended their active role in wireless to incorporate internal government discussions, domestic legislation, and international regulations, a role they would share with the Admiralty.

The "institutional innovations" conducted by the Royal Navy and the Admiralty in relation to wireless communications were three-fold. First, the Royal Navy offered a welcome home for institutional innovation and experimented with an internally developed wireless system from the mid-1890s onwards. During this period, the navy was one of the foremost innovators and customers in the field of wireless telegraphy. By providing centres of innovation such as HMS Vernon, the navy was able to harness and support the cutting edge scientific knowledge and research being enacted by members of its fleet. Individuals such as Henry Jackson, with the support of the Admiralty, developed innovative wireless systems specifically designed to meet the navy's needs, that is ship-to-ship communication. In setting the agenda in terms of their demands for wireless communications, the Admiralty forced Marconi to adapt his wireless system which had a longer range than the internally developed naval wireless system but was also unsuited to the maritime communications demanded by the navy. Secondly, the navy was one of the earliest customers for wireless systems,

15 For a discussion of the wider context of the 'invention' of telegraphy, broadened to include the machine shop and the industrial laboratory, see Israel (1992). However, alternative locations for the 'invention' of wireless telegraphy beyond commercial development and the scientific laboratory have not been previously considered.

particularly the Marconi system. As a customer of the Marconi Company, the Admiralty not only made technical demands but also questioned the company's policy on patents and temporarily ceased negotiations with the company when pushed on this issue. Further to this, it shaped wireless communications to meet its needs for maritime signalling and through the incorporation of wireless signalling into their institutional structure and practices, something that offered wider implications for the development of wireless communications. Finally, the Admiralty acted as a regulator – shaping international rules and regulations to match both its needs and more generally the British national interest.

Thirdly and finally, in the case of the Institution of Electrical Engineers (IEE), "institutional innovation" was a more subtle and complex activity. The IEE did not practice straightforward first order "institutional innovation" *per se* but instead this member-led institution held a second order role, offering a public domain and forum for critical debate and discussion on and about innovations. In relation to early wireless communications, these centred about sometimes competing claims of historical priority. The role of the IEE also demonstrates how public demonstrations and debate are an essential and important part of technical innovations. This exploration of the complex role of the IEE in early wireless communications also raises the point that, in relation to aspects of wireless communications such as wireless rules and regulations where the IEE might be expected to take a role, this did not come to pass. Instead wireless rules and regulations were considered a political matter, rather than a technical or purely regulatory matter, and so authority was allocated to the best-placed government departments; the Post Office and Admiralty.

The diverse and changing natures of my case studies in the formative history of wireless communication offers the chance to fully explore the concept of "institutional innovation" and to give a deeper consideration as to the role of these institutions in early British wireless history. To meet these goals, I have chosen three institutions that best exemplify their role and influence within the technological systems of wireless and related innovations in Britain; the Admiralty, the Post Office, and the Institution of Electrical Engineers. In contrast to the more strongly defined roles of the Admiralty and the Post Office with their government and state roles and the Marconi Company with a clear commercial role, the Institution of Electrical Engineers (IEE) offers a more subtle role in wireless communications. The membership of the institution eschewed potential involvement in wireless standardisation, education, and training in this formative period in its history. Instead the institution provided support for a community of early wireless pioneers and a space in which to exchange ideas and to pursue the gentlemanly debate and discussion that was so clearly lacking from the cut and thrust of the commercial world. More generally, this thesis interrogates the conceptual framework and nature of an institution. Moreover I will question and explore whether state-controlled institutions such as the Admiralty and Post Office were better placed or indeed better suited to accomplish wireless innovations than a member-led techno-scientific institution such as the Institution of Electrical Engineers in terms of wireless innovations. If this is the case, what might this say about the nature, structure, and operation of institutions in relation to their engagement with technological innovations?

All three institutions functioned largely but not entirely independently of commercial concerns. Despite the differing functions and research cultures of these institutions, they had significant roles in the regulation and social shaping of wireless communications in Britain and throughout the empire at the end of the nineteenth and beginning of the twentieth century. My thesis explores these differences and their contributions to the resulting alternative and institutionally focused narrative of early wireless communications. All three institutional case studies have left significant and under-explored archival material. I have selected three British and British-centric institutions as my focus as Britain was the home of and market for all major telecommunication systems of the period, including the earliest operating commercial wireless services. By the late 1890s, these three powerful and diverse institutions were collaborating and competing to establish a role in wireless communications and to shape the resulting systems, practices, and material culture. All three institutions were situated outside of what has been considered the traditional location of invention, the commercial sphere. They were not developing or patenting technological systems and artefacts but rather utilising their institutional structures and connections in order to shape and control this embryonic and evolving technology. As a result these developments are contextualised within a complex, intersecting and much richer historical weave rather than the traditional heroic narrative. Through the work and support of institutional innovation, different forms of wireless communications were transformed from the physical research in a laboratory to a more practical application: signalling.

These institutions also adapted and thrived during this period of immense social, technological, and cultural change at the end of the nineteenth century and the beginning of the twentieth century. While all have been the subject of institutional histories, their roles in early wireless development have not been thoroughly researched and explored.[16] The archives of the IEE (held by the Institution of Engineering & Technology) and telecommunications at the Post Office (held by British Telecom) hold a unique collection of correspondence, papers, technical discussions, patent details and other ephemera relating to early wireless developments. These archives, along with material in the Marconi Collection archives at the Bodleian Library, Oxford, also offer a chance to revise the role of the Marconi Company and to reconsider the resources, support, and expertise provided to the company by the aforementioned three institutions. As discussed in the next chapter, Marconi's earliest activities upon arriving in Britain involved neither patenting nor steps towards the establishment of a company.[17] Instead Marconi used family connections and wrote letters of introduction to key figures in the War Office, the Admiralty, the Post Office, and other government departments.[18] It is open to debate whether Marconi was seeking institutional support, access to expertise, potential customers, or some combination of all three. Although Marconi may have later disputed the contribution of these institutions, the evidence suggests that he saw access to these powerful institutions as an important first step in the establishment and development of his wireless system.

My thesis seeks to undermine the mythology surrounding wireless development – the lone “heroic” genius toiling away for commercial gain in the model of the self-made Victorian

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16 The four standard institutional histories of the Post Office are: Campbell-Smith (2011), Daunton (1985), Perry (1992), and Robinson (1948). In addition, there is a volume on the Post Office Engineers, Bealey (1976).

There are two standard institutional histories of the Institution of Electrical Engineers: Appleyard (1939), this covering the first 60 years of its history from 1871 to 1931 and Reader et al. (1987) which marks the centenary of the institution covering the period from 1871 to 1971 but focussing on the period not covered in Appleyard's volume, that is 1931 to 1971.

17 See **Chapter 2 - “Something in the Air”: The Post Office and early wireless experiments, 1882-1899**.

18 A copy of the letter of introduction from A.A. Campbell-Swinton, written on behalf of Marconi, to William Preece dated 30 March 1896 can be found in Marconi Collection MS. Marconi 1774 - HIS 62: Early demonstrations and tests – Marconi and Preece, 1951-89. A letter to the Secretary of State for War Affairs at the War Office from Marconi dated 20 May 1896 can be found in National Archives WO 32/8594 - INVENTIONS AND PATENTS/TELEGRAPHY: Consideration of Marconi systems of transmission of electric signals without wires. Possible military uses (1896).

man – and queries the mode of historiography that considers commercial development the sole centre of innovation and measure of success. Instead I wish to present and explore a less exclusive domain of invention, innovation, and practice – one which encompasses electrical engineers, techno-scientific institutions, government departments, and the military – in order to provide a more complete narrative of wireless communications. I will build upon the work of previous scholars in the field of wireless history and use popular methodologies in the history of technology, in order to examine the role of institutional innovation in the early history of wireless. The methodology of actor-network theory provides a useful framework in which to examine and understand processes of innovation and knowledge-creation in early wireless histories.[19] In order to better understand the collaborative elements of innovation within, without, and between institutions, I have used the model of "collective invention".[20] Most prominently, this thesis borrows concepts from social constructions of technology (SCOT) such as interpretative flexibility, relevant social groups, design flexibility, and technological closure. However, I will question whether closure, rhetorical or otherwise, can be a useful tool from SCOT with which to interrogate institutional involvement in early wireless history.

Wireless systems developed within the Engineering Department of the Post Office in the 1880s and 1890s are considered by scholars of broadcast radio to be the pre-history or indeed proto-history of standard wireless narrative.[21] I place the Post Office firmly at the genesis of wireless history and demonstrate their influence on later wireless communications and related systems and expectations. The Post Office was a true pioneer and innovator in the field of wireless and remained deeply influential throughout the period covered by this thesis. Beyond the development of a pre-Hertzian wireless system, this institution played an active role in internal government discussions and national regulations. Through an extension of the 1868 and 1896 Telegraphy Acts, the Post Office had a national monopoly on telecommunications, beginning with telegraphy and later extended to telephony and wireless telegraphy.[22] As a part of their role in licensing inland domestic communications (and with a range extending to three miles off the British coast), the Post Office was a central figure in the introduction of the 1904 Wireless Telegraphy Act, the earliest example of wireless legislation.

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19 See Latour (2005), Latour (1987), and Law (1999).

20 See **footnote number 13**.

21 Briggs (1961), Geddes (1972), Hennessy (2005), Hilmes (2012), and Sivowitch (1970).

22 See **Section 2.2 The Post Office and Telecommunications** for further details.

Another government institution with a strong role in wireless and a more immediate and practical demand for wireless communications was the Admiralty. Initially the Post Office and the Admiralty shared a common interest in and consensus on wireless technology and how this might fit into British national interests and strategy. However, the Admiralty did a quick *volte-face* and formed a close alliance with the Marconi Company, with whom they had signed an exclusive contract for wireless telegraphy apparatus and manpower in 1901. These two institutions, representing the two facets of the British government best-placed to deal with wireless communications and related issues of governance, had completely different agendas and sets of interests. These diverging interests and related tensions peaked between the 1903 Preliminary Conference on Wireless Telegraphy and the pre-conference discussion prior to the 1906 International Radiotelegraph Conference with a compromise reached only just before the conference. These issues were only completely resolved during the 1907 Select Committee hearings. While my thesis emphasises the agency and involvement of institutions such as the Post Office and the Admiralty, that is not to say that it completely ignores the contribution of the Marconi Company to the field. Instead, my thesis provides a "missing" history of the Marconi Company – one that emphasises, in contrast to the standard wireless historiography, how the company and related commercial concerns were not the only factors shaping wireless telecommunications during this formative period in its history.

In contrast to the prominent and pivotal role played by the two primary case studies, I also examine the role of the Institution of Electrical Engineers. While eschewing an active role and lacking the agency and resources of government institutions such as the Post Office and the Admiralty, nonetheless this techno-scientific, member-led institution hosted influential papers by early wireless pioneers such as Preece, Lodge, and even Marconi himself.[23] These wireless papers and debates took place at the end of 1898 and beginning of 1899 and demonstrate not only the existence of an active community of wireless pioneers (one which existed long before Marconi arrived on British shores in 1896) but also demonstrate the diversity of this community, bridging commercial, government and academic concerns. Within the pages of the thesis, I wish to revive, revise, and reinterpret some of the wireless histories found within the pages of primary sources. The objective outcome of this thesis is to present a parallel, more inclusive narrative of early wireless communications. Additionally this institutionally focused narrative complements existing wireless historiographies while also

23 See **Chapter 3 - Electrical Potential: Wireless and the Institution of Electrical Engineers, 1898-1908** for further details.

serving to offer a wider, more complex, and more nuanced understanding of events within the standard narrative of wireless history.

The traditional narrative of wireless history focuses on the commercial development of wireless technologies to the near exclusion of all other forms and locations of invention and innovation. While commercial aspects of this technological system came to the fore in the later post-war development of wireless communications and broadcast radio, these were not the sole context for and contribution to the earlier history of wireless. In conclusion, this thesis does not ignore commercial concerns but rather attempts to revise wireless history in order to present a more balanced narrative and one which embraces the many facets of and influences on wireless communications during this period – institutional, academic, and commercial. And so I will return to the key question of this thesis: what was the role of state and technical institutions in the early history of British wireless and how did this influence wireless technology and constrain the activities of the Marconi Company? In answering the latter part of the question, it is important to first consider the standard historiographies and how they present the activities of the Marconi Company during this formative period in wireless history.

1.2 Heroes, Hagiography, and Historiography

> ...not until Signor Marconi induced the British Post Office and foreign Governments to try large scale [sic] experiments did wireless signalling become generally and popularly known or practically developed as a special kind of telegraphy.[24]

> The individuals we shall be dealing with – Heinrich Hertz, Oliver Lodge, Guglielmo Marconi, and a host of others – were actors in a drama of large-scale social change, and to some degree their personal characteristics and circumstances influenced the way the drama worked itself out.[25]

Academic and popular publications on wireless communication create a clear narrative from the work of a few isolated wireless pioneers to the creation of a global wireless network

24 "The British Association." *The Times*, 8 September 1898, 5.

25 Aitken (1976), 20.

and beyond to the later successes of broadcast radio.[26] Many of the standard wireless and radio histories depict its early history as beginning with the arrival of Marconi in Britain in 1896, emphasising his commercialisation of wireless, his use of patents and related claims of ownership, and the later successes of the Marconi Company in broadcast radio. Knowingly or not, this historiographical approach echoes the technological workings of wireless communications, a transmitter-receiver model: that is a single or sometimes multiple "heroic" inventor(s), inventing and innovating in order to present their technology to multiple passive and grateful consumers with the technological transfer being in one direction only. Furthermore this monolithic narrative of wireless adds a nationalistic element, in the case of Britain presenting Marconi's interests and successes as being aligned with and supported by Britain, her government and her military, within the context of a nationalistic story of wireless.[27]

Many of the early Marconi-centric publications were written by Marconi, his supporters, or his staff and used the standard biographical narrative to argue for Marconi's historical priority.[28] In the 1920s and 1930s, the dramatic successes of broadcast radio along with the advanced age of a number of wireless pioneers led to a proliferation of "heroic" biographies and autobiographies relating to the early era of wireless communications being published by practitioners.[29] In these volumes, individuals, companies, and indeed nations (but not institutions, it may be noted) actively pursued claims of historical priority and associated credit. These publications place wireless communications as being the produce of a "sole" genius thereby ignoring the potential communities based around wireless communications. By contrast, my thesis examines afresh key technical-professional institutions as a home for these mostly forgotten and ignored communities about wireless.

Within this thesis I wish to challenge the traditional wireless historiography and to revive a wireless history which moves beyond the monolithic commercial and scientific histories of wireless. This parallel narrative analyses the cacophony of voices innovating and shaping wireless during its formative period and offers the chance to examine the wireless pioneers omitted from the traditional wireless histories – scientists, engineers, and many others – in order to present a revisionist history but also a revived history, one which would be deeply

26 See **footnote number 2**.

27 Coe (1943), Geddes (1974), Weightman (2004).

28 Baker (1970), Jacot de Boinod and Collier (1935), Jolly (1972), Vyvyan (1974), and others.

29 Appleyard (1930), Harlow (1936), Hawks (1927), and Lodge (1931).

familiar to the many early wireless pioneers. To this end, I have chosen to explore an aspect of wireless history which up to now has not been examined, researched, or analysed: the influence and impact of institutional innovation on the embryonic technological system that was wireless communications during this era.

In contrast to the accepted wireless histories, contemporary wireless historians put forth a narrative almost unrecognisable to modern wireless histories – with a cast of unfamiliar characters and little-known events.[30] This contemporaneous narrative was a prominent feature of many early publications on wireless, most of these written by early wireless pioneers and practitioners. I will use these texts in my thesis in order to further analyse the rhetoric, audience, and context for early wireless experiments. I will use these "source community" texts in order to by-pass the retrospective wireless narrative of some later scholarship. More recent scholarship has attempted to revise the early history of radio, either to widen the scope of research to include a comparative element with other forms of telecommunications or to de-construct its early history so as to find yet another "father of radio history", Oliver Lodge being a recent and popular candidate.[31] I will go further than this "narcissism of minor differences" in relation to the sole inventor of wireless and, instead, argue for a community-based and institutional basis for its invention, early development, and promotion.[32] Further to this, I will revise the oft-presented view of William Preece as an outsider and administrator.[33] Instead I will consider Preece in light of his contributions to the wider electrical engineering community and his central role in the community of early wireless pioneers centred about two institutions, the Institution of Electrical Engineers and, to a lesser degree, the Post Office.

As I have previously stated, the novel concept of "institutional innovation" is central to the research questions posed in my thesis. Wireless communications do not feature in the institutional histories of the two main institutions, the Institution of Electrical Engineers and

30 In order of publication: Lodge (1894), Kerr (1898), Fahie (1899), Fleming (1903), Story (1904), Marconi International Marine Communication Company Limited (1908), White (1912).

31 Aitken (1976), Burns (2004), Constable (1980), Rowlands and Wilson (1994), and Sarkar, Mailloux, Oliner, and Sengupta (2006).

32 For a more detailed discussion of 'the narcissism of minor differences', see Freud and Riviere (1930).

33 Preece is often derided particularly in relation to his approach and opinions on Maxwellian science. For example, see Hunt (1983).

the British Post Office, and the sole biography of William Preece devotes a mere five pages (out of 377) to the Post Office's early wireless experiments.[34] Moreover scientific research and other experimental practice in relation to the smorgasbord of early wireless systems are misrepresented by certain elements of wireless historiography as being technological dead-ends or failed commercialisation.[35] Instead I will show that the numerous wireless systems being developed leading up to and beyond the discovery of Hertzian waves were a response to the inadequacies of the previous orthodoxy, electrical telegraphy and telephony. Furthermore these early wireless trials, failed or not, provided a foundation and agenda which was taken up by and shaped later wireless systems and successes. Hence, this chapter will examine the evolution of different historiographical approaches to wireless history in order to demonstrate clear gaps in scholarship which my thesis will fill.

Another area in which a gap in literature and scholarship can be perceived is institutional involvement in wireless. Both the Post Office and the Institution of Electrical Engineers are the subject of institutional histories.[36] However, their roles in early wireless development does not feature prominently, or sometimes at all, in these somewhat “internalist” histories. In terms of the histories of the IEE, both volumes are a product of their times – Appleyard (1939) covers the IEE from 1871 to 1931 and is a more lengthy volume and contains a vast scholarship on the early history of the IEE. It includes material on the evolution and nature of membership and explicitly discusses the society's role in professional advancement, including in relation to the Post Office. However, despite the interesting points raised, Appleyard (1939) is quite traditional and conservative in approach and execution. Meanwhile Reader et al. (1987) is shorter and more analytic in approach. Both volumes provide detailed context to the history of the IEE, its members, activities, correspondence and publications although neither contain an in-depth discussion of wireless telegraphy. In relation to other forms of contemporary literature, journals such as *The Electrician*, *the Journal of the Institute of Electrical Engineers*, *the Electrical Review*, and others are used to map the roles of these institutions and their members in the collective and institutional development of wireless. The concept of a network or empire of engineers, particularly electrical engineers, has been previously considered in Marsden and Smith (2005).[37] Their detailed and well-researched survey history of nineteenth-century British engineering presents engineering empires as networks of trust and expertise.

34 See **footnote number 3** and Baker (1976).

35 Appleyard (1930), Garratt (1994), Pocock (1988), and others.

36 See **footnote number 16**.

37 Marsden and Smith (2005).

Further to this, Marsden and Smith present engineers as having economic, political agency and influence beyond their engineering communities. They conclude with a case study of cable telegraphy in the mid- to late-nineteenth century, but the study of wireless telegraphy as an engineering empire lies beyond the scope of their investigation. However, their methodological approach offers a template with which to consider networks and empires of electrical engineering in relation to wireless telegraphy.[38]

Another aspect of wireless history which has yet to be rigorously examined is wireless legislation and regulations. Most wireless historians' narratives leapfrog over the mid-years of the first decade of the twentieth-century emphasising dramatic and Marconi-centric events such as the 1901 Transatlantic transmission, the "Crippen Affair" in 1909 and, of course, the sinking of the Titanic in 1912.[39] The 1903 Preliminary Conference on Wireless Telegraphy and 1906 International Radiotelegraph Conference examined in later chapters of this thesis are rarely acknowledged in wireless historiography but, when examined external to this, are presented in the wider context of telecommunications history or international governance and regulations.[40] These two conferences are presented by historians of telecommunications as a continuation of the existing military tensions and telecommunications "battle" between Germany and Britain during this period, the two most powerful imperial nations in Europe if not the world at this time.[41] As a result, these conferences are considered by these historians as a victory for the Marconi Company who, according to this narrative, prevented intercommunication being enforced during the first conference and, for the most part, ignore the ratification of the second conference in 1906.

The 1868 and 1869 Telegraph Acts which nationalised the British telegraph network are relatively well-studied due to their novelty and impact with the significance of these Acts being magnified by the noticeable delay between first commercial application of telegraphy and its

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38 See **Chapter 3 - Electrical Potential: Wireless and the Institution of Electrical Engineers, 1898-1908**.

39 See **footnote number 2** for examples.

40 See **Chapter 5 - "If the Government did take over wireless it meant that they would take over us": simmering tensions between commercial and state interests, 1903-1905** and **chapter 6** - **"A question for commercial adjustment, and not for international legislation": wireless rules and regulations, 1905-1908** for a more in-depth discussion and analysis.

41 For example, see Hall (1993), Harper (1997) Headrick (1991), Hugill (1999), MacLeod (1988), and Tomlinson (1945).

nationalisation. In contrast, I have yet to find a publication, wireless or otherwise, which provides an in-depth study of the 1904 Wireless Telegraphy Act. The Act is mentioned briefly in Hall (1993), a story of telecommunications legislation and legal judgements in Ireland with the period up to the 1920s being essentially British telecommunications legislation and legal judgements, and is covered very briefly in a two-page unpublished and unreferenced conference paper *The Introduction of Wireless Licensing in the United Kingdom* by Pocock.[42] The extension of the state-controlled domestic monopoly managed by the Post Office to the telephone and then to wireless telegraphy has not been properly examined or considered. To the modern mind (especially in Britain), modes of telecommunications coming under strong state control is not unusual or worthy of comment. A recent publication, Wu (2010), establishes that state regulation of different modes of communication is an accepted part of standardisation but this is usually followed by attempts by powerful industrial monopolies and cartels to circumvent these regulations, this being an accepted part of the science – innovation – industrialisation – standardisation – monopolisation cycle. [43]

The events discussed in later chapters of this thesis and which take place in a pivotal part of wireless history are downplayed in most wireless historiography although they do feature to a certain degree in wider telecommunication history.[44] The conferences are best known in terms of the introduction of SOS – an adaptation of a German standard, the British standard was CQD – agreed upon by the 1906 conference but not widely used (at least by the Marconi Company) until the Titanic disaster in 1912 and thereafter.[45] Hence the complex, deeply politically charged, and revolutionary role of these two international conferences is boiled down to their impact on an event nearly six years later. A dramatic event, to be sure, but one intrinsically connected with the pre-war success and public recognition of the commercial development of wireless communications and the Marconi Company. In relation to Marconi and his company, the 1903 Preliminary Conference on Wireless Telegraphy and 1906 International Radiotelegraph Conference are essentially dismissed in passing in the two main publications – the sole authorised biography of Marconi, Jacot de Boinod and Collier's *Marconi*

42 Hall (1993), 118 and Pocock, R.F. "The Introduction of Wireless Licensing in the United Kingdom." In *IET History of Technology conference*, edited by P Strange. Manchester University, 1975.

43 Wu (2010).

44 See **footnote number 35**.

45 For a discussion of wireless telegraphy and the Titanic including primary source material from the Marconi Collection archives, see the recently published Hughes and Bosworth (2012).

– *Master of Space* (1935), and Baker's *History of the Marconi Company 1874-1965* (1970).[46] The conferences are also notable in their omission from the institutional histories and political memoirs of those involved.

Jacot de Boinod and Collier ignore entirely the 1903 Preliminary Conference on Wireless Telegraphy instead choosing to mention another development around this time – the installation of Marconi wireless apparatus on-board the *Deutschland*, a German liner on the Hamburg-Amerika line, in August 1903. The Marconi system replaced the German Telefunken system that had raised the spectre of intercommunication in the first place and led to the preliminary 1903 conference. The reasons provided by Jacot de Boinod and Collier for the installation are given as being due to no particular fault in the German system but rather that the Telefunken system was 'not nearly so advanced as the Marconi system, and so not nearly such satisfactory results could be obtained.'[47] In contrast, they cover the 1904 Wireless Telegraphy Act, the 1906 International Radiotelegraph Conference, and the 1907 Select Committee hearings in far greater detail but from a similar perspective.

The later volume on the Marconi Company by Baker presents a far more nuanced and balanced understanding of the events covered in this chapter. Baker describes the outcome of the 1903 Preliminary Conference on Wireless Telegraphy as a setback for the Marconi Company with intercommunication between shore stations and sharing of related technical knowledge being resolved by the protocol of the conference and recommended, with some reservations, to the British and Italian governments; Baker furthermore refers to this as a 'commercial war' echoing the language and rhetoric used by Marconi at the time.[48] However, Baker later acknowledges that forced intercommunication (whether put into practice or not by the Marconi Company) had not affected orders for their wireless systems.[49] Inverting the coverage of the earlier official biography, the 1904 Wireless Telegraphy Act, the 1906 International Radiotelegraph Conference and the subsequent 1907 Select Committee hearings are not discussed in much detail within the pages of this volume. Baker (1970) supports intercommunication saying that 'it was eminently the right decision to take' although noting that this caused some problems within the company.[50] With forced intercommunication, the

46 Jacot de Boinod and Collier (1935) and Baker (1970).

47 Jacot de Boinod and Collier (1935), 87.

48 Baker (1970), 96.

49 *Ibid.*, 98.

50 *Ibid.*, 115.

vast network of shore stations that the Marconi Company had built up could and would be used to communicate with any wireless system and hence the Marconi Company lost the exclusive right to these shore stations which they had painstakingly invested in. Baker (1970) concludes with the following, somewhat sombre, judgement of the 1906 International Radiotelegraph Conference and subsequent aftermath in Britain:

> Behind the political scenes, this decision was a triumph for the Telefunken Company, who had easily the most to gain under the new arrangement. But even though the Marconi Company spoke vehemently against the new provisions when a House of Commons Select Committee considered the matter in March 1907, the provisions of the Convention were confirmed by a majority vote of one. On the larger canvas of the struggle for power between Britain and Germany it was a distinct score for the latter.[51]

Here Baker echoes the rhetoric used by Marconi and his company – that the cumulative effect of the two conferences and the Select Committee hearings was a victory of sorts for Germany over Britain – and not, as I will argue, a victory of sorts for the national interests of the British government and her institutions over the commercial interests of the Marconi Company. Additionally this is yet another interesting example of the Marconi Company and the British government being presented as synonymous, with their interests allegedly perfectly aligned.

A more contemporary and perhaps politically aware scholar, Daniel Headrick, has much to say about the International Radiotelegraph Conferences in the context of the general history of telecommunications.[52] Headrick makes a number of points about the 1906 conference and the subsequent 1907 Select Committee hearing.[53] He argues that the 1906 conference was about two core issues, intercommunication and the allocation of the international spectrum; Headrick goes on to say that, with regard, to these matters and others the British delegation supported and sided with the Marconi Company and its anti-intercommunication stance, a continuation of Britain's support of the Marconi Company from the previous preliminary conference.[54] However, on the same page Headrick contradicts himself stating that in return for 'giving up the right of intercommunication, Britain preserved the longer waves for

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51 *Ibid.*

52 Headrick (1991), Headrick (1988), Headrick (1981).

53 Headrick (1991), 120-121.

54 Headrick (1991), 120.

commercial use.'[55] In doing so, Headrick suggests that Britain simultaneously supported and opposed the Marconi Company. While these two contradictory positions clearly cannot be held simultaneously, this does allude to the complexities and uncertainties surrounding these conferences, something I will return to in later chapters of this thesis. Another scholar of the two earliest international radiotelegraph conferences is John D. Tomlinson, author of *The International Control of Radiocommunications* (1945). In this slim volume, Tomlinson used original primary source material to argue that it was the issue of intercommunication and related economic matters rather than international politics that lay at the core of the 1906 conference.[56]

This economically focused analysis of early wireless history was extended further and in a slightly different direction by a British economist working in the late 1950s and early 1960s, S.G. Sturmey.[57] Although primarily focused on the economic conditions for innovation in the broadcast radio, Sturmey's 1958 work also contained a secondary argument proposing that government policy was one of the main forces shaping technical progress and economic innovations in the field of radio communications. Sturmey argued that the state shaped the application and development of radio communication in three key areas: the organisation of overseas radio networks; the state-controlled monopoly of domestic telecommunications; and finally the large-scale purchase of wireless apparatus. The latter two aspects are more fully considered herein. As a result of Sturmey's overt economic stance, he completely ignored a fourth component which could complement and expand his thesis nicely, that is the political influence of state bodies and how this can shape and control wireless technology and innovations through legislation and regulations. I will build upon the work of Tomlinson, Headrick, Sturmey and others and hence argue for a more nuanced and indeed institutionally focused historical narrative of wireless communications and related regulations and a historical narrative which capably demonstrates that the Marconi Company was not the only body setting the agenda in relation to wireless regulations during this period.

In conclusion, I have pointed out the limitations and omissions in existing wireless scholarship particularly in relation to underexploited resources. Using a wide variety of primary source material across multiple archives including conference documentation, private

55 *Ibid*.

56 Tomlinson (1945).

57 Sturmey (1958) and Sturmey, S. G. "Patents and Progress in Radio." *The Manchester School* 28, no. 1 (January 1960): 19-36.

correspondence, government reports, parliamentary records, I have reconstructed and revised a mostly forgotten history of this period. These rich sources offer an alternative narrative with an institutional focus that develops in tandem with the commercial sphere and is, at times, deeply political. In order to develop a better sense of my overall argument and the events presented and considered within the thesis, I will next give a brief overview of the events and institutions that form the historical context of this thesis.

1.3 Historical Context & Timeline

Many of the events mentioned here may be unfamiliar to even those knowledgeable in the general history of wireless. In expanding the horizon of wireless history and selecting government departments as two of three case studies, it is important to consider the political context. Furthermore given the twenty-five year plus period examined by this thesis, I will also use the next section to provide a chronological overview of events and a brief history of the institutional case studies in order to orientate the reader and to provide a reference which will be referred back to in later chapters. Initially I will consider the political context because this influenced the positions and policies of two of government-sponsored institutions; the Admiralty and the Post Office. In the formative years of wireless communications, it was these two powerful government departments whose actions best articulated the informal government policy on wireless and hence their overall response to Marconi and the Marconi Company. The changing government policy on wireless communications was not formalised until the introduction of the 1904 Wireless Telegraphy Act with responsibility allocated to the Post Office.[58] The 1904 Wireless Telegraphy Act was a continuation of the Post Office domestic telecommunications monopoly and so, continuing on from the political context, I will provide a précis of the Post Office's role in telecommunications up to the early twentieth century. Subsequent to this, I will give a brief overview of the other two institutions examined in this thesis, the Admiralty and the Institution of Electrical Engineers. This section will conclude with a brief history of the Marconi Company. This is not to establish the importance or indeed history of the company which has been sufficiently analysed and published upon. Instead I wish to provide a context for the complex interactions between Marconi, the Marconi

58 See **Chapter 5 - "If the Government did take over wireless it meant that they would take over us": simmering tensions between commercial and state interests, 1903-1905** for further details.

Company and the institutions examined in this thesis in order to establish who was setting the agenda and where the balance of power lay.

1.3.1 Political Context

In 1895 after a mere three years of Liberal rule, a general election was called and the Conservatives were returned to power, a position retained until 1906. Having previously served as Prime Minister between 1885 and 1892, the Marquess of Salisbury returned to the role from 1895 and through the general election of 1900 until his resignation due to family reasons in December 1902. The role of Prime Minister was filled by Salisbury's nephew Arthur Balfour who continued until December 1905 when Henry Campbell-Bannerman was invited by King Edward VII to form a minority government as the first Liberal Prime Minister of the twentieth century. Somewhat unexpectedly, Campbell-Bannerman called an immediate General Election and the Liberals were elected to form a majority government in February 1906. The Liberals remained in power through three general elections until the outbreak of the First World War when a coalition government served. From 1906 to the outbreak of the war there were only two Prime Ministers; Campbell-Bannerman who served between February 1907 and April 1908 and H.H. Asquith who served between April 1908 and December 1916. Under Campbell-Bannerman the Liberals enacted a more radical form of socialism and shifted the Liberal position from that of a "laissez-faire" approach to a more collectivist one. The change in government and political leadership between the 1903 Preliminary Conference on Wireless Telegraphy and the 1906 International Radiotelegraph Conference had a limited effect on government policy on wireless. The change in government had a more noticeable effect in relation to commercial policy and hence influenced the role of the Marconi Company in British domestic wireless telegraphy. This was not a matter of control *per se* but rather, as per the introduction of this chapter, a matter of constraining commercial activities to meet the needs, perceived or otherwise, of the state and society.

Having established the chronology of governments during the historical era of this thesis, I will next give an overview of a less public facet of governments, government departments. The two state-controlled institutions that form the heart of this thesis, the Admiralty and the Post Office, can be better understood in terms of forming a less formal government policy. Hence I will provide an overview of the main institutions in order to both orientate the reader and to provide a comparison of the different institutions. Furthermore I will provide a brief overview of the Marconi Company in order to present a balanced comparison of the different bodies engaged with wireless during its early history.

1.3.2 The Post Office

The Telegraph Act of 1868 gave the Postmaster General the right to acquire and operate the inland telegraph systems in Britain, bringing the network of private-owned inland telegraph system under state control via the Post Office. Prior to this, the telegraph network had been installed and operated by independent telegraph and railway companies. A year later, the Telegraph Act of 1869 further conferred on the Postmaster-General a monopoly in telegraphic communication in Britain. The Telegraph Act of 1870 extended this privilege to the Channel Islands and the Isle of Man and on 28 January 1870 the previously privately owned telegraph system was transferred to the State. In 1869 and immediately prior to this transfer to the state there were 2932 telegraph offices across Britain and 6,830,812 telegrams – inland, press, and foreign – transmitted across the telegraph network bringing a total revenue of £550,000.[59] The nationalisation of the national telegraph network also brought about an expansion of the workforce above and beyond the staff brought in from private telegraph companies and also included a number of women working in this field, mostly as telegraph operators.[60]

The development of the telephone in Britain is worthy of further consideration as the Post Office's engagement with this innovative form of telecommunications was deeply influential upon their later response to wireless telegraphy. Furthermore the telephone forms the central part of a narrative of Post Office engagement with telecommunications that began with the telegraph and ended with wireless telegraphy. Furthermore early wireless systems developed by the Post Office had their origins in technical problems with newly established domestic telephone systems.[61] The development of the telephone in Britain echoed that of the telegraph but on a much more accelerated timeline and with the state-controlled monopoly of the Telegraph Acts fresh in the mind of those who worked at the Post Office.[62] In

59 IET Archives UK0108 SC MSS 022/VIII/576 - Post Office Telegraphs - Progress in 25 Years (1895).

60 For further information on female telegraph operators in the USA, see Jepsen (2000).

61 See **Chapter 2 - "Something in the Air": The Post Office and early wireless experiments, 1882-1899**.

62 For further details on the history of the telephone in Britain, see the two forthcoming University of Leeds PhD theses by Michael Kay and Peter Reilly. These theses are the outcome of "*Whose call?*

September 1876 William Thomson (later Lord Kelvin) and Preece introduced Bell's telephone before the annual meeting of the British Association for the Advancement of Science (BAAS) held that year in Glasgow. Two years later in 1878, Preece made the first practical demonstration of a pair of telephones before the annual meeting of the BAAS in Plymouth and later that same year, the Post Office provided its first telephones – a pair of Bell telephones – on rental to a firm in Manchester. In late 1880, the case of *Attorney General v Edison Telephone Company of London Ltd* came to court and in a landmark ruling Mr Baron Pollock and Mr Justice Stephen decided in favour of the state, in this case the Post Office.[63]

The final judgement of Pollock and Stephen determined that the telephone was a telegraph (or rather a "speaking telegraph"), a telephone conversation was a *de facto* telegram, and so the telephone network too came under the state-controlled national telegraph network. Although the telephone had not existed when the first Telegraph Act was passed in 1876 and in which a telegraph was defined as 'any apparatus for transmitting messages or other communications by means of electric signals', the newly invented telephone was included under this definition. Hence the telephone network came under the state-controlled and state-managed licensing scheme in which the telegraph network already operated. The judge further noted that the state monopoly would also apply to any future system of wireless communications.[64] As a result independent telephone companies were required to obtain thirty-one-year operational licenses from the Post Office with the Post Office taking ten per cent of gross income and having the option to purchase a telephone undertaking at the end of ten, seventeen or twenty-four years. The Post Office instead used their strong monopoly to limit the number of licenses issued to private companies which resulted in, some scholars have argued, a slow and limited growth of the telephone in Britain.[65] However, this approach has been challenged by more recent scholars.[66] In 1896 an agreement

Mapping the Early Usage and Non-Usage of the Telephone in Britain", a collaborative research project between Graeme Gooday and BT archives.

63 Preece's personal annotated copy of the judgement can be found at IET Archives UK0108 NAEST 039/3 - Attorney General v Edison Telephone Company of London Ltd: Arguments and Judgement in Exchequer Division, High Court of Justice (1880).

64 *Attorney General v Edison Telephone Co* (1880) 6 QBD 244, 249.

65 For example, see Perry, Charles Richard. "The British Experience 1876-1912: The Impact of the Telephone During the Years of Delay." In *The Social Impact of the Telephone*, edited by Ithiel de Sola Pool, 69-96. Cambridge, Massachusetts: The MIT Press, 1977.

66 Examples include two forthcoming University of Leeds PhD theses by Michael Kay and Peter Reilly on the social history of the telephone. These theses are the outcome of "*Whose call? Mapping*

was reached with the National Telephone Company with regard to the sale of trunk telephone lines. Although outside of the remit of the Post Office, the trans-global telegraph cable system was completed in 1902 with the opening of the Transpacific cable. By the time of the completion of the global telegraph cable system in 1902, around two-thirds of the global telegraph cable network was under British control and Britain had ten times more cable ships than France.[67] The Post Office's monopoly was further cemented with the 1904 Wireless Telegraphy Act introduced on 1 January 1905. The nationalisation of the British domestic telecommunications network reached completion with the purchase of the National Telephone Company in 1912.[68]

1.3.3 The Admiralty and the Royal Navy

One obvious reason why military use of a particular technology might not receive the attention or due scholarship it deserves is that much of the primary source documentation was unpublished or secret. This is no less the case with military usage of wireless communications, in particular the engagement of the Royal Navy and the Admiralty with this field of technology. Additionally those in military service were generally forbidden from reporting or publicising technologies which might be of strategic or military importance, this being formalised through the introduction of the Official Secrets Act in August 1889. The result was the omission of military use of wireless from contemporary publications. For example, the pioneering wireless work of Captain Jackson of the Royal Navy – a central figure in this thesis – received a scant one-sentence mention in John J. Fahie's contemporary *A History of Wireless Telegraphy, 1838-1899*, first published in 1899 with a second edition appearing in 1900.[69] However, these reasons neither excuse nor explain the absence of military consumers and users from more recent wireless scholarship. Early historiography on telecommunication and indeed wireless emphasise the many technological and commercial innovations being developed whilst presenting adopters of these technologies – including the military – as grateful consumers and passive users.[70]

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the Early Usage and Non-Usage of the Telephone in Britain", a collaborative research project between Graeme Gooday and BT archives.

67 de Margerie (1909), 36.

68 Further information on the Post Office's system of telecommunications can be found in a book chapter I co-authored with my supervisor, Professor Graeme Gooday: Bruton and Gooday (2010).

69 Fahie (1899).

70 See **footnote number 30**.

Rowland Pocock stands out as the sole wireless scholar to turn his attention to the wireless systems used by the Admiralty and the work of the Captain Henry Jackson RN at the end of the nineteenth century and into the early years of the twentieth century.[71] However, all three of his publications are overly focused on the technical aspects of the wireless systems used by the Admiralty with little to no analysis of how the Admiralty engaged with wireless and came to form an influential policy on these innovative technologies. While his works do highlight and indeed celebrate the work of institutional innovators such as Jackson, they ignore the more political and administrative aspects of the Admiralty's engagement with wireless, such as contracts, interdepartmental conferences, and international conferences. Furthermore even Pocock's monograph on the origins of maritime radio (written jointly with G.R.M. Garratt of the Science Museum) presents the 1900 contract and 1901 Deed of Agreement between the Admiralty and the Marconi Company as being an end point of sorts with the Admiralty unenthusiastically and unquestionably embracing use of the Marconi wireless system, a piece of analysis I wish to criticise and challenge in later chapters.[72] Other well-known and well-regarded publications in the field of wireless history have mostly ignored the military user and their agency or failed to consider how they might be influenced by anything other than technological needs.[73]

Moreover military signalling especially wireless communications are not widely examined, studied, or published upon in the field of military history. The relatively few publications that feature military use of wireless mostly consider the strategic use of wireless in battle and emphasise it as another part of military structure; the development of the technology and the interaction between the military, the technology, and its manufacturers are not examined.[74] As such military use of wireless is considered but a small part of the overall narrative of wireless communications; similarly the use of wireless communications in the military is considered to be a minor footnote in overall military history. Furthermore, the complex and delicate political and sometimes economic negotiations taking place about wireless communications do not appear in standard political and economic histories of this period.

71 Pocock and Garratt (1972), Pocock (1995), and Pocock (1998).

72 See **Chapter 4 - "Britannia rules the wireless waves": the Admiralty and wireless, 1899-1904**.

73 Aitken (1976), Garratt (1994), Geddes (1974), Rowlands (1994), and Weightman (2004).

74 Bridge and Pegg (2001), Burton (2002), Cole (1994), Lord and Watson (2003), Nalder (1958), and Priestley (1921).

1.3.4 The Institution of Electrical Engineers

In the mid-1800s, telegraph engineers had the option of joining one or other of the existing institutions, the Institution of Civil Engineers (ICE) or the Institution of Mechanical Engineers (IME) but by 1870 it was clear that the telegraphy profession had attained such a standing that its needs were inadequately met. Additionally there was a growing need for a learned society for telegraph engineers who, with their more practical knowledge of electricity, were set apart from civil and mechanical engineers. And so in 1871, the Society of Telegraph Engineers (STE) was established with membership consisting mostly of telegraph engineer members of existing techno-scientific institutions such as the ICE, IME, and others. It was established in distinct contrast to the social aims and strata of earlier scientific societies and institutions – the emphasis being, at least initially, more practical, technical skills and the society described as having 'taken the position of a scientific body uncontaminated by commerce.'[75]

Two years after its foundation the STE began publishing its own journal, the *Journal of the Society of Telegraph Engineers* published between 1872 and 1880. Initially the journal emphasised the public-facing interests of its members and published external papers but this ceased as the society established itself. The journal title also reflected the wider name changes of the society itself, becoming the *Journal of the Society of Telegraph Engineers and of Electricians* between 1881 and 1882, the *Journal of the Society of Telegraph-Engineers and Electricians* between 1883 and 1888, and then settling on the Journal of the Institution of Electrical Engineers (JIEE) between 1889 and 1963. The JIEE published Institution of Electrical Engineers (IEE) papers alongside abstracts or title of external papers of interest to members and material dealing with the administration of the society including reports of the Annual General Meeting. The JIEE did not include correspondence and so members were forced to go to other electrical engineering periodicals and the popular press for this form of discussion and interaction. This relationship was in a way reciprocal – external to the JIEE, IEE papers were also widely disseminated in these external publications, such as *The Electrician*, *Electrical Weekly*, *Nature*, *The Times*, and others.

75 Quoted on Reader et al. (1987), 73 as being from the reminiscences of Alexander P. Trotter, Trotter and Hewitt [ed] (1948).

From the early days of the society, there was a healthy and sometimes complex relationship between the IEE, the general public, and other scientific communities. As a voluntary, member-led learned society, the IEE was defined by a strong sense of community and common purpose in parallel with an awareness of the interests of its members external to the institution itself. The IEE prided itself on its ability to communicate with other institutions and commercial organisations with which its members were involved. Additionally, the IEE was itself externally scrutinised through wider publication and dissemination of their papers and discussions.

The society very much modelled itself on the ICE and IME and, indeed, was hosted by the former in their Great George Street premises in central London until 1909 when they acquired premises of their own. The ICE was very much considered the "mother" organization and there existed a deferential relationship from the IEE to the ICE. Papers delivered before the STE and its many successors were presented at the ICE headquarters, as were most of the meetings of the society. While some council and committee meetings were held in locations convenient to and accessible by its members elsewhere in central London, most of the meetings and gatherings were held in the ICE building. As such, this put a distinct constraint on the newly established society which, due to being hosted by the ICE, had limitations on the administration, structure, and constitution of the society enforced by the "mother society" that was ICE. However, the IEE was able to negotiate some changes and did amend its constitution while being hosted by the ICE. Nonetheless sharing the ICE premises was clearly a temporary solution and by the late 1880s a Building Purchase Fund was established. The society and its members began to put aside money for a more permanent home and in June 1909 the IEE purchased a lease on their current building at Savoy Place.[76]

By the late 1880s, the nature of this member-led society had clearly changed beyond its telegraphic origins with "electricians" (as they were known) becoming larger in number within the institution's membership and also moving to the fore of the society. This was reflecting wider changes within the profession, with electrical engineering beyond telegraphy to electrical power, lighting, transport, and other heavy industries. With this, there was an increased professionalisation of the field and this was reflected by terminological shifts within and outside the society. Initially the term "electrician" was used to describe those who studied or were knowledgeable about electricity, a term with origins in the late eighteenth century but

76 Reader et al. (1987), 60.

which was popularised, at least in Britain, in the early nineteenth century.[77] When the earliest electrical engineering periodical was first published in 1862, it was titled *The Electrician*. It was in the context of these developments and an increased sense of tension between the different types of electrical engineers – theoretical (usually referred to as "Maxwellians") and more traditional and practical electrical engineers – that the annual general meeting of the Society of Telegraph Engineers was called in late December 1880.[78] This meeting attempted to appease the "Maxwellian" elements within the society and so the society was renamed the Society of Telegraph Engineers and of Electricians (STEE).

The more progressive members of the society had hoped that the name change would lead the society to move beyond mere telegraphy to embrace the wider fields of electricity and magnetism. When this appeared not to be the case, they went on the offensive. In March 1873 John J. Fahie, an Irishman, early member of the society, and founder of the society's annual Fahie Premium for the best paper written on telegraphy or telephony, wrote a strongly worded letter to *The Electrician* about the continued narrow focus of the society.[79] Fahie noted that little had changed – the papers read before the society and the articles and abstracts in the journal continued to focus on telegraphy. Fahie further noted that papers on electricity and magnetism which fitted the new remit of the society had been taken elsewhere. Indeed, as Fahie pointed out, 'we frequently see distinguished members of our body – even members of our council – reading papers before the Royal and Physical Societies, the Society of Arts, and the Institutions of Civil and Mechanical Engineers, most, if not all of which, should, in fairness, be given to us.'[80] Fahie concluded his letter calling for the society to embrace the newer fields of electricity and magnetism lest the society grow static and die out. Comments such as these were not uncommon and by the late 1880s things again had come to a head.

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77 electrician, n. Third edition, March 2008; online version March 2011. <http://0-www.oed.com.wam.leeds.ac.uk/Entry/60258>; accessed 08 June 2011. An entry for this word was first included in *New English Dictionary*, 1891. For a more complete discussion of the changing meaning of "electrician", see Gooday, Graeme, and Stathis Arapostathis. "Electrical Technoscience and Physics in Transition, 1880-1920." *Studies in History and Philosophy of Science* In Press.

78 See Hunt (2005) for a wider discussion of "Maxwellians" and their increased influence in the field of electrical engineering at the end of the nineteenth century.

79 Fahie, J.J. "The Society of Telegraph Engineers [Letter to the Editor]." *The Electrician* 10 (24 March 1883): 445-46. Fahie was an early member of the society having joined as an Associate Member in 1873.

80 *Ibid.*

In 1888 and despite intense debate and the loss of certain members, a majority of the society's membership voted for the society to be again renamed, this time to the Institution of Electrical Engineers (IEE).[81] This name change also reflected wider terminological shifts with the term “electrical engineer” now entering common usage.[82] Indeed by 1892 there were two electrical engineering periodicals, one published in the UK and one published in the US, entitled *The Electrical Engineer.* There were of course many more examples of electrical periodicals being established and published in the late nineteenth century demonstrating increased interest in the field.[83] The newly renamed IEE quickly established itself as a member-led society, becoming the *de facto* professional representative for electrical engineers in Britain at the end of the nineteenth and beginning of the twentieth century. As belies its origins, this institution had most, if not all, of the key figures in telegraphy, wired and wireless, as its members. Almost all, if not all, senior figures in the field of British electrical engineers of this period were heavily involved in, if not officers of this prominent and active member-led institution. World-renowned figures in the field of electrical engineering such as William Ayrton, Charles Tilston Bright, William Crookes, David Hughes, Joseph Swan, Silvanus Thompson, and William Thomson (later Lord Kelvin) all served as Presidents of the Society with William Thomson serving three times.[84]

1.3.5 The Marconi Company

The Wireless Signal and Telegraph Company was established in July 1897 in order to acquire and exploit Marconi's potentially lucrative patents in the field of wireless telegraphy and to manufacture Marconi apparatus on a commercial basis. The original suggested name of the company, Marconi's Patent Telegraphs Limited, was vetoed by Marconi.[85] The company had an initial capitalisation of £100,000 with 100,000 shares sold at £1 each. Marconi sold his

81 For wider discussion of the resolution of tensions within the society and their name change, see Gooday, Graeme. "Faraday Reinvented: Moral Imagery and Institutional Icons in Victorian Electrical Engineering." *History of Technology* 15 (1993): 190-205.

82 "electrical, adj. and n.". OED Online. September 2012. Oxford University Press. http://0-www.oed.com.wam.leeds.ac.uk/view/Entry/60254?redirectedFrom=electrical+engineering (accessed October 17, 2012).

83 See **Appendix 2: Electrical Engineering Periodicals of late nineteenth and early twentieth century** for further details.

84 William Edward Ayrton (1892), Charles Tilston Bright (1887), William Crookes (1891), David Hughes (1886), Lord Kelvin (1874, 1889, 1907), Joseph Swan (1898), and Silvanus Thompson (1899).

85 Baker (1970), 35.

patent rights for £15,000 and also received 60,000 of the £1 shares; the remainder were sold by public subscription. The Company utilised Marconi's initial British Patent Number 12,039 *Improvements in Transmitting Electrical Impulses and Signals and in Apparatus therefor* [sic]. The patent was applied for shortly after Marconi came to London in June 1896 with the complete specification provided in March 1897 and this wide-ranging and controversial patent being issued on 2 July 1897. The patent application was completed with the assistance of one of Marconi's London-based Irish cousins and entrepreneur, Jameson Davis, who also became the Company's first Managing Director. The company demonstrated Marconi apparatus at their headquarters in central London while Marconi offered demonstrations to potential customers in Britain, Italy, and elsewhere. In December 1898 the Marconi Company built the first wireless factory in Hall Street, Chelmsford.

By 1899 it had become apparent that the rapid development of the company along with the increasing demands of international demonstrations and commitments was beyond the time and capability of the existing Managing Director, Jameson Davis. This was cemented by the establishment of the Marconi Wireless Telegraph Company of America in November 1899 although the controlling interest for this company and its Canadian counterpart remained with the British company. In late 1899, Jameson Davis resigned as Managing Director and in February of the next year, the company was completely restructured and a new Managing Director, Major Flood Page, was appointed. Flood Page continued the previous activities of research, development, and demonstration but with a more commercial edge. Under the 1868 and 1869 Telegraph Acts all forms of domestic telecommunications – telegraphy, telephony, and wireless telegraphy – came under a state-managed monopoly. The Marconi Company wished to challenge the state-controlled domestic telecommunications monopoly and establish once and for all the rights of a private company to handle wireless telegraphy messages. As a result the Wireless Signal and Telegraph Company was restructured and split into two separate companies. The main company, named (against the wishes of Marconi) the Marconi Wireless Telegraph Company Limited was allocated responsibility for domestic wireless telegraphy in Britain. The second company, the Marconi International Marine Communication Company, was incorporated in April 1900 and was responsible for the potentially more profitable ship-to-shore activities and technologies.

Despite having his name attached to all three companies and a strong association with the technological artefacts themselves – Marconi became synonymous with "wireless telegraphy" and wireless telegrams sent via Marconi's system being referred to as

Marconigrams – the interests of the different Marconi Companies and Marconi himself were not always allied. Instead the (British) Marconi Company was represented by its Managing Director who corresponded regularly with Marconi while Marconi was away building up international business, demonstrating his system, and patenting his system internationally.

Just over a year after the renamed Marconi's Wireless Telegraph Company Limited was launched in order to more aggressively pursue domestic wireless telegraphy in Britain and elsewhere, a new Managing Director of Marconi's Wireless Telegraph Company Limited and the Marconi Marine International Communication Company was appointed in August 1902 – Henry Cuthbert Hall. Hall had initially begun his career at the Marconi Company as a consulting electrical engineer and in 1901 he was appointed Manager of Marconi's Wireless Telegraph Company Limited. Hall frequently corresponded with Marconi when Marconi was out of London and had a strong and formative role in the company during its early years. Cuthbert Hall stayed with the company for five years before resigning in 1908 with reasons for this development made clear in the final chapter. In turn, Hall was replaced by Godfrey Isaacs who stayed in the post until 1911. Hall's regular correspondence with Marconi, albeit with only Hall's correspondence surviving, in combination with his working relation with Marconi raises a question which will be more fully explored in later chapters; who was in charge of the Marconi Company (or rather Marconi companies) and setting the company's agenda during this early period in its history, Marconi himself or the Managing Director?[86]

As referred to earlier in this introduction, a missing piece of the history of the Marconi Company is the relationship between the company and external institutions, in particular the two governmental case studies of this thesis, the Post Office and the Admiralty. Later on, I will explore where the shifting balance of power lay between the state and the company. Many of the "internalist" histories of the company place control firmly in its own hands.[87] However, unpublished correspondence and documents produced and held by the Post Office and the Marconi Company challenge this standard history. Instead, it appeared that the strongest concern held by those managing the Marconi Company at the turn of the twentieth century related to the potential for wireless rules and regulations being introduced in Britain. Regulations introduced in Britain – the company's potentially most lucrative market and the centre for the existing telecommunications network which spanned the empire and the globe –

86 See **Chapter 5 - 'If the Government did take over wireless it meant that they would take over us': simmering tensions between commercial and state interests, 1903-1905** for further details.

87 See Baker (1970) and Jacot de Boinod and Collier (1935).

had the potential to severely curtail the Company's “natural” monopoly and activities. Limitations, possibly in the form of legislation, might go as far as to nationalise the industry and hence close the domestic market to all private wireless companies. It was a fear of nationalisation of the domestic British wireless telegraphy network potentially achieved through the 1868 and 1869 Telegraphy Acts and further compounded by the 1880 Edison judgement rather than patent litigation that concerned the Marconi Company during its early years. Furthermore the fears of the Marconi Company give a brief sense, more fully expanded upon later in this thesis, of how the institutional activities, perceived and otherwise, were shaping the policies and activities of this commercial endeavour in the first decade of its establishment.

1.4 Overview

Chapter 2 - 'Something in the Air': The Post Office and early wireless experiments, 1882-1899 examines early wireless tests conducted by the Post Office Engineering Department under the auspices of electrical engineer William Preece, from the early 1880s until the turn of the twentieth century. This quarter century of engineering practice, technical expertise, and institutional innovation resulted in the world's first, albeit short-lived, wireless system brought into working and practical operation. For the first fifteen years the Post Office stood alone as the sole investigator into and experimenter with wireless modes of electrical communication. These experiments were led by William Preece but were supported by the Post Office and, more widely within the British government, by the Treasury. Based on telegraphic technologies, these experiments, trials, and eventual practical wireless systems used the electrical engineering expertise and technical knowledge located within the state-controlled institution that was the Post Office and the resources, knowledge, and practice located within its Engineering Department. These innovative wireless systems demonstrated the practicalities and practical application of wireless telegraphy and its place within electrical engineering practice within the Post Office. It was these wireless systems and related tests and demonstrations that laid the foundation for the positive reception towards and successes of later, different wireless systems. These early wireless systems were developed independently of the commercial sphere and hence external to related concerns, modes, and tropes. The knowledge and experience gained from over a decade of practical tests was shared between the Post Office Engineering Department and the Royal Engineers, who assisted with Post Office telecommunications work testing. This combination of formal and tacit knowledge offered much-needed support and assistance to Marconi's early demonstrations and systems. Nonetheless Marconi went on to develop his system commercially independently of the Post Office, despite some strong hopes and expectations from within the institution particularly Preece. The commercial activities of Marconi from 1897 onwards can be considered a clear rejection of institutional innovation on Marconi's part. However, in this chapter I will demonstrate that the early successes of Marconi and his company were very much grounded in "institutional innovation" within government departments such as the Admiralty and the Post Office.

In **Chapter 3 - Electrical Potential: Wireless and the Institution of Electrical Engineers, 1898-1908**, I view the technological developments and systems of wireless telegraphy through a different lens and introduce a contrasting case study, the Institution of Electrical Engineers. This techno-scientific institution, which had its origins in the Society of Telegraph Engineers established in 1871, can be used to reveal how early wireless telegraphy was viewed and utilised (or not) by the wider electrical engineering community. This chapter further interrogates how electrical engineers and the professional, scientific, and technological institutions representing them and their interests responded to and shaped the advent of this innovative technology.

The Admiralty provided an important early contract in 1899 for the newly established and fledgling Marconi Company and were the company's most important British client for much of the period analysed within this thesis; this is covered in more detail in **Chapter 4 - 'Britannia rules the wireless waves': the Admiralty and wireless, 1899-1904**. Similarly on an international level, many of the early customers for and users of wireless telegraphy were government institutions such as Post Offices, the government department in charge of telecommunications, and assorted branches of the military. This furthermore echoes the experiences of early telegraphic systems, networks, and companies. The early histories of all forms of telecommunication – telegraphy, telephony, and wireless telegraphy – could be easily told through commercial interaction with assorted governments, and related control and shaping in line with the national interests of that country. This lens of focus is reconsidered in later chapters of this thesis but can be, at times, a limited field of study.

Chapters 5 and **6** continue to build upon themes developed earlier in the thesis. **Chapter 5 - 'If the Government did take over wireless it meant that they would take over us':**

simmering tensions between commercial and state interests, 1903-1905 outlines the early control and regulation of wireless communications in Britain on a domestic and international level between 1903 and 1905 and hence exploits previously ignored primary sources in order to boldly reconstruct a polemical history of wireless communications during this mostly forgotten yet deeply influential period in wireless history. This radical historical narrative places two of my case studies – the Post Office and the Admiralty, both government institutions – at the heart of this truly original narrative. Standing in contrast to the standard secondary literature, which emphasises technical developments and commercial concerns, this chapter explores an alternative, parallel narrative with government institutions at the centre. In Chapters two and four of this thesis, I have shown how two government departments and institutions – the Post Office and the Admiralty – were at the forefront of wireless developments, both globally and domestically. In Britain, the Post Office and the Admiralty were the primary customers for wireless systems, a fact openly acknowledged by Cuthbert Hall (then Managing Director of the Marconi Company) in his evidence before the 1907 Select Committee hearings.[88] In this chapter, I will furthermore show how these government departments shaped and controlled domestic legislation and international regulations.

Chapter 6 - 'A question for commercial adjustment, and not for international legislation': wireless rules and regulations, 1905-1908 contrasts the 1903 Preliminary Conference on Wireless Telegraphy described in **Chapter 5** with the 1906 International Radiotelegraph Conference to demonstrate how the latter conference more openly challenged the Marconi Company's attempt at wireless world domination by legislatively tackling the issue of refusal to intercommunicate with any other system. The pivotal 1906 conference is frequently presented as a battle between the commercial interests of Germany and Britain: a challenge to the British telecommunications hegemony, particularly their extensive global cable network, by Germany. Instead, I will show that the conference can be better understood in relation to a divergence of opinion between state and commercial interests within the British contingent. The central role played by the Post Office and the Admiralty in the conference is well-documented but not well-known: there is significant, previously 'confidential' information on the politics and manoeuvring at the conference held by the Royal Naval Museum, Portsmouth and an extensive body of material in relation to the Post Office held by the BT archives. This chapter and the thesis overall concludes with the events

88 *Report from the Select Committee on Radiotelegraphic Convention; Together with the Proceedings of the Committee, Minutes of Evidence, and Appendix*. Vol. 246, House of Commons Reports of Committees. London: Printed for His Majesty's Stationery Office, 1907, 147, Line 1249.

surrounding the 1907 Select Committee hearings described in detail and quoted earlier in this chapter. The selection of witnesses along with the evidence present a unified community of institutional men – wireless pioneers, military officers, civil servants – who collectively played an active role in the early history of wireless.

1.5 Research Methodology

In order to better understand the collaborative elements of innovation within, without, and between institutions, I have drawn on concepts of "collective invention", social construction of technology (SCOT), and, to a lesser degree, actor-network theory.[89] These methodologies provide a useful framework in which to examine and understand processes of innovation and knowledge-creation in early wireless histories. Rather than focusing on a single research methodology, I have synthesised these research methodologies in an original manner that opens up novel historiographical research approaches and addresses important questions relating to technological invention and associated communities within an institutional framework.[90] Utilising elements of actor-network theory, I will argue against the heroic and individualist invention of wireless communications. Instead I will compare and contrast "institutional innovation" with the research framework provided by "collective invention" in order to illuminate the networks and communities that form within and without an institution. I will argue that an institution is more than any one user or indeed the sum of its parts, and consider how institutional structure, power, patronage, and politics can exist independent of individuals.

The emergence of science-technology-society (STS) studies in the late 1970s and the development of the Social Construction of Technology (SCOT) in the mid-1980s marked a revolution of sorts for studies of wireless communications. Rather than presenting wireless communications as a stepping stone on the path to the successes of broadcast radio, this body of literature studied the development of point-to-point wireless communications alongside other technologies and de-constructed them in terms of the influence on technical, scientific,

89 See **footnotes numbers 13 and 19**.

90 Hall, and Rosenberg (2010), 575 defines "collective invention" as being "when competing organizations share knowledge about the design and development of new technologies." See **footnote number 13** for a full set of references for these research methodologies.

economic, political, and social matters. However, these works were mostly centred upon the mass media application of wireless communications, broadcast radio, leaving space for a revised sociological and institutional study of the early history of wireless communications.

An early yet influential publication in STS studies is Hughes (1983).[91] While the title – *Networks of Power: Electrification in Western Society, 1880-1930* – might initially suggest a niche publication upon the electrification of Western society in the late nineteenth and early twentieth century, instead this publication placed technological development and networks in a wider context and utilised wider modes of scholarship to question technological determinism. In his seminal volume, Hughes suggested an inextricable bond between technology and society and a two-way conversation between the two. This publication also sparked further scholarship and is frequently cited by Bijker, Pinch, and other key authors of later SCOT texts. The historiographical approach undertaken by proponents of SCOT analyses users as agents of technological change and their roles in the development of technological artefacts thereby providing what can be considered a more balanced and relevant take on history of technology. Headrick, Huggill, Edgerton and others build upon this – extending this to wider field including geopolitics and other modes of analysis.[92] Most prominently, this thesis utilises concepts from social constructions of technology (SCOT) such as interpretative flexibility, relevant social groups, and design flexibility.[93] However, I will question whether closure, rhetorical or otherwise, can be a useful tool from SCOT with which to interrogate institutional involvement in early wireless history.

In conclusion, my interpretation of research material has been informed by ideas and models taken from SCOT, STS studies, and actor-network theory but research methodology is not the focus of this work and is not especially influential. I have chosen to utilise the ideas and models put forward but to not strictly adhere to the techniques and models contained within. Instead I have chosen to focus on documents and archival material and the primary focus of this thesis is the rich source material found in archives, contemporary publications, and elsewhere and described in more detail in the next section.

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91 Hughes (1983).

92 Edgerton (2006), Headrick (1991), and Hugill (1988).

93 See Bijker (1995), Bijker, Hughes, and Pinch (1987), Bijker and Law (1992), and Oudshoorn and Pinch (2003).

1.6 Research materials, sources, and resources

My thesis uses two main forms of primary source materials: contemporary publications, with particular emphasis on electrical engineering periodicals, and institutional documentation. These two primary sources span the public and the private, the institutional and the commercial and are utilised to produce a more nuanced portrayal of wireless communications in Britain at the end of the nineteenth and beginning of the twentieth century.

The archival partners for my thesis are the Institution of Engineering and Technology (IET) archives and British Telecom (BT) archives, both London-based. The former holds the archives of their antecedent, the Institution of Electrical Engineers (IEE), while the latter is home to the archives of telecommunications in the Post Office. Both have rich and complementary archival records spanning the early history of telecommunications and related technology in Britain in the nineteenth and twentieth centuries. These archival records include a smorgasbord of unpublished and private documents – internal correspondence, institutional minutes, private reports, and many other rich resources. I have also used the archives of the Marconi Company held by the Bodleian Library in Oxford in order to explore the multiple complex interactions between the Marconi Company, the Post Office, and the Admiralty in order to explore the changing balance of power between these three organisations and to consider whether these interactions were as successful or fruitful for the Marconi Company as the company would have liked, or indeed as some wireless histories suggest.

In contrast to this private and sometimes confidential material, I have also researched more public and indeed public-facing material in the form of electrical engineering periodicals. By the end of the period covered in this thesis, there were over twenty different electrical periodicals being published in Britain alone. These ranged from institutional journals such as the Journal of the Institution of Electrical Engineers to more general electrical engineering press such as *The Electrician*. Independent of these specialised publications, electrical engineering, wireless communications, along with the work of institutions in these fields were frequently featured in more general periodicals such as *Nature*, *Science*, and the popular press including newspapers such as *The Times*, the *Manchester Guardian*, and others. These contemporary periodicals present a contrast with later wireless histories which are very much presented with an eye to the later successes of broadcast radio. One fundamental aspect of contemporaneous sources is the terminology used to describe wireless communications. In tracing the terminological shifts which take place during the twenty-five year period covered herein, it is also possible to trace changing claims about wireless communications.

1.7 What we talk about when we talk about wireless[94]

> When I use a word, it means just what I choose it to mean – neither more nor less.
> - *Humpty Dumpty in Through the Looking-Glass, and What Alice Found There* by Lewis Carroll (1871)[95]

One aspect of wireless communications worthy of further research is the terminology used and the associated etymological shift which took place during the quarter of a century genesis of wireless communications analysed within this thesis. The language and terms used can be matched to various claims made about that type of wireless communications, and further the evolution and eventual standardisation of language can be used to trace and map interesting wider historical trends in the field of wireless.

Earlier in this chapter and in further detail in the next chapter, I describe the early wireless experiments conducted by the Post Office Engineering Department which began in the early 1880s and continued until the turn of the century. In the initial 1882 paper by William Preece, there was a discussion of sea-water conduction as a means of replacing broken telegraph cables and there was a separate discussion of the problem of “cross-talk” between telegraph cables and telephone wires, the latter problem being referred to in modern terms as inductive interference. By the mid-1880s these two modes had evolved into conductive telegraphy and inductive telegraphy and were considered merely sub-classes of telegraphy or different transmission types. During this period, a third mode of transmission, radiation, was mentioned briefly but was not discussed again. As befits technologies which had their origins in technological limitations and properties of existing modes of telecommunication, that is telegraphy and telephony, there was no need for a new language for these systems and hence no use of nor indeed need for the term “wireless”. These technologies were not perceived to

94 Section title is a paraphrase of Raymond Carver's *What We Talk About When We Talk About Love: Stories* (1981).

95 Carroll (1871).

be new or indeed "wireless" but were very much building upon the existing telecommunication systems and the language used to describe them reflects this. They were, I admit, sometimes referred to as "new telegraphy" but this was as a means to communicate that they were an evolution of telegraphy rather than an entirely new mode of telecommunication. It is worth noting that although they were "wireless" in the strictest sense of the word, that is a point-to-point mode of electrical communication without wires between the two points, they would not be considered "wireless" according to modern usage of the word. In fact, they were considered by engineers, scientists, and indeed some wireless historians as something closer to interference than a legitimate form of wireless communications.[96] Despite this, it must be noted that I use "wireless communication" throughout this thesis to mean all modes of electrical communication without wires, this being more convenient and simplistic than strictly accurate.

As somewhat of a brief sidenote, it was around this time that the first usage of "radio" as a mode of electrical telecommunications pre-dated the early usage of "wireless" by over a decade. In 1880 Alexander Graham Bell developed and patented an original device, the "photophone" (also referred to as a "radiophone"), which used beams of light to transmit sound over relatively short distances.[97] The device was declared by Bell's contemporaries to be unsuitable for its designated purpose but some have suggested it was a pre-cursor to present-day fibre-optic telecommunications. The concept and subsequent device was suitably promising enough to be the subject of four of Bell's eighteen patents, and was the subject of two lectures by William Preece in 1880 and 1881. The terms "photophone" and "radiophone" were used interchangeably as the titles of two papers delivered by Preece himself before the Society of Telegraph Engineers and Electricians in 1880 and 1881 aptly demonstrated; *The Photophone and the Conversion of Radiant Energy into Sound* delivered in 1880 and *Radiophony* delivered a year later in 1881.[98] The latter paper defined the term "radiophony" as being 'the production of sounds by radiant energy.'[99]

96 Lochte (2000).

97 Bell, Alexander Graham. "Apparatus for Signalling and Communicating Called 'Photophone'." edited by United States Patent Office. USA, 1880. URL: http://www.google.com/patents/about?id=VpdyAAAAEBAJ

98 Preece, William Henry. "The Photophone and the Conversion of Radiant Energy into Sound." *Journal of the Society of Telegraph Engineers* 9, no. 34: 364-83.; Preece, William Henry. "Radiophony." *Journal of the Society of Telegraph Engineers and of Electricians* 10, no. 37: 212-31.

99 Preece (1881), 213.

By the early 1890s, a multitude of terms were in use to describe wireless communications - “space telegraphy”, “aetheric telegraphy”, “new telegraphy”, and “magnetic telegraphy”. The plethora of terms available matched the plethora of claims being made about these wireless systems and the increasing number of practitioners in the field. When there was a technological stabilisation around 1896 a terminological stabilisation also occurred with “wireless” or “wireless telegraphy” (at least in Britain) becoming the accepted taxonomy. As the commercialisation of wireless began, so the language shifted yet again, with some terms referring to specific systems with “Marconi telegraphy” becoming synonymous for a while with “wireless telegraphy”. The interchangeability of these two terms matched the rise in popularity of the Marconi wireless system and also fell out of use as the Marconi Company's power and influence decreased.

It was also in the late 1890s that the first use of “wireless” in official government documents began. The earliest use of “wireless” in government publications is in relation to “wireless” torpedo tubes acquired by the Royal Navy and also by the Army for ordnance. The first recorded use of “wireless” in the sense of “wireless telegraphy” in parliamentary papers was a reference to the establishment of the Wireless Telegraph and Signal Company (renamed Marconi's Wireless Telegraph Company Limited in 1900) in 1898.[100] Later in 1898, “wireless” was used in reference to “wireless telegraphy” in a report of the committee appointed by the Treasury to consider the desirability of establishing a national physical laboratory.[101] It was also during this time that the phrase “wireless telegraphy” began to be included in dictionaries, a clear indicator of more general use and acceptance. At the turn of the twentieth century, Webster's International Dictionary published one of the earliest published definitions for “wireless telegraphy”: 'a system of telegraphy in which communication through space is accomplished by electric waves without wires or other conductors.'[102] Meanwhile the *Oxford*

100 "Joint Stock Companies. Return to an Order of the Honourable the House of Commons, Dated 8 August 1898." in *House of Commons Papers; Accounts and Papers* (1898). URL: http://gateway.proquest.com/openurl?url_ver=Z39.88-2004&res_dat=xri:hcpp&rft_dat=xri:hcpp:rec:1898-076500

101 John William (Third Baron Rayleigh) Strutt, "National Physical Laboratory. Report of the Committee Appointed by the Treasury to Consider the Desirability of Establishing a National Physical Laboratory," in *Command Papers; Reports of Commissioners* (1898). URL: http://gateway.proquest.com/openurl?url_ver=Z39.88-2004&res_dat=xri:hcpp&rft_dat=xri:hcpp:fulltext:1898-075978:96

102 A New Edition of Webster's International Dictionary. 1901?

English Dictionary (*OED*) cites early examples of “wireless” and “wireless telegraphy” from the late 1880s up to 1898 with the earliest two examples – from 1887 and 1892 respectively – being from American sources and relating to Edison's early experiment with inductive telegraphy and “vacuum tubes” (later referred to as “radio valves”).[103] Speaking of “tubes”, the *OED* erroneously cites an 1893 reference in *The Times* to “wireless tubes” as being the earliest British example of “wireless” as referring to electrical communication without wires. However, “wireless tubes” did not refer to a “vacuum tube” (which, despite Edison's early experiments, did not reach practical development until about 1904) but rather a component of a submarine relating to naval torpedoes. Hence the earliest British mention of “wireless” to be found in the *OED* is from a July 1898 edition of *the Electrical Review*. It was also around the late 1890s when the term “wireless” began to be used in the popular press with reference to electrical communication without wires, usually but not always involving Hertzian waves. However, earlier terms continued to be used in parallel and it was not until the early twentieth century that the term “wireless” began to enter common usage and began to be the most popular and common term utilised to describe this embryonic technology.

The earliest examples of the term “wireless” in British publications I have been able to find come from *The Times* and *The Economist* from September 1897 and October 1898 respectively.[104] The September 1897 article from *The Times* was entitled “Telegraphs Without Wires” but referred to “wireless telegraphy” throughout the article. The article was reporting upon technical aspects of wireless experiments being conducted by the Post Office at Dover who were testing Marconi apparatus quite possibly without the knowledge or approval of the Marconi Company.[105] The October 1898 reference from *The Economist* was referring to the Wireless Signal and Telegraph Company's extraordinary general meeting of that year. *The Economist* contained a mere four references to “wireless” communications prior to 1900 while, in contrast, the term was used far more frequently in *The Times* with over one-hundred

URL: http://johnjohnson.chadwyck.co.uk/search/displayItemFromId.do?ItemID=20090610124259kw&DurUrl=Yes

103 "wireless, adj. and n.". OED Online. June 2012. Oxford University Press. http://www.oed.com/view/Entry/229458?rskey=kWwTru&result=1&isAdvanced=false (accessed August 09, 2012).

104 "Telegraphs Without Wires." Times [London, England] 18 Sept. 1897: 8. *The Times Digital Archive*. Web. 28 September 2012; "The Bankers' Gazette." Economist [London, England] 22 Oct. 1898: 1533+. *The Economist Historical Archive*. Web. 28 September 2012.

105 See **Section 2.5 – 1896 and all that: Marconi's arrival in Britain** for further details.

references to “wireless” prior to the turn of the twentieth century.[106] In contrast to the national press, mentions of “wireless” appeared earlier in regional newspapers and periodicals and pre-date the arrival of Marconi's wireless system and company with the latter appearing to be the catalyst for the term “wireless” entering popular usage in the national press.

1.8 Conclusion

In offering up some concluding and overarching remarks for this chapter, I wish to return to the research question that informs this thesis: what was the role of state and technical institutions in the early history of British wireless and how did this influence wireless technology and constrain the activities of the Marconi Company? There are two distinct elements to this question, both of which will be answered in subsequent chapters of this thesis. The first and primary aspect of this thesis is an examination of institutional innovation and the impact of these institutional activities on the early history of wireless. These innovations are not merely technological but also regulatory, legislative and consumer-driven. Secondly I will examine the effect of these institutions on the commercial endeavours of the Marconi Company and the constraints this was to place on the monopolistic goals of the company. More generally, I wish to demonstrate that early modes of wireless communications were not solely constrained and controlled by commercial concerns. Rather than being the exclusive domain of commerce and, to a lesser extent, science, I wish to show the vital role of engineers, institutions, innovators, consumers, and regulators who have for too long been omitted or side-lined in the traditional narrative of wireless development. My narrative of wireless is not just about producers but also users and consumers – their role in shaping the technology, both internally through internally produced apparatus and technological systems and also externally, incorporating their institutional expert knowledge into valuable and practical adaptations to externally produced technologies. The roles of these institutions moved beyond the physical hardware and artefacts to a wider change of technological systems – establishing the demand for these technologies, shaping domestic and international legislation and regulations, establishing the work of wireless pioneers, and educating the electrical engineering community along with the wider population about wireless technologies.

106 A search of *The Times Digital Archive* performed on 15 November 2012 reveals 133 entries for “wireless” prior to 1 January 1900 with most but not all of these referring to “wireless telegraphy.” A similar search for “wireless telegraphy” reveals 105 entries hence the estimate of over one-hundred entries.

Chapter 2: 'Something in the Air': The Post Office and early wireless experiments, 1882-1899[1]

2.1 Introduction

> Attention has been directed to the utilisation of electric impulses for the transmission of signals, without connecting, wireless, from one locality to another, since the very early days of electric telegraphy. ...until the subject was taken up and developed in the British Post Office, no system in which signals could be transmitted to any considerable distance was evolved.
> - Post Office's general technical report on wireless telegraphy (1903).[2]

In 1903 the Post Office produced a controversial report on wireless telegraphy. This report was produced internally and confidentially for the Post Office and was authored by Post Office engineering staff including assistant Engineer-in-Chief John Gavey and Post Office engineer J.E. Taylor. Mostly technical in content, it outlined a historic timeline of wireless telegraphy with focus on a series of experimental wireless systems developed by the Post Office Engineering Department between 1884 and 1899. These wireless systems originated in telephonic research conducted by the Post Office in 1882. This followed soon after a legal judgement which extended the Post Office's monopoly on telecommunications to include telephony in addition to telegraphy.[3] During this brief period, the Post Office conducted in-

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1 Some material from this chapter was presented at "Owning & Disowning Invention: Managing Knowledge in the Techno-sciences, 1850-2000" conference held at University of Leeds, 5-8 July 2010 and is included in Bruton, Elizabeth. "Something in the Air: William Preece and Experiments with Wireless Telegraphy, 1882-1902." In *Knowledge Management and Intellectual Property: Concepts, Actors and Practices from the Past to the Present*, edited by Graham Dutfield and Efstathios Arapostathis. Cheltenham: Edward Elgar, 2013.

2 BT Archives Post 30/1066C – General technical report on wireless telegraphy (1903), 1.

3 The Attorney General v The Edison Telephone Company of London Ltd was heard in the Exchequer Division of the Hugh Court of Justice in November and December 1880, presided over by Mr Baron Pollock and Mr Justice Stephen. The case referred to a dispute between the Edison Company and the Post Office on the rights of the Post Office over telephone systems. A printed copy of the case and final judgement was kept by William Preece and his personal annotated copy can be found at IET Archives UK0108 NAEST 039/3, The Attorney General v The Edison Telephone Company of

depth research into the newly established field of telephony. Many of these developments and experiments were described in a paper by William Preece, in his role as Assistant Electrician of the Post Office, entitled “Recent Progress in Telephony” delivered at the 1882 annual meeting of the British Association for the Advancement of Science (BAAS).[4]

Two distinct developments described within Preece's paper were of particular note: first, a short-term solution to a broken undersea telegraphic cable using sea-water conduction; secondly, the problem of inductive interference between telephone wires and telegraph cables with over 250 yards between them. This paper, which was widely published and disseminated, formed the genesis of two distinct, experimental forms of “wireless” communications: inductive telegraphy and conductive telegraphy.[5] In 1884 and two years after Preece's initial report before the BAAS, further investigations were conducted on the long-distance telephone line between London and Bradford in order to detect and resolve inductive interference between the telephone wires and nearby telegraph cables. The outcome was a solid fifteen-year programme of experiment and practice into two distinct pre-Hertzian wave wireless systems developed by the Post Office. Through research and experiments conducted by their Engineering Department and utilising the full resources of the Post Office, this state-sponsored institution and government department, was the first in the world to develop an operating wireless system. Their system pre-dated the published discovery of Hertzian waves in the late 1880s and so utilised non-Hertzian electromagnetic waves resulting from inductive

London Ltd: Arguments and Judgement in Exchequer Division, High Court of Justice (1880).

4 Preece, William Henry. "Recent Progress in Telephony." *Nature* 26, no. 673 (1882A): 516-19; Preece, William Henry. "Recent Progress in Telephony." *The Electrician* 9 (1882B): 389-93; Preece, William Henry. "Recent Progress in Telephony." *Journal of the Society of Telegraph Engineers and of Electricians* 11, no. 45 (1882C): 610-24.

5 An entire book could be dedicated to a discussion of the term “wireless” – to its changing meanings, terminological shifts, and associated technological claims. “Wireless” was not a term in regular use during the timespan covered by this chapter although it was coming into usage by the early twentieth century. It was generally used to refer to Hertzian (electromagnetic) wave-based systems however it can also be used to describe other “without wire” electrical telecommunications systems such as those developed by the Post Office and others. Hence, for simplicity's sake, I will use the term “wireless” to describe any electrical communications/signalling system without wires connecting the transmitter and receiver(s). The contemporary term used was generally “new telegraphy” or sometimes “space telegraphy”, the latter term being also applied to Hertzian wave wireless systems. For a relatively contemporaneous discussion of this issue, see Collins (1901).

interference between different modes of telecommunications. Later, practical versions of this system were capable of transmitting over distances of up to ten miles and were utilised by the Royal Engineers and War Office to communicate across the Bristol Channel in 1897 and 1898 where it was the world's first practical working wireless telegraphy installation.

These early wireless systems were key precursors to the innovations of Hertzian wave-based wireless communications developed by Marconi, Lodge, and others in the mid- to late-1890s. Hence this proto-system of wireless telegraphy was quickly forgotten and mostly ignored with the Post Office and Preece being notable exceptions. These early Post Office wireless systems and experiments do not fit into the standard wireless historiographies or the institutional histories of the Post Office, being generally presented as an oddity or failure in the former genre, if at all.[6] Instead, I will resurrect these wireless systems and consider their historical importance and roles in the early history of wireless. One important aspect of these early Post Office wireless systems was their commercial-free operation. The Post Office's systems of wireless telegraphy were free of any patent claims or commercial monopoly, in stark contrast to Marconi's wireless system and apparatus. This is unsurprising considering the institutional location of these innovative systems, taking place within state-controlled formalised technological systems and networks of power and external to the traditional framework of scientific practice and commercial developments. This left these wireless systems independent of traditional or expected claims of commercial competition, secrecy, and intellectual property including patenting.

Instead Preece and the Post Office pursued a strategy and agenda of “institutional innovation”, engaging with concepts of research, expertise, agendas, resources, publicity in order to meet the needs and demands of this state-controlled institution and mostly independent of commercial concerns. The delineation between the institution of the Post Office and the individual Preece is one I will further explore in this chapter. From an institutional perspective, Preece was allocated responsibility to publicly present and demonstrate these wireless systems. However, from Preece's point of view, he offered a representation of the authority and knowledge of the Post Office. Nonetheless the outcomes were regular papers presented on the Post Office wireless system by Preece before techno-scientific institutions and learned societies such as the British Association for the Advancement

6 Standard wireless histories include Appleyard (1930), Aitken (1976), Pocock (1988), Garratt (1994), Hong (2001), and Burns (2004). There are five Post Office histories: Robinson (1948), Bealey (1976), Daunton (1985), Perry (1992), and Campbell-Smith (2011).

of Science (BAAS), the Institution of Electrical Engineers, the Royal Institution, and others.[7] Without the need to commercially justify its work, the Post Office was free to present and demonstrate its wireless systems in the public sphere. The resulting scientific papers were disseminated and discussed within and without the aforementioned institutions. They were published and commented upon in the institutions' journals and were also printed externally in other electrical engineering publications and more general periodicals. These public presentations – papers and publications – were the main mode of knowledge transmission engaged with by the Post Office. Additionally, the Post Office produced internal documents and reports on early Post Office wireless experiments and authored by the Post Office engineers involved. Access to these confidential documents was limited with the intended readership being limited to the Postmaster General and other high-ranking civil servants of the Post Office, along with similarly ranked members of the Treasury and other government departments. These reports mapped out the changing technological claims with regard to the Post Office wireless systems and also made strenuous attempts to map the tacit knowledge acquired by the staff of the Post Office Engineering Department. These internal documents – quoted throughout this chapter – show a clear continuity of engineering practice from telegraphy to telephony and beyond to these "new" systems of wireless telegraphy.

In this chapter I will show how these early Post Office wireless experiments, which existed prior to Marconi's arrival in Britain in 1896, transcended the legal character of commercial development and took place without patents or litigation. I will also argue that it was Marconi's use of patents rather than his technical innovations which marked a paradigm shift in wireless communications at the end of the nineteenth century, bringing with it complex and controversial issues of priority, authority and associated rights of recognition and exploitation. Furthermore I will consider how these early and experimental forms of wireless communications existed adjacent to existing modes of electrical telecommunications experiments – telegraphic and telephonic – that came under the jurisdiction of the Post Office and often had a shared apparatus and experimental practice. Finally I will discuss how the expectation and potential promise laid down by these early wireless experiments and systems were ruthlessly exploited by later wireless practitioners such as Marconi and others. Through original research and the use of contemporary sources, I will show that it was the earlier Post Office wireless systems and related engineering practices which laid the foundation for the later successes of Marconi's wireless telegraphy in the early twentieth century.

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7 For further information on the British Association for the Advancement of Science (BAAS), see Howarth, (1931), Lodge (1931), MacLeod and Collins (1981), Morrell and Thackray (1984).

2.2 The Post Office and Telecommunications Legislation

The connection between the state-run Post Office and telecommunications began in the late 1860s when the Telegraph Acts of 1868 and 1869 brought the network of private-owned inland telegraph network under a state monopoly, managed by the Post Office.[8] The 1868 Telegraph Act was the result of much lobbying to widen public access to the telegraph network and granted the Postmaster General the right 'to acquire, work and maintain Electric Telegraphs' and hence to take control of the inland telegraph systems in Britain.[9] Previously the telegraph network had been installed and operated by independent telegraph and railway companies.[10] A year later, the Telegraph Act of 1869 further conferred on the Postmaster-General a monopoly in telegraphic communication in Britain and in 1870 the domestic telegraph network came under a state-controlled monopoly. As a result of this, William Preece came to work for the Post Office, being transferred from the Electrical Telegraph Company to the Post Office as Southern District Engineer in 1870.[11] A more general outcome of the Telegraph Acts was the emergence of telecommunications innovations from the Post Office.

Initially the Post Office began to investigate, experiment with, and promote different telegraphy technologies including duplex and quadruplex working. Duplex working was introduced by the Post Office shortly after it took over the telegraphy networks in 1870 and hence Britain was one of the first countries to use this efficient and simultaneous mode of transmission. In order to achieve a practical working of this innovative technology, the Post Office had to overcome problems relating to the poor insulation resistance of telegraph lines

8 For recent scholarship on the nationalisation of the telegraph network, see Fari, Simone. "Competing in a Victorian Market: Telecommunication Service from Its Origins to Nationalisation, 1846-69." In *2012 Economic History Society Annual Conference*. St Catherine's College, University of Oxford, 2012.

9 *31&32 Vict. c.110*

10 For an excellent first-hand, illustrated account of the telegraph network in Britain prior to the Telegraph Acts along with the story of the genesis of the undersea transatlantic cable, see Dodd (1867).

11 William Preece is the subject of a sole biography, Baker (1976). For further information on Preece and wireless, see Pocock (1965), Tucker (1981), and Constable (2006). For a discussion of Preece's antagonism with Maxwellian electrical engineers, see Hunt (1983) and Hunt (2005).

along with difficulties in obtaining accurately differential instruments.[12] Poor telegraph line insulation may have been a contributing factor to inductive interference between telegraph cables and telephone wires which led to the development of one of the early wireless telegraphy systems developed by the Post Office. A year later in 1872 the Post Office introduced quadruplex circuits, a system where a total of four messages (two messages in each direction) can be sent simultaneously. A further telegraphy innovation introduced by the Post Office around this time was the mobile telegraph office, introduced in 1873. Many of these innovations were described by Preece in a celebrated Friday evening discourse delivered before the Royal Institution in May 1879.[13]

The development of the telephone in Britain mirrored that of the telegraph but on a much more accelerated timeline and with the state-controlled monopoly of the Telegraph Acts fresh in the mind of those who worked at the Post Office. In September 1876 William Thomson (later Lord Kelvin) and Preece introduced Bell's telephone before the annual meeting of the British Association for the Advancement of Science (BAAS) held that year in Glasgow.[14] Less than eighteen months after Bell filed his controversial US patent, 1878 marked a series of firsts in relation to the telephony in Britain with all of these events taking place. In June 1878 Bell established the Telephone Company Ltd in order to exploit his British patents. A few months later, Preece made the first practical demonstration of a pair of telephones before the annual meeting of the BAAS in Plymouth and later that same year, the Post Office provided its first telephones – a pair of Bell telephones – on rental to a firm in Manchester.[15] Less than four years after the telephone was first introduced in Britain, a legal case was heard which had a long-term effect upon the development of telephony in Britain.

From November to December 1880, the case of *The Attorney General v The Edison Telephone Company of London Ltd* was heard in the Exchequer Division of the Hugh Court of Justice, presided over by Mr Baron Pollock and Mr Justice Stephen.[16] The case referred to a dispute between the Edison Company and the Post Office on the rights of the Post Office over

12 "Telegraphy." *Post Office Electrical Engineers Journal* 49, no. 3 (1956).

13 Preece, William Henry. "Multiple Telegraphy, or Duplex and Quadruplex Telegraphy." *Proceedings of the Royal Institution* 9 (1879B): 194-200.

14 See *Report of the Forty-Sixth Meeting of the British Association for the Advancement of Science; Held at Glasgow in September 1876*. London, 1877 for full details.

15 See *Report of the Forty-Seventh Meeting of the British Association for the Advancement of Science; Held at Plymouth in August 1877*. London, 1878 for full details.

telephone systems. In a landmark ruling the court decided in favour of the state, in this case the Post Office. The judgement concluded that the telephone was a "speaking telegraph" and a telephone conversation was a *de facto* telegram. Even though the telephone had not existed when the first Telegraph Act was passed in 1876, a telegraph was defined as 'any apparatus for transmitting messages or other communications by means of electric signals' and under this definition the newly invented telephone fell. The judge further noted that the state monopoly would also apply to any future system of wireless communications.[17] This resulted in the earlier Telegraph Acts being extended to cover telephonic communication with the telephone network coming under the Postmaster General's monopoly. In 1884 legislation was introduced which offered generous 31-year licenses allowing private companies to provide long-distance telephone lines. Independent telephone companies could apply for these licenses to operate from the Post Office with the Post Office taking ten per cent of gross income and having the option to purchase a telephone undertaking at the end of ten, seventeen, or twenty-four years. The Post Office used its strong monopoly to limit the licenses issued to private companies resulting in, some scholars have argued, a slow and limited growth of the telephone in Britain.[18] This approach has been challenged by more recent scholars.[19] Furthermore this ignores the telephonic innovations taking place within the Post Office. Many of these innovations took place in parallel to existing telegraphic innovations and experiments, and were contributed to and involved the same Post Office engineers. Public emphasis on and revenue from telegraphy prevents the Post Office from embracing telephonic innovations to the same degree as they have those of telegraphy.

As a result of the somewhat controversial and narrowly held 1880 judgement, the Post Office presumed to hold a clear monopoly on all forms of domestic telecommunication. One

16 A printed copy of the case and final judgement was kept by William Preece and his personal annotated copy can be found at IET Archives UK0108 NAEST 039/3, The Attorney General v The Edison Telephone Company of London Ltd: Arguments and Judgement in Exchequer Division, High Court of Justice (1880).

17 *Attorney General v Edison Telephone Co* (1880) 6 QBD 244, 249.

18 For example, see Perry, Charles Richard. "The British Experience 1876-1912: The Impact of the Telephone During the Years of Delay." In *The Social Impact of the Telephone*, edited by Ithiel de Sola Pool, 69-96. Cambridge, Massachusetts: The MIT Press, 1977.

19 Examples include two forthcoming University of Leeds PhD theses by Michael Kay and Peter Reilly on the social history of the telephone. These theses are the outcome of "*Whose call? Mapping the Early Usage and Non-Usage of the Telephone in Britain*", a collaborative research project between Graeme Gooday and BT archives.

outcome of this was a dramatic expansion of the telecommunications network and in the number of telegraph offices across Britain in the 1880s and 1890s. Parallel to these developments, the Engineering Department of the Post Office performed trials and experiments relating to "long-distance" telephone communication and various systems of telegraphy. The results of these experiments and trials were presented before a wide selection of scientific and engineering audiences and, as a result, were widely published, discussed, and disseminated. Preece himself was especially prolific in presenting and publishing the recent telecommunications developments and experiments conducted by the Post Office Engineering Department before a large range of audiences. Preece's papers and speeches, of which he produced hundreds, were regularly published in the scientific and electrical engineering press and also reported on more widely in popular periodicals such as *The Times* and others.[20]

Further to this, the Post Office presumed to hold a monopoly on wireless telecommunications and viewed itself as the natural, and possibly sole, home for potential wireless telegraphy systems. In addition, inductive telegraphy with its origins in "crosstalk", a property of the intersection between telegraphy and telephony, clearly fell within existing Post Office jurisdiction and responsibility. A combination of legislation and the location of wireless within the field of electrical engineering practice meant the Post Office did not consider their systems of wireless telegraphy within the context of traditional commercial development nor associated patent rights and related claims, something I will further explore in this chapter.

2.3 Wireless Experiments, 1882-1893

In this section, I will provide further details of the origins of the Post Office wireless experiments along with an exploration of the first decade of their development by the Post Office. Wireless experiments conducted by the Post Office had their origins with investigations conducted in 1882 by its Engineering Department and under the command of William Preece, then Assistant Engineer of the Post Office and later Engineer-in-Chief and Electrician (1892-1899). These investigations were described in detail in a paper entitled "Recent Progress in Telephony" read before the British Association for the Advancement of Science at their annual meeting held in Southampton in September of that year. The paper was delivered before

20 For a list of Preece's main lectures and papers, see Baker (1976), 355-362 – Appendix I: "Principal Lectures and Publications".

Section G – Mechanical Science, the more practically minded and engineering-inclined section of the association and was widely disseminated and reported upon. It was described prominently in *The Times*' daily report of the meeting's proceedings as being 'of being public interest as bearing upon the development and extended use of the telephone.'[21] An abstract of the paper was published in the meeting's reports and emphasised Preece's concluding remarks about the potential use of telecommunications systems without wires.[22] A revised version of the paper was published in *Nature*, *The Electrician*, the *Journal of the Society of Telegraph Engineers and of Electricians*, and possibly other contemporary publications.[23] The paper covered recent developments in telephonic communication and included two distinct and relatively minor events. In the paper's introductory paragraph, Preece noted that the telephone had been introduced to the British public at another British Association annual meeting, held in Glasgow in 1876, a mere six years previously.

Preece's 1882 paper covered recent developments in this new field within telecommunications and included two distinct and relatively minor problematic events connected with these still developing systems of telecommunications. First Preece described the problem of 'leakage' or 'cross contact', in this case inductive interference between telephone wires and telegraphic cables separated by a distance of 250 yards or more.[24] Entirely separately and towards the concluding section of the paper, Preece described a new system of telegraphy temporarily put in place to replace a broken undersea telegraph cable between Southampton and Newport on the Isle of Wight.[25] When the undersea telegraph cable was repaired the following day no further experimentation was conducted.[26] The temporary system between Southampton and the Isle of Wight utilised the conductive properties of sea-water in order to transmit a message between the two points. The terminology used to describe the system is complex; as per other forms of “telegraphy without

21 "The British Association." *The Times*, 29 August 1882, 5A.

22 "Report of the Fifty-Second Meeting of the British Association for the Advancement of Science; Held at Southampton in August 1882." London: British Association for the Advancement of Science, 1883, 666-667.

23 Preece, William Henry. "Recent Progress in Telephony." *Nature* 26, no. 673 (1882A): 516-19; Preece, William Henry. "Recent Progress in Telephony." *The Electrician* 9 (1882B): 389-93; Preece, William Henry. "Recent Progress in Telephony." *Journal of the Society of Telegraph Engineers and of Electricians* 11, no. 45 (1882C): 610-24.

24 Preece (1882A), 517.

25 *Ibid.*, 518.

26 Fahie (1889), 139.

wires", etymological standardisation was a long way off and assorted terms were used to describe this system.[27] Although it was described thus in 1882, it was later presented as a form of "telegraphy without wires" or "new telegraphy". Whether this system fits into the category of "wireless telegraphy" is open to some debate as "conductive telegraphy" and "inductive telegraphy" both pre-date this term and it is more generally associated with Hertzian wave wireless telegraphy systems. Nonetheless, for the sake of simplicity although not historical accuracy, I have chosen the simplest descriptors – "conductive telegraphy", "inductive telegraphy", and collectively "wireless telegraphy" – for these early experimental "telegraphy without wire" systems.

While "cross contact" was clearly an engineering problem (at least in origin), "conductive telegraphy" was considered an innovative extension to the existing electrical telegraphy system and not a new form of technology in its own right. These two completely distinct and separate properties of telecommunications led to a fifteen-year period of experimental practice and trials conducted by the Post Office Engineering Department between 1884 and Preece's retirement in 1899.[28] It was Preece, at first in his capacity as Assistant Engineer, and later between 1892 and 1899 as Engineer-in-Chief and Electrician of the Post Office who publicly presented the outcomes of these wireless systems. Preece continued the pattern of his 1882 paper in presenting before the annual meetings of the BAAS until 1893 when he presented a paper on the subject at the International Electrical Congress at Congress.[29]

In presenting before the BAAS, Preece was presenting to a general audience with a strong interest in science and not to a specialist technical or engineering audience. Of the nine papers delivered by Preece on the Post Office's wireless telegraphy systems and related contributions, four were delivered before the BAAS annual meetings. The context of these papers is worth considering, if only briefly. The BAAS was founded in 1831 with the original purpose 'to give a stronger impulse and a more systematic direction to scientific inquiry; to

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27 See **Section 1.7 - What we talk about when we talk about wireless** for further details.

28 For contemporary overviews of the experiments, see Preece, William Henry. "The Transmission of Electric Signals through Space." *The Electrician* 31 (1893A): 520-22; Preece, William Henry. "Electrical Signalling without Wires." *Journal of the Society of Arts* 42 (1894A): 274-80; Kerr (1898); Fahie (1899); and BT Archives Post 30/1066C – General technical report on wireless telegraphy (1903).

29 Preece, William Henry. "The Transmission of Electric Signals through Space." *The Electrician* 31 (1893A): 520-22.

promote the intercourse of those who cultivate Science in different parts of the British Empire with one another and with foreign philosophers; to obtain more general attention for the objects of Science and the removal of any disadvantages of a public kind that may impede its progress.'[30] In the late nineteenth century, the association began to further clarify its aims and objectives which caused increased tension within the association. The increased specialisation of science led to problems in facilitating communication between scientists and hence there were problems relating to their laudable aim of communicating scientific advancement to a general audience. Despite the name, the British Association was a place to introduce and promote general scientific advancements. Meeting the demands of the Post Office and providing publicity for their work was foremost and, for these purposes, the British Association was well suited. However what the British Association did not provide was an audience of technical or electrical engineering specialists. As a result, Preece's papers between 1882 and 1893 did not contain many technical diagrams or illustrations nor were many technical details provided. It was not until 1893 that Preece presented details of the Post Office's wireless systems outside of the BAAS and before an international audience at the International Electrical Congress in Chicago.

Between 1882 and 1884, these potential new systems of telegraphy remained unexplored by Preece and the Post Office but in 1884 something would happen to revive interest. In 1884, Preece was directed to the use of interference as a potential form of new telegraphy by a mere accident: some telegraph messages sent through the Post Office's central exchange in Bradford were being read upon the nearby circuit of a telephone company and the signals were recognised by an old telegraphist who had formerly worked for the Post Office.[31] Preece investigated this matter, a serious lapse of security, thoroughly and eventually traced the cause to induction. As a result of these investigations, the Post Office Engineering

30 *Report of the Twelfth Meeting of the British Association for the Advancement of Science; Held at Manchester in June 1842*. London, 1842, v.

31 This is described in lectures given by Preece in the lead-up to his retirement and in many articles published upon Preece's retirement in 1899 but was not mentioned in contemporaneous publications (c.1884). See BT Archives TCK 89/23 – [Album of press cuttings relating to Preece, mainly regarding his appointment as Chief Electrician and Engineer-in-Chief, and his retirement from the Post Office], 1890-1903; IET Archives UK0108 SC MSS 022/III/184 – MS notebook on Aetheric Telegraphy [probably authored by Preece], dated 5 December 1898. The notebook contains notes on the history of telegraphy and the progress of its development prepared for talks given at the Midland Institute, Birmingham on 5 December 1898; Blackheath, Surrey on 13 March 1899; and Wimbledon Literary Society on 22 April 1899.

Department began a series of investigations between 1885 and 1886 in order to more fully understand this new form of telegraphy and these experiments continued in a similar format until Preece's promotion to Engineer-in-Chief (and Electrician), the latter part of the title personally requested by Preece himself, in 1892.

While the early investigations and resulting outcomes were publicly presented by William Preece before numerous learned societies and techno-scientific institutions, the subsequent fifteen years of experimentation and practice utilised the full resources of the Post Office and its Engineering Department. Experiments by Post Office electrical engineers were, both literally and figuratively, conducted parallel to tests and demonstrations of other telecommunication systems that came under the jurisdiction of the Post Office. These experiments, demonstrations, and tests were all conducted by the Post Office Engineering Department. The various internal reports quoted throughout this chapter were written by the many engineers within the Post Office who managed and conducted these wireless systems and experiments. Post Office engineers such as John Gavey, J.E. Taylor, and Arthur Heaviside produced regular reports on these wireless systems.[32] They brought their technical expertise and experience, some external to the Post Office, to bear on these wireless systems and reported openly and honestly about their potential and failings. At times these internal and private reports contradicted the public-facing papers and lectures delivered by Preece on the topic. This divide and potential source of tension is something I more fully explore in later sections of this chapter. Many Post Office engineers contributed to this project and these wireless systems were developed utilising the full resources, manpower, expertise, and support of the Post Office. However it was Preece alone who publicly presented, published, and commented upon these embryonic wireless systems. As a result, it could be difficult to delineate between Preece's work in this field and the overall contribution of the Post Office. This blurring of lines and crossing of boundaries between the private and the public, the individual and the institution, the open and the secret is one more fully interrogated in the later sections of this chapter.

Initially in 1884 there were two completely distinct and separate concepts and systems – conduction and induction. Inductive wireless telegraphy utilised inductive interference

32 See BT Archives Acc 2002/0057 – Small notebook labelled "Trunk Telephones LV etc - Hertzian [wireless telegraphy] Experiments at Penarth May 1897'' (1897); BT Archives POST 30/631A – Experiments into electrical communication without wires by William Preece (1887-1893); BT Archives – POST 30/1066C – General technical report on wireless telegraphy (1903-1919).

(sometimes referred to as “crosstalk”) between telecommunications networks to transmit and receive signals via the air. Conductive wireless telegraphy used a medium such as water or earth to transmit and receive signals. Both of these early wireless systems pre-dated the discovery of Hertzian waves by nearly a decade and were considered the best and most practical system of wireless communications until the end of nineteenth century. It is indeed worth noting that the discovery of Hertzian waves in 1888 did not immediately lead to wireless telegraphy systems utilizing this form of electromagnetic waves. The idea of using the newly discovered physical phenomenon of Hertzian waves as a form of wireless signalling was probably first considered in the early 1890s; in an 1891 editorial in *The Electrician* by A.P. Trotter or, more celebrated, in an 1892 magazine article by William Crookes.[33] However investigations and experiments into the physical properties of Hertzian waves were still on-going and so there were no practical demonstrations of Hertzian wave signalling until the mid-1890s.[34]

Meanwhile in 1885 the Post Office was conducting experiments with inductive, conductive, and reflective telegraphy systems at Town Moor, Newcastle. The last method is mentioned only once in passing, was not described in detail, and was not utilised for further experimentation. These experiments were conducted alongside long-distance telephony experiments by the Divisional Engineer of the Post Office for the region, Arthur West Heaviside. Arthur Heaviside is probably best known as one of Oliver Heaviside's older brothers but was a talented electrical engineer in his own right.[35] As somewhat of a brief side note, Arthur Heaviside was the sole Post Office employee to hold a patent remotely related to inductive telegraphy, this being the sole patent to his name.[36] The patent, British Patent No, 1407 (1880) – *Electrical conductors etc*, was held jointly with his brother Oliver and offered an apparent solution to the problem of “crosstalk”. Rather than utilising inductive interference as a means of communication, this patent offered a means of preventing interference in the first

33 Trotter, Alexander Pelham. "Notes." *The Electrician* 26 (1891): 685-86; Crookes, William. "Some Possibilities of Electricity." *The Fortnightly* Review, 1 February 1892, 174-76. See Gooday (2008) for an in-depth discussion of Crookes' 1892 paper.

34 Aitken (1976), Hong (2001), Burns (2004), and Sarkar, Mailloux, Oliner, and Sengupta (2006).

35 The (Oliver) Heaviside Collection, which includes correspondence between the two brothers, is held by the IET Archives: IET Archives UK0108 SC MSS 005 – Heaviside Collection (1872-1923).

36 See Kraeuter (2001), 179 and Nahin (2002), xvi-xvii. I was made aware of this patent via private electronic correspondence with my supervisor, Professor Graeme Gooday at the University of Leeds, 16-18 August 2010.

place. Furthermore the patent pre-dated the Post Office experiments by two years and most likely relates to work done with his brother external to the Post Office. There was even some mention of an attempt to commercialize the invention but this came to naught.[37]

Like Preece, Arthur Heaviside worked for the Post Office and so was constrained by government regulations and limitations on patenting by civil servants, a topic which remained under regular discussion for much of the period covered by this thesis.[38] Nonetheless Heaviside brought the knowledge gained in these experiments and the related patent with him to his post at the Post Office and was heavily involved in early wireless experiments conducted by the Post Office, with particular expertise in inductive telegraphy. The apparatus used included telephone receivers which were used as a more sensitive form of receiver rather than to receive voice signals. By the late 1880s, this had become the accepted use for telephone receivers on the telegraph network, particularly in relation to the British military, and something with which Preece was very familiar.[39] With such a sensitive form of receiver, signals were received over a distance of a quarter of a mile with "long-distance" effects being detected just over ten miles away.[40] The capability and reliability of both systems of wireless telegraphy, conductive and inductive, had been tested and proven. Now both systems evolved according to the practical demands for wireless systems of the time, short-distance maritime usage for lighthouses and lightships.

By the mid-1880s the Post Office began more rigorously to explore the technical limitations of these innovative wireless systems. In the early 1880s, they had conducted experiments alongside existing "long-distance" telegraphic and telephonic systems and experiments and, as a result, had focused on overland versions of these technologies. However, demands for wireless telegraphy external to the work of the Post Office took place in a very different sphere, that of the maritime. This was the need for an effective, reliable and

37 Appleyard (1930), 215 makes a passing comment about the Heaviside brothers attempting to sell an invention for "neutralizing disturbances in cables". See also Appleyard (1930), 215, 221; Yavetz (1995), 13.

38 For example, see BT Archives POST 30/2668B – Regulations concerning patents and payment for inventions by Government servants (1895-1914).

39 See Preece and Maier (1889), 451-455. I was made aware of this practice via private electronic correspondence with Michael Kay, a fellow PhD student in history of science at the University of Leeds, on 15 October 2012.

40 IET Archives UK0108 SC MSS 022/III/184 – MS notebook on Aetheric Telegraphy [probably authored by Preece], dated 5 December 1898.

short-distance mode of telegraphy suitable for lighthouses and lightships, one which would interconnect easily with the vast existing domestic telecommunications network. These demands had their origins in campaigns, led by prominent physicists such as Lord Kelvin, as early as the sinking of the "Schiller" off the Scillies in 1875 but was eventually formalised in the foundation of the Royal Commission on Electrical Communication with Lighthouses and Lightships in 1892.[41]

The commission was charged with enquiring into 'the desirability and practicability of telegraphic communication between lighthouses and lightships and the shore'.[42] With this the government charged the Post Office with extending their network of inland telegraphs to include offshore lighthouses.[43] However, the *raison d'etre* for these lighthouses in the first place, namely as a warning system of potential danger, meant that the use of maritime telegraph cables was clearly unsuitable. The demands for some form of electrical communication with lightships and lighthouse remained a concern of the government into the late nineteenth century and beyond. The earliest recorded mention of wireless telegraphy in parliamentary debates was June 1898 when Charles Ritchie (President of the Board of Trade, 1895-1900) reported that the process of connecting lighthouses and lightships with submarine cables to the shore and beyond the telegraph network had been temporarily ceased in order to experiment with wireless telegraphy systems.[44] The connection of lighthouses and lightships to the vast domestic telegraphic network remained of importance to the government and was the primary topic in relation to wireless telegraphy in parliamentary debates beyond the period covered in this chapter until 1902 and was raised regularly until the middle of the first decade of the twentieth century.[45]

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41 Pocock (1995), 57.

42 “Lighthouses and Lightships.” *The Electrical Engineer* [London], 9 (1892): 601. The Committee was presided over by Lord Mount-Edgcumbe and with the committee also consisting of Sir Edward Birkbeck (Conservative MP for Norfolk 1879-1892), Admiral Sir G. Nares, Admiral Sir L. M'Clintock, Henry Mulholland (Conservative MP for Londonderry 1885-1895), Ronald Munro-Ferguson (Liberal MP for Ross and Cromarty 1884-1885 and for Leith Burghs 1886-1914), J. Cameron Lamb CMG, Edward Graves (Engineer-in-Chief of the Post Office 1878-1892), and J.A. Kempe.

43 Pocock (1988), 38-44.

44 Hansard HC Deb 30 June 1898 vol 60 col636 – ELECTRICAL COMMUNICATION WITH LIGHTHOUSES. URL: http://hansard.millbanksystems.com/commons/1898/jun/30/electrical-communication-with-lighthouses#S4V0060P0_18980630_HOC_88

45 See **Appendix 3: 'Wireless' in Hansard, the official report of debates in British Parliament, 1898-1918** for an in-depth textual analysis of the content of Parliamentary Debates in relation to

Hence in 1886 the Post Office began experimenting with wireless telegraphy both through and, for the first time, over bodies of water. Initial experiments using inductive wireless telegraphy over water were conducted in the Severn, South Wales. This location was chosen partially as it was over fourteen miles distance from electrical interference from streetcars, railways, and other electrical circuits and interference.[46] Furthermore the area was the site for many additional wireless trials and experiments leading up to and continuing with Marconi's early trials and the first practical wireless system in 1898. At the British Association annual meeting at Birmingham in 1887, Preece presented the results of these experiments in a paper entitled "On Electric Induction between Wires and Wires".[47] Later in 1887 experiments were conducted in collaboration with Arthur Heaviside, this time down a mine. The Post Office had a clear strategy of exploring the scientific and technical limitations of this new form of telegraphy – testing how and where these wireless telegraphy signals could be transmitted and received. Again Preece presented the results of these experiments before the British Association Annual Meeting this time at Manchester with a paper entitled "On Induction between Wires and Wires".[48]

In 1889 experiments with inductance over water were extended – two major trials were conducted across significant bodies of water, the Menai Straits in Wales and Lake Coniston in the Lake District in Cumberland, England. In addition successful wireless telephony experiments using three and a half miles of wire were conducted between the coastguard station at Cemlyn and the Skerries Islands. Inductive wireless telegraphy signals were successfully transmitted and received over a distance of about a mile of water at Coniston Water in the Lake District in Cumberland.[49] As mentioned earlier, Preece was promoted to Engineer-in-Chief (and Electrician) in November 1892. This appointment led to a flurry of publicity for Preece and presented the opportunity to further promote the Post Office's wireless systems, in particularly inductive telegraphy system. Furthermore the appointment of the Lighthouse Commission earlier in the same year meant there was now a practical demand

wireless telegraphy.

46 Preece, William Henry. "Induction between Wires and Wires." *The Electrician* 19 (1887C): 461-64.

47 Preece, William Henry. "On Induction between Wires and Wires." *The Electrician* 37 (1886A): 410-12.

48 Preece, William Henry. "Induction between Wires and Wires." *The Electrician* 19 (1887C): 461-64.

49 Preece, William Henry. "Wireless Telephony." *the Electrical Review* 47, no. 1191 (1900A): 484-86; Preece, William Henry. "Wireless Telephony." *The Electrician* 45 (1900B): 773, 82-84.

for a system of wireless telegraphy. This synergy of opportunities – Preece's promotion to Engineer-in-Chief and the appointment of the Lighthouse Commission – presented the opportunity to promote and demonstrate the practical application of these previously experimental wireless systems developed within the Post Office.

One outcome of Preece's recent appointment was a celebratory article published in *The Times* and elsewhere in late November 1892 entitled "Wire-to-Wire Electric Communication", most probably based on a personal interview with Preece himself.[50] The article gave a detailed if occasionally vague overview of the wireless systems developed by the Post Office and concluded optimistically:

> It is possible, and not unlikely, that this first achievement [of transmitting and receiving over a distance of three miles] may soon be as far surpassed in magnitude and in importance, as the first induced currents exhibited at the Royal Institution by Faraday have been surpassed by the machinery and the applications of the present day.

This article marked the first public presentation of the Post Office's wireless systems beyond the limited audience of the BAAS. Furthermore the article laid bare the problem of credit; should credit for these wireless systems be allocated to the Post Office, to Preece, or somehow to both? The article very much credited Preece with responsibility and reward for these wireless systems and this was repeated widely with the article being widely disseminated. The article along with Preece's claims were responded to, republished (in one form or another), celebrated, and criticised in equal measure. Reaction to the article appeared to be very much divided by genre of publication – the popular press celebrated the wireless system and the potential long-distance uses of this technology ranging from transatlantic to extra-terrestrial communication. In distinct contrast, the electrical engineering press and periodicals remained at best cynical about the system and at worst were rather critical of Preece and his system with the central tenet being the lack of originality of Preece's system and Preece's lack of acknowledgement of earlier work in the field by pioneers such as Willoughby Smith, Scotsman James Bowman Lindsay, and others. In some cases, they also criticised the unfounded and outlandish claims made about the system with telephonic communication with the people of Mars being a particularly good examples. The unfounded claims – at least according to the scientific principles – in relation to Preece's system led to much discussion about the potential of the system and its many possibly uses.

50 "Wire-to-Wire Electric Communication." *The Times*, (1892), 7.

Meanwhile Preece continued his programme of experimentation and, to this end, experiments were conducted across the Severn in 1892, between Lavernock Point and Flat Holm and Steep Holm islands, distances of just over three and five miles respectively. These places were used in order to simulate the use of this system in relation to lighthouses and lightships and to demonstrate Preece's previously experimental system. These experiments formed the basis for the world's first commercial wireless telegraphy system run by the Post Office on the same site six years later. The relative geographical isolation of this site – away from electrical signals such as trams and major telecommunications network – meant that it was used for testing other wireless systems including early experiments with Marconi's wireless system conducted by the Post Office Engineering Department in 1897. In November 1892, an internal report on Post Office wireless experiments on the South Wales Coast was submitted by Post Office engineer and later Engineer-in-Chief, John Gavey.[51] In this report, Gavey provided an overview of earlier experiments before describing the two main methods then available: earth conduction and induction, with the latter taking the form of electrostatic and electromagnetic induction. The experiments in 1886 and 1887 using electromagnetic induction had 'warranted further investigation' and so this method also was used in the 1892 experiments.

In 1893 further experiments were conducted at Conway and a paper entitled "On the Transmission of Electric Signals through Space" was presented before the International Electrical Congress at Chicago.[52] As mentioned previously, this paper marked the first time Preece presented upon the Post Office wireless systems outside of the BAAS, outside of Britain, and before an international and specialist electrical engineering. However Preece's paper, in particular technical and theoretical details, did not sufficiently clarify matters for some electrical engineers, including A.P. Trotter, editor of *The Electrician*. In a strongly worded commentary on Preece's paper, Trotter had the following to say about the lack of details provided by Preece's 1893 paper before the International Electrical Congress and his earlier November 1892 interview with *The Times*:

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51 BT Archives Post 30/631A File II – ELECTRICAL COMMUNICATION WITHOUT WIRES. Experiments with Mr. Preece's system on South Wales Coast. Interim report by Mr. Gavey. Submitted to Postmaster General. 1892. (1892).

52 Preece, William Henry. "The Transmission of Electric Signals through Space." *The Electrician* 31 (1893A): 520-22.

> Nearly a year ago [in 1892] we commented on a description in *The Times* of some experiments made by Mr. Preece on telegraphy without wires. The details then given were very vague, and some suggestion was made about the use of Hertzian oscillations. We … ventured to hope that when the time came for Mr. Preece to describe his experiments with his usual lucidity, the confusion and ambiguity of this preliminary bit of newspaper science would matter little. The time has come, but we regret that our wish has been by no means gratified. A Paper has been read at Chicago by the author of these experiments, but though we have given it most careful attention, we must confess that the theoretical conclusions as well as the description of the experiments are of an indefinite character.[53]

However, earlier in the year, a report authored by one of Preece's assistants, John Gavey, concluded that there was no long-term future for the conductive system of wireless telegraphy, particularly in relation to practical off-shore application.[54] Gavey concluded:

> Although the results obtained in the first experiments were of considerable scientific interest it will have been gathered from the original report that they were not thoroughly satisfactory from a practical point of view, that is, they were scarcely sufficiently reliable to justify the Department in adopting a system based thereon, for the purpose of establishing working communication between the mainland and isolated rock lighthouses.[55]

The report was the source of potential tension between the two Post Office engineers, Gavey and his superior, Preece. Preece supported continued experimentation with conductive telegraphy while Gavey believed that conductive telegraphy had reached its full and limited potential. He concluded that conductive wireless telegraphy was of limited range, practicality, reliability, and use. With some degree of reluctance, Preece signed off on the report and the Post Office ceased experiments with conductive telegraphy. In the meantime, a solid programme of experimentation and practice had established that inductive wireless telecommunications could be used over significant bodies of water and with a significantly

53 *Ibid*., 520.

54 BT Archives Post 30/631A File III. ELECTRICAL COMMUNICATION WITHOUT WIRES. Experiments with Mr. Preece's system on South Wales Coast. Final report showing system has no practical value. Submitted to Postmaster General 1893, (May 1893).

55 *Ibid.*, 1.

longer range than that of conductive wireless systems. Furthermore inductive wireless systems were based almost entirely upon existing telegraphic systems and technology utilised by the Post Office and its Engineering Department and so were better suited to the Post Office's needs. Finally these inductive wireless telecommunications systems were best placed to fit the contemporary demands for a wireless system; a secure, short-range system capable of connecting with the existing and well-established domestic telecommunications infrastructure and network, one which could be used to communicate over bodies of waters to lighthouses and other locations where traditional telecommunications system were impractical or impossible. Inductive wireless telegraphy matched all of these criteria and was, by far, the most practical means then available to satisfying these demands. By 1893 the Post Office made a concentrated effort to further develop their inductive wireless telegraphy system in order to pursue a concentrated strategy with the goal being nothing less than a short-range, reliable, and practical system of wireless telegraphy.

2.4 Wireless Experiments, 1893-1896

The extensive and thorough trials of inductive wireless telecommunications conducted by the Post Office Engineering Department and led by Preece continued through 1894 and beyond. Signals were transmitted and received between Kintyre and Arran, a distance of four miles, this being 'practically a repetition of the Conway Experiments but on a much larger scale and specially instituted to ascertain the laws governing the transmission.'[56] More advanced experiments across Loch Ness were also conducted using ordinary telephones in place of the telegraphic instruments which had been used up to this point. This enabled speech to be transmitted across the Loch, a distance of one and a half miles. This was the first time it was explicitly stated that telephonic apparatus was being used to transmit and receive voice signals rather than Morse code, an important practical development for this system and the first time inductive “wireless telephony” was successful. Preece again presented these exciting developments and his research yet again before the British Association Annual Meeting, held in Oxford this year.[57] This was also the controversial British Association meeting in Oxford when Lodge presented a lecture entitled “The Work of Hertz” which was later published as

56 BT Archives Post 30/1066C – General technical report on wireless telegraphy (1903), 6.

57 Preece, William Henry. "Signalling through Space." *The Electrician* 33 (1894B): 460-63.

journal articles and in book form under the same title.[58] The lecture a matter of great dispute with some claiming that Lodge demonstrated Hertzian wave wireless signalling for the first time.[59] Notably Preece also presented a paper describing these wireless systems and experiments before the Society of Arts in this year, the first time these experiments and systems had been presented in Britain before an audience beyond that of the British Association.[60]

By 1895 inductive wireless telegraphy was used between Oban and the Isle of Mull in order to temporarily replace a broken submarine telegraph: 'wireless communication was readily established and the work carried on with facility and certainty.'[61] In 1896 the Post Office conducted wireless lightship experiments between North Sandhead and Goodwin, at the request of the Royal Commission on Electrical Communication with Lighthouses and Lightvessels. It was also in this year that the young Marconi arrived in Britain and sought the assistance of William Preece and the Post Office in promoting and developing his own system of Hertzian wave wireless telegraphy.

2.5 1896 and all that: Marconi's arrival in Britain

> ...[Preece] invented a system of wireless telegraphy which was in practical use between some of the Scottish islands long before Signor Marconi was heard of, but it was a system of quite different character, and nobody gave a warmer welcome to the Italian inventor than Sir William. ...
>
> - “Sir W. Preece”, *Manchester Evening Chronicle*, 16 February 1903.[62]

58 Lodge, Oliver. "The Work of Hertz." *The Electrician* 33 (1894): 153-55, 86-90, 204-05; Lodge, Oliver. *The Work of Hertz and Some of His Successors: Being the Substance of a Lecture Delivered at the Royal Institution on Friday Evening, June 1, 1894*. London: The Electrician Printing and Publishing Company, 1894.

59 For further details about this controversy, see Lodge (1894), Pocock (1969), and Rowlands and Wilson (1994).

60 Preece, William Henry. "Electrical Signalling without Wires." *Journal of the Society of Arts* 42 (1894A): 274-80.

61 BT Archives Post 30/1066C – General technical report on wireless telegraphy (1903), 6-7.

62 "Sir W. Preece." *Manchester Evening Chronicle*, 16 February 1903. From BT Archives TCK 89/23 – [Album of press cuttings relating to Preece, mainly regarding his appointment as Chief Electrician

Marconi's arrival in Britain is widely considered to mark the genesis of wireless communications, particularly when considered in light of two subsequent and related events. The earliest event is the granting of what is generally acknowledged to be the world's first wireless patent, British Patent 12039/1896, which was applied for by Marconi in June 1896 and granted in July 1897. The second event was the establishment of the Wireless Signal and Telegraphy Company Limited in July 1897 in order to exploit the aforementioned patent. In order to better understand these events, it is worth looking beyond these headline events and to instead trace Marconi's initial activities upon arrival in Britain in February 1896. Initially, Marconi did not seek to establish a company but, as mentioned in the introduction, wrote letters of introduction to the War Office, the Royal Navy, and the Post Office seeking support and potential custom for his wireless system.[63] It is open to debate whether Marconi was seeking institutional support, access to expertise, potential customers, or some combination of all three. Although Marconi may have later disputed the contribution of these institutions, the evidence suggests that he saw access to these powerful institutions as an important first step in the establishment and development of his wireless system. The initial contact with the War Office was successful while contact with the Royal Navy and the Post Office was initially unsuccessful. Through these series of correspondence, Marconi can be seen to be prioritising institutional support and custom for his wireless system over patenting. Marconi did apply for an initial patent British Patent 5028/1896 on 5 March 1896, only a month after his arrival in Britain. However this initial patent application was written without the advice of a patent lawyer and so the patent application was abandoned by Marconi with no details beyond the title surviving.[64] Marconi would however re-use the title, *Improvements in telegraphy, and in apparatus therefor* [sic] for his second, better-formulated and more legally informed patent application in June of 1896. The patent was granted a little over a year later in July 1897.

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and Engineer-in-Chief, and his retirement from the Post Office], 1890-1903.

63 A copy of the letter of introduction from A.A. Campbell-Swinton, written on behalf of Marconi, to William Preece dated 30 March 1896 can be found in Marconi Collection MS. Marconi 1774 – HIS 62: Early demonstrations and tests – Marconi and Preece, 1951-89. A letter to the Secretary of State for War Affairs at the War Office from Marconi dated 20 May 1896 can be found in National Archives WO 32/8594 – INVENTIONS AND PATENTS/TELEGRAPHY: Consideration of Marconi systems of transmission of electric signals without wires. Possible military uses (1896).

64 Burns (2004), 290.

It is Marconi's patent strategy and commercial activities which inform early histories of Marconi and his company.[65] However these histories fail to take into account the strong degree of institutional support, both from the Admiralty and the Post Office.[66] Furthermore these histories present Post Office support for Marconi as merely being a generously provided platform from which to promote and demonstrate Marconi's wireless systems to other government departments including the Admiralty, the War Office, and the Board of Trade. However, in this section I wish to explore how early development of Marconi's wireless system was enabled by the "institutional innovations" – research, expertise, agendas, resources, publicity, and need and demand – developed by the Post Office and their engineers through their work with their earlier wireless systems. Furthermore, there was a continuity of these "institutional innovations" from the earlier Post Office wireless systems through to Marconi's wireless system and beyond. Although the hardware of the Post Office's wireless systems did not continue, the technology, practice, and skills continued and were cleverly appropriated by Marconi upon his arrival in Britain. Additionally related expectations – established through the Post Office's work – of wireless technology provided a solid foundation and framework for later wireless systems and successes but also provided less welcome constraints, as discussed in later chapters.[67]

In June 1896 Marconi was given an introduction to William Preece by an electrical engineering peer of Preece's, A.A. Swinton-Campbell with the intention of demonstrating his "new" system of wireless telegraphy.[68] As the results he claimed to be able to produce appeared to give promise of success for lightship communication, Preece offered the facilities and knowledge of the Engineering Department to test Marconi's apparatus. Preece provided more than just individual engineering expertise and fatherly type advice; he also provided access to the technical-professional institutions and networks such as the Post Office and the Institution of Electrical Engineers, with which he was actively involved. In addition Marconi

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65 Baker (1970) and Jacot de Boinod and Collier (1935).

66 See **Chapter 4 – 'Britannia rules the wireless waves': the Admiralty and wireless, 1899-1903** for further details of meetings and demonstrations between the Admiralty and Marconi.

67 See **Chapter 5 – 'If the Government did take over wireless it meant that they would take over us': simmering tensions between commercial and state interests, 1903-1905** and **Chapter 6 – 'A question for commercial adjustment, and not for international legislation': wireless rules and regulations, 1905-1908**.

68 Guagnini, Anna. "Patent Agents, Legal Advisers and Gugliolmo Marconi's Breakthrough in Wireless Telegraphy." *History of Technology* 24 (2002): 171-201.

was granted access to the technical knowledge, experience and experimental practices of the Engineering Department and the associated recognition and authority of the Post Office itself. Without these, Marconi would not have been able to so quickly demonstrate on Salisbury Plain before the Admiralty, Board of Trade, War Office, and other governmental departments a few months after his arrival in 1896. However this was not as simple as providing a platform for Marconi and his wireless system; rather the technical expertise and engineering practice of the Post Office was especially important.

In a small notebook written between December 1896 and May 1897, Post Office Engineering Department officer J.E. Taylor described Hertzian wave experiments with Marconi's wireless apparatus alongside other work performed for the Post Office around this time including further development of the trunk telephone network.[69] Taylor's eye-witness account establishes that the Post Office's role in Marconi's early demonstrations was far greater than previously suspected and was not merely one of providing assistance for demonstrations. Instead the staff of the Post Office Engineering Department utilised the expertise and experience they had gained from their early wireless experiments to modify and adapt Marconi's wireless apparatus from 'converting crude appliances into good working devices.'[70] This was further emphasised in the report on wireless telegraphy produced internally and confidentially for the Post Office in 1903 and regularly cited throughout this chapter, in which it was noted:

> The apparatus used at this time was partly Marconi's own gear and partly modified and redesigned appliances made in the Post Office Workshops, or purchased by the Department. There was, however, on the whole still much to be desired in the construction from the point of view of converting crude appliances into good working devices.[71]

In December 1896 Preece introduced Marconi to a general audience through his demonstration entitled 'Telegraphy without Wires' at Toynbee Hall in London, breathlessly

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69 BT Archives Acc 2002/0057 – Small notebook labelled “Trunk Telephones LV etc - Hertzian [wireless telegraphy] Experiments at Penarth May 1897.” Inside front cover reads “Dec. 1896 [Post Office Engineering Department officer] J.E. Taylor Room 55 G.P.O. London.”

70 *Ibid.*

71 BT Archives Post 30/1066C – General technical report on wireless telegraphy (1903), 27.

reported upon in *The Times* and elsewhere.[72] The impressive media coverage received by Marconi, his system of wireless telegraphy, and related demonstrations was not matched, at least at this stage, by the technical abilities of his system. It is worth highlighting that, even at the end of 1896, Marconi's wireless system had a shorter transmission range than that of Preece's inductive telegraphy system from 1892.[73] In May 1897 experiments using Marconi apparatus were conducted on the Bristol Channel, similar to the earlier wireless trials conducted by the Post Office there in 1880s and 1890s. In these trials conducted by the Post Office, reliable signals were obtained between Flatholm Island and Lavernock Point and an attempt to communicate entirely across the Channel from Lavernock to Brean Down near Weston-super-Mare, a distance of nine miles, was also successful despite problems with apparatus provided by Marconi. The Post Office reported:

> Most of the coherers used appeared to be of too sensitive a pattern to give stable and consistent results. Out of a number supplied by Signor Marconi only a few were capable of maintaining sufficient constancy in action to allow readable signals to be recorded.[74]

In June 1897 Preece presented "Signalling through Space without Wires" at the Royal Institution and used this paper to introduce Marconi and his wireless telegraphy system to the community of scientists and engineers of which Preece was such an active and valued member.[75] At this stage, Preece was still on cordial terms with Marconi and hoping to acquire his patents for use by the Post Office. Meanwhile Marconi had been approached by certain London financiers and relatives who were anxious to purchase the patent rights to his inventions. In July 1897 the Wireless Telegraph and Signal Company was established with the sole purpose of exploiting Marconi's wireless patents; the company was reconstituted as Marconi's Wireless Telegraph Company Limited in February 1900. The original company came into being on 20 July 1897 with its business being 'manufacturers of telegraphy apparatus' with the Memorandum of Association being signed by nine people and with a nominal capital of

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72 "Telegraphy without Wires." *The Times*, 11 June 1897, 6C.

73 Pocock (1965), 141.

74 BT Archives Post 30/1066C – General technical report on wireless telegraphy (1903), 33.

75 Preece, William Henry. "Signalling through Space without Wires." *Science* 6, no. 155 (1897A): 889-96; Preece, William Henry.Preece, William Henry. "Signalling through Space without Wires." *The Electrician* 39 (1897B): 146-48; Preece, William Henry. "Signalling through Space without Wires." *Proceedings of the Royal Institution* 15 (1897C): 467-76.

£100,000, this being divided into 100,000 shares with 95,015 of these shares being taken by the end of the year (December 1897).[76] It is worth noting that the nominal capital of £100,000 was ten times the value ascribed to Marconi's patents by William Preece in a confidential report entitled “Marconi's Telegraph” sent to the Secretary of the Post Office a few weeks earlier in July 1897.[77]

In this short report, Preece stated that Marconi's system was of 'extreme sensitiveness and of great delicacy' and had reached the stage where 'the acquisition of the patent rights by the Government [required] consideration.'[78] Preece noted that Marconi had 'received very tempting offers from financial people of high position who are ready and willing to buy [Marconi's] rights and “exploit” [Marconi].'[79] However Preece noted that since Marconi had submitted his scheme for consideration by different government departments such as the Post Office, the Admiralty, and the War Department, Marconi could not 'morally enter into any negotiation with any one [sic] else or listen to any financial proposals' and that Marconi had apparently accepted and recognised this position.[80] Preece went on to note that Marconi's patent was a strong one but that Oliver Lodge had made claims of priority of invention, these being baseless according to Preece. Lodge further suggested that his claims and the claims of other wireless pioneers might lead to the validity of Marconi's patents being questioned and contested. However, despite these reservations, Preece concluded that the government should indeed purchase Marconi's patent rights:

> My own view [Preece's view] is that subject to the system being made really practical … and being favourably reported upon by the Admiralty and the War Department, the Government would be justified in acquiring the patent rights for £10,000 if the Attorney General pronounces in favour of the validity of the patent.[81]

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76 "Joint Stock Companies. Return to an Order of the Honourable the House of Commons, Dated 8 August 1898." in *House of Commons Papers; Accounts and Papers* (1898), 164.

77 IET Archives UK0108 NAEST 013/2/09 - Report by William Preece to the Secretary entitled “Marconi's Telegraph” discussing the British Government's and/or British Post Office's attitude to the system and the possible acquisition of patent rights, dated 15 July 1897.

78 *Ibid*, 1.

79 *Ibid*, 2.

80 *Ibid*, 2.

81 *Ibid*, 3.

When Preece wrote this report (and noted by Preece himself), Marconi was in Italy negotiating with the Italian Navy and staying with his family at the Villa Griffone in Bologna. From there, Marconi wrote a letter on 21 July which Preece received a little over a week after he wrote the report quoted above and a few days after the “Wireless Telegraph and Signal Company” was established on 20 July 1897.[82] In this carefully phrased letter, Marconi announced that a company had formed to exploit his patents and that he owned half the shares. In the letter, Marconi claimed the complexity of arranging experiments and demonstrations before many foreign governments and the expense of obtaining patents in different companies had led to the establishment of the Wireless Telegraph and Signal Company. Marconi noted that '[Preece's] great kindness shall never be forgotten by me in all my life' and that he would do his best 'to keep the company on amicable terms with the British Government.'[83]

This at once altered the position of the Post Office and its Engineering Department with regard to the inventions, and necessitated either the dropping of all further experimental investigations for developing the system or the pursuance of such with the strictest official secrecy.[84] This also marked the end of the close relationship between Marconi and Preece, and between Marconi at the Post Office. Prior to this, Marconi had an almost filial relationship with Preece and the two exchanged regular and lengthy correspondence.[85] Additionally Preece himself was deeply impressed by the potential of the young Irish-Italian's wireless system and could quite likely see the potential and valuable place of Marconi's system of wireless telegraphy within the context of a Post Office telecommunications monopoly. Moreover the Post Office became one of Marconi's major antagonists and refused to purchase his equipment until around 1903, quite a few years beyond Preece's retirement as Engineer-in-Chief.

In forming a company and pursuing the commercial aspects of his patents, Marconi had clearly built upon the knowledge and expertise of Preece, the Post Office, its Engineering Departments, and other wireless pioneers. Furthermore Marconi had also taken the needs

82 BT Archives TCB 273/5 – Marconi's letters (copy): Copy of 4pp. handwritten letter from Marconi to Preece, sent from Villa Griffone, Bologna, Italy, dated 21 July 1897.

83 *Ibid.*

84 BT Archives Post 30/1066C – General technical report on wireless telegraphy (1903), 36.

85 IET Archives UK0108 NAEST 013 Collection – Papers of Sir William Henry Preece on Wireless Telegraphy (1896-1937; 1976).

and expectations developed by these earlier wireless practitioners but in the model of a completely different system, that of commercial development and patenting. Marconi developed a system which inherited the technology – the apparatus, knowledge, expertise, and methodology – of existing systems of telegraphy, both electrical and wireless, but one placed external to the institutional structure of the state-controlled Post Office. Rather Marconi would transfer these systems and expectations to the closed world of patents and commercial development of wireless telegraphy.[86]

2.6 The End of the Road: Wireless in the Post Office, 1896-1899

Notwithstanding claims about the dramatic development of Marconi's systems, the world's first practical wireless system utilising inductive wireless telegraphy was actually established at Lavernock on the Severn in late 1897. The Post Office wireless experiments and investigations continued and, in parallel with trunk telephone testing, further wireless experiments were conducted at Penarth in 1898. At the end of 1898 and just three short months before his retirement in February 1899, Preece finally presented the results of the Post Office's wireless experiments and systems before the Institution of Electrical Engineers (IEE) of which he was an active and prominent member.[87] Preece's paper, described in more detail in the next chapter, was one of three papers presented at adjacent general meetings of the IEE in December 1898.[88] This series of wireless papers by three wireless pioneers including Preece was less about wireless telecommunication itself and more about combating claims of ownership and associated patent rights made by Marconi.

In February 1899 Preece reluctantly retired as Engineer-in-Chief and Electrician of the Post Office, as was Civil Service policy, upon his sixty-fifth birthday. Preece's retirement was marked by numerous articles, biographies, and celebratory remarks in publications near and wide, ranging from the popular press to electrical engineering periodicals. Many celebrated Preece's hard work, diligence, and engineering achievements with one article acclaiming Preece thus: '[Preece] is now President of the Institution of Civil Engineers, the highest honour

86 Hong (2001).

87 Preece, William Henry. "Aetheric Telegraphy." *Journal of the Institution of Electrical Engineers* 27, no. 137 (1898): 869-87.

88 See **Chapter 3 - Electrical Potential: Wireless and the Institution of Electrical Engineers, 1898-1908** for full details.

that can be conferred upon an engineer by this [sic] professional brethren.'[89] Preece was retained by the Post Office as Consulting Engineer for a further five years until 1904 with a salary of £400 a year while James Hookey, formerly assistant Engineer-in-Chief to Preece, became Engineer-in-Chief.[90] In April 1902 Hookey retired at the age of sixty-five, having served the Post Office for most of his adult and working life and having been employed at the Post Office for forty-seven years.[91] Hookey was replaced by John Gavey, a more out-going engineer and one who continued in the mould, if not necessarily opinions, of Preece, his former mentor. Like Preece, Gavey was elected president of the Institution of Electrical Engineers in 1905 and was also granted a knighthood upon retirement in 1907. Unlike his predecessor, Hookey, Gavey's work was recognised by obituaries in *Nature* and the *Journal of the Institution of Electrical Engineers* upon his death in 1923.[92] Preece's retirement marked an end of an era in terms of wireless experiments conducted by the Post Office – a combination of technological limitations and the work of Marconi had sounded the death knell for non-Hertzian wireless telegraphy. As the Post Office records report for 1903 – nearly two decades after work first began on wireless telegraphy:

> On the whole, though the Post Office system of Wireless Telegraphy could no doubt have been made capable of doing useful work over limited distances we are now forced to recognise that as compared with its later rival it is both unwieldy and unadaptable [sic] to circumstances. It must now give place to the new 'Hertzian' methods, and this has been fully recognised and admitted by the [Post Office] Secretary.[93]

In 1903 Gavey and the Post Office produced a highly controversial internal report, *General technical report on wireless telegraphy*, referred to throughout this chapter. This confidential report claimed historical priority and rights of exploitation of wireless for the Post

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89 "Mr. Preece Retires. Facts from the Life of the GPO's Chief Engineer." *Evening News*, 15 February 1899. Found in BT Archives TCK 89/22 – Album of press cuttings relating to Preece, Marconi and others; scientific experiments to do with telegraphy, collected by "Romeike and Curtice", Press Cutting and Information Agency, on Preece's behalf, 1892-1899.

90 Baker (1976), 277.

91 "Court Circular." *The Times*, 21 February 1902, 8.

92 "Sir John Gavey." *Nature* 111 (1923): 124-25; "Sir John Gavey." *Journal of the Institution of Electrical Engineers* 61, no. 323 (1923): 1153-54.

93 BT Archives Post 30/1066C – General technical report on wireless telegraphy (1903), 11.

Office although earlier drafts had given this credit to Preece instead. Although Preece had considered himself and the Post Office as almost interchangeable entities, later managers of the Post Office including Preece's protégé John Gavey did not share this view and so credit was given to the Post Office rather than to individuals including Preece. This confidential report also included an open admission of intercepting signals sent between Marconi stations and the testing of multiple wireless sets quite possibly without the permission, license, or indeed knowledge of the sets' commercial owners. However more generally change was in the wind – by now, the Post Office was not the only government department with interests in wireless and it was clear that some form of domestic (and indeed quite possibly international) legislation was required. The eventual outcome of an Interdepartmental Conference on wireless between 1901 and 1902, which was attended by the Admiralty, the Post Office, and the Board of Trade, was an acceptance of the validity of Marconi's patents and increased negotiations with the Marconi Company.[94] Meanwhile, Preece (increasingly loudly) claimed historical priority and authority but clearly conflicted greatly with the official position of his former employers, the Post Office, and the government itself and their on-going and active negotiations with the Marconi Company.

2.7 Conclusion

The Post Office was the first institution, British or otherwise, to conduct formal investigation and experimentation in the field of wireless communications. These early experiments were conducted in the context of a clear public need for a wireless communications system for lighthouses, lifeboats, and additional locations incapable of cable telegraphy; thus responsibility for trials devolved to the most appropriate public institution, the Post Office. As I have shown, it is clear that these early wireless experiments and systems form a distinct contrast to later wireless developments with a complete absence of intellectual property claims, either through the use of patents or relatedly litigation. These systems were developed by the Post Office's Engineering Department and were led by William Preece, who regularly presented the resulting outcomes before an assortment of learned societies. These wireless systems were developed not in a commercial context but within a state-controlled institution and government department: they utilised engineering practice rather than scientific theory; they were born not in the laboratory but in the engineering workshop and in

94 BT Archives POST 30/940 – Interdepartmental conference on wireless telegraphy (1896-1901).

the field; and they existed almost entirely independent of the traditional framework of invention and innovation, external to commercial-related claims of historical priority and patenting. Freedom from the pressure to commercially develop these experimental systems, the Post Office had the time, space, expertise, and resources to develop them to fruition over a fifteen-year period. Furthermore the telecommunications monopoly held by the Post Office meant this state-controlled institution was better-suited and better-located to manage and develop these telecommunications systems. The foundation of the Royal Commission on Electrical Communication with Lighthouses and Lightships in 1892 meant there was now a demand for wireless communications, one which was best met by a state institution, a role fulfilled by the Post Office. Beyond this, the Post Office as an institution was a true pioneer and innovator in the field of wireless and remained deeply influential throughout the period covered by this thesis. In the early twentieth century their "institutional innovations" continued and were extended beyond the technological. Instead the Post Office's active role in wireless was extended to internal government discussions, domestic legislation, and international regulations, something I will explore in later chapters of this thesis.

Meanwhile the wireless systems developed by the Post Office were conceived of prior to the discovery of Hertzian waves and subsequently used the best available systems to put in place a practical wireless system. Although the outcome was a technological dead-end in terms of hardware, the "institutional innovations" surrounding the technology such as expertise, practice, and skills would continue. The importance of these wireless systems lay in their location and prominence within the state-controlled institution that was the Post Office and that they laid the groundwork for later wireless systems. It was this continued practice and expectation that was so cleverly appropriated and adopted by Marconi upon his arrival in Britain in 1896.

Marconi's post-patenting approach to wireless technology and "ownership", in combination with a new form of competition, marked a paradigm shift; Preece had offered his system freely and, in contrast, Marconi was advised by his lawyer John Fletcher Moulton to 'claim everything.'[95] This dramatic shift led to a reinterpretation of earlier wireless experiments and technologies alongside increased claims of historical priority. This was

95 University College, London (UCL) Archives Lodge Collection MS ADD 89/104 I Thompson to Lodge, 30 June 1897. For further details on Moulton, see Guagnini, Anna. "John Fletcher Moulton and Guglielmo Marconi: Bridging Science, Law and Industry." *Notes and Records of the Royal Society* 63 (2009): 355-63 and Hong (1996).

particularly focused on Marconi's novel patents and the foundation in 1897 of the Wireless Telegraph & Signal Company Ltd in order to exploit and commercialise Marconi's patent. These events led to an immediate divergence and breakdown in the relationship between Marconi and the Post Office and, in particular, the relationship between Marconi and Preece. It influenced Preece's publication strategy and destroyed the Post Office's idea of itself as the sole provider for, and market of, wireless telecommunications systems. Marconi's monopolistic demands, centred about his claims of historical priority and 'ownership' in parallel with his use of the patent system, marked a paradigm shift in the field of wireless. This shift forced earlier wireless pioneers and contemporary wireless practitioners of all kinds – experimenters, scientists, engineers including Preece – to re-examine their work and to begin asserting claims in new and interesting ways. These included, amongst others, creating a history, changing patterns of publication and presentation, and (last but not certainly least) use of the patent system.[96]

These changes combined with Marconi's commercialisation of wireless communications provoked a marked and immediate response from earlier British wireless pioneers. An initial outcome was a series of papers presented before the Institution of Electrical Engineers (IEE) in late 1898 and early 1899. These papers presented by Oliver Lodge, Sydney Evershed, and William Preece were the first wireless papers presented before the Institution. Preece's paper, which is also discussed in this chapter in relation to the Post Office's role in early wireless communications, fulfils a different role in the next chapter. These seminal papers by Lodge, Evershed, and Preece provide a focus for a consideration of the roles of the IEE in early wireless history in the next chapter.

96 For a discussion of wireless and intellectual property claims, see Arapostathis and Gooday (2013).

Chapter 3: Electrical Potential: Wireless and the Institution of Electrical Engineers, 1898-1908

3.1 Introduction

> I thought, Sir, that I would save the time of the meeting by putting on record the work that we have done in the Post Office in establishing the so-called 'wireless telegraphy.' ... The work that we have done during the past 16 years has been purely and absolutely experimental. We have started from a very small beginning, and we have pushed on steadily annually. … The system was not patented, as it might have been.[1]
>
> - William Preece's wireless paper "Aetheric Telegraphy", delivered before the Institution of Electrical Engineers on 22 December 1898.

In the previous chapter I examined early wireless tests conducted by the Post Office and their Engineering Department, led by William Preece, and considered how these institutional innovations led to the world's first, albeit short-lived, wireless system, put into practical operation in 1898. These innovations demonstrated the practicalities and practical application of wireless telegraphy and its place within electrical engineering practice at the Post Office. One output from this wireless system was a paper quoted above and delivered by Preece alongside papers by two other wireless pioneers, Oliver Lodge and Sydney Evershed, before the Institution of Electrical Engineers. In this chapter I shall shift the lens of focus away from a government department to the technological developments and systems of wireless telegraphy in relation to a completely different kind of organisation, the Institution of Electrical Engineers (IEE).[2] This chapter examines a more subtle form of institutional innovation taking place within this techno-scientific institution. The central core of this chapter are four wireless papers presented before the institution over a period of about three months at the end of 1898 and beginning of 1899. The initial three papers were the first wireless papers before the IEE and were presented at back-to-back meetings of the institution and published adjacently, both in the Journal of the Institution of Electrical Engineers and elsewhere. In March 1899, a

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1 Preece, William Henry. "Aetheric Telegraphy." *Journal of the Institution of Electrical Engineers* 27 no.137 (1898), 897.

2 The two histories of the Institution of Electrical Engineers are Appleyard (1939) and Reader et al. (1987).

fourth paper on wireless was presented by Marconi. This paper was very much a response to claims made in the previous three papers and the commentary sessions afterwards. In this chapter, I will also show how the origins of the Institution in telegraphy influenced its response and non-response to wireless telegraphy, and examine whether the response of the IEE membership echoed that of the wider electrical engineering community.

The role of the IEE in the field of wireless telecommunications does not fit into the standard narratives of either wireless or institutional histories, and so has been completely omitted from the former. In terms of the latter, the two official histories of the IEE are very much "internalist" with particular emphasis on the foundation, structure, and administration of the institution with little regard for external influence or influences.[3] In this chapter I shall endeavour to rectify this gap in wireless scholarship and to examine the significant but perhaps unexpected role that the IEE and the electrical engineering community played in shaping wireless telegraphy during this formative decade from 1898 to 1908.

Originally established as the Society for Telegraph Engineers (STE) in 1871, this learned society was renamed the Society of Telegraph Engineers and of Electricians (STEE) under then President, William Preece, in 1880 and renamed again to the Institution of Electrical Engineers in 1888.[4] Through these actions, the Institution gave a visible indicator that it had moved beyond its origins as a society for telegraph engineers and had become an institution for all forms of electrical engineering including power, lighting, and traction. With the change of name, the remit of the IEE was more apparent. In a report of a lecture on transformers and accumulators delivered before members of the institution in March 1888, the institution was described by a journalist from the *Electrical Engineer* thus:

> The object of societies like the Institution of Electrical Engineers is mainly practical. Papers are read and discussed not so much with a view to advance pure science as with the object of showing how scientific discoveries may be practically applied for business purposes, and as this object is more or less attained, so must we consider the

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3 See **footnote number 1**.

4 See For wider discussion of the resolution of tensions within the society and their name change, see Gooday, Graeme. "Faraday Reinvented: Moral Imagery and Institutional Icons in Victorian Electrical Engineering." *History of Technology* 15 (1993): 190-205.

> papers and discussion more or less useful, irrespective of their merits from the point of view of pure science.[5]

This quotation from an outsider perfectly illustrates how the papers and subsequent discussion and debate formed the keystone of the institution's activities, their *raison d'etre* if you will. Secondly it also shows the contemporary view of the institution as utilitarian, technological and commercially minded. This stood in contrast to the scientific and perhaps theoretical focus of more prestigious institutions such as the British Association for the Advancement of Science, the Royal Society, the Royal Institution and others. This focus would also, in part, explain why Preece chose not to deliver papers on inductive and conductive systems of telegraphy without wires before the Institution of Electrical Engineers until it was suitable for practical usage in 1898. The zenith of Preece's system also marked the end of its technological lifetime. Despite many technical and engineering innovations, these systems were a niche-use technology with their "swan song" celebrated, possibly unknowingly, by Preece's paper before the institution in late December 1898.[6] This was also an attempt by Preece to establish a legacy for himself and the Post Office in wireless telegraphy, as he would, with great reluctance, retire three months later in February 1899 upon reaching the British Civil Service retirement age of sixty-five.

Preece's paper was one of the first wireless papers delivered before the IEE and was presented as part of a three-part series of wireless papers with the two other papers being delivered by prominent British wireless pioneers, Oliver Lodge and Sydney Evershed.[7] These three wireless papers were presented at two general meetings of the IEE, a fortnight apart in December 1898. The papers marked the end of one era of wireless communications and the beginning of another, a transition from experimental systems to commercial application and the standardisation of Hertzian waves as being *de facto* wireless telegraphy. With regard to this, there were subtle differences between the three papers. Although all three shared claims of historical priority, sometimes in competition with one another, they dealt with different wireless technologies; Lodge with Hertzian waves and Evershed and Preece with magnetic

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5 "Transformers or Accumulators?". *The Electrical Engineer* [London] 1 (1888): 198.

6 Preece, William Henry. "Aetheric Telegraphy." *Journal of the Institution of Electrical Engineers* 27 no.137 (1898): 869-887.

7 Lodge, Oliver. "Improvements in Magnetic Space Telegraphy." *Journal of the Institution of Electrical Engineers* 27, no. 137 (1898): 799-851; Evershed, S. "Telegraphy by Magnetic Induction." *Journal of the Institution of Electrical Engineers* 27, no. 137 (1898): 852-69.

induction. Evershed argued for continued development of magnetic induction wireless telegraphy due to a continuity of technology and practices in line with existing electrical engineering technologies. Preece's paper was historical rather than technical, arguing for a historical narrative of wireless centred about the Post Office. Preece's paper was also a public articulation of the institutional innovations discussed in the previous chapter. These wireless papers and debates broadened the scope of institutional innovation. Innovation of all types including institutional innovation is not merely technical but can also be broadened to include the public presentation, communication, and reporting of invention and innovation. Public presentation of invention and innovation was a rare, perhaps sole, commonality between these three early British wireless pioneers and Marconi. A few months after the initial three papers, Marconi used the public forum of the IEE to stake his own claims over this burgeoning and embryonic field of technology. Marconi also used his paper, delivered before the IEE in March 1899, to respond to the anti-Marconi claims and rhetoric of the three earlier wireless papers. This flurry of papers delivered before the IEE marked the somewhat late entry of this institution into the field of wireless telecommunications.

Furthermore, I wish to apply previously unconsidered historiographical approaches both to the institution itself and to its role in wireless. First, I will examine the act of invention and innovation taking place within a learned society such as the IEE. Volunteer and professional societies such as the IEE are more commonly seen as spaces within which to present evidence of invention and innovation rather than a structure within which invention and innovation might take place. This is further emphasised by published histories of techno-scientific societies of this era such as British Association for the Advancement of Science (BAAS), the Royal Society, the Royal Institution, the Institution of Civil Engineers, the Institution of Mechanical Engineers, and others where the concept of scientific societies and institutional space as a location for innovation and invention is left unconsidered and ignored.[8] This analysis will utilise theories and ideas relating to use and non-use of technology, and will further utilise popular contemporary electrical engineering periodicals, such as *The Electrician*, the *Electrical Times*, and others. These external electrical engineering and scientific

8 For histories of the BAAS, see Collins (1979), Howarth (1931), Lodge (1931), and MacLeod and Collins (1981). For histories of the Royal Society, see Hartley (1960), Hunter (1982), Lyons (1944), and Purver (1967). For histories of the Royal Institution, see Ironmonger (1958) and Jones (1871). For histories of the Institution of Civil Engineers, see Institution of Civil Engineers (1928), Roberts and Black (1995), Watson (1988), and Watson (1989). For histories of the Institution of Mechanical Engineers, see Moore, et al. (1997), Parsons (1947), Pullin (1997), and Rolt (1967).

publications will be examined in two different ways. Initially, these publications will be used to examine the external perception of the IEE wireless papers and debates, and indeed of the institution and its members. Additionally, they will be compared with the questions and debates after the papers, these being published alongside the paper in the institution's journal, the *Journal of the Institution of Electrical Engineers* (JIEE), in order to more fully flesh out the details of these wireless debates. Furthermore, I will use these electrical engineering periodicals to examine the external activities of the IEE membership, with particular focus on letters and editorials published in these journals. The JIEE did not feature letters or editorials and so these forms of commentary were unavailable within the institution's journal. Finally, I will use these external electrical engineering and scientific publications to examine how wireless was perceived more widely in the engineering and scientific communities with a particular emphasis on the role of professional and scientific institutions.

Following on from this, I will consider why members of the IEE chose to present their wireless research elsewhere. What might this say about the perception of wireless communications within the electrical engineering community and more specifically within the IEE? Furthermore I will examine how the structure and history of the institution shaped its responses to wireless. Finally, I will examine how the wireless pioneers within the society utilised the structure and resources of the institution in order to further develop and promote their own agenda within the field of wireless. They did this not through papers, debates, and committees but rather through more subtle modes of communication: private correspondence, training documents, and technical education resources. During this period, the IEE became a centre for a community of British wireless pioneers and practitioners. To conclude, by examining and exploring the role of the IEE in wireless and vice versa, we can uncover how more practical concerns and aspects of wireless changed throughout this period and hence map wider changes in wireless history in Britain during this period.

3.2 A Brief History of the Institution of Electrical Engineers

As discussed in more detail in the introductory chapter, the origins of the Institution of Electrical Engineers (IEE) date back to the establishment of the Society of Telegraph Engineers

(STE) in 1871.[9] The newly established member-led society very much modelled itself on the 'parent institutions' of the Institution of Civil Engineers (established 1818) and the Institution of Mechanical Engineers (established 1847) and, indeed, was hosted by the former in their Great George Street premises in central London until 1909 when they acquired their current premises at Savoy Place. Almost all institution's activities were hosted at the Institution of Civil Engineers (ICE) headquarters in central London, from papers to general meetings to committee and council meeting. Furthermore, the rules and regulations of this electrically minded institution were based on and indeed constrained by those of the ICE.

By the 1880s, the nature of the society had clearly changed beyond its telegraphic origins with “electricians” (“electrical engineers” in modern parlance) moving to the fore of the society. This was a source of great tension within the society and led to dramatic changes. Another potential source of antagonism, both within the society and in the wider field of electrical engineering, was the division between theoretical and practical electrical engineers, the former being usually referred to as “Maxwellians”, something which also came to the fore in their dealings with wireless telegraphy.[10] This division between practical and theoretical electrical engineers continued throughout the early history of the institution and was not resolved until the early twentieth century with the advent of University-educated scientists and electrical engineers.[11] And so, after much discussion at the Ninth Annual General Meeting of the society, held on 22 December 1880 and chaired by then President William Preece, it was decided to rename the society as the Society of Telegraph Engineers and of Electricians (STEE). This name change lasted until 1888 when, despite more intense debate and the loss of certain members, the society was renamed again, this time to the Institution of Electrical Engineers (IEE). The IEE's first President was Sir William Thomson (later Lord Kelvin), who had also previously served as President of the Society of Telegraph Engineers in 1874.

During the early history of the institution and well into the twentieth century, the society was almost entirely run by members in voluntary roles. A few select roles such as Secretary and Librarian were salaried but the remaining council and committee roles were voluntary and unpaid. The institution was led by a council elected of and by its members. In turn, the council

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9 See **Section 1.3.4 – The Institution of Electrical Engineers** for a more complete history of the Society of Telegraph Engineers and its antecedents, including the Institution of Electrical Engineers.

10 Hunt (2005).

11 Hunt (1983).

(whose membership changed regularly) appointed different committees to advise and make recommendations on important issues. Committees were generally formed through a proposal made and supported by members at an ordinary general meeting, or sometimes at the bequest of the council. These committees were, in essence, special interest groups, meeting irregularly and charged with a specific task or problem. The lifespan of committees varied with a select few, mostly administrative committees such as the Financial Committee, the Scholarships Committee, and the Library and Editing Committee having a permanent position within the society. The internal working and membership of the society has been covered in much detail in the two official histories of the institution. As discussed previously, the institution was its members, in that their concerns and motivations controlled the direction and strategy of the institution. The working background of the many members of the institution could also be used to describe the society itself, viz. '[standing] at the confluence of the streams of academic and practical knowledge' or '[having] the position of a scientific body uncontaminated by commerce.'[12] While the former can be said to be an accurate description of the institution, the latter reflects aspirational thinking rather than the reality of the nature of the institution.

As reflects its origins as the Society of Telegraph Engineers (STE), most of the members of the IEE worked in the field of telegraphy for most of the timespan covered by this chapter and the interests of these founding members remained influential long after their professional field had been overtaken by more modern fields such as electric lighting & supply and electrical manufacturers in the early twentieth century.[13] In terms of their more general working background, many of the members worked in the commercial sphere or government and municipal bodies (and sometimes both) and hence brought their commercial motivations with them to the IEE; other members worked in the academic sphere which brought a different set

12 Quoted on Reader et al. (1987), 73 as being from the reminiscences of Alexander P. Trotter, Trotter and Hewitt [ed] (1948).

13 Reader et al. (1987), 306 provides figures for the employment of IEE members from 1881 to 1911. Utilising these figures (and allowing for some sampling errors), the following can be calculated. In 1881, approximately 61.7% of Members and Associate Members worked in the field of telegraphy. By 1891 this had dropped to 35.1% but this still remained the most common class of employment. By 1901 the figure had dropped further to 15.1% and fields such as electric lighting and supply and electrical manufacturers had become the most common classes of employment with telegraphy a distant third. By 1911 the decline had continued with 8.1% of members employed in telegraphy with employment in educational bodies also overtaking telegraphy as the third most common class of employment in the IEE.

of concerns. As a result, the institution offered a good balance of many types of electrical engineers and catered for them all. In contrast to the commercial world, the IEE offered a space where the new and exciting world of electrical engineering could be debated and discussed in a gentlemanly manner and forum. IEE debates were neutral in terms of commercial concerns, in that no one company had better representation than another, but were not entirely independent of commercial concerns. Unlike patent cases held in civil courts and other more commercially centred spaces, the debating forum of the IEE was for the most part gentlemanly, genteel, and civilised.

However, that is not to say that the papers and related debates that took place before the IEE audience were staid or lacking in passion. A particularly interesting example and one with resonance of the IEE's role in wireless was a debate centred about lightning conductors which took place both within and without the society in the late 1880s and early 1890s. While this debate was nominally about lightning conductors, in practice it was also concerned with electrical theories and models and their influence on the future direction of the institution itself. The debates took place shortly after the society was renamed the Institution of Electrical Engineers but this title change, which was intended to encourage a more agreeable and inclusive institution, did not have the desired effect. The antagonism within the institution between old and new electrical engineers, between the practically minded and the more theoretical approach, between “Maxwellians" (or sometimes “Theoreticians”) and “older electricians” (as Lodge sometimes referred to them) remained.[14]

The debate was exemplified by the two main participants, Oliver Lodge and William Preece, and originated with papers delivered outside of the institution by Lodge. Similar to the context of the wireless papers delivered later before the IEE, these papers were delivered externally and so the papers delivered before the IEE occasionally have the appearance of a dialogue or conversation which had begun earlier. In May 1888 and just over a year before his IEE lecture on the lightning conductors, Lodge delivered two lectures on the topic as part of the Mann lecture series at the Royal Society of Arts.[15] Lodge later engaged with Preece over the issue at the annual meeting of the British Association for the Advancement of Science at Bath

14 For further information, see Hong, Sungook. "Marconi and the Maxwellians: The Origins of Wireless Telegraphy Revisited." *Technology and Culture* 35, no. 4 (1994): 717-49; Hunt (2005); Sarkar, Mailloux, Oliner, Salazar-Palma, and Sengupta (2006); Sengupta, D. L., and T. K. Sarkar. "Maxwell, Hertz, the Maxwellians, and the Early History of Electromagnetic Waves." *IEEE Antennas and Propagation Magazine* 45, no. 2 (2003): 13-19.

in 1888.[16] Despite the strong degree of antagonism between Lodge and Preece, both about lightning conductors and the underlying electrical theories, Preece had 'magnanimously' invited Lodge to present before the IEE. As is the case with the later wireless papers presented before the IEE, the post-paper debate was often more illuminating and indeed interesting than the paper itself. This is a general theme across IEE papers, and indeed it can be said that some of the formal and gentlemanly manner of the IEE and its members sometimes slips a little here too to reveal underlying concerns and tensions.

In late April 1889 Oliver Lodge delivered a paper, "On Lightning, Lightning Conductors, and Lightning Protectors", containing a brief overview of the dispute between Lodge and Preece over lightning conductors and related electrical theory.[17] The paper also described how, in 1883, Lodge and J.W. Clark working together rediscovered the principle of coherence (later referred to as "syntony", a term Lodge himself coined). This principle laid the foundation for the development of early wireless telegraphy receivers. Lodge continued to work on this principle in 1888 and 1889 when he developed the "coherer", another term he himself coined.[18] Later in the paper, Lodge discussed his further observations of cohesive action whilst working on lightning protection for telegraphic instruments and cables. The post-debate discussion began with comments from Preece, Professor Fitzgerald, William Thomson, Lodge himself, and others – all stalwarts both of the institution itself and of the field of electrical engineering.[19] Preece's comments were cordial and, although he held an opposing view to

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15 Lodge, Oliver. "*Dr. Mann Lectures*. Protection of Buildings from Lightning. Lecture I." *Journal of the Society of Arts* 36, no. 1856 (1888): 867-74; Lodge, Oliver. "*Dr. Mann Lectures*. Protection of Buildings from Lightning. Lecture II." *Journal of the Society of Arts* 36, no. 1857 (1888): 880-93. The papers were later reprinted together in pamphlet form as Lodge (1888).

16 Abstracts of Lodge's two papers, "On the Measurement of the Length of Electro-magnetic Waves" and "On the Impedance of Conductors to Leyden-jar Discharges", both presented on Friday 7 September 1888, are in "Report of the Fifty-Eighth Meeting of the British Association for the Advancement of Science Held at Bath in September 1888." London, 1889, 567.

17 Lodge, Oliver. "On Lightning, Lightning Conductors, and Lightning Protectors." *Journal of the Institution of Electrical Engineers* 18, no. 80 (1889): 386-430.

18 Lodge and Hill (1932), 47.

19 Preece, W.H., Charles W. Vincent, J. Farquharson, J. Wimshurst, W. Grylls Adams, G.F. Fitzgerald, Oliver Lodge, D.E. Hughes, G.J. Symons, R.Y. Armstrong, A.J.S. Adams, C.E. Spagnoletti, Sydney Evershed, William Thomson, Major Cardew, J.T. Bucknill, and Leonard Joseph. "Discussion of Professor Oliver Lodge's Paper "on Lightning, Lightning Conductors, and Lightning Protectors"." *Journal of the Institution of Electrical Engineers* 18, no. 81 (1889): 445-564.

Lodge, he remained respectful and friendly throughout stating that no ill feeling was borne by either party. Furthermore his comments argue for the IEE as a gentlemanly forum where two opposing proposals could be respectfully proposed and discussed. Preece concluded with a comment on the discussions within the IEE: '...I am representing to-night a certain school … I am the defender of a class of men who Professor Oliver Lodge has called the “older electricians.”'[20]

Lodge presented another paper on the topic before the IEE about a year later in 1890.[21] The paper was more practically minded in content and was received with warmth by Preece and others. In his post-paper comments, Preece concluded with the following:[22]

> ...While I am perfectly satisfied with our own form of protector on practical as well as theoretical grounds, if there is any good to be gained by having a thorough, sound, practical test of Dr. Lodge's protectors, we shall be very happy indeed to give them a fair trial.[23]

These papers could be approached and analysed in different ways but there are two points worth drawing attention to and further analysing. Firstly, it is noteworthy that many of the IEE members interested in lightning conductors also contributed to wireless within the IEE. Independent of pre-existing non-Hertzian systems, wireless telegraphy was not entirely new and original within the IEE. Rather it found a place within existing communities and networks within the institution. Secondly, I will show that the deep-seated mutual antagonism displayed by Preece and Lodge over lightning conductors was topic-specific. While they disagreed entirely over the operation and nature of lightning conductors, the two remained on cordial terms and corresponded regularly. Shortly after Marconi's arrival but before Preece and

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20 Lodge, Oliver. "On Lightning, Lightning Conductors, and Lightning Protectors." *Journal of the Institution of Electrical Engineers* 18, no. 80 (1889): 386-430.

21 Lodge, Oliver. "On Lightning-Guards for Telegraphic Purposes, and on the Protection of Cables from Lightning." *Journal of the Institution of Electrical Engineers* 19, no. 87 (1890): 346-80.

22 Saunders, H.A.C., William Thomson, William H. Preece, Charles Bright, Captain A.W. Stiffe, Sir Henry Mance, Major Cardew, Professor D.E. Hughes, Major-General Webber, Professor W.E. Ayrton, W.M. Mordey, C E. Spagnoletti, R.E. Crompton, W.B. Sayers, and Oliver Lodge. "Discussion on Dr. Oliver Lodge's Paper, "on Lightning-Guards for Telegraphic Purposes, and on the Protection of Cables from Lightning"." *Journal of the Institution of Electrical Engineers* 19, no. 87 (1890): 382-410.

23 *Ibid.*, 390.

Marconi went their separate ways and also two years before wireless appeared on the public-facing agenda of the IEE, Lodge and Preece corresponded regularly about wireless telegraphy. The two formed a strong allegiance against Marconi with particular focus on claims made about his systems and relatedly patent rights.

3.3 The Institution of Electrical Engineers – An epicentre for early wireless practitioners?

As the previous discussion has shown, there was a small, pre-established community within the IEE with an interest in electromagnetic waves and a potential interest in wireless telegraphy. As was the case with Lodge and others, these interests sometimes spilled out of the IEE but were generally received favourably and warmly before the institution. Additionally there was a community of wireless practitioners within the IEE, one whose activities were not centred about traditional modes of communication such as a committee or papers but through regular private correspondence. At the centre of this network Lodge and Preece formed the epicentre of this network and went on to present two of the initial wireless papers delivered before the institution. This contrasts with previous interactions, which were passionate and combative at times. One further way to establish the community of wireless practitioners within the IEE independently of such public-facing activities such as delivering papers is to present alternative methods of engaging with the society and each other. Through regular private correspondence, members of the society were able to form a network and community of wireless practitioners independent of a centrally managed structure such as a committee. Regular correspondents on wireless within the IEE included members such as Lodge, Preece, Muirhead, Captain Brett, S.P. Thompson, Marconi, and many others. One particularly interesting series of correspondence was between William Preece and Oliver Lodge in the 1890s and beyond.

Notably, the correspondence between these two former enemies pre-dates the schism between Marconi and Preece that occurred after the foundation of the Marconi Company in mid-1897. Correspondence between the two appears to have begun when Preece sent a report on Marconi's early experiments at Salisbury to Lodge seeking feedback.[24] The

24 Referred to in IET Archives UK0108 SC MSS 022/III/208 – Letter from Sir Oliver Lodge to Preece, dated 16 October 1896.

correspondence initially focused on Marconi's experiments and pre-dates the receipt of – but not application for – Marconi's patents. There was a distinct change in Lodge's attitude towards Marconi in the period thereafter. Initially Lodge alternated between acknowledging Marconi's unique contribution to wireless telegraphy at this time and establishing his own credentials and work in the field:

> Some of my friends seemed to feel aggrieved, but I told them that if I had come asking for facilities for large-scale experiment you would doubtless have given it over 2 years ago & that it was well for a man who took the trouble to work all the thing out in detail to have facilities given him. … At the same time there is nothing new in what Marconi attempts to do, it could have been done any time these years in a laboratory way, & I thought it little to demonstrate practically to the section that I too could work a morse [sic] instrument by electric waves & get dots & dashes without any notice.[25]

In correspondence communicated in May 1897, Preece acknowledged the influence of Lodge's work and his 1894 publication on Hertz upon the work and apparatus of Marconi.[26] Henceforth, the two corresponded regularly on matters relating to wireless and indeed shared correspondence from others in the field of wireless. Initially the focus was on the work of Marconi as this was what Preece was working on during this period, and also what was significantly concerning Lodge during this period. In May 1897 and with Marconi's claims over wireless telegraphy and its commercial application becoming more overt, Lodge's concern was apparent:

> The papers seem to treat the Marconi method as all new, of course you know better, & so long as my scientific colleagues are well informed [sic] it matters but little what the public press say. The stress of business may however caused you to forget some of the details published by me in 1894. I used brass filings in vacuums then too. It could all have been done 3 years ago had I known that it was regarded as a commercially important derivation. I had the automotive tapping back & everything, see enclosed pamphlet. … Besides, as you said in your letter last October, you are not likely to forget

25 IET Archives UK0108 SC MSS 022/III/208 – Letter from Sir Oliver Lodge to William Preece, dated 16 October 1896.

26 Referred to in IET Archives UK0108 SC MSS 022/III/210 – Letter from Sir Oliver Lodge to William Preece, dated 29 May 1897.

> my share in the work, or the fact that Marconi must have got all his initial ideas from my little book.[27]

Lodge also took more concrete steps to establish his claims of priority in the field of wireless – in May 1897 he applied for British Patent no. 11575 *Improvements in syntonised telegraphy without line wires*; this patent was accepted just over a year later in August 1898. Although Lodge's patent application was filed a year after Marconi's, it pre-dated the acceptance of Marconi's patent. Lodge's patent was based on ideas of syntony and resonance tuning that he had included in his lecture and subsequent publications of "The Work of Hertz."[28] Lodge also made other patent applications around this time and throughout 1897: British Patent no. 29069 was registered on 10 December 1897 and two Lodge patents relating to improvements in coherers – British Patents No 16405 and 18644 – were also filed in 1897.[29] During this year, Lodge also took another approach to establishing his historical priority in the field of wireless and the debt the wireless system developed by Marconi owed to Lodge's earlier work and apparatus, especially his coherer. This contentious claim was one which, at least in relation to Lodge's apparatus, Marconi repeatedly and vehemently denied. For example, in testifying before an American court in 1913 Marconi claimed to have never heard of Lodge's work let along having read it prior to submitting his initial British patent in June 1896.[30] This seems an unlikely claim given Marconi's background, knowledge, and education in electromagnetism, beginning with an informal yet thorough education in electromagnetism from early mentor and renowned Italian physicist, Augustus Righi and further developed by Marconi's admittedly brief connections with the British electrical engineering community.

In May 1897 Lodge attempted to establish his priority in the field through correspondence with Righi. In addition to being a physicist of the highest calibre, Righi had also developed early apparatus for use in the field of electromagnetism including the "Righi oscillator", a form of

27 IET Archives UK0108 SC MSS 022/III/210 – Letter from Sir Oliver Lodge to William Preece, dated 29 May 1897.

28 Lodge, Oliver. "The Work of Hertz." *The Electrician* 33 (1894): 153-55, 86-90, 204-05; Lodge, Oliver. *The Work of Hertz and Some of His Successors: Being the Substance of a Lecture Delivered at the Royal Institution on Friday Evening, June 1, 1894*. London: The Electrician Printing and Publishing Company, 1894.

29 Burns (2004), 301.

30 'Wireless as a Commercial Fact: From the Inventor's Testimony in the United States Court in Brooklyn. Guglielmo Marconi. Part III.' *The Wireless Age* 1 (October 1913): 75-79.

spark-gap which Marconi used in his early wireless apparatus.[31] Righi replied to Lodge's letter promptly, acknowledging Lodge's claim and giving a rather juicy description of Marconi, a description Lodge somewhat gleefully shared with Kelvin and also Preece:

> I know this young man, who is very intelligent although but little instructed in Physics. I have advised him to pursue a regular University course. I shall be very curious to know about his apparatus, but I suspect it much resembles what he rigged up here with my oscillator and your [Lodge's] coherer.[32]

In the aftermath of patenting in 1897 and 1898, Lodge's focus shifted and he began, in direct competition to Marconi, to develop his own system of wireless telegraphy and to further consider how it might be of use to the Post Office or the government. In doing so, Lodge sought advice from Preece and described the technical workings of his system whilst acknowledging his debt to the early method of wireless telegraphy developed by Preece and the Post Office:

> I have been working for six months & more at a method of magnetic telegraphy, using an oscillatory condenser-discharge indeed … With very primitive arrangements I can signal from the college to my house i.e. nearly two miles; & I have all the calculations ready to plan a circuit for any distance (literally for any distance). … Naturally I should like the [government] to take it up, as I believe it is the most powerful & by far the simplest plan possible. … It has developed into something not unlike your old plan, with stretched wire along the Sound of Mull etc, hence you may be interested in it...[33]

In a letter written a month later, Lodge further acknowledged these influences and the feedback he received from Preece on his system:

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31 Two early Righi oscillators, from 1895 and 1896 respectively, used by Marconi have survived in the Marconi Collection currently held by the Museum of the History of Science, Oxford. See http://www.mhs.ox.ac.uk/collections/search/displayrecord/?mode=displaymixed&module=ecatalogue&irn=15803 and www.mhs.ox.ac.uk/collections/search/displayrecord/?mode=displaymixed&module=ecatalogue&irn=15409.

32 IET Archives UK0108 SC MSS 022/III/211 – Extract of letter from Professor Righi of Bologna to Professor Oliver Lodge dated 18 June 1897.

33 IET Archives UK0108 NAEST 021/038 – Letter from Oliver Lodge to William Preece, dated 4 March 1898.

> I wish to say that the idea of using induction for Telegraphy occurred to me after reading the account of your experiments and partial successes with it. Also that my present plan, though an outcome of some of my Leyden jar experiments, is practically a development and improvement of your plan.[34]

In late 1898 Preece and Lodge discussed the experiments and system developed by their wireless pioneer, Evershed, in preparation for their lectures before the IEE.[35] A year later in September 1899, they had moved on from technical discussions to more defensive discussions on references in relation to the early history of wireless with particular emphasis on wireless work pre-dating that of Marconi.[36] Lodge claimed, somewhat disgruntledly, that '[this] last achievement of [the Marconi Company], that of signals to the Atlantic liner, strengthens him once more, & extracts more for advertisement from the newspapers.'[37] Through regular correspondence these two wireless pioneers exchanged ideas on different methods of wireless telegraphy, on technical details, on commercial development, and on patenting. This regular correspondence continued until Preece's death in 1913. Lodge's opinion of Marconi and his early work continued in this vein thereafter, even in correspondence to others. In a letter written on 11 December 1914 to John Arthur Hill on the subject of Lodge's role in wireless telegraphy, Lodge had the following to say about Marconi:

> ...[in 1896] Marconi came over with the same thing [as Lodge] in a secret box, with aristocratic introductions to Preece of the Government Telegraphs, and was taken up and assisted by him – who was far more ignorant than he ought to have been of what had been already done. … So with great spirit and enthusiasm, and preserving energy, and assisted by Government officials, Marconi overcame many practical difficulties and

34 IET Archives UK0108 NAEST 021/040 – Letter from Oliver Lodge to William Preece, dated 5 August 1898.

35 IET Archives UK0108 NAEST 021/041 – Letter from Oliver Lodge to William Preece, dated 18 September 1898.

36 IET Archives UK0108 NAEST 021/042 – Letter from Oliver Lodge to William Preece, dated 26 September 1899.

37 IET Archives UK0108 NAEST 021/045 – Letter from Oliver Lodge to William Preece, dated 19 November 1899.

> really began to establish on a practical commercial basis his system of Wireless Telegraphy by Herztian waves.[38]

In conclusion, many of the shared thematic elements of the initial series of wireless papers before the IEE in late 1898 and early 1899 had their origins in earlier private correspondence and continued to be discussed in this format subsequent to a relevant paper being delivered. In this regard, private correspondence between IEE members relating to papers delivered before the Institution form another, less public aspect of the debating forum provided by the Institution. These complementary communiques offer a more private and personal insight into the community of wireless pioneers who found a home at the IEE and also articulate the community's activities, individually and collectively, prior to the initial presentation of wireless telegraphy papers before the IEE in late 1898.

3.4 Wireless Papers at the Institution of Electrical Engineers

The entry of the IEE into the field of wireless telegraphy was marked in December 1898 when the first three papers on the subject were presented before the IEE. As elaborated upon earlier, wireless was not considered an engineering enterprise until the late 1890s and so was absent from the agenda – literally and figuratively – of the IEE until the turn of the century. To be sure, the JIEE had included an abstract of Hertz's ground-breaking 1889 paper, and a couple of wireless-related abstracts by Augustus Righi, one of Marconi's early mentors, but this topic was not discussed before the IEE until these initial three wireless papers delivered in late 1898. Wireless telegraphy was not a topic of discussion within the Institution either publicly through Presidential addresses and so forth or in private at council and committee meetings. This is despite the fact that most of the early British wireless pioneers were members (and active ones at that) of the IEE. One point worthy of further consideration is that although most of the early British wireless pioneers were indeed members of the IEE, the majority of the members of the IEE were not involved with or indeed interested in wireless telegraphy.

The three papers were presented by long-standing and active members – Oliver Lodge, Sydney Evershed, and William Preece – of the institution on two successive ordinary general meetings on 8 December and 22 December 1898. The first paper, "Improvements in Magnetic Space

38 Lodge and Hill (1932), 48.

Telegraphy" was delivered by Oliver Lodge on 8 December. The following two papers, "Telegraphy by Magnetic Induction" by Sydney Evershed and "Aetheric Telegraphy" by William Preece, were delivered together on 22 December. All three papers, along with the post-paper discussion, were published in the same issue of the Journal of the Institution of Electrical Engineers. As was common protocol with papers presented before the society, comments and correspondence from attendants as well as from those unable to attend (but who had read the papers in the *JIEE* and in other electrical engineering publications) were published later in the same edition of the institution's journal.[39]

These papers had shared a number of different commonalities. First, they were all distinctly interlinked, with the latter two papers clearly reacting to claims made in the earlier paper. Secondly, they shared joint post-debate discussions and these comments were published across a number of issues of the institution's journal. The latter two papers responded to earlier paper(s) and more generally all three papers responded to external events of concern to the three individuals presenting these papers. The debating space created by the IEE, its members, and audience is something I will discuss later in this chapter but it would not be presumptive to state that, during the early history of the institution, it could be seen to have a reactive rather than proactive role in electrical engineering. That is not to say the society was passive but, for a variety of reasons more fully explored later in this chapter, the institution was not overt or aggressive in pursuing an agenda or strategy, although both was hard to define given the member-led nature of the institution. This was as true of the institution's response to wireless telegraphy as it was to any other field in electrical engineering. Another shared commonality was that, although this was the first time their authors had presented before the IEE on wireless telegraphy, this was not new research even in these early days of wireless telegraphy in the late 1890s. As explored in the previous chapter, the wireless system developed within the Post Office and presented upon by Preece had its origins over fifteen years earlier in the early 1880s.[40] Rather than presenting new research or technologies, these papers were responding to the concerns of their individual authors and shared a common

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39 In order of presentation: Lodge, Oliver. "Improvements in Magnetic Space Telegraphy." Journal of the Institution of Electrical Engineers 27, no. 137 (1898): 799-851; Evershed, S. "Telegraphy by Magnetic Induction." Journal of the Institution of Electrical Engineers 27, no. 137 (1898): 852-69; and Preece, William Henry. "Aetheric Telegraphy." Journal of the Institution of Electrical Engineers 27, no. 137 (1898): 869-87.

40 See **Chapter 2 - 'Something in the Air': The Post Office and early wireless experiments, 1882-1899** for further details.

theme of being a response to concerns about the commercialisation and patenting of wireless, in particular the activities of Marconi.

Although this was not overtly or explicitly stated in the papers themselves, these papers were a reaction to Marconi's claim of historical priority and associated rights of monopoly, articulated through his patent applications and associated rhetoric. Marconi's claims can be simplified thus; he considered himself the first to develop practical wireless systems in Britain using Hertzian waves and, as a result, was granted the world's first wireless patent, a master patent in all but name. As such, Marconi argued that he had the right to a monopoly on the commercial development of wireless in Britain and elsewhere. This widely encompassing claim would agonise and antagonise earlier wireless pioneers and competing wireless companies for years to come. As discussed in further detail in my previous chapter, Marconi had founded his wireless company in July 1897 thereby ending his close relationship with Preece and the Post Office.[41] By 1898 Marconi was presenting widely, drumming up extensive publicity for his system of wireless telegraphy. In response to these wide-ranging claims, Lodge, Preece, and Evershed presented the results of their wireless work before the IEE in December 1898 in order to establish their role in early wireless history and hence their historical priority. The three papers very much read as if they were planned to be presented together as a series – they made references to their fellow members' work and it was made clear that much of the discussion would wait until the third paper had been presented. Despite this unity and collaboration of a kind, each presenter made distinct and sometimes competing claims to historical priority and innovation in wireless communications. All three utilised a strongly anti-Marconi rhetoric to emphasise their roles in the early history of wireless and to play down the importance and significance of Marconi's work and system.

3.4.1 "Improvements in Magnetic Space Telegraphy" by Dr Oliver Lodge

On 8 December 1898 Lodge, aided by his Liverpool-based assistant Benjamin Davies, presented a paper entitled "Improvements in Magnetic Space Telegraphy" before the IEE and hosted by the Institution of Civil Engineers at their London headquarters. This paper has been described as marking 'the culmination of a year of frenzied activity' on electromagnetism for which Lodge was awarded the Royal Society's Rumford medal less than a week before he delivered his IEE paper.[42] Lodge began this paper with a brief outline of the three different methods of wireless telegraphy then available: earth current method (sometimes referred to as "earth

41 See **Section 2.5 – 1896 and all that: Marconi's arrival in Britain** for further details.

42 Rowlands (1990), 188-189.

conduction"), the magnetic induction method, and the Hertzian wave method. As a brief aside, it is interesting to note that although Lodge used "magnetic space telegraphy" and sometimes "electric space telegraphy", he acknowledged that "wireless telegraphy" seems to have become the accepted term. This contrasted with Preece who preferred the term "aetheric telegraphy" and used this as the title of his paper. As elaborated upon in the introduction, terminological stability and agreement had not yet been established in this still embryonic field.[43] Lodge began by briefly describing the earliest systems of wireless telegraphy – conduction and induction – and acknowledged the work of the two subsequent speakers, Preece (and the Post Office) and Evershed, in these methods of wireless telegraphy. While Lodge acknowledged the importance of these earlier methods of wireless telegraphy, it is Hertzian waves that are the focus and subject of his paper. Early in the paper, Lodge credited his former antagonist Preece with introducing Hertzian wave wireless telegraphy to Britain while also acknowledging his own role with the publication of his "little book" in 1894.[44] Lodge also took an opportunity to belittle Marconi's role in this system of wireless telegraphy thus:

> ...the public owes its knowledge and interest [of Hertzian wave wireless telegraphy] ... to Mr. Preece; for, had Mr. Preece not taken up the subject, very few persons would, in all probability, have heard of Hertz waves and Branly detectors and coherers to this day, not withstanding [sic] the amount of work that had been done on them, and made known to scientific bodies, not only in this country... As it is, owing to Mr. Preece's great influence and power of lecturing, this third and most recent method, since he took the subject up in 1896, has become the best known of them all; though, unfortunately, in such a form that it is generally supposed that the discovery was made in Italy.[45]

Lodge then described his method of syntony in great technical detail, supporting his claims with diagrams and multiple intricate equations; this is clearly the work of a seasoned scientific speaker and a well-established academic. Lodge established his credentials and established work in the field by referring back to earlier work he conducted in the field of "syntony", sometimes referred to as "tuning", as early as 1890 although this clearly pre-dates his work on

43 See **Section 1.7 – What we talk about when we talk about wireless**.

44 Lodge (1894).

45 Lodge, Oliver. "Improvements in Magnetic Space Telegraphy." *Journal of the Institution of Electrical Engineers* 27, no. 137 (1898): 799-851.

wireless telegraphy.[46] Lodge concluded with a caveat that this is but a brief selection of his work in the field and that, in relation to the future development of wireless telegraphy, 'the resources of science are very far from being exhausted, and that thoroughly known principles can be applied to obtain a practical result.'[47]

The protocol for thematic papers dictated that in-depth comments and discussion waited until the concluding paper had been delivered but a few brief comments could be made upon the conclusion of each individual paper. Hence comments by Preece, Swan, and Lodge (in reply) delivered in the aftermath of Lodge's paper were brief and congratulatory. Protocol for multiple papers presented together with a common overarching theme was to wait until after the last paper had been delivered before beginning an in-depth discussion. Preece's brief comment emphasised the distinctiveness of Lodge's paper, this being the first paper on wireless telegraphy (or so Preece claimed) being delivered by someone other than Preece.[48] Preece also used his comment to highlight the sole practical system of wireless telegraphy in daily use; the Post Office inductive wireless system across the Bristol Channel between Lavernock and Flatholm.

Two weeks after Lodge's paper and at the next Ordinary General Meeting of the IEE, Preece had the chance to elaborate upon these claims when he presented a summary of the fifteen year programme of wireless experimentation and research by the Engineering Department at the Post Office, led by Preece himself. At the same meeting and immediately prior to Preece's paper, Sydney Evershed presented a short paper on wireless. Again both papers were delivered before the IEE and hosted by the Institution of Civil Engineers at their London premises. Similar to Lodge, Preece and Evershed too made overt claims about historical priorities and wireless systems but there were notable differences. Unlike Lodge whose paper was the only paper presented at the meeting, Preece and Evershed presented their papers together at the same meeting. As a result, their papers are notably shorter than Lodge's.[49] When taking into account the space required for equations and diagrams, Evershed's paper

46 Lodge, Oliver. "On Lightning-Guards for Telegraphic Purposes, and on the Protection of Cables from Lightning." *Journal of the Institution of Electrical Engineers* 19, no. 87 (1890), 352.

47 Lodge, Oliver. "Improvements in Magnetic Space Telegraphy." *Journal of the Institution of Electrical Engineers* 27, no. 137 (1898), 849.

48 *Ibid.*, 850.

49 In terms of pages in the JIEE, Lodge's paper was 52 pages; Evershed's was 18 pages; Preece's was 19 pages.

was the shortest of all in terms of content. Furthermore these two papers described wireless systems using induction while Lodge's paper described wireless experiments and developments using Hertzian waves. While, as discussed in the previous chapter, these are subtle technical distinctions that were not fully understood at the time and so were significant to these early wireless pioneers. Despite these commonalities, there was tension between Evershed and Preece as the two articulated very different approaches and contexts for their wireless work; Evershed came from the world of commerce, in distinct contrast to the 'institutional innovations' of Preece and the Post Office.

3.4.2 "Telegraphy by Magnetic Induction" by Sydney Evershed

On 22 December 1898, Sydney Evershed, an Associate Member of the IEE, presented a short paper entitled "Telegraphy by Magnetic Induction" before the IEE.[50] Evershed's background in electrical engineering was purely commercial.[51] He began his career in electrical engineering in 1885 as a manager of a small London electrical instrument manufacturer, Goolden & Trotter, and in 1895 he took over the company with his assistant and renamed the company Evershed & Vignoles.[52] Evershed was a regular contributor to IEE post-debates discussion since the early 1890s but "Telegraphy by Magnetic Induction" was his first paper before the IEE. Evershed began his paper with an acknowledgement of the technical limitations of his magnetic induction system of wireless telegraphy in comparison to the 'brilliant possibilities' of Hertzian wave-based wireless systems.[53] However, he also noted that a magnetic induction wireless system along with the necessary power plants and electrical apparatus required was more familiar and better understood than the apparatus used for Hertzian wave wireless systems. Furthermore Evershed suggested that magnetic inductive wireless had been the subject of many practical trials over a decade and utilised apparatus and well-established electrical principles which was familiar to electrical engineers generally and to his audience at the IEE. In doing so Evershed, knowingly or unknowingly, was engaging with some of the wider reasons for the IEE's lacklustre engagement with wireless telegraphy up to this point. Many aspects of the technologies of Hertzian wave wireless telegraphy were more familiar to physicists such as

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50 Evershed, S. "Telegraphy by Magnetic Induction." *Journal of the Institution of Electrical Engineers* 27, no. 137 (1898): 852-69.

51 For background material on Evershed, in particular his later work in magnetics, see Gooday, Graeme. "Domesticating the Magnet: Secularity, Secrecy and 'Permanency' as Epistemic Boundaries in Marie Curie's Early Work." *Spontaneous Generation* 3, no. 1 (2009): 68-81.

52 *Ibid.*, 76.

53 Evershed, S. "Telegraphy by Magnetic Induction." *Journal of the Institution of Electrical Engineers* 27, no. 137 (1898), 852.

Lodge than electrical engineers such as Evershed. Furthermore the majority of IEE members worked with the heavy industry aspects of electrical engineering and were unfamiliar with the physical principles and working of the newly discovered Hertzian waves.

At the core of Evershed's paper lay a description of the technical working and operation of his system, including equations, diagrams, and the technical details of inductive circuits, transmitting devices, receiving devices, and absorption (range). Evershed proposed a systematic study of the absorption of electromagnetic waves by the earth whereby these waves were observed, measured, and calculated. Like Lodge, Evershed provided a detailed description of his system of wireless telegraphy. Unlike Lodge's technical description which was founded in physics and related theories, Evershed's system was described in terms that most electrical engineers of this era was familiar. At the conclusion of his paper, Evershed acknowledged the prior work and assistance of Post Office engineers Preece and John Gavey (his assistant) with relation to the magnetic induction method of wireless telegraphy. As mentioned previously, Evershed's paper was about a third the length of that of Lodge and was less overt in its claims of historical priority. Instead, Evershed's paper positions this magnetic induction as an alternative to Hertzian waves for wireless telegraphy systems. In particular, Evershed emphasises that a magnetic inductive wireless system is based on established electrical principles and utilising commonly used electrical apparatus.

Despite describing the same type of wireless telegraphy, the two papers were quite distinctive and indeed there was a tension between the two papers that was more noticeable in the subsequent discussion. Evershed's paper was delivered by a man of commerce and was quite technically detailed. Independent of whether Evershed could patent his wireless system given the Post Office's prior work in the field, one reason he may have chosen to present his paper before the IEE was to advertise and promote the wireless system he and possibly also his company were developing. In contrast, Preece's paper was not about the commercial promotion of the Post Office's wireless system *per se*. Rather the purpose of Preece's paper is to establish a historical narrative of wireless telegraphy which begins with Post Office experiments in the early 1880s while also limiting the technical details of his system. It may be for this reason that there was tension between the two men and these two papers. Given Evershed's credit to the work of the Post Office, his system was quite probably technically similar to the Post Office system. Evershed's detailed technical description of this system may have led to concerns from Preece and other Post Office engineers that research and technical details of the Post Office wireless system were being presented by others and outside of their control. Furthermore Evershed's personal thanks to John Gavey may have furthered tensions between Preece and Gavey, articulated earlier through Post Office wireless experiments and related reports.[54]

3.4.3 "Aetheric Telegraphy" by William Preece[55]

Preece delivered immediately after Evershed's paper on 22 December 1898. He began his paper with an acknowledgement that, although he had presented his wireless telegraphy systems and experiments regularly before Section A of the British Association for the Advancement of Science (BAAS), much of it had not been published.[56] Preece's papers before the BAAS had been reported upon by *The Electrician* and some other work in this field has been reproduced by others. The latter was, most likely, a pointed comment aimed at the author of the previous wireless paper. However, by presenting at the IEE, Preece was granted the opportunity to finally publish details of the wireless system developed by the Post Office in the journal of learned society. In the opening section of his paper, Preece made what was probably the most important claim of his paper, a claim which placed him in direct opposition to Marconi and one he will repeat for years to come: 'Nothing has been patented, and the work done is open to everyone.'[57] Far from being a general comment on the state of wireless telegraphy, this was highlighting the increased pursuit of patenting taking place in wireless telegraphy in the aftermath of Marconi's ambitious patenting strategy. With his comments, Preece was setting up the open and unpatented system developed by the state-controlled Post Office in direct opposition to the Marconi Company and Marconi's claims of patent rights and historical priority. This deeply antagonistic relationship between the Post Office and the Marconi Company continued beyond Preece's retirement from the Post Office and well into the first decade of the twentieth century. Preece's paper included a discussion of the origins of his systems of wireless telegraphy and the extensive experiments and developments he has made since 1884 before describing his improved system installed across the Bristol Channel in March 1898 and its many successes: 'it is in actual practical daily use, and has never failed ever

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54 See **Section 2.3 – Wireless Experiments, 1882-1892** and **Section 2.4 – Wireless Experiments, 1892-1899** for further details and articulations of the tension between Preece and Gavey in relation to the Post Office wireless experiments and systems.

55 Preece, William Henry. "Aetheric Telegraphy." *Journal of the Institution of Electrical Engineers* 27 no.137 (1898): 869-887.

56 As mentioned in the previous chapter, the BAAS did not publish a journal or proceedings. Reports of their annual meetings were printed but generally only contained abstracts of papers.

57 *Ibid.,* 869.

since it was established in March, 1898. … Hence the signals are simply splendid, and their rate of working dependent only on the skill of the operator.'[58]

Towards the end of his paper, Preece discussed 'the most important experiment attempted' – to communicate between England and Ireland.[59] A circuit was set up from Carlisle to Haverfordwest, and another in Ireland from Belfast to Wexford, both using the existing telegraphy infrastructure. The entire telegraphy system in Britain and Ireland was shut down early one morning for two hours in June 1895. Attempts were made to communicate but this was unsuccessful due to background noise which Preece attributed to electrical alternate current systems and non-terrestrial electrical 'noise'. Preece concluded: 'I have not thought the experiment worth repeating. It can have no practical value, but I arranged in the event of its success to communicate between England and Europe, and then between Europe and America.'[60] Unlike the other two speakers, Preece preferred to consider the future development and application of wireless telegraphy. Preece believed the future application of wireless telegraphy was long-distance, even transatlantic, wireless telegraphy even if this was beyond the technological potential of the Post Office wireless system. Preece saw beyond the obvious albeit much-needed use of wireless telegraphy as a replacement for broken undersea cables, or for short-distance communications between lighthouses and lightships.

In his paper, Preece created a historical narrative of wireless which features the institution of the Post Office as a formative authority in the early history of wireless. Through the form and content of his paper, Preece establishes the strong role and authority of the Post Office in wireless telegraphy, illustrated by their institutional innovations. In absence of the commercial tools of recognition such as patent and profit, institutions promoted their contributions to the field and innovative practices through public presentation of their system. In this regard, institutional innovation was not merely about technical innovations but also about public articulations of these innovations. For this purpose, the mostly civil and gentlemanly debating forum of the IEE was a perfect venue.

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58 Preece, William Henry. "Aetheric Telegraphy." Journal of the Institution of Electrical Engineers 27, no. 137 (1898), 872-873. See **Chapter 2 – 'Something in the Air': Wireless Telegraphy and the Post Office, 1882-1899** for further details of the development of wireless telegraphy within the Post Office.

59 *Ibid.*, 876.

60 *Ibid.*

3.4.4 Post-debate discussion

As mentioned previously it was common protocol with regard to papers presented before the society to publish comments and correspondence from attendants as well as from those unable to attend (but who had read the papers in the *JIEE* and in other electrical engineering publications) later in the same edition of the institution's journal.[61] This was the only method with which members unable to attend a paper could comment and debate upon issues raised and topics discussed *within the institution*; it also provided an opportunity for dialogue for the paper's author and for further discussion beyond that available immediately after the paper's presentation.[62] This commentary and dialogue has been sometimes ignored but is a valuable tool in establishing the importance of a topic within the institution and the number of members with an active interest, professional or otherwise, in the subject.

The post-paper discussions initially covered Lodge's and Evershed's papers before widening to also include that of Preece. The initial discourse was contributed to by Evershed, Preece, Dr John Ambrose Fleming, General C.E. Webber, and Lodge. J.A. Fleming was then professor of electrical engineering at University College, London and the epitome of the new class of electrical engineers, with a strong background in more theoretical-founded electrical engineering and active in technical education. Some outcomes of his work in laboratory education was authorship of two of the key textbooks in the field of laboratory practice, *Laboratory Notes and Forms* (1893) and *Handbook for the Electrical Laboratory and Testing Room* (1901–3).[63] Fleming became interested in electromagnetic waves upon the publication

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61 Evershed, Sydney, William H. Preece, John Ambrose Fleming, C. E. Webber, C. S. Whitehead, H. Mance, A. R. Sennett, W. E. Ayrton, and Oliver Lodge. "Continuation of Discussion on Dr. Lodge's Paper, "Improvements in Magnetic Space Telegraphy", and Mr. S. Evershed's Paper, "Telegraphy by Magnetic Induction"." *Journal of the Institution of Electrical Engineers* 27, no. 137 (1898): 887-922.

62 Foreign Member was one of the five main membership classes when the Society of Telegraph Engineers were established in 1871. The other four were Honorary, Member, Associates, and Students. By 1899, an additional class of Associate Members had been added. By 1912, the class of Foreign Member had fallen out of use and was merged into the revised Members' class. See Reader et al. (1987), 304 for further details. In the early 1880s, Foreign Members formed about 10% of total membership. However, this percentage would have dropped significantly by the timespan covered in this chapter.

63 Fleming (1893) and Fleming (1901).

of Maxwell's equations and avidly followed the work of Hertz and others, including Marconi, in this field.

Initially, Fleming's expertise was in alternating current but Marconi's arrival in 1896 and the publicity surrounding his wireless system whetted Fleming's appetite and he quickly began extending his expertise to the higher frequency wavelengths of wireless telegraphy.[64] Fleming first met Marconi in April 1898 when he happened to come across Marconi's wireless station at Bournemouth while on holidays.[65] Fleming inspected Marconi's apparatus and came away very impressed with Marconi's wireless system. A few weeks after his IEE lecture, Marconi succeeded in transmitting across the English Channel from South Foreland lighthouse near Dover to Wimereux near Bologne. Around this time, Fleming was invited to become scientific adviser for the Marconi Company. It was a role he gladly accepted. Even prior to being officially employed by the Marconi Company, Fleming had a close connection: 'When the youthful Marconi arrived in England, Fleming followed his progress with the keenest interest and on more than one connection championed his cause.'[66] Some time in early 1899 and prior to being formally invited to join the Marconi Company, Fleming provided advice on the design of the first high-power transmitter at Poldhu and, in doing so, may have lined himself up for employment by the Marconi Company.

Although there is some uncertainty as to Fleming's exact role in the Marconi Company at the time of Marconi's IEE paper, his motivations are not so ambiguous and his comments demonstrate a distinct bias towards Marconi and his company. In contrast to the theoretically inclined and university-trained Fleming, Dublin-born Charles Edmund Webber was one of the more traditional types of engineers, serving in the Royal Engineers from 1855 until his death in 1904.[67] Webber was an expert in military telegraphy and had been lent to the Post Office from 1869 to 1871 to assist in constructing and organising the newly nationalised telegraph service.

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64 J. T. MacGregor-Morris, 'Fleming, Sir (John) Ambrose (1849–1945)', rev. Graeme J. N. Gooday, *Oxford Dictionary of National Biography*, Oxford University Press, 2004; online edn, Jan 2011 [http://0-www.oxforddnb.com.wam.leeds.ac.uk/view/article/33170, accessed 1 Nov 2011]

65 Hong (2001), 55.

66 Baker (1970), 63.

67 R. H. Vetch, 'Webber, Charles Edmund (1838–1904)', rev. James Falkner, *Oxford Dictionary of National Biography, Oxford University Press*, 2004 [http://0-www.oxforddnb.com.wam.leeds.ac.uk/view/article/36805, accessed 1 Nov 2011].

Webber was a founding member of the Society of Telegraph Engineers and served as its second President in 1872.

The diversity of the institution's membership, even amongst those contributing to a post-paper discourse on wireless is indeed striking. Contributors included commercially minded electrical engineer such as Sydney Evershed, civil servants and engineering consultants such as William Preece, University professors such as John Ambrose Fleming, military engineers such as Charles Edward Webber and physical researchers such as Oliver Lodge. All had a strong interest, both practical and theoretical, in the field of electrical engineering and were long-standing and active members of the electrical engineering community. There was an almost equal mix of "Maxwellians" (theoretical) electrical engineers and more practically minded and hands-on electrical engineers. It is not surprising to note that within such a diverse and wide-ranging community, there is clear evidence of disagreement and diversity of opinion. For example, there are passionate disagreements and discussions about which equipment and methodology to use in relation to magnetic inductive telegraphy.[68] Preece began his discussion with an overt and somewhat political statement of the antecedence of the Post Office in relation to wireless telegraphy, quoted at the beginning of this chapter.

Next to join the discussion was Fleming. As mentioned previously, Fleming was commenting nominally in his role as professor of electrical engineering at University College, London and the foremost expert on high-power, high-frequency electrical engineering of his era. However, by March 1899, Fleming had aligned his interests with those of Marconi and the Marconi Company and so it is most probable that he was also using the IEE as a platform from which to publicly support Marconi and his company, by whom he was employed presently. Fleming lightly complimented Lodge and Evershed on their papers before discussing a rough classification for methods of wireless telegraphy. Fleming was also the first person in the

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For further information on Webber, see Forgan, Sophie, and Graeme Gooday. "'A Fungoid Assemblage of Building': Diversity and Adversity in the Development of College Architecture and Scientific Education in Nineteenth-Century South Consignment." *History of Universities* 13 (1994): 176-82.

68 Evershed, Sydney, William H. Preece, John Ambrose Fleming, C. E. Webber, C. S. Whitehead, H. Mance, A. R. Sennett, W. E. Ayrton, and Oliver Lodge. "Continuation of Discussion on Dr. Lodge's Paper, "Improvements in Magnetic Space Telegraphy", and Mr. S. Evershed's Paper, "Telegraphy by Magnetic Induction"." *Journal of the Institution of Electrical Engineers* 27, no. 137 (1898), 890-891, 896.

discussion to mention Marconi by name, referring to 'the interesting experiments of Signor Marconi.'[69] Fleming concluded with congratulating Lodge on his successes thus: 'space telegraphy which the newspaper articles persistently call "wireless telegraphy", though in reality only telegraphy with less wire than we are generally accustomed to use.'[70] Next to contribute to the discussion was Webber who only spoke briefly in order to highlight a paper by Professor Dolbear, entitled "New Telephone", given on 23rd March 1882 which may have described the world's first wireless conference telephone call.[71] In his comments, Lodge reveals a certain degree of tension between himself and Evershed, stating that he had been unaware of Evershed's work in wireless telegraphy until relatively recently. Lodge also strongly disagreed with Evershed's ideas about the future development of wireless telegraphy. As demonstrated with the lightning conductor debates between Preece and Lodge a decade previously, debate, discussion, and disagreement were common practice during IEE post-paper debates.[72] Lodge queried Evershed's summarising of his (Lodge's) paper which concluded that Lodge had suggested Hertzian wave wireless telegraphy would replace all other forms of wireless telegraphy. Lodge suggested that different uses required different systems and that privacy was a major concern for wireless telegraphy, *viz.* 'There are cases, perhaps – such as newspaper intelligence – where you want to shout it all over the country simultaneously, for which space telegraphy may be suitable...'[73]

Hence a discussion of all three papers took place, contributed to by Lodge, W.P. Granville, Captain W.P. Brett (R.E.), Dane Sinclair, A.C. Brown, C.A. Stevenson (communicated), Charles Bright (communicated), A.J.S. Adams (communicated), and Evershed.[74] The number of

69 *Ibid.*, 900.

70 *Ibid.*, 903.

71 Dolbear, A. E. "On the Development of a New Telephonic System." *Journal of the Society of Telegraph Engineers and of Electricians* 11, no. 41 (1882): 130-44.

72 See **Section 3.2 – A Brief History of the Institution of Electrical Engineers**.

73 Evershed, Sydney, William H. Preece, John Ambrose Fleming, C. E. Webber, C. S. Whitehead, H. Mance, A. R. Sennett, W. E. Ayrton, and Oliver Lodge. "Continuation of Discussion on Dr. Lodge's Paper, "Improvements in Magnetic Space Telegraphy", and Mr. S. Evershed's Paper, "Telegraphy by Magnetic Induction"." *Journal of the Institution of Electrical Engineers* 27, no. 137 (1898), 915.

74 Evershed, Sydney, Oliver Lodge, W. P. Granville, W. P. Brett, Dane Sinclair, A. C. Brown, C. A. Stevenson, Charles Bright, and A. J. S. Adams. "Continuation of Discussion on Dr. Lodge's Paper, "Improvements in Magnetic Space Telegraphy", Mr. Evershed's Paper, "Telegraphy by Magnetic Induction", and Mr. Preece's Paper, "Aetheric Telegraphy"." *Journal of the Institution of Electrical Engineers* 27, no. 137 (1898): 924-67.

respondents, some communicated, showed a strong degree of interest in wireless telegraphy, and furthermore beyond the expected and perhaps limited audience. For example, Captain Brett was a member of the Royal Engineers and was not a typical electrical engineer; Charles Bright was one of the premier telegraph engineers of the day. Additionally, some of the respondents, such as Granville, Brett, and others were working in the field of wireless telegraphy and were noticeably aware of the work of the authors of the three papers and indeed of each other's work. Additionally, the discussion shows an interest in and awareness of these different and sometimes competing systems of wireless telegraphy outside of this community of wireless practitioners. The comments of Captain Brett in relation to wireless telegraphy are, in particular, worth highlighting.[75] Brett was an open supporter of Marconi; as a member of the Royal Engineers, he had worked with Marconi on experiments conducted between South Foreland and the East Goodwin Lighthouse. Somewhat unsurprisingly, Brett considered Hertzian waves to be the best and most practical method of wireless telegraphy. Despite this bias, Brett was skilled in getting to the essence of a system and its potential limitations. In comparing inductive and Hertzian wave wireless telegraphy, Brett highlighted the key limitation of the former system: '... [without] the facilities of the Post Office authorities, I do not think it is very feasible for people to carry out experiments on anything like a large scale.'[76] Brett concluded his comments with the concerns and needs of the military community in relation to wireless telegraphy; security against interference, privacy, and mobility.

3.4.5 "Wireless Telegraphy" by Guglielmo Marconi

The last of the four wireless papers delivered before the IEE in this three-month period in late 1898 and early 1899 was perhaps the most important and was delivered before a packed

75 Brett could indeed be described as an 'expert' on wireless telegraphy at this stage. On 9 December 1897, he delivered a lecture at the Royal Artillery Institution Woolwich entitled "Wireless Telegraphy and Its Military Possibilities." It was published as Brett, Capt. W P. "Wireless Telegraphy and Its Military Possibilities." *Proceedings of the Royal Artillery Institution* 25, no. 3 (1898), which was later reprinted in pamphlet form. A copy of the pamphlet annotated by the author can be found in the Papers of William Preece held by the IET archives at IET Archives UK0108 SC MSS 022/III/247 – Wireless Telegraphy and Its Military Possibilities by Capt. W P Brett.

76 Evershed, Sydney, Oliver Lodge, W. P. Granville, W. P. Brett, Dane Sinclair, A. C. Brown, C. A. Stevenson, Charles Bright, and A. J. S. Adams. "Continuation of Discussion on Dr. Lodge's Paper, "Improvements in Magnetic Space Telegraphy", Mr. Evershed's Paper, "Telegraphy by Magnetic Induction", and Mr. Preece's Paper, "Aetheric Telegraphy"." *Journal of the Institution of Electrical Engineers* 27, no. 137 (1898), 944.

audience on 2 March 1899.[77] Originally intended to be delivered a month earlier in February, the paper was delayed until March upon the request of Walter McMillian, then Secretary of the IEE.[78] At the end of February Marconi corresponded with the IEE, requesting space to hang wall diagrams and also the physical space to accompany the lecture with a demonstration of his wireless apparatus.[79] This paper can be read in a number of different ways. First it can be used to demonstrate the rapid and rising popularity of Marconi's wireless system – according to contemporary reports in the electrical engineering press, nearly 300 people were turned away from the original lecture. At the request of the IEE Council, Marconi repeated the lecture at the larger venue of Lower Exeter Hall on Embankment on 16 March, having originally delivered the lecture at the Examination Hall at the Institution of Civil Engineers.[80] The repeat of a paper was one indicator of interest in a paper and in this regard Marconi's paper was not entirely alone. Tesla's popular 1892 paper before the IEE was repeated by request although the repeat lecture was by request of the Royal Institution rather than the IEE. Some idea of the interest aroused by Tesla's lecture may be formed by the fact that *The Times* went to the unusual length of devoting a column editorial to it and publishing a complete description of the paper along with Tesla's more striking demonstrations.[81] However, according to a contemporaneous report in *The Electrician*, Marconi's paper before the IEE was 'an event absolutely unique in the annals of the Institution of Electrical Engineers' and well in advance of the reception for Tesla's paper.[82]

Marconi's paper was chaired by Dr John Perry, professor of mathematics and mechanics at the Royal College of Science and School of Mines in London from 1896 to 1913.[83] Perry was

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77 Marconi, G. "Wireless Telegraphy." *Journal of the Institution of Electrical Engineers* 28, no. 139 (1899): 273-90.

78 IET Archives UK0108 IET/ORG/06/08 – Correspondence between Guglielmo Marconi and Walter McMillan regarding a lecture by Marconi in 1899.

79 *Ibid.*

80 "Wireless Telegraphy." *The Electrician* 42 (1899): 660.

81 Tesla, Nikola. "Experiments with Alternate Currents of High Potential and High Frequency." *Journal of the Institution of Electrical Engineers* 21, no. 97 (1892): 51. For a full report of the repeat lecture, see "Mr. Tesla at the Royal Institution." *The Times*, no. 33552 (4 February 1892): 6.

82 *Ibid.*, 724.

83 Graeme J. N. Gooday, 'Perry, John (1850–1920),' in *Oxford Dictionary of National Biography*, ed. H. C. G. Matthew and Brian Harrison (Oxford: OUP, 2004); online ed., ed. Lawrence Goldman, October 2009, http://0-www.oxforddnb.com.wam.leeds.ac.uk/view/article/39459 (accessed July 26, 2011).

a well-regarded electrical engineer although by the late 1890s he was, as his professorial title indicates, more active in the field of mechanical engineering than he was in the field of electrical engineering. In the following year, Perry became President of the IEE and in his inaugural address, he recalled Marconi's lecture as follows:

> And is it not one of the important functions of the engineer to do as Mr. Marconi has done, to convince capitalists ignorant of science that if the successful laboratory experiment is tried on a large scale it must also be successful?[84]

This raises questions about the nature of Marconi's wireless system and how this might, or might not, fit into the general themes of papers delivered before the IEE along with the interests of the audience. As Evershed had alluded to in his paper a few months previously, Hertzian wave wireless telegraphy was better-suited to the field of physical sciences than electrical engineering. However, recent developments in the field of Hertzian wave wireless telegraphy were indicative of wider change within the field. The arbitrary delineation between the physical sciences and electrical engineering was becoming increasingly blurred at this time and, if it existed in practice, was merely a delineation by application and scale. Marconi's system of wireless telegraphy possessed many characteristics of both fields – experimentation methodology and theoretical framework from physical sciences alongside the practical application and scale of electrical engineering. And so this raises the question of why Marconi might choose to present before the IEE?

Marconi's wireless system, embroiled as it was in issues of patenting, claims of historical priority, and notions of invention, offered a distinct contrast to earlier wireless systems presented and discussed before the IEE but was not without the remit of the IEE. It must be further noted that while Marconi presented papers before many learned and scientific societies during this period, few would welcome him as a member. Marconi, through the support and nomination of Lord Kelvin, was elected as a member of the IEE as early as 1898 and presented the paper in question before the institution in early 1899.[85] In contrast, Marconi did not present a paper before the prestigious Royal Society until 1902.[86] Furthermore, in 1925 Marconi's nomination as a Fellow of the Royal Society (FRS) was declined

84 Perry, John. "Inaugural Address of the Chairman of the President, Professor John Perry, D.Sc." *Journal of the Institution of Electrical Engineers* 30, no. 147 (1900), 53.

85 Marconi Archives MS. Marconi 142 – Demonstrations to Lord Kelvin and Lord Tennyson, with related items, 1898.

despite being proposed by Oliver Lodge.[87] Although it was Lodge who had put forward the nomination, its failure was also a reflection of Marconi's standing or lack thereof in the learned and scientific societies of Britain. Nonetheless, Marconi began as he meant to continue – utilising the authority and respectability of other individuals and institutions in order to further the ambitions of his company and wireless system. Moreover it can be argued that Marconi's paper was an attempt to seek professional recognition and also a clear response to the claims made by the earlier wireless papers delivered before the IEE in 1898. In some ways, Marconi's paper can be seen to be an effort to address these claims before an audience of electrical engineers – a profession with which he had much respect but no qualifications – and to furthermore regain the moral high ground and perhaps scientific credibility he had lost due to his aggressive patent strategy and commercial development of wireless telegraphy.

In form and, to a lesser degree, rhetoric, Marconi's paper was most closely aligned with that of Lodge than any of the other wireless pioneers speaking before the IEE. In borrowing these methods and tools from the physical sciences, Marconi wished to demonstrate his respectability, along with his scientific rigour and credentials. This was despite his lack of formal academic qualifications or indeed – and possibly more important to his IEE audience – practical electrical engineering training. Marconi attempted to continue this theme of scientific credibility and authority later in the paper, while acknowledging the lack of theoretical model for his model of wireless telegraphy.[88] Scientific rigour, credibility and authority formed the central theme of Marconi's paper. These were demonstrated in two ways. First, they were demonstrated through articulations of rigorous investigation and experimentation. Secondly through invocation of the weight and authority of the scientific community including figureheads such as Lord Kelvin, Professor G.F. Fitzgerald, and others.[89] A general description of an almost idealised scientific visitor was elucidated upon thus:

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86 Marconi, G. "Note on a Magnetic Detector of Electric Waves, Which Can Be Employed as a Receiver for Space Telegraphy." *Proceedings of the Royal Society of London* 70, no. 459-466 (1902): 341-44.

87 For further information on Marconi's failed nomination as FRS, Guagnini, Anna. "Patent Agents, Legal Advisers and Guglielmo Marconi's Breakthrough in Wireless Telegraphy." *History of technology* 24 (2002): 171-201.

88 Marconi, G. "Wireless Telegraphy." *Journal of the Institution of Electrical Engineers* 28, no. 139 (1899), 280.

89 See *Ibid.*, 285, 286.

> We have given demonstrations to several eminent scientists, who came down and wanted a show, often when we did not expect them, but on no occasion have they found any difficulty in the work of transmitting and receiving messages between the two stations.[90]

The presence, support, and impeccable academic credentials of these scientific elites by proxy provided Marconi with a scientific credibility he may have felt lacking when presenting before an audience at the IEE. Additionally, Marconi attempted to further the credentials through impeccable social connections. The epitome of this was the installation of a wireless system used by Queen Victoria and the Prince of Wales to communicate between the Royal Yacht and Osborne House on the Isle of Wight in July of 1898. Marconi also described Lord Kelvin's wireless message to William Preece, the first paid wireless telegram. In his paper Marconi failed, most probably deliberately, to acknowledge or even allude to the significance of Lord Kelvin's message to Preece. This was not merely a message from one scientific colleague to another but a blatant disregard of the domestic telecommunications monopoly held by the Post Office at this time over telegraphy and telephony in Britain at this time, as stated in the 1868 and 1869 Telegraphy Acts.

A further concession by Marconi to his audience was Marconi's keenness to use the most suitable tools of communication for this audience, to speak their language. Hence Marconi began his paper with a description of the apparatus used, with acknowledgement of prior work including that of Lodge. He went on to discuss the theoretical discoveries he had made in relation to the transmission range of his apparatus. This approach was an overt attempt to demonstrate that Marconi's system of wireless telegraphy was founded in rigorous experimentation and possessed an established theoretical framework. By implication, Marconi was also attempting to promote the reliability and accuracy of his system – adjectives such as 'careful....sure and safe' used to describe the experiments and results were also, it was implied, properties of Marconi's system itself.[91]

Later on Marconi introduced his system of wireless syntony without reference to Lodge's work and newly granted patent in this area. His system utilised parabolic reflectors and is described as achieving 'by means of syntonising arrangements, to prevent, to a certain extent, messages affecting instruments or receivers for which they are not intended, and therefore to select any

90 *Ibid.*, 284.

91 *Ibid.*, 279.

receiver by altering the wave length of the transmitter.'[92] Marconi elaborated upon the potential uses of syntony; secure transmission of wireless messages in enemy territory or indeed while surrounded by enemy forces; warning of obstacles at sea such as rocks and lighthouses with the ability to inform the ship of the proximity of danger and also the direction. Marconi also described the practical application of his wireless system for lightships and lighthouses, a practical task the Post Office had been attempting with their wireless system since 1892, but to little success. Marconi also emphasised the official recognition he was granted by different branches of the British government including the Post Office and Admiralty. This may have been yet another attempt by Marconi to gain further credibility and to, by proxy, grant the authority and respectability Marconi and his company so desperately desired. Marconi concluded his paper with some remarks upon the future development of his wireless system; 'other installations are now contemplated in this country for commercial and military purposes, and I am confident that in a few months many more wireless telegraph stations will be established both here and abroad.'[93]

Initial comments on this well-attended lecture were made by the Chairman (Professor John Perry), J.A. Fleming, E. Murray, Sydney Evershed, H.W. Sullivan, W.P. Granville, Captain W.P. Brett, Captain Vyvyan, and Captain J.N.C. Kennedy. I have selected a couple of these to highlight the varying response to Marconi's paper and his associated claims. Fleming began his comments thus: '[Marconi] is in such complete possession of the field that there is very little most of us can add in the discussion of his paper except by way of confirmation or questions to elicit more information.'[94] As he had done in his earlier comments on Preece's earlier paper, Captain Brett went straight to the heart of the paper with his criticisms, namely its lack of substance, scientific rigour, and reporting:

> It is somewhat difficult, to discuss the paper, which is mainly a record of facts, which are, however, very interesting from the point of view that success has been obtained over distances unattained as yet by any other system of wireless telegraphy.[95]

92 *Ibid.*, 282. See the objects in the Marconi Collection at the Museum of the History of Science, Oxford at http://www.mhs.ox.ac.uk/collections/search/displayrecord/?irn=15938

93 *Ibid.*, 290.

94 *Ibid.*, 291.

95 *Ibid.*, 295.

In conclusion, I have given a brief overview of wireless papers presented before the IEE in 1898 and 1899 in order to establish a solid foundation for discussions later in this chapter. While it might initially appear that the papers themselves, limited in number, are evidence for a distinct lack of wireless community within the IEE, I have shown this was not the case. A deeper consideration of the post-paper discussions reveals an active and well-connected community utilising the IEE as a public forum with which to communicate and share their contributions to the field of wireless. Furthermore I have shown how these debates were responding to external concerns of individuals within the small yet important community of wireless practitioners within the IEE.[96] Hence I will examine how these wireless papers and debates were discussed more widely by IEE and non-IEE members alike in external electrical engineering publications.

3.5 The IEE and external electrical engineering press

As discussed in the preceding chapter, the wider electrical engineering press had been reporting on wireless as early as 1882 including Preece's early experiments and early developments by other wireless pioneers including Lodge and other IEE members. Furthermore, the electrical engineering press regularly reported upon the British Association meetings where Preece and others presented their results and systems, and also printed revised versions of papers on wireless. At the turn of the nineteenth century, the electrical engineering press in Britain was thriving and there were a plethora of British publications that an electrical engineer, home or abroad, could turn to for articles, reviews, news, and editorials in his field.[97] The progression of the field of electrical engineering and the increased professionalisation of the field and its members led to a number of different publications such as *the Electrical Review*, *Electrical World*, *Lightning*, and others being first published in the late 1880s and early 1890s. Additionally electrical engineering demonstrations and developments were regularly reported in detail in periodicals such as *Science*, *Nature*, *the Fortnightly* Review, as well as in newspapers – for example, *The Times* and *the New York Times* – in a manner and with a degree of popularity almost unimaginable to contemporary readers. In this section, I will consider how wireless telegraphy was considered in the wider electrical engineering

96 See **Section 4.5 - Wireless pioneers within (and without) the IEE** for further details.

97 For a list of electrical engineering periodicals published over this period and further details, see **Appendix 2: Electrical Engineering Periodicals of late nineteenth and early twentieth century**.

community external to the IEE. I will also examine how the IEE papers on wireless fit, or not, into this genre of publication.

Before offering a detailed analysis of wireless systems in the electrical engineering press, I must first consider: what is the electrical engineering press? To present this genre of publication as a unified and monolithic entity is inaccurate. During this early period in electrical engineering publication, there was a degree of tension between the specialised electrical engineering press that published illustrated versions of papers and verbatim reports of meetings and post-paper debate and discussion and the popular press that 'embraced colorful [sic] charlatans as enthusiastically as it did certified [sic] experts.'[98] The degree of tension was further developed by the editorial stance of the earliest, most established, and well-regarded electrical engineering periodical in Britain, *The Electrician*. *The Electrician* first appeared in 1861 but ceased publication after about three years. The title was revived through the publication of an entirely separate "new series" beginning in 1878 and this continued to be published weekly for almost a full century with the last issue appeared in 1952. In the same year, *Popular Science Review* was also first published and five years later in 1866 *Engineering* was first published. The overt editorial stance of *The Electrician* at the end of the nineteenth century – whose subtitle was “a weekly illustrated journal of electrical engineering, industry and science” – has been described as 'lofty...[and despising] of popular science.'[99] The divide between the electrical engineering press and the popular press was, in some ways, an artificial but necessary arbitration: *The Electrician* and other specialist electrical engineering periodicals made claims that “popular science” and its ilk had the potential to diminish the expertise of the field and to furthermore open up the field to those without credibility or established reputation in the field. They were not the only body in this field claiming expertise and authority – the Institution of Electrical Engineers claimed a similar if not more popular form of authority within the institution itself and more widely within the electrical engineering community from within the pages of its journal.

For these reasons and the fact that it was the premier journal in its field – widely read and quoted – I have chosen to focus on *The Electrician* as the main source for how the IEE wireless papers were perceived by and reported on in the wider electrical engineering world. This further shows that the Journal of the Institution of Electrical Engineers *(JIEE)* was not the only form of external publicity for the institution and its papers during this period. Furthermore

98 Carolyn (1988), 13.

99 *Ibid.*, 42.

these publications gave a different type of forum – utilising features such as editorials, reports, letters to the editor – that were simply unavailable in the *JIEE*. The closest equivalent for this type of forum in the *JIEE* was the post-paper debate and commentary. However, *The Electrician* also provided a different type of audience and a wider readership, while also providing a more critical view of the institution and its papers. Its articles, editorials and commentaries was indicative of how the IEE and its wireless debates were viewed more widely in the electrical engineering community and establishment. More widely the electrical engineering press provided a critique of the self-expressed role of the IEE found within the pages of its journal.

The coverage of wireless telegraphy in the external electrical engineering began with reports on Preece's papers before the British Association for the Advancement of Science in the early 1880s. Amended copies of the paper were printed along with diagrams and illustrations and a verbatim report of the post-paper discussion.[100] At the end of 1886, *The Electrician* also briefly reported on experiments conducted on telephoning without wires by the American scientist Dolbear.[101] In November 1887, experiments conducted by Preece and the Post Office were featured in the "Notes" column with which the periodical opened.[102] The "Notes" section contained a combination of news, brief reports, and mini-editorials, and can be used as a tool of gauging the concerns and interests of the electrical engineering community at the time and extracting important developments in electrical engineering. In late 1887 and early 1888, *The Electrician* had regular entries to the "Notes" on the use of electrical communication with Lighthouses and Lightships, and the investigation of this issue – at no less instigation than Queen Victoria herself – by the Board of Trade.[103] Even prior to the suggestion of existing forms of wireless telegraphy as a possible option, organisations such as Lloyd's of London maritime insurance company and the Post Office – who also featured prominently in early wireless telegraphy a decade later – were being fêted and considered. In September 1888 *The Electrician*, as per usual reported avidly upon the annual British Association meeting where William Preece in his role as President of Section G (Mechanical Science) made his presidential address and briefly mentioned his wireless experiments and how a wireless system using induction was in practical use on the American railways.

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100 See **Chapter 2 - 'Something in the Air': The Post Office and early wireless experiments, 1882-1899** for a complete list.

101 "Telephoning without Wires." *The Electrician* 18 (1886): 3-4.

102 "Note on [Experiments Conducted by Preece and the Post Office]." *The Electrician* 20 (1887): 9.

103 See **Section 2.3 – Wireless Experiments, 1882-1893** for further details.

By the end of the 1880s, wireless telegraphy had clearly gained some traction – quite literally in the case of railway usage – with the electrical engineering community with "Wires, Telegraphy Without" appearing in the index of Volume 22 (November 1888-May 1889) of *The Electrician* with a number of letters on the subject from prominent electrical engineers such as Willoughby Smith, Charles Bright, A.A. Campbell-Swinton, Oliver Heaviside, and others appearing in this volume. The discussion which continued throughout a number of different of issues was led by Campbell-Swinton who acted as a strong supporter and advocate of the wireless telegraphic systems developed by Preece and the Post Office. As discussed in the previous chapter, Campbell-Swinton later introduced the young Marconi to Preece in 1896.

In April 1891 a noteworthy letter appeared from a Mr Luke, Directory of the Construction Branch of the Indian Government Telegraph Department suggesting that telegraphy without wires had being achieved in India and that this might be used for lightships and lighthouses in Britain.[104] Luke referred to Willoughby Smith's experiments conducted at Eastbourne and a paper delivered by a Mr Melhuish to the Institution of Electrican Engineers on experiments he conducted utilising wireless signalling across rivers in India.[105] The latter may be, in fact, the first paper on a system of telegraphy without wires delivered before the IEE.[106] Remarks on the paper were contributed by such notable electrical engineers and IEE members as Major Cardew, Major-General Webber, Charles Bright, W.P. Granville, W.M. Mordey (the President).[107] Melhuish was a long-standing member of the Institution (since 1874) and his experimental wireless systems resulted in the award of a Paris Electrical Exhibition Premium in 1889.[108] Furthermore, Melhuish delivered a further article on his wireless system before the IEE in 1891, discussing how his system was adapted to incorporate

104 "Notes." *The Electrician* 26, no. 673 (1891): 685-86.

105 Both were reported upon in earlier editions of *The Electrician*. See "Note on [Willoughby Smith's System of Inductive Telegraphy]." The Electrician 24 (1890): 597; and "Note on [Melhuish's System of Inductive Telegraphy]." *The Electrician* 22 (1886): 56.

106 Melhuish, William Francis. "On Signalling across Rivers in India." *Journal of the Institution of Electrical Engineers* 19, no. 87 (1890): 323-31. The paper was delivered before the IEE by the Secretary since Melhuish was on his way home from India and was unable to present the paper in person.

107 Cardew, Major, Webber, Charles Bright, W. P. Granville, F. Wyles, and W. M. Mordey. "Remarks on "on Signalling across Rivers in India"." *Journal of the Institution of Electrical Engineers* 19, no. 87 (1890): 331-38; Mordey, W. M., and William Francis Melhuish. "Reply to Remarks on "on Signalling across Rivers in India"." *Journal of the Institution of Electrical Engineers* 19, no. 87 (1890): 338-40.

Major Cardew's vibrating sounders.[109] However, Melhuish's system was not developed further nor did it influence other wireless systems or practitioners in the field and so Melhuish's early wireless system was mostly forgotten. Melhuish's article did not become part of the accepted canon of wireless-related literature (such as it was at the time), was not referenced in any other subsequent papers on wireless telegraphy, and so Meluish and his system disappeared into obscurity.

In the early 1890s the lightning rod debate referred to earlier in this chapter was reported upon avidly and with no small level of detail and delight in *The Electrician* and elsewhere in the electrical engineering press. By this time Preece's wireless system had begun to be featured in the more popular press, matching claims made by Preece himself in a 1906 letter to *The Times* quoted in the previous chapter.[110] Around the time of the lightning rod debate in 1892, there was a lull in wireless telegraphy experiments. Preece had just been promoted to the role of Engineer-in-Chief (and Electrician) of the Post Office in 1892 and both the individual and the institution were kept busy with the nationalisation of the telephone trunk network and the subsequent investment in developing the long-distance telephone network. The absence of Preece, both in terms of driving the impetus behind these systems of wireless telegraphy and also notable in presenting far fewer other papers before societies and institutions, created a distinct void in wireless telegraphy until 1894 when this abyss was filled by Hertzian wave experiments by Lodge in 1894 and Marconi's arrival on the scene in 1896. Lodge's 1894 paper *The Work of Hertz* before the Royal Institution in June on 1894 made a big impact in the electrical engineering world and was considered of such importance that it was described in intricate detail over three issues of *The Electrician* on 8, 15, and 22 June 1894.[111]

In early 1896 Marconi arrived in England and by June of that same year he had applied for his first patent. The events surrounding Marconi's first year in Britain along with his introduction to William Preece and his engagement with the Post Office is described in more detail in the previous chapter. One important aspect of Marconi's early time in Britain which I have

108 "[Obituary Notice of] William Francis Melhuish." *Journal of the Institution of Electrical Engineers* 51, no. 222 (1913): 873.

109 Melhuish, William Francis. "On Signalling across Rivers in India with Cardew's Vibrating Sounders." *Journal of the Institution of Electrical Engineers* 20, no. 93 (1891): 347-49.

110 For example, see 'Wire-to-Wire Electrical Communication', *The Times*, Tuesday 23 November 1892, and many others.

111 Lodge, Oliver. "The Work of Hertz." *The Electrician* 33 (1894): 153-55, 186-90, 204-05.

purposefully left until now to consider is how the press, in particular the electrical engineering press, engaged with Marconi and his claims. On 10 December Preece introduced Marconi to the general public through his demonstration entitled 'Telegraphy Without Wires' at Toynbee Hall in London. Just over a week later on 18 December, a brief and somewhat critical note providing corrections to *The Daily Chronicle*'s excited but shallow reporting of the event was published in *The Electrician*.[112] The un-named author and a fellow electrical engineer (quoted below) had much to say about Preece's claims and *The Daily Chronicle*'s reporting. The electrical engineer is quoted as describing the daily newspaper's reportage thus: '...a most daring and amusing raid upon the reputation of Hertz who, although taken away from us but three short years ago, has already to make way for the latest adventurous Italian patentee.'[113] A direct quote from *the Daily Chronicle* was thought sure to confound and amuse better-informed readers, as were related claims made by Preece: 'The invention [of wireless telegraphy] is that of Signor Marconi, a well-known young Italian electrician...'[114]

In the following year, in June 1897 Preece again introduced Marconi, this time to the scientific and engineering elite that was the audience of the Royal Institution. An abstract of this Friday evening discourse, entitled "Signalling Through Space Without Wires", appeared in *The Electrician*.[115] It is notable that within the same volume, numerous letters and articles about Marconi and his system of wireless telegraphy now began to appear.[116] Shortly after this presentation, Marconi established the Wireless and Signal Telegraph Company and Preece and Marconi went their relatively separate ways.[117] Just over a year later, Lodge, Preece, and Evershed presented their wireless papers before the IEE. Both Lodge and Preece's papers – although Evershed's and Marconi's paper are noticeable in their absence – were printed in their entireties with amendments in *The Electrician* Volume 42 (October 1898-April 1899). The versions printed in *The Electrician* were subtly different from the versions printed in the *JIEE*. This was most noticeable in the case of Lodge's paper which contained photographs of apparatus in the version of his paper published in *The Electrician* whereas the version

112 "Note on [Hertzian Waves]." *The Electrician* 38 (1896): 236.

113 *Ibid*.

114 *Ibid*.

115 Preece, William Henry. "Signalling through Space without Wires." *The Electrician* 39 (1897B): 146-48.

116 See *The Electrician*, Volume 39 (April 1897-October 1897): 3, 207-208, 216-218, 431, 665, 667, 686-687, 773.

117 See **Section 2.8 1896 and all that: Marconi's arrival in Britain** for further details.

published in the *JIEE* articles was limited to diagrams. Additionally it was Lodge's paper which was published internationally: a copy of his paper, retitled "Various Forms of Detectors for Magnetic Space Telegraphy", was published in US edition of *The Electrician* on 2 March 1899.[118] These articles sparked much discussion and commentary within the pages of *The Electrician*, much as they had done in their delivery before the IEE and subsequent publication in their journal.[119] Before a copy of Preece's paper could be printed, it was described thus in the Notes column of 31 January 1899: '...Mr Preece is either badly informed or unduly modest in his statement in the first paragraph of his Paper, for we think more attention has been paid to his work than he supposes.'[120] The brief note went on to say that Preece's papers before the British Association, while not yet available in the public domain, were published in *The Electrician* and provided a gentle critique that the IEE paper shared much of the content of Preece's British Association paper delivered at Oxford in 1894.

As per the original papers themselves, the most revealing aspect was the post-paper discussion and debate and this was certainly the case with *The Electrician* too. In the subsequent issue on 20 January 1899, an abstract of the unified post-paper discussion was also published.[121] For the most part, the discussion matched that described in the *JIEE* but there were notable differences – the summary in *The Electrician* was very much that – a detailed summary rather than a verbatim report. However, it is clear that the *JIEE* edited their commentary as some comments mentioned in *The Electrician* summary were not listed in the commentary printed in the *JIEE*. Comments by C.S. Whitehead, Sir Henry Mance, A.R. Sennett and Professor Ayrton to be found in *The Electrician* summary are absent from the *JIEE*. It is particularly noteworthy that Professor Ayrton's comments formed a connection between the work of Evershed and theories and ideas published by one Oliver Heaviside with whom Preece had previously come into conflict – see earlier section of this chapter. Ayrton's comments very much focused on the theoretical aspects of inductive telegraphy hence the involvement of Heaviside and, according to Ayrton's comments, Ayrton and Heaviside had corresponded on the wireless telegraphy researches and experiments of Evershed and others. The lectures themselves along with the

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118 Lodge, Oliver. "Various Forms of Detectors for Magnetic Space Telegraphy." *The Electrician* [US] 87 (1899): 246-48.

119 Lodge's paper was spread across four issues – December 16 1898, December 23 1898, January 6 1899 and January 13 1899 issues.

120 "Notes." *The Electrician* 42 (1899): 395.

121 "Induction Telegraphy." *The Electrician* 42 (1899): 442-45.

commentary sparked off a flurry of letters in *The Electrician* which had barely abated when Marconi gave his wireless paper before the IEE a few months later in March 1899.

Marconi's paper was given on 2 March 1899 but, similarly to Evershed's paper, was not published in *The Electrician*, possibly by request of the author. Both Evershed and Marconi were approaching wireless telegraphy from a commercial footing and it is probably for this reason that they did not publish their papers, or even the abstracts, in a widely read and well-disseminated periodical such as *The Electrician*. It is a possibility that *The Electrician* chose not to publish these papers but given their avid reporting of both papers, particularly Marconi's, this seems unlikely. In contrast, Lodge who was coming to wireless telegraphy from an academic background published with "full disclosure" including photographs of apparatus. However, Marconi's paper sparked a lengthy editorial in *The Electrician* a few weeks later on 17 March 1899.[122] The editorial opened with the series of lectures on wireless telegraphy at the IEE as '[providing] for members and their friends an unusually sensational programme.'[123] Marconi's paper was given an overwhelming response:

> It is not too early yet...to say that the reception of Mr Marconi's paper is the most brilliant feature of the session; but we can assert that nothing approaching it has occurred in the history of the Institution not even excepting the memorable occasion when Nikola Tesla gave his lecture [at the Royal Institution]. Yesterday's overflowing meeting at Exeter Hall, when Mr Marconi repeated his discourse, was an event absolutely unique in the annals of the Institution of Electrical Engineers.[124]

Despite this enthusiastic opening, *The Electrician* article provided an in-depth critique of the paper, one echoing comments made in the discussion after the paper. Some audience members were left 'thirsting for knowledge' from a paper which followed 'in the form of a popular narrative of what was already known' with Marconi 'not likely to have received … any new inspiration.'[125] As per the other papers, a précis of the post-paper discussion (in this case, the post-paper discussion of the repeat performance of the paper) and, in this case, the summary of the discussion matched that published in the *JIEE*. The editorial concluded thus:

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122 "Hertzian Telegraphy." *The Electrician* 42 (1899): 724-25.

123 *Ibid.*, 724.

124 *Ibid.*

125 *Ibid.*

> Telegraphic practice and theory, in times to come, will probably look back upon Mr Marconi's paper and its discussion as marking an important point in the history of wireless telegraphy – important, that is to say, in the same sense that a pillar of stone acquires importance when it becomes a landmark or a milestone.[126]

The editorials' conclusion echoed points raised earlier in the article and also mirrored comments made in the post-paper discussion published in more detail in the *JIEE*. For reasons relating to commercial concerns, Marconi's paper was rather pedestrian in form. The paper told the audience nothing new but instead established a new Marconi-centric narrative of wireless telegraphy. Despite or perhaps because of this, the paper is memorable as a landmark in the overall history of wireless telegraphy but the content is not regularly cited. *The Electrician* editorial was also complimentary of the programme of wireless papers put together by the Institution of Electrical Engineers. It must be noted that evidence of a plan for a series of wireless papers is noticeably absent from the Papers Committee during this period with the sole mention being Marconi's lateness in submitting his paper for commentary.[127] Hence the editorial in *The Electrician* was the sole evidence of a coherent strategy on the part of the IEE to present a series of wireless papers. In conclusion, it must be noted that the complimentary comments from *The Electrician* about the IEE wireless papers was the sole comment by the publications on the role of the IEE in selecting, hosting, and publishing these papers. *The Electrician* did not appear to have any comments to make – explicit or implicit, negative or positive – on the role of the IEE itself in the field of wireless nor the contribution it might make to the overall field.

In this section, I have shown that different methods of wireless telegraphy were featured in electrical engineering periodicals from the early 1880s onwards. However the publication of early articles on wireless telegraphy in electrical engineering periodicals says less about how these systems were perceived by the electrical engineering community and more about the incorporation of scientific news and content by the electrical press. Furthermore, articles on wireless telegraphy followed the trajectory of wireless terminology, with sporadic publications in the 1880s and early 1890s before increased popularity and publicity in the late 1890s as Hertzian wave wireless telegraphy systems were being developed.[128] In summary, the engagement of the IEE membership with wireless telegraphy very much mirrored that of the

126 *Ibid.*, 725.

127 IET Archives UK0108 IET/ORG/4/5 – Signed Minutes of Library & Editing Committee, 1888-1907.

128 See **Section 1.7 – What we talk about when we talk about wireless** for further details.

wider electrical engineering community. Furthermore I have used external electrical engineering publications to consider whether "internalist" perceptions of the IEE matched those found externally. This is not the case, both in terms of wireless telegraphy and indeed more generally. The "internalist" view of the IEE put forward in the pages of the *JIEE* and elsewhere was as a popular form of authority in the field of electrical engineering. However, this rhetoric was not matched externally with the IEE being presented as a prominent, but not the sole, electrical engineering authority by the wider electrical engineering press.

3.6 Conclusion

As a member-led institution, the IEE offered a public domain and forum for debate and discussion and thematically these they were centred about sometimes competing claims of historical priority. The three papers also shared sometimes competing claims of historical priority with these being in direct response to Marconi's wide-ranging patent rights and associated claims of 'ownership' over wireless. Collectively, these papers provided evidence of a small but unified community of electrical engineers who were making contributions to the development of wireless communications, some of which were outside of the commercial sphere. Marconi himself provided a further response to these papers and their claims of historical priority when he presented a well-attended paper before the IEE in March 1899. Marconi's arrival in Britain marked a change in the claims made about wireless communications. He may not have been the inventor and technical innovator that is often suggested but his claims of master patent rights backed through his rhetoric of historical priority was truly original in the field of wireless communications. These changes combined with Marconi's commercialisation of wireless communications provoked a marked and immediate response from earlier British wireless pioneers. An initial outcome was a series of papers presented before the IEE in late 1898 and early 1899. The first three papers – presented by Oliver Lodge, Sydney Evershed, and William Preece – were the first papers on wireless telegraphy presented before the society.

The IEE response to these papers and indeed more generally to wireless telegraphy was somewhat neutral and lukewarm. Rather than responding to a strong member-led demand, many of the wireless papers presented before the IEE were responding to external events or the concerns of a few members. After the initial flurry of papers in response to Marconi's patents claims in 1898 and 1899, wireless did not appear on the agenda – at least in terms of wireless papers – until 1907 and the aftermath of the Select Committee hearings.[129] Furthermore some unresolved issues about patenting and intellectual property in this era may have discouraged some wireless pioneers from presenting before the IEE and other similar scientific societies.

Furthermore the more subtle role of the IEE with relation to wireless communications perhaps says more about their origins, structure, needs, and demands than it does about wireless communications but, as such, it does offer a window on the contemporaneous view of wireless communications from the electrical engineering community. The origins of the society with the Society of Telegraph Engineers along with the needs and demands centred about electrical engineering in heavy industry did not leave significant space for wireless-related activities within the IEE. However, changes did occur in the field of wireless communications in the aftermath of the "Marconi Scandal" in 1911 and the sinking of the Titanic in April of the following year. As a result of these events, new opportunities in wireless became available.[130] The IEE hosted the 1912 International Radiotelegraph Conference between 4 June and 5 July at the institution's premises on Victoria Embankment.[131] Also in the aftermath of the much-publicised and 'heroic' use of wireless in the sinking of the Titanic, the Council of IEE established a national committee to serve a proposed international association for scientific experiments in wireless telegraphy in 1913.[132] This was more likely to have been a response to the establishment of the Wireless Society of London a few months previously rather than meeting a perceived demand from members of the society. Despite these origins, the importance of the committee was recognised through the appointment of the then President of the IEE and esteemed wireless pioneer William Duddell as Chairman of this committee.[133] Appointment of a wireless pioneer as President was one indicator of the gradual change of importance of wireless within this society. Furthermore, Duddell spent a considerable part of

129 See **Chapter 6: "A question for commercial adjustment, and not for international legislation": wireless rules and regulations, 1904-1907** for further details.

130 For details of the **"**Marconi Scandal**"** see Donaldson (1962) and a brief discussion in **Chapter 8 – Conclusion**. For further details of wireless and the Titanic, see Hughes and Bosworth (2012).

131 "The Radio-Telegraphic Conference." *The Times*, 13 June 1912, 6.

132 See **Chapter 3: Electrical Potential: Wireless and the Institution of Electrical Engineers, 1898-1908** for further details.

133 "Report of the Council for the Year 1925-1926, Presented at the Annual General Meeting of 27 May 1926." *Journal of the Institution of Electrical Engineers* 64, no. 354 (1926): 655-63.

the inaugural presidential address – where he set the agenda of the society for the coming year – discussing recent developments in wireless telegraphy and calling for a general review of the subject.[134] Wartime temporarily paused changes within the Institution and it was not until 1920 when a Wireless Committee of the IEE was established. Furthermore their proceedings were not published until 1926 with publication of proceedings being a measure of importance within the Institution.[135]

The combination of the thirty-year gap between the advent of wireless communications in the late nineteenth century and the integration of this subject into the structure and working of the IEE is one indicator that this topic was not considered of great importance to the society nor possibly to the wider community of electrical engineers. In turn the formative role of the IEE in electrical and wireless regulations – a role they continue to hold to this day – might have led to an expectation of a similar role in wireless communications.[136] However, due to a lack of demand from within the society and a previous failed role in electrical standards as opposed to regulations in the late 1890s, the society remained aloof to any potential involvement in wireless rules and regulations. Instead wireless rules and regulations were considered a political matter, rather than a technical or purely regulatory matter, and so authority was allocated to the best-placed government departments; the Post Office and Admiralty. The roles of these two institutions in controversial issues of technical standardisation and intercommunication were, in some regards, a continuation of their prior distinctive roles in wireless communications. The Post Office's involvement in wireless rules and regulations was also a continuation of the domestic telecommunications licensing monopoly they managed on

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134 Duddell, William. "Inaugural Address." *Journal of the Institution of Electrical Engineers* 50, no. 217 (1913): 5.

135 Binyon, Basil. "Wireless Section: Chairman's Address." *Journal of the Institution of Electrical Engineers* 64, no. 348 (1925), 83.

136 For further details on the formative role of the IEE in electrical wiring standards, see Bruton, Elizabeth. ""Moderate in Scope": The Role of the Institution of Electrical Engineers in Electrical Apparatus Standardization at the End of the Nineteenth Century"." Paper presented at the Institution of Engineering and Technology/Defence Electronics History Society HISTEST (History of Testing Standards, Components & Systems) Conference, University of Bournemouth, UK, 2011.

For current details of IET electrical wiring regulations (BS 7671), see http://electrical.theiet.org/wiring-regulations/index.cfm.

behalf of the state. In terms of wireless legislations, this took the form of the 1904 Wireless Telegraphy Act.

Chapter 4: 'Britannia rules the wireless waves': the Admiralty and wireless, 1896-1903[1]

4.1 Introduction

Between 1896 and 1897 a young naval officer, Henry Jackson, utilised resources and technical expertise embedded within the Royal Navy (henceforth “the navy”) to develop an innovative Hertzian wave wireless system designed specifically to meet naval demands for maritime signalling. Jackson had the full support of the Admiralty, the government authority responsible for the command of the Royal Navy, and used resources made available to him at HMS Vernon, the naval centre for electrical training and research. In August 1897, Jackson sent a signal between two ships moored in harbour separated by a distance of several hundred yards. Within months, this wireless system was capable of transmitting over distances measured not in yards but in miles. However, the strategic and military importance of this internally developed wireless system meant that confidentiality was required. Patenting and publishing were forbidden by the Admiralty and so the origins and successes of naval wireless signalling are generally credited externally, to Marconi and his wireless company.

In July 1899 three naval ships – HMS Alexandra, HMS Juno and HMS Europa – tested Marconi wireless sets during naval manoeuvres and later that year Marconi wireless sets originally intended for the British Army were instead used by the navy during the Second Boer War, which took place between 1899 and 1902. In February 1901 the Admiralty signed a Deed of Agreement with the Marconi Company. The agreement was one of the newly established company's earliest and most important contracts. However, the Admiralty continued to concurrently test two similar wireless systems, one designed and manufactured within the navy itself and the other manufactured by the Marconi Company. This continued beyond their initial full contract with the Marconi Company, signed in April 1903, until about 1904 when they switched to exclusively using Marconi wireless apparatus. While the wireless apparatus was supplied by the Marconi Company, wireless operators were naval serviceman and related training was controlled and determined by the navy and was integrated into the structure and working practices of this military institution. Henceforth the

1 Chapter title taken from 'New World. Old World.' article in *The Star*, 18th October, 1907. Article described opening of first transatlantic wireless service from Clifden to Glace Bay using Marconi wireless. An early version of this chapter was presented at the 2012 Three Societies conference in Philadelphia, USA and the comments received were very helpful indeed and were much appreciated.

Admiralty continued to invest in wireless, both with land-based stations and on-board wireless sets. This process of installation, adaptation, and adoption continued up to and throughout World War One.

On the surface, the Admiralty's engagement with wireless telegraphy fits into the traditional historiography of commercial development and early success of the Marconi Company. However, I will question whether the Admiralty's engagement with wireless during this formative period in its history was, as it is often presented, as a passive customer. I will challenge this approach and instead propose that their engagement with wireless was a more active and complex one, with agency and authority being mostly a military matter and not a commercial one. I will explore the significance of the Admiralty's role in the moulding of early wireless, particularly in relation to institutional invention and innovation. To this end, I will consider three-fold engagement of the Admiralty and Royal Navy's with early wireless communications and their roles therein. First, the Royal Navy offered a welcome home for institutional innovation and experimented with an internally developed wireless system from the mid-1890s onwards. This system was developed prior to Marconi's arrival in Britain. Secondly, the navy was one of the earliest customers for wireless systems, particularly the Marconi system. They shaped wireless communications to meet their needs for maritime signalling and incorporated wireless signalling into their institutional structure and practices. This had wider implications for the development of wireless communications. Finally and something covered in more detail in the next two chapters, the Admiralty acted as a regulator – shaping international rules and regulations to match both its needs and more generally the British national interest.[2] In this chapter I will show how the role of the Royal Navy and the Admiralty demonstrated the power of the institution and innovations offered within its fold and furthermore demonstrate the significance of maritime wireless communications in the pre-radio history of wireless communications. The traditional narrative of wireless emphasises the power and control of wireless companies, especially the Marconi Company. I will counteract this and show how the Admiralty and the Royal Navy were not passive consumers but instead took an active role in wireless innovations during this formative period in its history.

Traditional wireless historiography emphasises the importance of technological and commercial innovations while presenting adopters of these technologies – including the military – as

2 See **Chapter 5 – 'If the Government did take over wireless it meant that they would take over us': simmering tensions between commercial and state interests, 1903-1905** and **Chapter 6 – 'A question for commercial adjustment, and not for international legislation': wireless rules and regulations, 1905-1908** for full details.

grateful consumers and passive users.[3] This perception is comprehensible to some degree: commercial developments were prominent in the public sphere while military technologies remained hidden and understudied due to the confidentiality of much of the primary source documentation. Military secrecy was formalised through the Official Secrets Act, first introduced in 1889.[4] Prior to this, naval technologies were more openly and publicly discussed. A notable example and one which has been the subject of recent scholarship is naval architecture before the British Association for the Advancement of Science in the mid-nineteenth century.[5] Nonetheless the introduction of the Official Secrets Act in the late 1880s led to increased military confidentiality and a fifty-year lag in the availability of primary sources on military technologies including wireless communications. Further to this, much naval expertise – technological and general – was kept within the navy and was not published externally. To a certain degree, the confidential and internal nature of naval expertise contributed to a distinct omission of military use of wireless from contemporary publications. For example, the pioneering wireless work of Captain Jackson of the Royal Navy – a central figure in this chapter – received a scant one-sentence mention in J.J. Fahie's contemporary *A History of Wireless Telegraphy, 1838*-1899, first published in 1899 with a second edition appearing in 1900.[6] This remained the case until the release of related archival material with expiration of the fifty-year limitation of the Official Secrets Act. At last, the full contribution of the Admiralty could be acknowledged. However, much scholarly attention was focused on Jackson's work and technical developments in the field of wireless resulting in a flurry of publications in the late 1950s and early 1960s.[7] One of the early scholars publishing upon early naval wireless and the work of Henry Jackson was Rowland F. Pocock who continued to publish in this area until the late 1990s.[8]

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3 Examples of traditional wireless scholarship include Aitken (1976), Appleyard (1930), Coe (1943), Garratt (1994), Geddes (1974), Jacot de Boinod and Collier (1935), Jolly (1974), Rowlands (1994), and Weightman (2004).

4 *52 & 53 Vict. c. 52.*

5 Marsden, Ben. "The Administration of the "Engineering Science" of Naval Architecture at the British Association for the Advancement of Science, 1831-1872." *Jahrbuch für Europäische Verwaltungsgeschichte* 20 (2008): 67-94.

6 Fahie (1899).

7 See for example, Pocock, R. F. "Admiral Sir Henry Jackson." *Proceedings of the IEEE* 52, no. 4: 440-41; ———. "Captain Henry Jackson and the Early Development of Radio." *Journal of the Royal Naval Scientific Society* 20, no. 1 (January 1965); Pocock, R. F., and C. Susskind. "Pioneers of Radiotelegraphy." *Proceedings of the IEEE* 51, no. 6: 959-60; Rawles, Alan T. "Jackson of the "Defiance"." *Journal of the Naval Scientific Service* 19, no. 6 (November 1954): 239-42.

8 Pocock (1995), Pocock (1998), Pocock and Garratt (1972).

However, Pocock's publications are unduly focused on the technical aspects of the wireless systems used by the Admiralty and treat Jackson as a scientific pioneer, and do not consider the institutional context of Jackson's work a historiographical priority. Furthermore Pocock included little analysis of how the Admiralty as an institution engaged with wireless, nor does his work consider how it came to form an influential policy and strategy with regard to these innovative technologies. While his publications highlight and indeed celebrate the work of institutional innovators such as Jackson, they did not explore in detail the more political and administrative aspects of the Admiralty's engagement with wireless such as contracts, interdepartmental conferences, and international conferences. Furthermore even Pocock's monograph on the origins of maritime radio – written jointly with the Science Museum's G.R.M. Garratt – presents the 1900 contract and 1901 Deed of Agreement between the Admiralty and the Marconi Company as being an end point of sorts with the Admiralty unenthusiastically and unquestionably embracing use of the Marconi wireless system, a thesis I wish to question and interrogate further.

Another outcome of the fifty-year embargo on early naval development of wireless communications is a confusion about the timing of their early wireless developments, in particular those of Jackson. This originates from scholars who have referenced pre-1950s works featuring early naval wireless systems and this is something I wish to clarify. For example, wireless historians such as Sarkar (citing Crowther, published in 1954 before archival records on naval wireless became widely available) and Bray have claimed that Jackson began experimenting with Hertzian wave wireless signalling as early as 1891 but that these were kept confidential by the Admiralty.[9] This somewhat unlikely claim has been corrected and clarified by more in-depth research utilising the archival material made available by scholars such as Royal Naval Scientific Service member and historian of engineering, Alan Rawles along with physicist and historian of science Paul Halpern.[10] These scholars have utilised original Admiralty documents made available from the mid-1950s onwards. Rawles's article along with a more recent and more definitive 2004 *Oxford Dictionary of National Biography* entry on Jackson by Halpern confirm that it was circa 1891 that Jackson stated

9 Sarkar, Mailloux, Oliner, Salazar-Palma, and Sengupta (2006), 84 cites Crowther (1954) as evidence of Jackson's 1891 experiments. Bray (2002) also makes reference to Jackson's 1891 trials. Crowther (1954), 137 claims that Jackson had been conducting secret research on behalf of the Admiralty as early as 1891.

10 Rawles, Alan T. "Jackson of The "Defiance"." *Journal of the Institution of Electrical Engineers* 1, no. 12 (December 1955): 743-45 and Halpern, Paul G. 'Jackson, Sir Henry Bradwardine (1855–1929).' *Oxford Dictionary of National Biography*. Ed. H. C. G. Matthew and Brian Harrison. Oxford: OUP, 2004. Online ed. Ed. Lawrence Goldman. Jan. 2007. Accessed: 29 June 2012 <http://0-www.oxforddnb.com.wam.leeds.ac.uk/view/article/34134>.

Hertzian waves might have practical naval application but he was unable to begin experiments until a few years later. This conclusion is matched by private correspondence between Jackson and historian of electrical engineering, J.J. Fahie, written in June 1902.[11] In his letter, Jackson suggested Fahie might include details of Jackson's wireless experiments and system in an updated edition of *A History of Wireless Telegraphy, 1838-1899*. Jackson wrote that he first considered Hertzian waves as a means of wireless naval signalling upon reading Trotter's 1891 editorial in *The Electrician*.[12] Trotter's editorial described two potential systems of wireless telegraphy: inductive telegraphy, which had been realised by Preece, Melhuish, Willoughby Smith, Luke, and others, and Hertzian waves. As mentioned previously, Trotter may have been the first to suggest wireless signalling as a potential use for Hertzian waves and his 1891 editorial certainly pre-dated Crookes' 1892 article, with the latter being generally considered the earliest published suggestion of Hertzian waves as a form of wireless signalling.[13] Trottter concluded that Hertzian waves of a certain wavelength 'would probably pierce not only a fog, but a brick wall' and that there would be many interesting uses including the possibility of communicating between lightships and the shore.[14]

Although the possible applications of Hertzian waves discussed by Trotter in 1891 led Jackson to consider Hertzian wave wireless telegraphy as a solution to naval demands for signalling, Jackson acknowledged in his letter to Fahie that it was not until Jackson joined HMS Defiance in 1895 and had access to suitable electrical instruments that he could begin practical steps towards developing a Hertzian wave wireless system. Jackson concluded with a note that the letter should be destroyed if it was not to be used. Needless to say it was not destroyed but instead languished in obscurity and, as far as I know, has not been featured in any research on wireless history. It was not until Admiralty records were released through the Public Records Office (now National Archives) in the mid-1950s that better-informed research upon Jackson's wireless systems was published.[15]

Despite the current availability and accessibility of primary and secondary source material on early naval wireless signals, military consumers and users remain marginalised in contemporary recent wireless scholarship. For example, Headrick downplays the contribution of the Admiralty to

11 IET Archives UK0108 SC MSS 009/2/79/1 – 6pp. Als from Henry Jackson to Fahie … giving details of his experiments dating from 1893, working along same lines as Marconi, dated 30 June 1902.

12 Trotter, Alexander Pelham. "Notes." *The Electrician* 26 (1891): 685-86.

13 Crookes, William. "Some Possibilities of Electricity." *The Fortnightly Review*, 1 February 1892, 174-76. See **Section 2.3 - Wireless Experiments, 1882-1893** for further details.

14 Trotter, Alexander Pelham. "Notes." *The Electrician* 26 (1891), 685.

15 See **footnote number 7**.

early wireless developments considering these developments solely through the prism of commercial development and the perceived early successes of the Marconi Company.[16] For example, Headrick condenses Jackson's wireless system into a single paragraph, and describes the three-mile range of Jackson's system as 'poorly' in comparison to the four-and-a-half range of Marconi's system.[17] In doing so, Headrick does not consider the practical application of each system with Jackson's system designed for maritime usage. He also fails to acknowledge that Marconi's system was adapted for maritime usage through the assistance of Jackson and other naval officers. Moreover Headrick summarises Jackson's contribution to wireless as being 'most important of all [making] the Admiralty Marconi's first and best customer.'[18] Another more contemporary scholarly study of Admiralty engagement with wireless was a Ph.D. thesis by A.J.L. (Lee) Blond completed in 1993.[19] This study, which was heavily influenced by the work of Pocock, was a more “internalist” history covering naval engagement with wireless from 1895 to 1920 in the context of implications for personnel and organisation, the influence on tactical operations and maritime strategy, the impact on the Admiralty and the development of security consciousness, the problems of administration and control, concluding with the transition from wireless telegraphy to the 'new' medium of radio broadcasting.[20] Technical developments and the influence of these institutional innovations upon the external and commercial development of wireless communications are not considered within this fascinating thesis.

Furthermore other well-known, well-regarded, and more recent publications in the field of wireless history have mostly ignored military users and their agency or failed to consider how their engagement with wireless technologies might be influenced by anything other than technological needs.[21] This chapter shows how different forms of wireless technologies, internal and external, came to be embedded within the institutional structure of Royal Navy and the Admiralty. Furthermore I will demonstrate how wireless telecommunications were not shaped merely by technological needs but also by institutional innovation, consumer and user demands, political concerns, and military strategy. Furthermore I will show that wireless communications in this first decade were shaped by complex interactions between state institutions and commercial

16 Headrick (1991), 116-137.

17 *Ibid.*, 117.

18 *Ibid.*

19 Blond, A.J. Lee. "Technology and Tradition: Wireless Telegraphy and the Royal Navy, 1895-1920." University of Lancaster, 1993.

20 *Ibid*, Abstract.

21 See **footnote number 3**.

organisations with the balance of power and a strong sense of agency lying with the best-placed state institution, the Admiralty.

4.2 The Royal Navy as a Technical Innovator

As discussed in the previous section, the received view of the Royal Navy in relation to wireless communications is one of a consumer, and a grateful and passive one at that.[22] Only a wireless historiography such as this, centred on the commercial development of these innovative technologies, could ignore the contribution of the navy (and indeed other institutions such as the Post Office) in terms of technical innovations in the field of wireless. A wireless system developed entirely within the Royal Navy and without commercial concerns such as patenting was the first wireless system to communicate from ship-to-ship and indeed set the standard in terms of technical innovations in wireless at the end of the nineteenth century. Indeed Marconi followed the advice of Captain Henry Jackson – the naval innovator in question – and adapted his wireless system in order to meet the demands of the navy and make it better suited for maritime usage. The military context of these developments meant secrecy and confidentiality rather than publicity and publication were the priority and, as a result, much of the documentation relating to these technical and institutional innovations have languished unexamined in military and institutional archives. Through my research, I will show how the Admiralty and the Royal Navy were setting the agenda in terms of wireless technical innovations during this period. I will show how initially this powerful agency was used to shape wireless technologies to meet their needs and demands for military and maritime communications. Furthermore I will show that this continued when later their role changed to one of a powerful consumer, with military demands for privacy, security, and reliability coming to the fore.

Maritime use offered the first and indeed only practical demand for wireless communications and early wireless companies were dependent on marine communications, military and civilian, both financially and technologically.[23] This remained the case until the development of aircraft capable of carrying wireless sets during the early stages of World War One and the advent of post-war broadcast radio in the 1920s.[24] Indeed wireless, or rather Marconi's wireless system (this being the

22 For example, see Fahie (1899) and Headrick (1991).

23 Pocock (1995).

24 For details of the development of aviation wireless communications in the British military during World War One, see Bruton, Elizabeth. '*Experiments in radio telephony in the Royal Flying Corps and Royal Air*

sole commercial wireless system available in 1896), was described in an Admiralty report as having 'no [other] possible market' than maritime use.[25] The well-established and vast network of telegraph cables stretching across the lands of the British Empire and almost around the globe (the Trans-Pacific cable completed the global telegraph network in 1909) meant there was little demand for land-based wireless telegraphy. Furthermore, there was a distinct lack of practical demand for airborne wireless communications until heavier-than-air powered aircraft were being developed in 1903.[26] In direct contrast to the distinct lack of demand from their land-based and air-borne military comrades, there was a strong maritime demand for a mode of wireless communications, preferably long-distance, within the navy and also within the civilian maritime community. Existing modes of signalling within the navy were limited to visual and audio signalling which could and regularly were severely constrained by limited range and weather.

The limitations and restrictions of these existing methods of naval signalling and a strong demand for a reliable form of long-distance signalling led the navy to become one of the earliest wireless innovators and adopters. Initial demand for wireless centred about the needs for communication with lighthouses and lightships, both locations where the vast existing network of telegraph cables were unable to go. This need was articulated prior to the discovery of Hertzian waves and was met with the best-placed government department and institution in the field of telecommunications at the time, the Post Office. With the discovery and publication of Hertzian waves – that is electromagnetic waves – in the late 1880s, interest in the signalling and weapon potential of these invisible waves was sparked, both literally and figuratively. In the late 1880s, the three most powerful navies in the world were those of Britain, France, and Russia. With forty-two battleships, fifty-nine cruisers, and one-hundred and forty-three torpedo boats in operation by 1888, the Royal Navy had a clear margin of superiority over France and Russia but remained deeply

Force during the First World War' presented at Technology, Technologists & Networks: A Symposium on the History of Communication Technologies at the Smithsonian National Postal Museum, Washington D.C., USA (2007). Electronic copy available from author.

25 National Archives ADM 116/523 – Records of the navy Board and the Board of Admiralty – Cases: Wireless Telegraphy (1899) – Correspondence from Captain H.B. Jackson to Commander-in-Chief HMS Devonport, dated 16 September 1896.

26 Early aeroplanes lacked both the engine power and space to carry early wireless sets which were heavy, cumbersome, and temperamental. These practical obstacles would not be overcome until World War One and the advent of radio telephony. In the meantime another field of aviation, ballooning, would be first to experiment with wireless communications with ground-to-air wireless telegraphy with balloons and airships being put into practice by the Royal Engineers as early as 1907. Also see **footnote number 22**.

concerned about torpedo attacks upon the fleet, a distinct possibility given that torpedo boats were where the three most powerful fleets were closest matched.[27] The responsibility for a solution to these problems was allocated to the navy's torpedo school, HMS Vernon in Portsmouth, this being a shore station and the naval centre for electrical training and research. The solution was centred about two initial ideas requiring a wireless system: a means of controlling torpedoes and a system to identify friend or foe at sea. The latter was where the navy's initial demand for wireless communications was located.

Much of the technical innovation within the navy was centred upon HMS Vernon, the naval centre for electrical training and research. HMS Vernon was officially established in 1876 as a torpedo-school and gradually expanded its remit to include mines, gunnery, and electricity. However, its origins date back further to early development of the self-propelling torpedo by Luppis and Whitehead in the late 1860's. Their work made apparent the naval application and weapon capabilities of this new technology and in 1872 the rights of manufacture were obtained by the Admiralty on behalf of the navy. This led to the hulk of the frigate HMS Vernon, named after Vice-Admiral Edward Vernon, the hero of the Battle of Portobello in 1739, being fitted out at Portsmouth as a torpedo instruction ship in 1876.[28] From its early days, HMS Vernon was the single authority within the navy for mines and torpedoes, these being classed together by the Admiralty since 1867. It was later allocated responsibility for gunnery and electrical engineering and was the centre for naval scientific research and training and was the source of much larger innovative practices emerging from the navy.

In 1881 the first annual report of the Torpedo School was published and these detailed reports continued to be published in this format until the 1920s.[29] During the thirty-year period of its existence from 1876 to the early twentieth century, the electrification of the maritime world – military and civilian – had taken place parallel to the development of the field of electrical engineering at the end of the nineteenth century. HMS Vernon was the centre for the navy's torpedo training school with every Midshipman being required to attend a preliminary training course in torpedoes prior to being commissioned as a Lieutenant. Those naval Lieutenants requiring further training were required to attend and pass a practical course of instruction either at HMS Vernon at Portsmouth or HMS Defiance at nearby Devonport, these being the navy's two torpedo

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27 Pocock (1998), 136-137.

28 Miller, Francis H. 'Concerning the Names of Ships'. *The Navy and Army Illustrated* 3 no. 29 (1897): 72-73.

29 See ADM 189 – Admiralty: Torpedo Instructions School, later Torpedo and Anti-Submarine School: Reports (1881-1958) for full details.

training schools.[30] In addition Royal Marine Artillery recruits were trained in torpedoes and gunnery at HMS Vernon and HMS Excellent.[31]

One of the many young officers working in the exciting and promising field of torpedoes and one who worked with Whitehead torpedoes was a Lieutenant Henry Bradwardine Jackson. Jackson had joined the navy aged 13 from a background of poverty in Yorkshire and had worked his way up to an officer. Along the way, he had acquired an interest in electricity and in September 1881 he joined HMS Vernon and qualified as a torpedo lieutenant, later serving in command of the school's tender, the torpedo vessel HMS Vesuvius. Jackson had a strong interest in the scientific aspects of his work and in 1883 he was elected an associate of the Society of Telegraph Engineers, later the Institution of Electrical Engineers. As part of his studies, he had acquired a distinctive set of skills and scientific knowledge and in 1885 he was put in charge of "Whitehead" torpedo instruction at HMS Vernon.

The "Whitehead" torpedo was one of the main torpedoes being used by the navy in the late nineteenth century and was the world's first effective self-propelled naval torpedo, developed by an English engineer, Robert Whitehead.[32] These torpedoes were trialled by the navy between 1869 and 1870 and, with successful trials completed, a batch of torpedoes were purchased by the navy. A year later in 1871, the Admiralty bought the manufacturing rights for Whitehead's 14-inch and 16-inch torpedoes for £15,000 with production starting the following year at the Royal Laboratories, Woolwich.[33] Despite the initial promise of the torpedoes, there were a number of specific technical problems with the early Whitehead torpedoes provided to the navy, especially with their launching method. Woolwich Arsenal was provided with practical experience and suggestions from the staff at HMS Vernon and so adapted the torpedoes in order to improve their speed and strength.[34] These adapted torpedoes, resulting from internal innovation within the navy, were named the *Fiume*

30 For an illustration of naval torpedo training, see "Torpedo Instruction on Board The "Theseus"." *The Navy and Army Illustrated* 1 no. 13 (1896): 298.

31 'Officer Instructors of Royal Marine Artillery'. *The Navy and Army Illustrated* 2 no. 18 (1896): 87.

32 For further information on Whitehead, see Gray (1991). On a side note, Robert Whitehead left the fortune he had accumulated from his torpedo company, Whitehead and Company, to his grand-daughter Agathe Whitehead. In 1911 she married Georg Ludwig von Trapp, a submarine captain, and they had seven children together before she died of scarlet fever in 1922. Her children were later be immortalised as the Trapp Family Singers in *the Sound of Music*.

33 Kirby, Geoff. 'A History of the Torpedo. Part 1 – The Early Days.' *Journal of the Royal Navy Scientific Service* 27 no. 1 (1972): 33.

34 'Torpedo Practice at Sea: HMS Boomerang'. *The Navy and Army Illustrated* 3 no. 29 (1897): 62.

pattern, after the location of the Whitehead torpedo factory in Austria-Hungary.[35] In July 1890 Jackson himself temporarily served at the Whitehead factory at Fiume alongside his torpedo duties at HMS Vernon. This example shows how, in addition to providing training and instruction, HMS Vernon also provided the navy with an internal centre of innovation and excellence where, in the case of HMS Vernon, electrical instrumentation could be developed, calibrated, and improved and where scientific knowledge and technical expertise could be shared. Shared technical expertise and institutional innovation had a welcome home within the Royal Navy at HMS Vernon. The promising field of wireless communications provided an opportunity to continue these scientific and technological innovations. Furthermore, wireless communications was an aspect of electrical engineering which offered many practical applications for the navy and fitted in well with Jackson's theoretical and electrical knowledge.

Jackson excelled in teaching and sharing his knowledge of electrical theory and its practice, including work on torpedoes and thus on 1 January 1890 he was promoted to the rank of Commander.[36] As mentioned above, Jackson was appointed to further torpedo duty on board HMS Vernon in July 1890 and also spent time in service at the Whitehead torpedo factory in Fiume.[37] Torpedoes were not Jackson’s only area of expertise and he was very well read in the discipline of electrical engineering, as was expected of an early member of the Society of Telegraph Engineers. Around the late 1880s and shortly before being promoted to Commander, Jackson read of the work of Heinrich Hertz and possibly Oliver Lodge, although Jackson disputed having come across the work of the latter until after he began experimenting in 1895 and later adapted his apparatus to include features described in Lodge's “little book”.[38] In 1891 and while serving on HMS Edinburgh in the Mediterranean squadron, Jackson read an article by Alexander Pelham Trotter published in *The Electrician* which suggested that lighthouses might use Hertzian waves to signal on foggy days.[39] Jackson went on to suggest that these Hertzian waves might further hold the solution for the navy's problems with torpedo attacks.[40] However, Jackson was unable to put his wireless experiments into full practice until he was appointed to command HMS Defiance, the torpedo school at Devonport, on

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35 *Ibid.*

36 *The London Gazette* no.26007 (31 December 1889): 7553. URL: http://www.london-gazette.co.uk/issues/26007/pages/7553. Accessed 2012-09-05.

37 The Dreadnought Project. 'Henry Bradwardine Jackson.' http://www.dreadnoughtproject.org/tfs/index.php/Henry_Bradwardine_Jackson. Accessed 2012-09-04.

38 Lodge (1894). See **Section 2.4 – Wireless Experiments, 1893-1896** and **Section 2.5 – 1896 and all that: Marconi's arrival in Britain** for further discussions of Lodge's 1894 paper and its significance in wireless history.

39 Trotter, Alexander Pelham. "Notes." *The Electrician* 26 (1891): 685-86.

29 January 1895. Now Jackson had access to the resources required to develop a prototype wireless system. Furthermore HMS Defiance shared a close connection with HMS Vernon, the naval electrical engineering and torpedo school, where Jackson had formerly served and trained. As such, Jackson's early wireless experiments were situated adjacent to other naval technologies including electrical engineering and to larger innovative practices emerging from HMS Vernon.

By the time of his appointment to HMS Defiance, Jackson had also read about the experiments conducted by the Indian scientist Jagadish Chandra Bose who visited London and gave a lecture describing his apparatus before the prestigious Royal Society.[41] Jackson decided to develop a wireless system utilising Bose's 'spring coherer' and by December 1895 he had constructed a working wireless set of his own construction using a 'spring coherer' of Bose's design, a spark-gap transmitter and a one-inch induction coil.[42] The results from the wireless set were not very satisfactory, unsurprising considering the small length of the spark produced by the induction coil, and so by March 1896 Jackson had improved his apparatus. Jackson obtained a more powerful induction coil and also constructed a new coherer using the Branly type coherer, a small narrow glass tube of iron fillings.[43] Jackson had also connected an electric bell trembler to the coherer to act as a tapper, to tap the coherer and decohere the fillings after the Morse code signal had been received. Both the coherer and the tapper were features described in Lodge's aforementioned 1894 publication *The Work of Hertz*. On 20 August 1896 Jackson had successfully transmitted and received Morse code signals for the first time and by the end of the month he was able to transmit and receive along the length of HMS Defiance, a distance of a few hundred yards.[44] Reports of Jackson's wireless system first appeared in the Annual Report of the Torpedo School in 1896 with a brief paragraph on 'transmitting electrical signals without connecting wires' allocating credit for these 'interesting

40 Halpern, Paul G. 'Jackson, Sir Henry Bradwardine (1855–1929).' Oxford Dictionary of National Biography. Ed. H. C. G. Matthew and Brian Harrison. Oxford: OUP, 2004. Online ed. Ed. Lawrence Goldman. Jan. 2007. Accessed: 29 June 2012 <http://0-www.oxforddnb.com.wam.leeds.ac.uk/view/article/34134>.

41 Bose's apparatus was described in an 1895 lecture before the Royal Society and published as Bose, Jagadish Chandra. "On the Determination of the Indices of Refraction of Various Substances for the Electric Ray." *Proceedings of the Royal Society of London* 59 (1895): 160-67.

42 Fahie (1899), 202.

43 Branly used the term “radio-conductor” while Lodge preferred “coherer”, a term he coined himself. By the mid-1890s and especially in Britain, Lodge's term “coherer” was more commonly used and I have used this term throughout this chapter. See Hong (2001), 29-33 for further details.

44 National Archives ADM 116/523 – 'Tabular Statement of Dates of Working Out Important Points of '*Defiance's*' System' (1899). Former file reference PRO ADM 116/523.

experiments' to staff of HMS Defiance.[45] The operation of the apparatus was described thus: '[it] slowly transmitted and recorded at short distances.'[46]

By August of the following year Jackson had improved upon his initially crude apparatus with a larger spark gap and more efficient coherer and was able to signal between two ships moored in harbour and over a distance of several hundred yards. This was, without a doubt, the world's first wireless electrical signalling from ship-to-ship. As a result of this, it is Jackson rather than Marconi who was celebrated as the “father of wireless” in contemporaneous internal and paternalist naval accounts of early wireless history.[47] Soon Jackson was transmitting over distances measured not in yards but in miles. However, as Jackson was a serving naval officer and working on a confidential matter of military and strategic importance, he was neither unable to publish his results at the time nor was he encouraged to patent.

In 1892 and around the time when Jackson first began to consider the use of Hertzian waves with relation to naval signalling, the Admiralty issued a statement – widely disseminated in the electrical press and elsewhere – revising and clarifying their official policy in relation to institutional invention and patenting.[48] The statement described the procedures for applying for a patent, that is anyone employed by the Admiralty as an officer or as a civilian in administrative, manufacturing or experimental work would have to obtain the approval of the Lords of the Admiralty prior to seeking the provisional protection of a patent application. Furthermore they would have to make the application through their head of department and provide a full description of the invention. The statement issued the proviso that 'permission...will not be granted as a matter of course, but each application will be dealt with according to the circumstances of the case.'[49] If the invention was of application (even potential or future application) to Her Majesty's service then it would 'be subject to such conditions as to assignment of the patent or to its use by the Government as they may think fit to impose.'[50] In terms of settlement for use of the patent by the government, it would be taken into consideration whether the patentee(s) had utilised facilities obtained through their position in the Admiralty. Due to these strict conditions, it is unsurprising that Jackson did not patent his wireless system. Furthermore the military application led to a veil of secrecy covering much of Jackson's

45 National Archives ADM 189/16 – Annual Report of the Torpedo-School (HMS Vernon) for 1896, 71-73.

46 *Ibid*, 71.

47 For example, see "Wireless Telegraphy in the Navy." *The Navy and Army Illustrated* 11 (1901): 589-90.

48 'The Admiralty and Departmental Inventors.' *The Electrician* 30 (1892): 116.

49 *Ibid.*

50 *Ibid.*

work and his contributions to early wireless history were mostly unknown until archive material was released in the late 1950s.

The confidential military context of Jackson's experiments meant they were not publicised and hence received little recognition outside of the navy. One learned society which did recognise Jackson's work in the field of wireless was the Royal Society and in June 1901 Jackson was elected a Fellow of the Royal Society.[51] Jackson had originally applied for election in January 1899 while serving as a naval attaché in Paris and his application was read before the society in the following month.[52] Applications to become a Fellow of the Royal Society were supported by individuals with personal knowledge and those with general knowledge. Jackson's application, in particular those supporting his application through personal knowledge, reads like a *Who's Who* of senior figures in naval scientific research.[53] Furthermore, his application was also supported by William Preece who supported Jackson's application with regard to personal knowledge and Oliver Lodge who supported with regard to general knowledge. Jackson's citation read as follows:

> Naval Attaché to the British Embassy, Paris. Invented (1886) a practical system of electrically illuminating gun sights for firing at night, which was adopted and used for some years in HM navy, but has since been replaced by later methods. Proved (1888) that considerable stability is necessary in order that a totally submerged automobile torpedo may maintain a straight course. Has given much attention to the theory and practice of aerial telegraphy. Invented a serviceable apparatus for signalling between ships at sea without wires. Proved that if the Hertzian oscillations are transmitted and received by vertical wires, the distance to which

51 The Royal Society. "The Royal Society Past Fellows: Jackson; Sir; Henry Bradwardine (1855-1929)." http://royalsociety.org/DServe/dserve.exe?dsqIni=Dserve.ini&dsqApp=Archive&dsqCmd=Show.tcl&dsqDb=Persons&dsqPos=16&dsqSearch=%28%28text%29%3D%27jackson%27%29. Accessed 2012-08-17.

52 Royal Society Archives EC/1901/06 – [Fellow Application for] Jackson, Sir Henry Bradwardine (1901). URL: http://royalsociety.org/DServe/dserve.exe?dsqIni=Dserve.ini&dsqApp=Archive&dsqCmd=Show.tcl&dsqSearch=RefNo==%27EC%2F1901%2F06%27&dsqDb=Catalog Accessed 2012-08-17.

53 Jackson's application was supported through personal knowledge by George Joachim Goschen (Liberal and Conservative politician; First Lord of the Admiralty 1871-1874 and 1895-1900; Chancellor of the Exchequer 1891-1892), Sir William Henry White (Naval architect), Arthur Mason Worthington (Master, Royal Naval College, Greenwich), Arnold William Reinold (Professor of Physics, Royal Naval College, Greenwich 1873-1908), Samuel Hawksley Burbury (lawyer and mathematician), and Ettrick William Creak (Superintendent of Compasses, Hydrographic Department, Admiralty 1887-1901).

> effective signals can be sent tends to vary within limits as the product of the lengths of the wires.[54]

Similarly to two of his proposers and two fellow wireless pioneers, Oliver Lodge and William Preece, Jackson worked outside of the commercial sphere and so did not patent any of these developments, wireless or otherwise. While Preece and Lodge did hold patents with Lodge being the sole holder of a wireless patent, neither fully commercially exploited their patents. Both Preece and Jackson were, to a certain degree, constrained by their institutional backgrounds in what they could patent. And so in absence of the potentially lucrative financial rewards, an alternative reward existed in the worthy election to fellowship of the Royal Society. In contrast, Marconi who held multiple patents and ruthlessly exploited the patent system for commercial gain was never elected a Fellow despite seeking admission since 1906 and possibly earlier.[55]

In May 1902 and a year after being elected FRS, Jackson presented a paper on the subject of wireless telegraphy entitled “On Some Phenomena Affecting the Transmission of Electric Waves over the Surface of the Sea and Earth” before the Royal Society but was forced to focus on the scientific rather than technical aspects of his wireless work and did not discuss the origins of his pioneering work.[56] Instead the paper opened with a brief sentence describing Jackson's wireless system as having originated in 1895 with experiments on the effects of Hertzian waves on imperfect electrical contacts in order to develop a system of naval signalling.[57] In contrast to other wireless pioneers and fellow members of the Institution of Electrical Engineers and Fellows of the Royal Societies, William Preece and Oliver Lodge, Jackson did not present his research before any audience outside of the Royal Society. He did not present before the British Association for the Advancement of Science nor the Institution of Electrical Engineers, or indeed its previous iterations. The constraints placed on an ambitious serving naval officer on active duty were severe and Jackson was forbidden to publicise or

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54 Royal Society Archives EC/1901/06 – [Fellow Application for] Jackson, Sir Henry Bradwardine (1901).

55 Royal Society Archives MM/22/68 – Letter from James Swinburne, 82 Victoria Street, to [Guglielmo] Marconi, dated 26 January 1906. This letter advises Marconi to keep back his Royal Society paper, since Marconi may be a candidate for admission in 1906. Marconi Collection MS. Marconi 28 – Papers concerning British honours and awards [of Guglielmo Marconi], 1900-1932 notes that despite presenting numerous papers before the Royal Society and a concentrated effort to get elected with the support of Oliver Lodge in 1925, Marconi's application for FRS would be firmly rejected.

56 Jackson, Henry. "On Some Phenomena Affecting the Transmission of Electric Waves over the Surface of the Sea and Earth." *Proceedings of the Royal Society of London* 70, no. 459-466 (1902): 254-72.

57 *Ibid.,* 254.

publish upon his wireless work. Instead Jackson took a different tack when staking his modest claims in the early history of wireless.

As mentioned previously, just over a month after his Royal Society lecture, Jackson wrote to J.J. Fahie, author of *A History of Wireless Telegraphy, 1838-1899*, enclosing a copy of his Royal Society paper and describing in more detail his contributions to wireless for an unpublished later edition of Fahie's seminal publication.[58] The first two editions had been limited by the confidential nature of Jackson's earlier work and, as a result, had limited Jackson's work and pioneering role to a single sentence.[59] With the confidentiality of his work still remaining, Jackson was forced to ask Fahie to destroy the letter if it was not to be used. Needless to say given that the letter survives intact in the IET archives in London, Fahie did not comply with this request. In the letter, Jackson stated that it was around 1893 that he read of Hertz's experiments and concluded that Hertzian waves might be of practical maritime application and of use to the navy. Jackson also explained that it was not until he had access to the workshop and electrical instruments at HMS Defiance in Devonport in 1895 and furthermore had read of Bose's spring coherer that he could begin work developing a practical wireless system.[60]

In the meantime, Trotter and Jackson were not the only ones to see the practical application of Hertzian waves in relation to maritime usage, nor indeed the specific practical application in relation to torpedoes. Prior to his demonstration on Salisbury Plain and independent of his early meetings with Preece in mid-1896, Marconi offered demonstrations of his wireless systems to the relevant government departments including the Admiralty, War Office, Army and others.[61] An early letter to the Secretary of State for War Affairs at the War Office, dated 20 May 1896 and one of the earliest surviving English-language documents by Marconi, offered his system of wireless telegraphy not as a mode of communication but instead as a form of remote control for a small boat or torpedo.[62] Marconi's system soon reached the attention of Assistant Inspector of Submarine Defences and an experienced torpedo officer Major C. Penrose of the Royal Engineers, who examined the system on 18 June 1896 and wrote a report on 20 June 1896 where he described Marconi's remote torpedo

58 IET Archives UK0108 SC MSS 009/2/79/1 – 6pp. Als from Henry Jackson to Fahie … giving details of his experiments dating from 1893, working along same lines as Marconi, dated 30 June 1902.

59 Fahie (1899), 202 and Fahie (1900), 206.

60 See **footnote number 58**.

61 See **Section 2.5 – 1896 and all that: Marconi's arrival in Britain**.

62 National Archives WO 32/8594 - INVENTIONS AND PATENTS/TELEGRAPHY: Consideration of Marconi systems of transmission of electric signals without wires. Possible military uses (1896). Original file reference PRO War Office file 84/M/3975.

control system as 'crude and in need of considerable development.'[63] This closely echoes comments made by Post Office engineering staff on Marconi's early apparatus (prior to adaptation and improvement by the Post Office staff) which in a Post Office report described them as 'home made [sic] and somewhat crude apparatus.'[64]

In contrast, Penrose immediately recognised the potential and promise of Marconi's wireless telegraphy system and on 24 June it was minuted that Penrose recommended further consideration of both systems by the Torpedo Committee of which he was Secretary.[65] A mere week later on 1 July and Penrose had submitted a report to the committee noting that wireless telegraphy 'should be further examined by electrical experts, with the view of ascertaining whether the principle is likely to be capable of development, and that the Admiralty should be informed of the invention and invited to participate.'[66] Despite the maritime application, at this time the Army was responsible for coastal defences and so was allocated responsibility for mines and remotely controlled torpedoes, amongst other devices. On 27 July the Director of Naval Ordnance accepted the War Office's invitations and by 14 August a small committee had been appointed consisting of Major Penrose, Major G.A. Carr (Instructor in Electricity at the School of Military Engineering, Chatham) and a certain Captain H.B. Jackson (in his role at the navy's Torpedo School) to consider Marconi's system.[67] As a result, Jackson was ordered to attend a meeting on 31 August 1896 at the War Office on the subject of wireless telegraphy and represent the views of the Admiralty.

At this War Office meeting at the end of August 1896, Jackson first met Marconi and they discovered they were both independently developing wireless systems along similar lines. At this early stage, the Marconi system and the Jackson system (as their respective wireless systems were referred to by the Admiralty) differed little technically but, according to a naval report, Marconi's system was 'more fully developed, and the instruments themselves were much more sensitive.'[68] Marconi's system also had a longer range but Jackson's apparatus was far better suited to maritime signalling. As a result of meeting Marconi at the War Office, Jackson was invited to attend Marconi's early wireless demonstrations at Salisbury Plain in September 1896 along with Army officers and

63 Pocock, R. F. "Mr Marconi and the Royal Engineers in 1896." In *IET History of Technology conference*, edited by D.G. Tucker. Goldsmith's College, London, 1974, 1.

64 BT Archives POST 30/1066C – General technical report on wireless telegraphy (1903-1919), 12.

65 Pocock, R. F. "Mr Marconi and the Royal Engineers in 1896." In *IET History of Technology conference*, edited by D.G. Tucker. Goldsmith's College, London, 1974, 2.

66 *Ibid.*

67 *Ibid.*

68 National Archives ADM 189/16 – Annual Report of the Torpedo-School (HMS Vernon) for 1896, 71.

representatives of the War Office with Jackson attending as the naval observer and reporting back to the Admiralty.[69] Utilising his extensive personal technical knowledge, Jackson was able to offer invaluable feedback to Marconi in the aftermath of his early demonstration on Salisbury Plain and to suggest improvements that made the apparatus better suited to maritime use.[70] In his correspondence with Marconi, Jackson suggested adapting the apparatus by replacing his parabolic reflectors with 'all round lenses' and made further recommendations as to the size and nature of the power supply: 'All parts of the apparatus would have to be protected from wet and capable of standing rough usage, and heavy shocks from the firing of guns.'[71] Jackson estimated this would take about six weeks to prepare and to have the transformer made. However, Marconi was busy arranging other demonstrations and further publicising his wireless system and so did not get around to implementing Jackson's suggestions until the following spring. Jackson's suggestions led to significant improvements of Marconi's apparatus, in particular the range which in the six months since the Salisbury Plain trails had nearly doubled from four to seven miles. By this stage, Marconi and Jackson had developed a close working relationship and exchanged knowledge and advice. In return for Jackson's valuable advice, Marconi provided suggested improvements for Jackson's apparatus at Devonport.

In March 1897 Marconi sent a twelve-page report on technical aspects of his wireless experiments in Wales near Salisbury and in the report he noted that Jackson had attended Marconi's demonstration on 24 March and that Jackson was 'very pleased of the results and has made a report to the Admiralty.'[72] In September 1897 Jackson, again as a representative of the Admiralty, attended Marconi's wireless demonstrations at Dover along with representatives of the War Office and foreign governments.[73] In attending the experiments, Jackson was acting both as an individual interested in electrical engineering and wireless telegraphy and as a representative of the Admiralty, enquiring as

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69 For correspondence between Jackson and Marconi about the Salisbury Trials, see Marconi Collection MS. Marconi 129 – Papers relating to Salisbury Plain experiments, 1896-1909.

70 Marconi Collection MS. Marconi 1774 – Copy of letter from Jackson to Marconi dated 15 September [1896].

71 *Ibid.* The original parabolic reflector and transmitter used by Marconi for his Salisbury Plain trials in 1896 have survived and are held in the Marconi Collection at the Museum of the History of Science, Oxford. Further details can be found at http://www.mhs.ox.ac.uk/marconi/exhibition/marconiarrives.htm

72 IET Archives UK0108 NAEST 013 – Papers of Sir William Henry Preece on Wireless Telegraphy - Report on Marconi's experiments in Wales, dated 31 March 1897.

73 See Marconi Collection MS. Marconi 130 – Typescript drafts of 'Report on Recent Experiments with the so called [sic] Wireless Telegraphy', relating to experiments at Dover, Oct. 1897 for further details.

to how these systems might be of use to the navy while continuing to experiment with, improve and demonstrate his own system.

Jackson was typically modest in claims about his wireless system and openly stated that Marconi's system was technically superior. As a result later wireless scholars positioned Jackson as a 'staunch ally' of Marconi and claimed that Jackson played down his early experiments and later wireless systems in order to support Marconi.[74] But it was not merely technical superiority that was the deciding factor for the navy's choice of wireless system. Other factors such as cost – the Treasury had kept a close eye on the financial costs of wireless tests and systems as far back as the Post Office's early experiments in the 1880s – and suitability for maritime communications were of great importance. By July 1897 the Marconi Company had been established and the short-term goal of the company was to defend and exploit Marconi's patents and to progress towards long-distance wireless communications. Much of these developments were focused on wireless land stations and, although the Marconi Company continued to test and demonstrate their maritime wireless sets, it was not until April 1900 and the establishment of the Marconi International Marine Communication Company that maritime communications again became a priority for the company. The company was established with an initial capital of £35,000 in order to acquire the maritime rights to all Marconi patents in all parts of the world, with certain limited exceptions.[75] In the interim, this left the space in which a technically inferior but better-placed and indeed more practical wireless system could flourish and be used by the navy and so Jackson continued to develop and test his wireless system.

In May 1897 Jackson demonstrated his wireless system before the commander-in-chief of Devonport, transmitting a signal from the Defiance's tender HMS Scourge to HMS Defiance at ranges of up to 5800 yards (three miles) while steaming up the Lynher estuary for a distance of two miles, and down the Hamoaze for three miles.[76] As a result of these demonstrations and his other activities at the torpedo school, Jackson's reputation as an expert in his field was established with the front cover of the 20 August 1897 edition of *The Navy & Army Illustrated* being a full-length portrait of Jackson himself, illustrating “Life on-board a torpedo school-ship”.[77] Further contemporary images

74 Headrick (1991), 117.

75 Sturmey (1958), 48.

76 National Archives ADM 189/17 – Annual Report of the Torpedo-School (HMS Vernon) for 1897. Appendix C. Report from Captain H.B. Jackon, of "Defiance", on Experimental Telegraphy Without Connecting Wires: 108-111.

77 "Life on-Board a Torpedo School-Ship." *The Navy and Army Illustrated* 9, no. 44 (1897). For a digital copy of the front cover of this issue, see http://www.cyber-heritage.co.uk/armynavy/defi.jpg. Copy available

of Jackson's apparatus from 1897 – possibly from the same photography session – have survived.[78] Furthermore some of the 1897 Jackson apparatus may have survived and are on display at HMS Collingwood although there is some speculation as to whether it is a contemporary reproduction or the surviving wireless sets. An image of the transmitter from a 1965 edition of the *Journal of the Royal Navy Scientific* Service entitled 'the first naval transmitter' stated that the surviving transmitter was a full-scale working replica.[79] Towards the end of 1897 Jackson was reaching ranges of 5800 to 6000 yards (three and a half miles) and was transmitting at about eight words per minute.[80] Jackson had also used his wireless apparatus to establish a permanent wireless link between HMS Defiance and Admiralty House at Devonport. In November 1897 Jackson was appointed as a naval attaché and sent to Paris for just over two years. This marked the end of Jackson's close practical involvement with wireless telegraphy experiments in the navy.

A mere two years after Jackson had begun to develop an experimental method of naval signalling using Hertzian waves, the system was firmly embedded in the institutional structure of the navy. From 1896, they were regularly reported upon in the Annual Report of the Torpedo School and by late 1897 they had moved beyond the province of a single officer. Instead these wireless systems were actively supported within the structure of the torpedo school and were further developed in the two years during Jackson's absence. In November 1897, the wireless system originally developed by Jackson was handed over to his less technically capable successor at HMS Defiance, Captain F.T. Hamilton. With his assistant Lieutenant William Nicholson, Hamilton continued 'the experiments in a rather desultory fashion and with little success.'[81]

Although less technically adept than his predecessor Jackson, Hamilton had additional capabilities beyond those of Jackson's technical expertise and he used these skills to further develop and promote wireless signalling within the navy at the turn of the century. First, Hamilton tested the navy's internally developed wireless systems under adverse sea conditions and successfully proved

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from author.

78 For more images of Jackson's 1897 apparatus and demonstration, see http://www.g0akh.f2s.com/SADARC/jackson.php. Copies of all images available from author.

79 'The First Naval Transmitter.' *Journal of the Royal Navy Scientific Service* 20 no.3 (1965), 149. See also http://www.g0akh.f2s.com/SADARC/jackson.php and http://www.rnmuseumradarandcommunications2006.org.uk/ for further discussion.

80 'The First Naval Transmitter.' *Journal of the Royal Navy Scientific Service* 20 no.3 (1965), 149.

81 Rawles, Alan T. "Jackson of The "Defiance"." *Journal of the Institution of Electrical Engineers* 1, no. 12 (1955): 743-45.

that the wireless system would not affect the safety of the vessel on which it was installed.[82] This was a serious worry within the navy. Indeed the Admiralty's Signal Committee were so concerned that wireless signals might ignite gunpowder on-board a ship that they went so far as to seek the opinion of several distinguished scientists on the matter. Both Kelvin and William Preece agreed there was no real risk of combustion.[83] The combination of practical demonstrations from Hamilton and assurances from Kelvin, Preece, and others addressed the Admiralty's concerns and, as a result, Hamilton was able to persuade the Admiralty to financially support wireless telegraphy. The ability to obtain funds was another skill of Hamilton's and one which Jackson may not have considered in relation to his position. Hence the Admiralty had decided to support the wireless systems now being developed within the structure of HMS Vernon and finally granted funds for experiments to continue. The now Commander Nicholson essentially became the first Experimental Commander of the Wireless Telegraphy Department of the navy.[84] Jackson later claimed in 1902 that '6 years ago [in 1896], Mr Marconi & I were the only two persons in the Universe who were absolutely confident that [wireless telegraphy] would have a successful future.'[85] This may have been the case in 1896 but, a year later in 1897, this was no longer the case and the Admiralty was actively supporting the development of a wireless system internal to its institutional structure.

Jackson's departure abroad in late 1897 did not mark the end of the wireless advances emerging from the navy but marked the end of a period of dramatic technical innovation. Much of the technical developments produced by Jackson during this period were incorporated into later wireless sets used and tested by the navy. Furthermore the knowledge and technologies gained from his early wireless work was incorporated both externally into wireless system designs, particularly those relating to maritime usage, and internally into the systems and practices of HMS Vernon. About six months after Jackson departed HMS Vernon for Paris, Marconi gave a successful demonstration of his wireless apparatus at the Kingstown (now Dun Laoghaire) yacht races near Dublin in July 1898. Through these demonstrations, Marconi adequately showed that this particular wireless system was now capable of maritime usage and so the Admiralty began to more widely evaluate the technology. As a result, by the time of Jackson's return in 1899 the Admiralty had

82 National Archives ADM 116/523 – Report by F.T. Hamilton to Commander-in-Chief, *Devonport*, dated 28 January 1899.

83 National Archives ADM 116/523 – Letter from Lord Kelvin to Evan MacGregor (Secretary of the Admiralty), dated 10 October 1898; Report by F.T. Hamilton to the Commander-in-Chief, *Devonport*, dated 2 November 1898.

84 Kent (1993), 26.

85 IET Archives UK0108 SC MSS 009/2/79/1 – 6pp. Als from Henry Jackson to Fahie … giving details of his experiments dating from 1893, working along same lines as Marconi, dated 30 June 1902.

begun to more seriously consider the Marconi wireless system which, up to this point, had not been suitable for maritime communications.

In December 1899 Jackson returned to Britain and was appointed Commander of the torpedo depot ship HMS Vulcan in the Mediterranean. More unofficially he became generally responsible for wireless development in the navy but no longer dealt with the technical details of the navy's wireless systems.[86] From this post, Jackson liaised with the Admiralty and the Marconi Company and reported more generally upon wireless developments within the navy. An obituary for Jackson, published in the *Proceedings of the Royal Society*, concluded that between 1900 and Jackson's promotion to flag rank in 1908, Jackson played 'the foremost part in the development of radio telegraphy in the navy … the comparative rapid adoption of [wireless telegraphy was] a tribute to Sir Henry Jackson's enthusiasm and to the scientific character of his work.'[87]

The Marconi Company had initially centred its technical innovations on extending the range of wireless land stations but a few years into the company's existence had, on the advice of Jackson and others, shifted its attention to the more promising and potentially lucrative market of maritime communications. By the summer of 1899 they were demonstrating their apparatus at the naval manoeuvres. At the turn of the century, the Admiralty and the navy evolved from wireless innovators to wireless consumers but in both instances they displayed a strong sense of agency and had set the agenda. In the brief interim around the turn of the century, a conflict halfway around the globe offered up the first chance for testing of wireless communications in the field of battle.

4.3 Wireless at War: Wireless signalling during the Second Boer War

In this section, I will discuss how wireless signalling began to be incorporated into naval practice for the first time during military conflict. Military demands dictated the continued side-by-side development of the Marconi and Jackson wireless systems and both were used in the field of combat. Furthermore both of these wireless systems achieved practical results through institutional innovation and adaptation. The success of wireless communications for the first time in military conflict was achieved through institutional innovations and meeting of military needs and not solely through the efforts of the Marconi Company, despite contrary claims by the company.

86 *Ibid.*

87 F E S. "[Obituary Notice of] Sir Henry Bradwardine Jackson (with Portrait)." *Proceedings of the Royal Society of London*. Series A 127, no. 806 (1930): vi-ix.

The Second Boer War, between 1899 and 1902, had its origins in events whose timeline echoes some of the early developments in the field of wireless. The First Boer War had taken place between 1880 and 1881 a mere year before the Post Office began experiments with inductive and conductive telegraphy. The Second Boer War, which took place between October 1899 and May 1902, had its origins in events such as the unsuccessful Jameson Raid in 1895. The conflict also escalated wider tensions between the two European (and indeed world) powers, Britain and Germany, with the latter supporting the Boers, both politically and in terms of military technology. One of the military technologies available – at least in theory – to both sides during the conflict was wireless telegraphy with this short-lived and perhaps lesser-known conflict presenting the first real opportunity for this embryonic and indeed still experimental technology to be used in the field of war. In 1899 and with the outbreak of war in far-off South Africa imminent, the Marconi Company offered wireless sets along with operators and related apparatus to be used by the British Army. The conflict was a telecommunications first on other levels with the first practical military use of telephones in active conflict. Hence all three modes of telecommunications – telegraphy, telephony, and wireless telegraphy – were used in parallel in the field of conflict for the first time. Alongside these new, electrical modes of telecommunication, older modes of signalling such as heliographs, carrier pigeons and searchlights continued to be used. Early on in the conflict, the Boers had sabotaged much of the telegraph network in South Africa and so the British Army was forced to rely on visual signalling such as heliographs by day and naval searchlights by night. Hence although wireless communications were still primitive and relatively experimental, they were also urgently needed and so wireless sets were requested for the conflict.

The initial application for wireless telegraphy was, in fact, not from the military but from the newspapers with the then Wireless and Telegraph Signal Company arranging with the government to establish telegraph stations for transmitting war news in South Africa with six wireless sets along with five assistants from the company and a government engineer being sent on a government transport from Liverpool a month after the conflict began on 2 November 1899.[88] Independent of these sets, a further shipment of five horse-drawn wagon wireless sets and trained personnel being also sent by the then Wireless and Telegraph Signal Company being sent out on HMS Servia and due to arrive shortly after the first set of apparatus intended for use by the newspapers arrived.[89] However, no more is said about the wireless sets intended for newspaper usage and their destination, usage, and outcome remains a complete mystery. In contrast, early reports of wireless sets being used by the British Army were rapidly forthcoming and appeared to report that the

88 'Note on Wireless Telegraphy in South Africa.' *The Electrician* 44 (1899): 3; 'Note on Wireless Telegraphy in South Africa.' *The Electrician* 44 (1899): 33.

89 'Note on Wireless Telegraphy in South Africa.' *The Electrician* 44 (1899): 105.

wireless sets were practical and successful with experiments between Orange River and De Aar, the railhead for the dispersal of the British forces nearly 60 miles away, being a complete success although it was omitted from early reports that this required the use of a relay station at Belmont.[90] However, less than two months after they were first being put to use, the limitations of these bulky, heavy and cumbersome wireless sets soon became apparent. The sets were highly experimental and sensitive and geographical conditions – the rocky and hilly countryside interfered with signals – along with regular local thunderstorms meant the wireless sets were impractical. These claims were quickly and strongly refuted by the Marconi Company who dismissed early reports as being a 'rather doubtful rumour'.[91] Later in February 1900 and before an audience at the Royal Institution, Marconi himself offered up a more public response, defending his wireless system and blaming the military authorities for not making adequate preparations:

> It is, therefore manifest that their partial failure was due to the lack of proper preparation on the part of local military authorities and has no bearing on the practicability and utility of the system, when carried out under normal conditions. Had the light bamboo poles not collapsed from the dryness there is no doubt that a very practicable arrangement existed.[92]

Nonetheless the wireless sets were of no use to the British Army and instead were transferred to the navy where they were of some use. The distinct lack of success in relation to these wireless sets led to a 'radio silence' of sorts with regard to their usage in the South African conflict and it was not until June 1900 that reports began to emerge of their successful application maintaining communication between the convoy “Doris” and Delagoa Bay while the ship was at Kosi River.[93] Originally reported in the *Cape Town Argus* and reprinted in *The Electrician*, the authors of the latter report wondered somewhat tongue-in-cheek how the Marconi Company staff members who had been sent with their instruments to the front were occupying themselves.[94] In contrast to the perceived failures of the Marconi wireless sets in the early stages of the Boer War, the Jackson wireless sets had also been sent halfway around the world and was used, albeit far more successfully, in conflict. In July 1900 three Jackson sets were sent to the China naval squadron for use during the Boxer Rising with one of the sets being installed on board the battleship HMS Balfour,

90 'Note on Wireless Telegraphy and the War.' *The Electrician* 44 (1899): 322.

91 [Untitled note on Wireless Telegraphy in the Boer War]. *The Electrician* 44 (1900): 351.

92 Marconi, Guglielmo. "Wireless Telegraphy." *Proceedings of the Royal Institution* 16 (1900): 247-56.

93 'Note on Wireless Telegraphy.' *The Electrician* 44 (1900): 275.

94 *Ibid.*

this marking the first capital ship, that is a leading or a primary warship in a naval fleet, to use wireless on active service.[95]

The Boers had also ordered wireless sets for use in the conflict, placing an order for six wireless sets and accessories from the German firm Siemens and Halske on 24 August 1899 at a cost of £110 each; the apparatus also included a 120 foot mast and was capable of transmitting over 10 miles.[96] They had intended to use the sets for communication between fortifications at Pretoria but instead the sets were impounded by the British at Cape Town and never reached the Boers for use in conflict.[97] Instead many of the parts were cannibalised for use as spare parts for Marconi wireless sets with some of the remaining apparatus being sold off after the war.[98] Eventually some of the reconstructed parts did eventually reach Pretoria where a restored receiver is now preserved at the South African Corps of Signals Museum; other apparatus such as a restored Ruhmkorff coil transmitter, a receiver, and a Morse inker have been preserved at the Anglo-Boer War Museum at Bloemfontein.[99]

Meanwhile the five wireless sets provided by Marconi were instead made available to the navy who requested their use to support the naval blockade of Delagoa Bay (now Maputo Bay, Mozambique) and operating between Durban and Delagoa Bay on blockade duties.[100] By March 1900 these sets had been installed on the cruisers HMS Dwarf, HMS Forte, HMS Magicienne, HMS Racoon and HMS Thetis with HMS Thetis being the first vessel to be equipped with wireless apparatus under wartime conditions.[101] Unlike their dramatic failure on land, the wireless sets were quite successful at sea. Earlier problems relating to aerials were solved by the use of ships' masts and the rocky landscape no longer offered an obstacle. The wireless sets also extended the operational range of the vessels who could now exchange signals whilst out of visual range. Additionally HMS Magicienne in Delagoa Bay provided a relay to a telegraph landline and so quick communication was possible between the ships at sea and the navy's operational headquarters in Simon's Town, Cape Town nearly a thousand miles away. By April 1900, wireless messages were received over a distance of fifty miles, a distance comparative with those offered during

95 Pocock (1998), 141.

96 Fordred (1997), 66.

97 'Wireless Telegraphy and the War.' *The Electrician* 44 no.322 (1899): 322.

98 Baker (1998).

99 Baker (1998); Coe (1996), 90.

100 Fordred (1996), 1136.

101 Hezlet (1970), 35.

contemporary naval manoeuvres.[102] However, by November of 1900 the war had become a guerilla war and as the British military forces began to follow a 'scorched earth' policy, the blockade of naval ports was no longer a priority and hence wireless communications were no longer needed by the navy.

The utilisation of wireless communications in active military conflict along with earlier trials during naval manoeuvres had convinced the Admiralty of their utility but had also raised potential issues in relation to practicalities of security and interference. Furthermore ongoing trials of Marconi wireless systems in parallel with their own internally developed systems raised questions about the extent and validity of Marconi's patents and related financial commitments. In light of these reservations, the Admiralty took a two-pronged approach. First, they signed a short-term contract with the Marconi Company to further test their wireless apparatus and secondly, they opened up discussion with other governmental departments in order to clarify the government's position on wireless telegraphy leading to an Interdepartmental conference held in 1901 and 1902.

4.4 Contracts and Contradictions: The Admiralty as a customer for wireless

At the turn of the century, the maritime capability of Marconi's wireless system had been established and the Admiralty began an active programme of evaluation and adaptation. There was a very specific set of technical demands for a system of wireless communications suitable for the vast and disparate navy and merchant fleet that existed at the end of the Victorian era. These needs required significant change to the Marconi wireless system, one which the Admiralty demanded whilst also possessing the technical ability to adapt wireless sets themselves. Even as wireless consumers, the navy continued to innovate technically. Furthermore, as a consumer and user of wireless, the Admiralty questioned certain aspects of the fledgling Marconi Company's practices and, with other government institutions, began a thorough investigation into the strength and validity of the patents held by the company. The Admiralty and the navy did not support the patenting of their own wireless system possibly because, as a result of their investigations, they were aware of the potential pitfalls associated with this aspect of legal and commercial practices. This led to an Interdepartmental Conference being held between 1900 and 1901 with the result being an informal government policy on wireless and one that, in combination with international demands, led to the

102 Baker (1998).

world's first piece of wireless legislation, the 1904 Wireless Telegraphy Act, described in more detail in the next chapter.[103]

Jackson's early pioneering and indeed practical work led to a continued interest in wireless communications with a clear demand for an alternative to the existing and limited modes of visual signalling which had dual limitations of a very short-range and being entirely weather dependent. In the summer of 1898 and just over a year after the second set of demonstrations on Salisbury Plain, Marconi demonstrated his wireless system at the Kingstown yacht races in Dublin. This demonstration, along with positive reports from Captain Jackson, attracted the attention of the Admiralty and invited Marconi to demonstrate his wireless sets at the upcoming Naval Manoeuvres in the summer of 1899. In July 1899 three naval vessels – HMS Alexandra, HMS Juno and HMS Europa – were fitted with Marconi wireless and were tested during naval manoeuvres. HMS Juno was commanded by Jackson and the trials were also witnessed by Marconi from on board the Juno. Initially it was proposed that only two ships, HMS Alexandra (Vice-Admiral Sir Compton Domville's flagship) and HMS Juno (commanded by Captain Jackson) but a third wireless set was brought along and installed on board the cruiser HMS Europa.

As a result of his established expertise in the newly established field, Jackson was requested to return briefly to Britain and take part in the naval manoeuvres in the summer of 1899 and indeed it was his support that persuaded the Admiralty to conduct the trials at the 1899 summer manoeuvres, also called the "Peace manoeuvres". The naval manoeuvres were reported upon daily by correspondents from *The Times, The Daily Telegraph*, and the other British national newspapers and the addition of wireless to these naval manoeuvres meant they were more widely reported than previous naval manoeuvres with reports appearing in *The Electrician* and other electrical presses.[104] As stated in the introductory section of this chapter, Marconi wireless sets were tested on three of the many vessels taking part in the exercise with one of the testing vessels, HMS Juno, being captained by Jackson himself. The experimental apparatus was tested successfully with a transmission range of sixty to seventy miles however there were concerns about the security and privacy of the un-tuned wireless apparatus. The navy requested syntonised – that is, tuned – wireless apparatus from the Marconi Company and ordered a complete set of apparatus to be tested at HMS Defiance under the direction of Commander Nicholson 'who has made a special study of the system.'[105]

103 See **Chapter 5 – 'If the Government did take over wireless it meant that they would take over us': simmering tensions between commercial and state interests, 1903-1905** fur further details.

104 See for example, 'Wireless Telegraphy in the navy.' *The Electrician* 43 (1899): 473.

105 '[Note on] Wireless Telegraphy.' *The Electrician* 43 (1899): 589.

The tests were successful with signals communicated over distances of between sixty and seventy miles. However, the Admiralty were unhappy with the security of the system and, on a financial note, Marconi's system of payment and royalties in particular the £250 per wireless set payment for royalties, and so decided to continue with their own experiments. It was suggested by the Marconi Company that their 'experiments' involved producing cheaper and inferior imitation Marconi sets without royalty payment.[106] However, despite this claim, the Admiralty continued to experiment with Marconi Company wireless sets as did other branches of the British military. Hence the Treasury began negotiations with the then Wireless Telegraph and Signal Company but in the meantime the navy decided to continue in parallel with their own experiments and manufacture their own transmitters and receivers. As mentioned earlier, Jackson returned to HMS Vulcan in December 1899, this being in order to supervise the construction of suitable apparatus. By the end of the month, two navy-constructed wireless sets had been installed aboard HMS Hector and HMS Jaseur and the installation of Jackson sets continued in parallel with an order for thirty-two Marconi sets placed on 4 July 1900. Parallel tests of the two different systems of wireless telegraphy continued towards through the latter half of 1900 with the Marconi system communicating between St Catherine's and Poole while the Admiralty tested their system nearby between Portsmouth and Portland, these being about sixty-five miles apart.[107]

These parallel tests were described in a letter to *The Times* by Marconi Company employees – by the Managing Director Major Flood-Page in August and by Scientific Adviser J.A. Fleming in October although there remains significant ambiguity as to whether the system used between Portsmouth and Poole was a Marconi system or not.[108] Responding to an earlier article which had claimed wireless signals between Portsmouth and Portland were 'the result of a series of experiments by Captain C.G. Robinson and the staff of the Vernon Torpedo School, Flood-Page was adamant that all credit for wireless signalling in the navy was due to Marconi and the employees of the Marconi Company.[109] His letter notably failed to mention the pre-existing wireless systems developed within the navy, the technical assistance and expertise provided by Jackson and many other naval officers, and the on-going trials of Jackson wireless sets during this period. What the Admiralty thought of this presumption is, of course, unrecorded. Nonetheless, it was this type of

106 Geddes (1974), 13.

107 "Wireless Telegraphy." *Science* 12, no. 305 (1900): 690-91.

108 Flood Page, Major T. "Marconi Wireless Telegraphy in the Navy." *The Times*, 30 August 1900, 9 and Fleming, J.A. "Recent Advances in Wireless Telegraphy." *The Times*, 14 October 1900, 13.

109 "Naval & Military Intelligence." *The Times*, 29 August 1900, 9.

rhetoric that antagonised relations with the Admiralty but which also continued to echo throughout the years in relation to early wireless history.

Contradictory to Flood-Page's claims, the two wireless systems continued to be trialled together and the Marconi system was not the sole wireless option for the navy. By the summer manoeuvres of 1900 the relationship between the Marconi Company and the Admiralty had soured considerably. In contrast to the reporting of the 1899 naval manoeuvres, it was an early, un-tuned version of the Jackson system (sometimes referred to as Service Gear Mark I) which was prominently tested and reported upon at the 1900 naval manoeuvres. In a report in *The Electrician* it was noted that of the fifty-five ships mobilised for the naval manoeuvres, HMS Adrienne, HMS Camperdown and HMS Jaseur and others were being especially fitted with wireless, as were HMS Majestic and HMS Diadem with the system being used was not the Marconi system 'which the Admiralty [had] found too expensive.'[110] Unfortunately the non-Marconi system was not so successful during the manoeuvres with a range of about twenty-five miles being recorded. This forced the Admiralty to continue with parallel trials and by November 1900 the complete delivery and installation of Marconi and Jackson wireless sets to the navy was complete. A total of thirty-two Marconi wireless sets – twenty-six aboard naval vessels and six at Admiralty coast stations – and nineteen Jackson wireless sets (all installed aboard naval vessels) had been delivered; in addition both systems had provided two additional wireless sets for training at HMS Vulcan.[111] Shortly after the thirty-two Marconi wireless sets were installed, the Jackson sets were also delivered leading to a massive expansion of the wireless branch of the navy in the autumn of 1900.[112] By November nineteen sets of apparatus had been delivered – thirteen to operational ships and six to the torpedo schools.[113]

Jackson felt it was best that the wireless sets be constructed as similarly as possible to Marconi sets so that naval wireless operators could be transferred between the two systems without training. However, the operation of the sets was according to the earlier and un-patented design of Jackson. It was later suggested by the Marconi Company that the navy's “experiments” involved producing cheaper and inferior imitation Marconi sets without royalty payment but this remains open to some dispute.[114] However, despite this potentially antagonist claim, the Admiralty continued to test and evaluate Marconi wireless sets as did other branches of the British military. The massive expansion of the wireless branch of the navy led to increased training, much of this managed by Jackson. With

110 'Wireless Telegraphy.' *The Electrician* 44 (1900): 488.

111 Pocock and Garratt (1972), 43.

112 Baker, (1970), 51.

113 Pocock (1998) 141.

114 Kent (1993), 27.

the design of Jackson's wireless system finalised and wireless sets delivered, Jackson began to take a more hands-off role and instead became involved with setting the agenda in terms of the Admiralty's wireless policy. The policy of the Admiralty, as articulated by Jackson, was one of standardisation, hence the enforced similarity between Marconi and Jackson sets. Jackson supported this policy because it reduced the complexities of training when manpower and trained wireless operators were scarce, even though standardisation might potentially limit the technical operation of wireless sets designed to Jackson's specification. And so even with increased evaluation of Marconi wireless sets by the Admiralty, the institution was very much setting the agenda: it was designing a training syllabus; it was pushing the technology to match its needs of maritime communication especially with regard to ship-to-ship communications; it was setting a policy in relation to wireless developments, this being set by Jackson; and last and most definitely not least, it was providing a market, possibly the sole market, for wireless communications during this embryonic period in wireless history.

Jackson continued his keen interest in wireless communications but promotion necessitated a less hands-on role. Jackson remained in the navy until 1919 and rose to the rank of First Sea Lord between 1915 and 1916, where he had a central role in the strategic use of wireless interception during the Battle of the Jutland. He also served as first Chairman of the Radio Research Board between 1920 and 1927. As the Admiralty and the navy entered the twentieth century, they began a more wide-ranging appraisal of wireless systems and, within the first decade of the new century, arranged systematic trials of different wireless systems and apparatus in order to suit its needs. These trials and the continuing use of Marconi and Jackson wireless sets were clear outcomes of innovations from within the navy and the early, pioneering work of Henry Jackson.

The potential conflict of interest with Jackson developing his own wireless system by the navy whilst also advising the navy on wireless policy and evaluating other wireless systems did not appear to be a problem for the Admiralty who had a great deal of respect for Jackson who was at the forefront of expertise in wireless developments during this formative period. The Admiralty continued to seek Jackson's opinion on, and evaluation of, other wireless systems. Similarly, and despite being potential competitors, Jackson and Marconi remained in correspondence during this period, even while their respective wireless systems were under consideration and evaluation by the Admiralty. Although referred to elsewhere, very little of the correspondence between the two men has survived with correspondence relating to the Salisbury Plain demonstrations between 1896 and

1898 found in the Marconi Company archives in Oxford being all I have found during my research.[115] Nevertheless Marconi and Jackson remained on cordial and friendly terms throughout, this being evidenced by a piece of private correspondence between Henry Cuthbert Hall, Managing Director of the Marconi Company, and Marconi from 1905.[116]

By 1900 and beyond, the Admiralty were evenly supportive of both systems and continued to test the Marconi and Jackson systems until they moved exclusively albeit temporarily to using Marconi apparatus in 1904. Almost independent of their technical interactions with Jackson and his system, the Admiralty considered how Jackson's system might be used to establish historical priority and hence threaten the validity of Marconi's patents. Although in private, as early as 1901 the Admiralty considered the validity of Marconi's patents and how this might be used to challenge royalty payments owed by the Admiralty to the Marconi Company. The Admiralty proposed that Jackson's earlier and similar work null and voided Marconi's patents and hence negated the need to pay some royalties. This issue was not fully resolved until the 1903 Admiralty-Marconi Company contract and demonstrated that the Admiralty's relationship with the fledgling wireless company was not as amicable nor as unequal as some scholarship, particularly those works with a pro-Marconi slant, has suggested.[117]

By late 1900 and the signing of its first contract with the Marconi Company, the Admiralty became aware of problems relating to wireless, these being practical – issues of security and interference – and administrative – the extent and validity of Marconi's patents. Both issues, in particular the former, were first raised by Rear-Admiral Reginald Custance, then Director of Naval Intelligence, in correspondence with John Ardon, then Post Office Assistant Secretary.[118] In light of these concerns, the Admiralty decided to take a two-pronged approach. First, they signed a Deed of Agreement with the Marconi Company to further test their wireless apparatus. Secondly, they opened up discussion with other governmental departments in order to clarify the government's position on wireless telegraphy. In late 1900, the Admiralty proposed an Interdepartmental Conference and invited all relevant government institutions, including the Post Office, the Board of

115 Marconi Collection MS. Marconi 129 – Correspondence from Captain Henry B. Jackson to Marconi, discussing arrangements for the Salisbury Plain experiments and referring to other experiments, 1896-8.

116 Marconi Collection MS. Marconi 176 – 1pp. typed letter from H. Cuthbert Hall to Guglielmo Marconi, dated 1 September 1905.

117 For example, see Baker (1970) or Jacot de Boinod and Collier (1935).

118 See BT Archives POST 30/940 – Interdepartmental conference on wireless telegraphy (1896-1901) for full details.

Trade, the War Office, and other interested parties, to attend. A number of reports were prepared in advance of the conference with the conference itself being held in March and April 1901.[119]

The initial proposal for the conference from the Admiralty suggested the topic for consideration was interference between Admiralty wireless sets, mostly provided by the Marconi Company, and other wireless stations managed by the Marconi Company. During the conference, the issue of royalty payments was brought up for discussion by the Admiralty.[120] The Admiralty and the Post Office were the central institutions at this conference and reached two key conclusions. First, they concluded with some reservations that Marconi's patents were valid and should be upheld and respected.[121] Secondly, they observed the need for a more systematic and general form of wireless regulation especially with new systems and companies – the Lodge-Muirhead syndicate, Telefunken, and others – entering the marketplace. These conclusions marked a major turning point and rhetorical shift in the government strategy on wireless with their articulation marking the genesis of a formalised government strategy on wireless communications. Furthermore the Admiralty's proposed legislation, much amended, was enacted a mere three years later in the 1904 Wireless Telegraphy Act.[122]

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119 BT Archives Post 30/940 File I. INTER-DEPARTMENTAL CONFERENCE ON WIRELESS TELEGRAPHY. Printed copy of Admiralty Correspondence respecting Marconi system (1896-1899); BT Archives Post 30/940 File II. INTER-DEPARTMENTAL CONFERENCE ON WIRELESS TELEGRAPHY. Printed copy of further Admiralty correspondence respecting Marconi system (1899 to 1901); BT Archives Post 30/940 File III. INTER-DEPARTMENTAL CONFERENCE ON WIRELESS TELEGRAPHY. Proposed by Admiralty. Suggestion concurred in by Department (1900-1901); BT Archives Post 30/940 File IV. INTER-DEPARTMENTAL CONFERENCE ON WIRELESS TELEGRAPHY. Mr John Ardron appointed Post Office representative (1901); BT Archives Post 30/940 File V. INTER-DEPARTMENTAL CONFERENCE ON WIRELESS TELEGRAPHY. Memorandum by Post Office representative – Mr. J. Ardron. Question as to desirability of legislation. Solicitor's opinion (1901); BT Archives Post 30/940 File VI. INTER-DEPARTMENTAL CONFERENCE ON WIRELESS TELEGRAPHY. Draft report as prepared by Admiralty. Post Office objections formulated by Mr. Ardron (1901); and BT Archives Post 30/940 File VII. INTER-DEPARTMENTAL CONFERENCE ON WIRELESS TELEGRAPHY. (Draft) Memorandum prepared by Director of Naval Intelligence (1901).

120 BT Archives Post 30/940 File V. INTER-DEPARTMENTAL CONFERENCE ON WIRELESS TELEGRAPHY. Memorandum by Post Office representative – Mr. J. Ardron. Question as to desirability of legislation. Solicitor's opinion (1901).

121 BT Archives Post 30/940 File 5 – INTER-DEPARTMENTAL CONFERENCE ON WIRELESS TELEGRAPHY. Memorandum by Post Office representative – Mr. J. Ardron. Question as to desirability of legislation. Solicitor's opinion. 1901.

122 Briggs (1961) [Volume 1], 87.

Prior to this, and as explored in more detail in my thesis, the government had pursued a *laissez faire* attitude to wireless with an informal government strategy being articulated and led by the Post Office, the government institution best-suited for this role due to its domestic monopoly on other modes of telecommunications such as the telegraph and the telephone. Now other government institutions and departments were becoming interested in and involved with different forms of wireless with mixed results. The Post Office and the Admiralty had very different agendas in relation to wireless communications and at times this led to a strong degree of tension between the two powerful government bodies. Furthermore the interdepartmental wireless conference demonstrated that, although the British government viewed the Marconi Company as a potential albeit quite probably temporary ally in maintaining their telecommunications hegemony (that is their control of the international telegraph cable network), they took a cautious approach to Marconi and his company.

And so, after due consideration and much discussion, the Admiralty signed a Deed of Agreement with the Marconi Company in February 1901, formalising their initial contract placed in July of the previous year to lease thirty-two wireless sets from the Marconi Company. The Deed of Agreement also included a stipulation for the Admiralty to pay patent royalties of £100 per set to the Marconi Company which was not well received by the Admiralty nor by the Treasury but this being significantly cheaper than the initial £250 charge proposed by the Marconi Company a few years earlier. Another cause of objection from the Admiralty was Marconi's patents – they were not convinced of the strength or validity of the patents held by the Marconi Company and furthermore felt that Jackson's earlier wireless experiments and systems offered a strong case to challenge the practical implementation of the Marconi Company's patents and patent rights. This subject continued to be to a problem over the coming years and was only partially resolved by the later 1903 Admiralty-Marconi Company contract. While the 1901 agreement was on paper mutually beneficial, it possibly offered a little more to the Marconi Company than it did for the Admiralty. Even by signing a Deed of Agreement, the Admiralty were offering an air of stability and respectability to the fledgling wireless company. The Admiralty was also bringing its knowledge and experience of Jackson's previous wireless system which remained in operation alongside the Marconi system. Nonetheless, the agreement (as the title implies) was not a legally binding contract and offered room for negotiation and manoeuvring over the coming, uncertain years of wireless. The initial 1901 agreement was renegotiated extensively over the next two years especially in consideration of the Admiralty's insurance contract with Lloyd's and also in light of some considerable reservations, technical and administrative, on the part of the Admiralty. Many of these concerns were raised through a series of correspondence between Evan MacGregor, Permanent Secretary to the

Admiralty from 1884 until his retirement from the civil service in May 1907.[123] The role, commonly referred to as “Secretary of the Admiralty”, was the senior civil servant at the Admiralty. MacGregor held the office for twenty-three years and served under eight First Lords of the Admiralty – Northbrook, Ripon, George Hamilton, Spencer, Goschen, Selborne, Cawdor, and Tweedmouth.

Many of the initial problems related to practical and administrative concerns, for example certifying ship for wireless (that is registering them in order to calculate royalty payments based on the number of wireless sets being used) and also providing spare parts and fixing or upgrading assorted components.[124] However, in early 1902 wider concerns about long-distance wireless communication came to the fore and it was the Admiralty's desire to control and limit this application of wireless telegraph to military usage only that led to the Admiralty renegotiating their initial contract. In March 1902 Marconi sent a letter to Jackson describing long-distance signals received on SS Philadelphia in the mid-Atlantic when over 1500 miles from the sending station, Poldhu.[125] This letter caused much consternation at the Admiralty, where senior officers had come to the conclusion that long-distance wireless telegraphy was in the best interests of the nation and of the Empire, especially in case of war. As a result, a letter was rapidly despatched to the Marconi Company offering to renegotiate their contract if their needs could be met.[126] Their conditions boiled down to Britain having exclusive access to long-distance wireless telegraphy and furthermore to have access to details of other parties using Marconi wireless telegraphy systems. Essentially they were proposing that the Marconi Company, or at least the maritime arm, would become a state-sponsored and state-controlled company. In return they would sign a new five-year contract with the potential of the contract being extended to nine years. Under the new agreement the Admiralty would pay an annual fee and would also pay for the costs of wireless stations on board HM vessels but would not pay for the costs of shore stations. Furthermore the expense of trials – again excepting those relating to shore stations – would be borne by the Admiralty.

123 Baddeley, V. W. 'MacGregor, Sir Evan (1842–1926).' Rev. Andrew Lambert. In *Oxford Dictionary of National Biography*, edited by H. C. G. Matthew and Brian Harrison. Oxford: OUP, 2004. Online ed., edited by Lawrence Goldman, September 2010. http://0-www.oxforddnb.com.wam.leeds.ac.uk/view/article/34728 (accessed August 23, 2012). See also http://www.dreadnoughtproject.org/tfs/index.php/Evan_MacGregor.

124 Marconi Collection MS. Marconi 246 – Copy of 2pp. typed letter from Evan MacGregor, Admiralty, SW to Marconi Company, dated 10 March 1902 (Admiralty ref CP NS 5946/).

125 Marconi Collection MS. Marconi 246 – Copy of 3pp. typed letter from Evan MacGregor, Admiralty, SW to Marconi Company, dated 17 March 1902 and marked 'Confidential' (Admiralty ref CP 3983/4380)

126 *Ibid.*

Cuthbert Hall, the Marconi Company's Managing Director, replied promptly and put forward his concerns, namely the conditions put forward by the Admiralty would prevent the Marconi Company from: selling its patents and rights in any foreign country; enabling long-distance wireless communication between any two foreign countries where both are not part of the British empire and her allies; transmitting or receiving any wireless messages over land in a foreign country over distances of greater than fifty miles; or establishing any long-distance wireless stations in foreign nations.[127] Cuthbert Hall reasonably pointed out the limitations of these conditions, namely that their foreign contracts would be worth considerably less if they were unable to offer long-distance wireless telegraphy and that furthermore most of the Company's future revenue would derive from its long-distance wireless telegraphy, particularly long-distance trans-oceanic communication. Furthermore Cuthbert Hall pointed out the technical difficulties of limiting wireless stations to a range of fifty miles on land and one-hundred and fifty miles over the sea. However, despite all this, the Marconi Company was willing to enter into negotiations but, given the strict limitations demanded by the Admiralty, they would only do so for an annual payment of £75,000 and this would be subject to exceptions of existing contracts signed with the USA and Italy. This amount would also take into account the short five-year period of the contract and the lack of guarantee of renewal.

The Admiralty offered a brief and direct reply to the Marconi Company, stating that they were unwilling to pay £75,000 per annum in light of the Marconi Company's existing contract with the US and Italian governments.[128] The Admiralty felt it 'undesirable to enter into an agreement to pay a large annual sum in consideration of a partial monopoly that may fail to be maintained and the only security for which is dependent upon successfully keeping the secret from becoming known to Foreign Powers'. However, they were willing to consider other, non-monopolistic options. These negotiations continued throughout 1902 and it was not until July 1903 that the Admiralty signed a new eleven-year contract with the Marconi Company, this superseding the earlier Deed of Agreement signed on 20 February 1901.[129] In the meantime, the navy continued to develop its internal wireless experiments and expand its uses of wireless telegraphy including experimenting with solutions to problems of jamming and interference as early as 1902.

127 Marconi Collection MS. Marconi 246 – 6pp. typed letter from Henry Cuthbert Hall to Evan MacGregor at the Admiralty, dated 10 April 1902.

128 Marconi Collection MS. Marconi 246 - 1pp. copy of typed letter from Evan MacGregor at the Admiralty to the Marconi Company dated 16 April 1902 (Admiralty ref CP 5541/6345).

129 IET UK0108 SC MSS 143/01/01 – 7pp. agreement between the Admiralty and the Marconi Wireless Telegraph Company in relation to navy Wireless Telegraphy, dated 24 July 1903, and presented to both Houses of Parliament.

Prior to the signing of the 1903 contract, the Admiralty were spending an estimated £20,000 annually on wireless communications, most of this to the Marconi Company.[130] The initial 1901 Deed of Agreement was no longer sufficient to cover arrangements between the Admiralty and the Marconi Company and so on 24 July 1903 a new and more stringent contract was signed between these two parties.[131] The starting date for the new contract was backdated to 31 March 1903, as stipulated in Clause 2 of the contract; this oddity can be most likely explained by the proximity to the 1903 Preliminary Conference on Wireless Telegraphy held in Berlin less than two weeks after the contract was signed.[132] The new contract provided the Admiralty with thirty-two Marconi wireless sets and granted the Admiralty the right to use apparatus covered by existing and future Marconi patents for a period of eleven years, based on an annual payment. It is worth noting that at the time of the contract and as stated in clause three of the contract, the Marconi Company only held two relevant British patents – Patent No. 12039 (2 July 1896) and Patent No. 7777 (26 April 1900).[133] However, by the time the contract was signed in July 1903, Marconi had also been granted British Patent No. 10245 (1902). This patent was for Marconi's magnetic detector which, although it had maritime application, was not used by the Admiralty at this time. Meanwhile the most important clause of the contract was clause seven which forbade the Admiralty from using Marconi Company apparatus to intercommunicate with other wireless systems with the exception of emergencies or in the case of war. This caused much controversy in the years to come especially in relation to international regulations, a subject I will cover in detail in the next chapter.

In addition to the initial thirty-two sets provided, the contract also offered the Admiralty improved apparatus and methods of signalling, and also provided any installations required by the

130 Hansard HC Deb 23 July 1903 vol 126 col60 – Wireless Telegraphy in the navy. URL: http://hansard.millbanksystems.com/commons/1903/jul/23/wireless-telegraphy-in-the-navy

131 Three years after being signed the contract was released as a Command Paper, 1906 [Cd. 3047] navy (wireless telegraphy). Agreement between the Admiralty and the Marconi Wireless Telegraph Company, dated the 24th July 1903. URL: http://gateway.proquest.com/openurl?url_ver=Z39.88-2004&res_dat=xri:hcpp&rft_dat=xri:hcpp:fulltext:1906-007223. A Command Paper were reports printed for the benefit of the British Parliament which could be purchased by the general public. Although primary source materials, these documents should be used with caution as it is highly likely that the Admiralty (or indeed any other government department) would be extremely cautious in revealing anything of note to the general public or potentially their enemies.

132 See **Section 5.4 – 1903 Preliminary Conference on Wireless Telegraphy** for further details.

133 See Marconi Collection MS. Marconi 411 – Patents granted to Marconi and the company, 1896-1920 for further details of British patents held by the Marconi Company.

Admiralty, at trade prices.[134] Clause five of the contract covered payments and the limitations of the contract. The Admiralty was required to pay an initial lump sum of £20,000 to cover patents and associated rights. Also within three months of the starting date, 31 March 1903, the Admiralty was required to pay £1600 to cover royalties due from the initial 1901 Agreement. In return for meeting their obligations of the Agreement, the Marconi Company would be paid £5000 annually. One notable clause in the contract was Clause five Part (c) which noted that the contract was not an exclusive one and hence the Admiralty was allowed to obtain wireless apparatus from other sources.

By the time the contract had been signed, the navy had adopted wireless as the prime method of communication on all Royal Navy and Merchant Navy vessels and was testing long-distance wireless communications between Gibraltar and Portsmouth, with Jackson providing technical assistance and advice to Marconi during the trials.[135] In 1904 the navy converted all their sets across to the Marconi standard and a wireless experimental section was founded in Portsmouth with the proviso of designing specialised wireless equipment for the fleet. By this time, the navy viewed wireless as a reliable form of international communication and continued to invest in this technology both with land-based wireless stations and on-board wireless sets. Whilst older, more traditional modes of communication, such as flag-signalling over short distances, continued it was the newer, electrical modes of communication which dominated naval signalling and the process and installation of wireless sets continued up to and through World War One.[136]

The resolution of the two parallel wireless systems, however, did not offer a resolution to wider issues about wireless systems within the navy. While the administrative and technical aspects had, to a certain degree, being resolved by the contract between the Admiralty and the Marconi Company, problems continued but of a non-technological and more administrative nature. Through the technical expertise of those at HMS Vernon and other torpedo and electrical schools, the navy had one of most superior wireless systems in all regards excepting long-distance communication. However, with the technology stabilising, problems relating to larger cultural and institutional changes within the Admiralty and navy began to emerge with a key example being problems with the quality of operators. While a detailed training scheme had been put in place for operators, more senior signal staff remained principally experts in visual signalling, such as flag signals. Initially, they experimented with flag signallers also operating as wireless telegraphy operators but soon discovered that the quality of both forms of signalling significantly deteriorated. Furthermore wireless telegraphy required twenty-four hour attention. Signal staff began to recognise that flag

134 1903 Agreement between the Admiralty and the Marconi Wireless Telegraph Company, Clause 4.

135 "Scientific Notes and News." *Science* 18, no. 463 (1903): 636.

136 Edgerton (2006).

signalling and wireless operators required a completely new set of skills. These disparate sets of skills required wider institutional and organisational changes in order to be maximised.

Shortly after signing the initial contract with the Admiralty, Major Flood-Page (then Managing Director of the Marconi Company) wrote a letter to *The Times* acknowledging that the contract enabled the company to survive into the twentieth century.[137] This contract and the many others signed by the Admiralty have been regularly presented by wireless historians as supporting evidence for the argument that the Marconi Company was becoming established in the field of wireless telegraphy. But, to look at these contracts from another point of view, they can be seen as the Admiralty setting the agenda with regard to the development of wireless communications during this period. They were demanding new technical innovations that met their need for ship-to-ship communications. They were setting the training syllabus for new wireless operators. They were questioning the Marconi Company's use of patents and related royalty charges. They were setting new technical standards. They were continuing to develop wireless sets and systems that originated within centres of scientific research and innovation such as HMS Vernon and were a product of institutional innovation. They were providing the Marconi Company with much needed custom and so I will conclude that in relation to wireless developments during this period it was the Admiralty who was setting the agenda and the Admiralty with their vast maritime needs, in terms of the navy and the merchant fleet, that had the power and control over the future direction of wireless communications during this period. To be sure, the interests of the Admiralty and the Marconi Company converged for some of this period and so, when it was convenient to do so, the Admiralty closely aligned itself with the Marconi Company. But this was a temporary alliance at best and one that was questioned by upcoming domestic legislation and international regulations, explored in more detail in the coming chapters.[138]

137 Flood Page, Major T. "Marconi Wireless Telegraphy in the navy." *The Times*, no. 36234 (30 August 1900): 9. See also "Marconi's Wireless Telegraph Company, Limited. Directors' Report.". *The Times*, 25 March 1903, 13. This lists the Admiralty separately to all other customers. From the 1901 contract – the first major order for the Marconi Company – the Admiralty have Marconi wireless sets installed on 32 ships. Even two years later, this was more wireless set installations than for the combined total of all other customers, including installations in progress.

138 See **Chapter 5 – 'If the Government did take over wireless it meant that they would take over us': simmering tensions between commercial and state interests, 1903-1905** and **Chapter 6 – 'A question for commercial adjustment, and not for international legislation': wireless rules and regulations, 1905-1908** for full details.

4.5 Conclusion

In the late nineteenth and early twentieth century, the navy was one of the foremost innovators and customers in the field of wireless telegraphy. By providing centres of innovation such as HMS Vernon, the navy were able to harness and support the cutting edge scientific knowledge and research being enacted by members of their fleet. Individuals such as Henry Jackson, with the support of the Admiralty, developed innovative wireless systems specifically designed to meet the navy's needs, that is ship-to-ship communication. In setting the agenda in terms of their demands for wireless communications, the Admiralty forced Marconi to adapt his technically superior system to make it better suited for maritime communication. Furthermore they continued to test the Marconi and Jackson systems side by side whilst promoting standardisation of wireless apparatus and training, again setting the agenda. While Jackson was thought of as synonymous – especially internally – with early wireless developments by the navy, he was only able to do so by taking advantage of the tools and systems provided, that is by the technologies and expertise available at HMS Vernon and by the institutional support of his superiors and indeed of the Admiralty as a whole.

As a customer of the Marconi Company, the Admiralty not only made technical demands but also questioned the company's policy on patents and temporarily ceased negotiations with the company when pushed on this issue. Eventually this was resolved and in 1900 the Admiralty placed an order for thirty-two Marconi wireless sets, having extensively tested the Marconi systems at the naval manoeuvres in the summers of 1899 and 1900. It was not until this year that the Marconi Company received its first order for installation of a wireless set on a merchant vessel and this was after installing a wireless system, based on those developed for the navy, between the South Foreland lighthouse and the East Goodwin lightship nearly two years earlier in late 1898.[139] As I have shown in this chapter, the navy was the Marconi Company's foremost and indeed main paying customer for the first five years and supported the company's survival into the twentieth century.

In conclusion, the Admiralty had utilised the tools – public and private – at its disposal in order to address strongly held concerns related to wireless communications. These concerns were initially met by internal innovations and technologies before yielding to a cautious and considered evaluation of the different wireless systems then available. Through collaboration with other state institutions such as the Post Office, the Board of Trade, and others, the Admiralty carefully examined patents and technical claims made by early wireless companies such as the Marconi Company and others. Throughout these proceedings, the Admiralty demonstrated a clear and powerful sense of

139 Pocock (1995), 58.

agency with a clear strategy of meeting military needs and maintaining national interests. The outcome of these objectives was technological, political, and regulatory changes. In the next two chapters, I will examine how the Admiralty engaged with wireless communications on a more administrative and political level. The Admiralty continued their leadership in the field and decisively set the agenda in terms of domestic and international regulations. Political and regulatory changes took the form of national legislation such as the 1904 Wireless Telegraphy Act and international conventions such as those proposed at the 1906 International Radiotelegraph Conference; these are the subject of consideration in the next two chapters.

Chapter 5: 'If the Government did take over wireless it meant that they would take over us': simmering tensions between commercial and state interests, 1903-1905[1]

5.1 Introduction

The previous chapter explored some of the concerns raised through practical use of wireless communications for naval signalling up to early 1903 and this chapter continues some of the themes developed in previous chapters but broadens out to an international and more administrative context. At the end of the previous chapter, practical applications of wireless led to serious concerns relating to military signalling and government administration of this embryonic technology. Military concerns related to security, privacy, and interference while administrative problems related to the extent and validity of Marconi's patents and related financial commitments as well as wireless licensing. These concerns were partially addressed through government contracts with the Marconi Company, specifically with the Admiralty and later the Post Office, and related contracts such as Lloyd's of London (henceforth Lloyd's), who provided maritime insurance for the Royal Navy.[2] However more practical and wide-ranging systems were needed, both nationally and internationally, to take control of these embryonic and potentially troublesome technologies. The limited existing scholarship presents the International Radiotelegraph Conferences in 1903 and 1906 as reflecting international and commercial tensions between Germany and Britain and relating to the wider theme of telecommunications hegemony. This rhetoric was relied upon heavily by the Marconi Company in contemporary accounts and was repeated in subsequent pro-Marconi literature.[3] Throughout the next two chapters I will challenge this argument and propose that it is closer related to rhetoric than to reality. Instead I will argue that the two international regulatory conferences in 1903 and 1906 and related domestic events such as the 1904 Wireless

1 Chapter title is taken from a letter from Henry Cuthbert Hall, Managing Director of the Marconi Company 1902-1908, and Marconi which discussed Cuthbert Hall's fears of a completely nationalisation of wireless in Britain, along the lines of electrical telegraphy. Marconi Archive MS. Marconi 175 – 4pp. typed letter from Cuthbert Hall to Guglielmo Marconi at Poldhu Hotel, dated 25 July 1901.

2 For a history of Lloyd's, see Brown (1973).

3 Examples include Baker (1970), Jacot de Boinod and Collier (1935), Jolly (1972), Vyvyan (1974), and others.

Telegraphy Act served dual purposes; domestic legislation and international regulation of wireless telegraphy.

This chapter outlines the early control and regulation of wireless communications in Britain on a domestic and international level between 1903 and 1905. Exploiting previously unconsidered primary sources I will reconstruct the polemical history of wireless communications during this influential – though forgotten – period in wireless history. This radical historical narrative places two of my case studies – the Post Office and the Admiralty, both government institutions – at the heart of this alternative narrative of institutional innovation. Standing in contrast to the standard secondary literature, which emphasises technical developments and commercial concerns, this chapter explores an alternative, parallel narrative with government institutions at the centre. In earlier chapters, I have shown how two government departments and institutions – the Post Office and the Admiralty – were at the forefront of wireless developments, both globally and domestically.[4] In Britain, the Post Office and the Admiralty were the primary customers for wireless systems, a fact openly acknowledged by Henry Cuthbert Hall, Managing Director of the Marconi Company, 1902-1908, in his testimony at the 1907 Select Committee hearings.[5] Furthermore I will demonstrate how these government departments shaped and controlled domestic legislation and international regulations.

The short period covered by this chapter marked great change and advances in the field of wireless communications – both technological and regulatory. The importance of the technological advances and related commercialisation of this embryonic technology was recognised and responded to through regulation and legislation, both in Britain and internationally. Domestic legislation and international regulations also marked a continued role for the Post Office and Admiralty and offered the chance to move beyond technical innovations to an active role in shaping government policy and strategy on wireless communications. Through these activities, the Post Office and the Admiralty shaped wireless communications to meet their needs and demands. In turn, their active roles in wireless communications influenced the activities of the Marconi Company, supporting and

4 See **Chapter 2 - 'Something in the Air': The Post Office and early wireless experiments, 1882-1899** and **Chapter 4: 'Britannia rules the wireless waves': the Admiralty and wireless, 1896-1903**.

5 *Report from the Select Committee on Radiotelegraphic Convention; Together with the Proceedings of the Committee, Minutes of Evidence, and Appendix*. Vol. 246, House of Commons Reports of Committees. London: Printed for His Majesty's Stationery Office, 1907, 147.

constraining in equal demand according to national interests and military demands. Through this shift in focus away from the commercial sphere, wireless communications moves beyond concerns solely related to technologies, patenting, and claims of ownership. Rather it is situated within a model of institutional innovations and is characterised by a marked tension between commercial and national interests. While I will not go so far as to argue that this period was one marked by a complete lack of agency on the part of the Marconi Company, it was certainly not one of success either. Rather I will argue that this formative period in wireless history demonstrates a strong degree of tension and conflict between commercial and state interests in Britain. Furthermore, and in direct contrast to much of the limited secondary literature on this period, commercial concerns were not at the forefront. Moreover Marconi and his company were not in full control nor were they setting the agenda.

Instead wireless was shaped by government institutions attempting to align wireless communications to their shifting national interests while maintaining a functional if not always congenial relationship with commercial wireless company, particularly the Marconi Company. The Interdepartmental wireless conference in 1901 and 1902 discussed in the previous chapter demonstrates that the British government viewed the Marconi Company as a potential and possibly temporary ally in maintaining their telecommunications hegemony. Bearing this in mind, they took a cautious approach to Marconi and his company. The previous chapter analyses the complex negotiations and interactions between the different departments within the government and hence the institutional rather than parliamentary leadership provided on behalf of the British government, particularly during the early years of the twentieth century. Here the focus and analysis of wireless telegraphy shifts from the Marconi Company to the government and its departments. When the Preliminary Conference on Wireless Telegraphy opened in Berlin in August 1903, the Post Office and Admiralty were the foremost institutions represented in the British delegation and were to represent the national interests of the British government prior to and during the conference.

The aftermath of the Preliminary Conference provided an impetus for domestic wireless regulations in the form of legislation. In contrast to the private internal and interdepartmental correspondence about the conference, almost all the discussion relating to the 1904 Wireless Telegraphy Act took place in the public forum that was House of Commons parliamentary debate. The legislation had been under discussion, in one form or another, since 1901 and indeed had been formally proposed by the then Postmaster General Lord Stanley prior to the conference in May 1903. Lacking any official guidance or strategy from the government and little to no discussion at parliamentary level, government departments such as the Post Office and the Admiralty acting as agents of the government were setting the agenda for discussion of wireless control and regulations. Furthermore the introduction of 1904 Wireless Telegraphy Act in Britain marked a shift in the balance of power between national and commercial interests, and led to two very different monopolies being in potential conflict. The passing of the Act gave the government, via the state-controlled institution that was the Post Office, monopoly over the licensing scheme with the Marconi Company having a *de facto* monopoly over the wireless hardware. While the 1904 Wireless Telegraphy act did not offer a significant challenge to the Marconi Company and other commercial interests, it did offer up a clear indication of who was in charge – the British government and not the Marconi Company, despite the three-year *de facto* monopoly held by the latter.

However prior to the 1904 Wireless Telegraphy Act being enacted, the position of the Marconi Company was tenuous. Marconi and Cuthbert Hall, Managing Director of the Marconi Company, were aware the future viability and success of their Company was heavily reliant upon their relationship with the British governments and its departments. In this regard, they were constrained by strongly held national interests into attempting to develop a better relationship with the government, in particular with the Post Office with whom they had developed an antagonistic relationship in the late 1890s.[6] The two strongest suits in the deck of cards they held at this time was the 1901 Deed of Agreement with the Admiralty and nationalistic rhetoric.[7] In terms of the latter, Marconi shamelessly emphasised his Anglo-Irish heritage and the British home of his company, subtly entwining the success of the company and their wireless system with that of the British nation. As somewhat of an aside, it was a notable success of Marconi and his company during this period that they managed to do this in at least two countries, his home nation of Italy and his adopted home of Britain. This is especially impressive considering the opposing positions these nations took in the complex system of European alliances that originated during this period. In the domestic British sphere, the government and the Marconi Company had different angles and different agendas in relation to wireless communications both at times sharing a common agenda. Initially the two parties seemed like natural albeit potentially temporary allies involved in a strategic rather than a warm alliance. Despite this, underlying tensions between commercial and states interests remained – each side negotiated and manoeuvred with both thinking they had the

6 See **Section 2.5 – 1896 and all that: Marconi's arrival in Britain** for further details.

7 See **Section 4.4 – Contracts and Contradictions: The Admiralty as a customer for wireless** for further details of the 1901 Deed of Agreement between the Admiralty and the Marconi Company.

upper hand (and maybe they did). In this chapter, I will map the subtle, shifting distinction between the British government institutions representing national interests in wireless and the Marconi Company and hence mapping the divergence and convergence of their interests.

The events studied in this chapter and the next are notably absent from most wireless histories. Instead their narratives leapfrog over the mid-years of the first decade of the twentieth century emphasising other key events in dramatic and Marconi-centric fashion such as the 1901 Transatlantic transmission, the "Crippen Affair" in 1909 and, of course, the sinking of the Titanic in 1912. The initial two International Radiotelegraph Conferences that form the keystone of this chapter and the next are rarely acknowledged in wireless historiography but have been included in wider survey histories of telecommunications and international governance and regulations.[8] Within these publications, the two conferences are presented as a continuation of existing international tensions – military and telecommunications – between Germany and Britain, the two most powerful imperial nations in Europe during this period. However primary source material counteracts this impression and instead frames the two conferences in terms of tensions centred around the Marconi Company. Within private documentations about the conference, it appeared there was much conflict within the British delegation, particularly between the Post Office and the Admiralty. This tension was gradually revealed over the years covered by the next two chapters and amply demonstrates how these two government departments were meeting their own needs and demands. However this also raises questions about government policy on wireless. If the Admiralty and the Post Office were disagreeing over wireless then does this mean that there is no central government policy and strategy on wireless? If so, might it be the case that informal government policy on wireless was devised and articulated through the actions of its institutions rather than in the political sphere? These are questions I will consider over the next two chapters.

5.2 The origins of wireless legislation and regulation

As discussed in the previous chapter, the germ of the idea for wireless legislation lay in the Interdepartmental Conference conducted between 1900 and 1901.[9] There is perhaps a longer history. In the landmark ruling on the 1880 case *Attorney General v Edison Telephone*

8 For example, see Hall (1993), Harper (1997) Headrick (1991), Hugill (1999), MacLeod (1988), and Tomlinson (1945).

9 See **Section 4.4 – Contracts and Contradictions: The Admiralty as a customer for wireless**

Company of London Ltd, the Post Office monopoly originally established in the 1868 and 1869 Telegraph Acts was expanded to include the 'speaking telegraph'.[10] Furthermore the judge noted almost in an aside that the definition of a telegraph as 'any apparatus for transmitting messages or other communications by means of electric signals' would also include any wireless forms of telegraphy.[11] Hence the concept of legislating for wireless communications was not a novel concept but it became a politically charged one with the much politicking and manoeuvring. Government institutions such as the Post Office and the Admiralty came to the fore and took charge in relation to international regulations discussed at the 1903 and 1906 International Radiotelegraph Conferences. Domestically, the 1904 Wireless Telegraphy Act was a more political event with much discussion in the House of Commons. In the background of these dramatic events and discussions with the potential for long-term influence over the future of wireless communications was the Marconi Company. The Marconi Company used the tools at its disposal – government contracts and agreements, and the resulting publicity – to engineer a result to suit its needs.[12] Both the Post Office and the Admiralty followed the best interests of their respective departments which often led to conflict between the two powerful institutions and, at times, led to the Post Office 'flip flopping' its position in relation to the Marconi Company. The changes in Post Office policy was shaped by the political context following the change in government in early 1905. Alongside the introduction of the Wireless Telegraphy Act, this political change marked a dramatic shift in Post Office policy towards wireless communication, in particular the Marconi Company. Another influence on Post Office policy was the compromise required to get a single Instruction to Delegates for the 1906 International Radiotelegraph Conference, something I shall analyse in more detail in the next chapter.

Government activities and policy was something of deep concern to the Marconi Company during this period. More so than international legislation – although this was something of concern too – domestic legislation had the potential to destroy the domestic marketplace for the company and was perceived to be more of a threat than the limited

10 Preece's personal annotated copy of the judgement can be found at IET Archives UK0108 NAEST 039/3 – Attorney General v Edison Telephone Company of London Ltd: Arguments and Judgement in Exchequer Division, High Court of Justice (1880). See **Section 2.2 – The Post Office and Telecommunications Legislation** for further details.

11 Rickards (1869), 326.

12 See Marconi Collection MS. Marconi 176 – [Cuthbert Hall's] correspondence with Marconi, 1904-6 for further details.

amount of commercial competition. Institutions such as the Post Office and the Admiralty alongside the different governments were setting the agenda for wireless rules and regulations. Hence, the Marconi Company led by Cuthbert Hall attempted to manoeuvre through these difficult and uncharted seas by manipulating government departments via their contracts with the wireless company, with particular focus on the Admiralty and Lloyd's. Cuthbert Hall believed that government attempts to control or limit the company's “natural monopoly” would conflict with the 1903 Admiralty-Marconi Company contract and create tension between two governmental departments, the Post Office and the Admiralty. At this early stage in the commercial development, the Admiralty was the Marconi Company's primary customer and so the Admiralty very much held the power in the relationship. More so than technical interference or commercial competition, the Marconi Company feared government management and interference. The potential of wireless legislation was immense and informed much of the wireless developments during this period. Both the 1903 Preliminary Conference on Wireless Telegraphy and the subsequent 1904 Wireless Telegraphy Act were very much institutional-led with government departments setting the agenda. The surviving documentation shows very little guidance coming from the government with the closest thing to policy being financial recommendations provided by the Treasury. While there was some discussion of the 1904 Wireless Telegraphy Act in the Houses of Parliament, government-led and government-level politics did not come to the fore until the 1906 Radiotelegraph Conference and the 1907 Select Committee hearings.[13] Nonetheless the political context remained important with the turmoil surrounding the Radiotelegraph Conferences, both in 1903 and 1906, were very much echoed by the political turmoil of the time even if, at least in the case of Britain, there was no direct relationship between the two.

5.3 Prelude to the 1903 Preliminary Conference on Wireless Telegraphy

The initial, preparatory Preliminary Conference on Wireless Telegraphy (to give it its correct title) was held in Berlin in August 1903. The conference had its supposed origins in the refusal of the Marconi Company to pass on a Telefunken wireless message from Prince Henry of Prussia to his brother, Kaiser Wilhelm II, as Prince Henry travelled back from New York aboard the S.S. *Deutschland* in 1902. There is much controversy about this with some scholars claiming Telefunken, the German state-controlled wireless company, intentionally sent wireless messages to Marconi stations in order to test the company's refusal to

13 See **Chapter 1 - Introduction** and **Appendices** for further details.

intercommunicate with other wireless systems and commercial competitors.[14] In contrast other scholars have suggested that the Marconi stations' failure to pass on the messages was a technical issue and if correct protocol had been followed then the Marconi Company would have passed on the messages.[15] That these events occurred according to the intention of the Telefunken Company seems, to me, the most persuasive argument. During this period and as discussed earlier, Germany and Britain were arch enemies in the field of telecommunications and more widely in their imperialist goals. Marconi and Telefunken were serious international rivals in the commercial exploitation of wireless telecommunications. However there were two significant differences. First, Telefunken was a nationalised wireless company supported by the German government with a close allegiance to the national interests of the German nation. Secondly, Telefunken (and hence the German government) desired a public arena battle for wireless and were willing to test the boundaries of the bigger imperial rivalry and pre-existing international tensions in order to achieve their goal. Meanwhile in the contemporary press the 1903 conference was seen as being established in opposition to Marconi Company's “monopoly”, in particular their contract with Lloyd's and general desire to establish a worldwide network of wireless stations.[16] In many ways the Marconi Company's plans to such a network and refusal to intercommunicate were two different tools in support of the company's monopolistic desires. Furthermore these tools could be applied in the domestic and the international sphere.

The complex origins of the preliminary conference remain undetermined but, intentional or otherwise, the conference raised the politically sensitive topic that was the Marconi Company's refusal to intercommunicate with other wireless systems. This was not merely a technical issue but one centred around patents. The Marconi Company argued that intercommunicating with systems that infringed patents held by the company would null and void any subsequent litigation. While the Marconi Company had not issued legal proceedings on the basis of the patents they held, it was a threat they regularly employed and an effective one too. A further complexity in relation to the government's dealings with wireless telegraphy and, in particular, with the Marconi Company was the relationship between the Post Office and the Marconi Company. This antagonistic relationship had its origins in the interactions between Marconi and the Post Office prior to the establishment of the Marconi

14 Hugill (1999), 94; Douglas (1987), 121; Lyall (2011), 46.

15 Baker (1970), 95.

16 "[Untitled Article on German Government Plans for International Wireless Conference]." *Engineers Gazette* 16, no. 176 (1902): 217.

Company in 1897. This was further sourced by Marconi's continued ambivalence towards the role of the Post Office in his early work, discussed in more detail in an earlier chapter.[17] In June 1903 and two months prior to the Preliminary Conference on Wireless Telegraphy in Berlin, the Postmaster General Austen Chamberlain made a public statement in the House of Commons on the relationship between the Post Office and the Marconi Company.[18] In this widely reported statement, Chamberlain countered Marconi's claims of hindrance to the natural progression of wireless telegraphy by the government and Post Office and instead suggested that the Marconi Company had asked for too much, namely a permanent and exclusive right to wireless telegraphy in Britain.[19] With this divergence of opinion in relation to domestic wireless regulations, it is perhaps unsurprising that the conference prelude in Britain was marked by tension, in particular between the Post Office, the Admiralty, and the Marconi Company.

When the 1903 Preliminary Conference on Wireless Telegraphy was announced, private correspondence between Cuthbert Hall and Marconi made clear the contempt and disregard in which they held the conference proceedings. Already the Marconi Company was strongly and publicly arguing that the conference was an attempt by Germany to limit the wireless success of Britain and by proxy the Marconi Company.[20] This was not the last that the Marconi Company attempted to play the nationalistic card. They would repeat this rhetoric again in relation to the 1906 International Radiotelegraph Conference. In the prelude to the Preliminary Conference on Wireless Telegraphy, Cuthbert Hall arranged meetings with two of the British delegates, Captain Heath of the Admiralty and John C. Lamb of the Post Office and noted their opinions, this being generally in line with those of the Marconi Company.[21] Despite this, the Marconi Company was blocked from receiving information about the conference and was forced to get a translation from the Italian version. However in overall terms Cuthbert Hall

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17 See **Chapter 2 - 'Something in the Air': The Post Office and early wireless experiments, 1882-1899** for further details.

18 Hansard HC Deb 08 June 1903 vol 123 cc285289 - REVENUE DEPARTMENTS. URL: http://hansard.millbanksystems.com/commons/1903/jun/08/revenue-departments-1#S4V0123P0_19030608_HOC_230

19 Published reports of Chamberlain's speech include "Parliament." *The Times*, 9 June 1903, 6 and "Scientific Notes and News." *Science* 17, no. 443 (1903), 1022.

20 Examples include "Marconi's Wireless Telegraphy." *The Times*, 1 April 1903, 12; Cuthbert Hall, H. "The Berlin Wireless Telegraph Conference." *The Times*, 1 August 1903, 11.

21 Marconi Collection MS. Marconi 204 – 2pp. typed cover letter from Cuthbert Hall to Guglielmo Marconi, Poldhu Hotel, Mullion, dated 31 July 1903.

was not unduly concerned about the outcome of the conference and was confident the British government would not risk breaching the newly signed Admiralty-Marconi Company contract in order to agree to the articles of the 1903 Preliminary Conference on Wireless Telegraphy.[22] As discussed in the previous chapter, this contract followed prevailing practice with regard to Marconi Company contracts and contained a clause stipulating non-intercommunication with other wireless systems, excepting emergence cases. This introduced potential conflict with one of the proposed articles of the Preliminary Conference on Wireless Telegraphy which stipulated enforced intercommunication. Additionally Cuthbert Hall was convinced that the Admiralty-Marconi Company contract was having an effect in terms of creating a chasm between the public policy pursued by the British government and publicly represented by the Foreign Office and that of the Admiralty delegates:

> ...I have been unable to elicit the views of the Foreign Office since the Conference concluded. The fact that our Delegates took a line together opposed to the policy previously pursued by the Foreign Office in this matter of exclusive working, indicates that the Admiralty Agreement is having its effect. By the Agreement the Government is put in a very awkward position, because they either back us, or at least refuse to acquiesce in the tying of our hands as proposed at Berlin; or stultify that Department of the Government most concerned with the workings of Wireless Telegraphy.[23]

In the run up to the conference, the Post Office was the primary government department in relation to decisions about wireless telegraphy, both in and of itself and also in relation to regulations, with the Admiralty, the War Office, and the Board of Trade being very much secondary departments. The Post Office was considered the more senior government department in relation to wireless telegraphy regulations. As discussed in more detail in a previous chapter, the Post Office had the longest experience in the field and fitted wireless telegraphy into their overall state-controlled telecommunications monopoly.[24] This was also reflected in the selection of British delegates to attend the 1903 Preliminary Conference on

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22 See **Section 4.4 Contracts and Contradictions: The Admiralty as a customer for wireless** for further details of the 1903 Admiralty-Marconi Company and the earlier 1901 Deed of Agreement between the two organisations.

23 Marconi Collection MS. Marconi 175 – 3pp. typed letter from Cuthbert Hall to Guglielmo Marconi, Holland House, New York, dated 9 September 1903.

24 See **Chapter 2 - 'Something in the Air': The Post Office and early wireless experiments, 1882-1899**.

Wireless Telegraphy in Berlin. There were six members of the British delegations; three from the Post Office, two from the Admiralty, and one from the War Office.[25] Additionally the delegation was led by the chief Post Office delegate, John C. Lamb, Second Secretary of the Post Office.

In the prelude to the conference, all of the relevant government departments were 'on board' in relation to the proposals of the 1903 Preliminary Conference on Wireless Telegraphy, with the exception of the Admiralty. The proposals were considered to be 'in the public interest' and were broadly supported by the different government departments even if it was in contradiction of the newly signed Admiralty-Marconi Company contract.[26] Although backdated to 31 March 1903, the contract was signed on 24 July 1903, less than two weeks prior to the beginning of the conference.[27] Despite this being in potential contradiction of a conclusion reached by Mackay in July 1903 in relation to the Admiralty-Marconi Company contract, the "public interest" argument was still passed on and communicated more widely within the different government institutions.[28] Hence the Admiralty were invited to state their view before making a final decision although the decision was strongly recommended in one direction. These complex interactions bring to the fore a discussion about the nature of wireless regulations, domestic and international, and how this might fit into a wider context of military concerns, national interests, commercial desires, and institutional innovation.

5.4 The 1903 Preliminary Conference on Wireless Telegraphy

The 1903 Preliminary Conference on Wireless Telegraphy hosted by the Imperial German government at the Imperial Post Office in Berlin between 4 and 13 August 1903 was attended

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25 The three Post Office representatives were John C. Lamb, Second Secretary; John Gavey, Engineer-in-Chief and Electrician; and R.J. Mackay, Departmental Chief. The two Admiralty representatives were Captain H.L. Heath, Assistant Director of the Naval Intelligence Service and Lieutenant Christopher R. Payne. The War Office representative was Colonel R.J. Hippisley of the Royal Engineers.

26 BT Archives Post 30/1298 File II. WIRELESS TELEGRAPHY. Proposed International Conferences at Berlin. Report of the Cables Landing Rights Committee. Submitted to Postmaster General. 1903.

27 See **Section 4.4 – Contracts and Contradictions: The Admiralty as a customer for wireless** for further details of the 1903 Admiralty-Marconi Company contract.

28 BT Archives Post 30/1298 File I. WIRELESS TELEGRAPHY. Proposed International Conferences at Berlin. Letter from Mr. Mackay to Mr. Lamb, dated 28 July 1903.

by all nine countries with wireless systems – Austria, France, Germany, Great Britain, Hungary, Italy, Russia, Spain, and the United States. The purpose of the conference was to establish a general basis for wireless telegraphy regulations with a view to the conclusion of an International Convention. As the conference was by private and selective invitation of the Imperial German government, it was not recognised by the International Telegraphic Union (ITU), although the conference followed some of the practices of previous International Telegraph Conferences and partially based the conference protocols on ITU telegraph conference protocols.[29] The control and regulation of the international wireless waves and, in particular, the issue of intercommunication between different, competing wireless system was the central themes of both conferences. The 1903 conference was intended as a "preliminary" conference and the attendance by the British government was agreed to on the stipulation that the conference 'take the form of a preliminary discussion only, and that the delegates shall have no power to decide or to pledge their Governments to any particular course of action.'[30] This description made it clear that protocols of the 1903 conference were considered more of a starting negotiation point than a list of protocols to be legitimately ratified, something that has been misrepresented or misunderstood in the small amount of scholarship on this conference. Furthermore this description, found in a letter from the Foreign Office to the Secretary of the Marconi Company dated 30 July 1903, was considered reasonable grounds for refusing the Marconi Company's request to attend the conference.

The "preliminary" nature of the conference was intended so that the proposed protocols could be debated, discussed, and amended before each delegation returned to their home country for further discussion. This post-conference discussion was intended by the Imperial German government to be in anticipation of another wireless conference to take place the following year in October 1904. The outcome of this second conference would be a Convention that could be voted upon and ratified by individual nations. However this second conference was delayed for various reasons until October 1906. The most prominent and most discussed article put forward was article one, that 'radio-telegrams originating from and destined for ships shall be received and forwarded without regard to the system employed'.[31]

29 For a history of the ITU, see Lyall (2011).

30 Marconi Collection MS. Marconi 204 – 1pp. typed copy of letter from F.H. Villiers at the Foreign Office to the Secretary of the Marconi Company, dated 30 July 1903.

31 Neilson, George R (trans.). "Preliminary Conference at Berlin on Wireless Telegraphy. August 1903.", edited by Post Office. London: George Tucker, 1903, 1.

This complex matter of intercommunication would remain at the top of the agenda for the subsequent conference in 1906.

The preliminary conference opened with a discussion of five proposed articles suggested by the German government.[32] As mentioned above, the first article related mainly to intercommunication between different wireless systems but also related to administration of wireless telegraphy *vis-a-vis* allocated wavelengths and charges for exchanges of messages. The second article stipulated that article one was compulsory for wireless stations intended for maritime signalling, this covering most wireless stations at this time. Article three stated that wireless communications between maritime vessels and shore stations was regulated by Service Regulations which were to be obligatory. The fourth article was essentially a proviso for the first article, namely that enforced intercommunication would not apply to wireless stations used exclusively for military usage. However, a question was raised about whether an exception to this exception might be made for ships in emergencies. The fifth and final article put forward that countries which had not initially agreed to the Convention could be admitted by request.

The first proposed article was also the first article under discussion at the opening sitting of the conference on 4 August. The sitting opened with a brief overview of the early history of wireless provided by Reinhold Kraetke, Secretary of State for the Postal Department of the German Empire, before moving on to discussion of the first proposed article. Sydow, Under-Secretary of State for the Postal Department and President (chair) of the conference, opened the discussion with the suggestion that article one was intended 'to prevent the creation of a monopoly in favour of a single system, and ... to avoid disturbances of the different systems between themselves.'[33] Lamb, the head British and Post Office delegate, next joined the discussion making it clear from the offset the position of the British delegation. The delegation, as a representative of the British government, were 'not in position to submit definitive propositions … [and would find it] difficult ... to express definite opinions.'[34] Lamb put forward two distinct reasons for this position. First, the British delegation believed that wireless telegraphy was not sufficiently developed to regulate. Secondly, Britain required domestic legislation to formalise the Post Office's telecommunications monopoly in relation to wireless telegraphy. The British delegation was content to play a modest role in the

32 *Ibid.*, 1-2.

33 *Ibid.*, 7.

34 *Ibid.*

proceedings and listen to the views put forward by the other delegates. Nonetheless the British delegates did contribute occasionally to the discussion.

At the second sitting on 5 August, Lamb commented on the difficulty of administrating international regulations, in particular detecting when stations were not adhering to enforced intercommunication.[35] Further to this, Lamb noted that the introduction of enforced intercommunication to existing wireless stations was potentially problematic and might require financial compensation, an issue Lamb returned to throughout the discussion.[36] At the third sitting on 7 August another Post Office delegate, John Gavey, made a short and technical contribution with regard to the inclusion of syntonised and non-syntonised systems when drafting international regulations.[37] Also at this sitting, Lamb contributed brief comments upon the administering of charges for wireless messages.[38] At the conclusion of this sitting, Lamb expressed his disagreement to a proposal by the French government that countries whose colonies had made contracts 'not in harmony with the principles of an International Convention' could be forced to sign up to the Convention along with their colonial masters.[39] Lamb suggested that Britain 'could not be compelled to adhere to such a Convention both for the United Kingdom and for the self-governing colonies' and a long discussion ensued which was concluded at the fourth sitting on 10 August.[40] The fourth sitting began with a discussion of indemnification for existing wireless companies and the administration of charges. Lamb contributed briefly and sporadically to the discussion, repeating much of the points he had made previously.[41] Another Post Office delegate, R.J. Mackay, also contributed briefly to the discussion on charges for wireless messages and administration thereof.[42] Much of this discussion centred about disagreements between the French and British delegates. Lamb argued passionately stating that 'the stipulations formulated by France were too onerous, and that the British delegation was not in a position to accept them.'[43] With the eventual

35 *Ibid.*, 14-15.

36 *Ibid.*, 16.

37 *Ibid.*, 21.

38 *Ibid.*, 24-26.

39 *Ibid.*, 28.

40 *Ibid.*

41 *Ibid.*, 30, 31, 33, 35

42 *Ibid.*, 36.

43 *Ibid.*, 37.

interjection of the President, a compromise was reached and it was agreed that regulations would only apply to the home country and not to her colonies.

At the fifth sitting on 12 August, much of the discussion was taken up with article three which related to Service Regulations. This discussion was very much led bytwo of the Italian delegates, Captain Bonomo del Casale and Lieutenant Solari, with the latter delegate being a long-term friend and colleague of Marconi. Next the discussion moved on to article four, an exemption to enforced intercommunication which only applied to wireless stations used exclusively for military use. One of the Admiralty representatives, Captain Heath, suggested that this be amended so that enforced intercommunication did not apply to naval and military wireless telegraph stations, nor to naval or military communications. In this, Heath was broadly supported by Lamb.[44] The sixth and final sitting was held on 13 August and mostly involved a reading of the revised articles of the Final Protocol. During the discussion, the British and Italian delegates expressed severe reservations and these were reflected in the Final Protocol.

The Final Protocol began with a note that the delegations from Germany, Austria, Spain, the United States of America, France, Hungary, and Russia had agreed to present to their governments the articles of the Final Protocol for consideration as being suitable to form an International Convention on wireless telegraphy.[45] Britain and Italy were the only two delegations not to sign and their reasons for doing so were included in separate declarations listed at the end of the Final Protocol. The British declaration noted a 'general reserve' about two aspects of the protocol.[46] First, they had reservations about paragraph two of article one – enforced intercommunication. Secondly, they objected to article five as it related to article six. Article five related to the operating and positioning of wireless stations so as to avoid interference. Article six strongly proposed that countries adhering to the protocols should encourage wireless stations operating in their country to adhere to these protocols more generally in all their territories, even if these territories had not agreed to the protocols. The Italian delegates shared the reservations of the British delegates about paragraph two of article one (enforced intercommunication) – and article six. They were also concerned about paragraph three of article one which stipulated that countries who agreed to the international

44 *Ibid.*, 49.

45 *Ibid.*, 57.

46 *Ibid.*, 61.

regulations would publish all technical information on their wireless systems in order to support and encourage communications between coastal and marine stations.

Beyond these differences, there was one significant divergence between the Italian and British declarations of reservations. The British delegations merely expressed their reservations while the Italian delegation elaborated upon theirs, bringing up Marconi twice in the space of four short paragraphs. While the Italian delegation openly supported the Marconi Company in terms of non-intercommunication, this was not the case with the British delegation. Despite this, later secondary sources often present the British and Italian delegations as standing firm on the side of the Marconi Company in terms of non-intercommunication.[47] While this was mostly true of the Italian delegation, this was not an accurate reflection of the motivations of the British delegates. Instead the refusal of the British delegates to sign the Final Protocol and hence present these to the British government for consideration is far more complex. At the opening of the 1903 conference, the British delegation had expressed two initial reservations – the relative youth of wireless telegraphy and a lack of domestic legislation – as reasons not to fully engage with the conference. Through the conference discussions it was revealed that the British delegation, in particular the Admiralty, also had serious concerns about enforced intercommunication involving wireless stations used for military communications. Two of the three reasons – lack of domestic legislation and concerns about the security of military communications – related to institutional demands for wireless while none of the reasons directly related to the non-intercommunication policy of the Marconi Company.

5.5 Aftermath of 1903 Preliminary Conference on Wireless Telegraphy

In the immediate aftermath of the conference, other problems emerged in addition to those concerns expressed by the British delegations at the opening sitting of the conference. First, there was a complex network of agreements and contracts between the Admiralty, Lloyd's of London, and the Marconi Company which included stipulations of non-intercommunication by the Marconi Company. These needed to be amended before the British government could consider the conference protocols. Furthermore, the British government felt that more countries should be invited to the second conference. However, independent of these limitations, the British government and her departments with the

47 Hugill (1999), 94; Headrick (1991), 120.

exception of the Admiralty were positively disposed towards the proposals of the 1903 conference.

The attendees of the initial preparatory conference were invited to attend, along with governments of other maritime states not invited to the preliminary conference. The countries invited to attend the second conference were (initially): Austria, Spain, USA, France, Great Britain, Hungary, Italy, Russia (all original attendees), along with Belgium, Bulgaria, Denmark, Greece, Montenegro, Monaco, Norway, the Netherlands, Portugal, Roumania (sic), Sweden, and Turkey. A copy of the draft International Treaty (prepared by the German government) was circulated beforehand although it was noted as confidential.[48] At first the date for the conference was deferred due to the insistence by the British Government that more attendees were necessary, with a particular emphasis on members of the International Telegraphic Union of which Britain was a key member. The attendees of the Preliminary conference were Austria, Spain, USA, France, Great Britain, Hungary, Italy, and Russia; Belgium, Bulgaria, Denmark, Greece, Montenegro, Monaco, Norway, the Netherlands, Portugal, Roumania [sic], Sweden, and Turkey were invited to attend the second conference although more countries may have actually attended, at the suggestion of Britain and possibly other countries.[49] It is possible that these countries were also traditional allies of Great Britain or even countries who sided with Great Britain in the International Telegraphic Union although this requires further investigation.

As a result of these concerns, the British government requested that the second conference originally planned for October 1904 be postponed until early 1905. Other governments may have supported or requested this too. Initial plans for the second International Radiotelegraph Conference intended the conference to be held in October 1904, a year after the preliminary conference. As mentioned previously, the 1903 Preliminary Conference on Wireless Telegraphy mostly followed the conference template set by the International Telegraph Union (ITU). However the planned timing of the first two conferences was a notable exception to this. Most International Telegraph Conferences were around three

48 BT Archives Post 30/1298 File X. WIRELESS TELEGRAPHY. Proposed International Conference at Berlin. Invitation to British Government to take part. Department's view communicated to Foreign Office. 1904 – 2pp. typed copy (translated into English) of letter from German Embassy, dated 21 July 1904.

49 *Ibid.*

years apart.[50] However for reasons beyond the control of the organisers, the second conference was repeatedly delayed. By early 1905 and the date proposed by the British government for the second conference, there was reason for a second postponement. In February 1904 the Russo-Japanese war had broken out and this continued until September 1905. Britain did not have an entirely neutral role in the conflict, being an ally of the Japanese, and war was nearly declared between Russia and Britain in October 1904 when the Russian Baltic Fleet mistook British trawlers for an Imperial Japanese Naval Force in an incident known as “the Dogger Bank incident”. In fact, the Russo-Japanese war – both parties being invited to attend the second conference – led to the conference being again postponed, this time to October 1906.

The British government's main reasons for deferment were of an administrative rather than a principled nature. The government was not against the conference protocols *per se* but rather were of the opinion that certain steps must be taken before they could consider agreeing to or enacting the conference protocols. They believed that domestic wireless legislation and an amendment of government wireless contracts and wireless contracts negotiated on behalf of the government were required. Contracts between government departments and the Marconi Company and other contracts with the Marconi Company negotiated on behalf of the government by Lloyd's insurance company were amended.[51] The problem of lack of domestic legislation was solved through the 1904 Wireless Telegraphy Act, a concentrated step towards national wireless regulations and licensing and something I will explore in more detail shortly.[52] The introduction of this legislation issued a clear warning to the Marconi Company's plan of domestic and international monopoly in two key regards. First, it licensed domestic wireless stations within Britain thereby opening up the domestic wireless spectrum to commercial competition. Secondly, it was an indicator that the British contingent was more seriously considering the protocols of the preliminary conference and was in a position to agree to the proposals of the second International Radiotelegraph Conference.

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50 The initial five International Telegraph Conferences were held in 1865 (Paris), 1868 (Vienna), 1871-1872 (Rome), 1875 (St Petersburg), and 1879 (London).

51 See BT Archives Post 30/1298 File I. WIRELESS TELEGRAPHY. Proposed International Conferences at Berlin. Letter from Mr. Mackay to Mr. Lamb, dated 28 July 1903.

52 See BT Archives Post 30-1203 - Wireless telegraphy patents, part 1 (1892-1902), BT Archives Post 30-1204 – Wireless telegraphy patents, part 2 (1904-1912), and IET Archives UK0108 SC MSS 143 Collection – Papers of Sir Henry Norman (1903-1939), for further details of internal discussions and legal agreements.

Meanwhile, Cuthbert Hall's reaction to the Final Protocol of the conference was immediate and forthright. At the conclusion of the conference, Cuthbert Hall wrote to Marconi stating that he believed the conference attendees would be forced to reconsider in light of the impracticability of the conference proposals in combination with the ire of the smaller countries who were not invited to the conference.[53] Furthermore, Cuthbert Hall suggested that the attending countries 'really understand nothing about [wireless regulations]'. This rather bizarre conclusion was further compounded by another letter from Cuthbert Hall to Marconi a mere four days later and in the immediate aftermath of the conference. Hall, writing about the domestic outcome of the conference, was confident the British delegation would not accept the protocols. Despite being unable to canvas the Foreign Office directly and without any real evidence that his confidence was well-placed, Cuthbert Hall believed the British delegates would oppose previous Foreign Office policy supporting intercommunication. Furthermore Cuthbert Hall believed that the government's decision was influenced by their contracts with the Marconi Company including the newly signed Marconi-Admiralty agreement which had been signed a few months previously in July 1903. As noted in the previous chapter, the 1903 contract stipulated non-intercommunication with stations or ships using non-Marconi Company apparatus unless in a case of emergence or outbreak of war in Clause seven.[54] Cuthbert Hall concluded optimistically:

> By the Agreement the Government is put in a very awkward position, because they either back us, or at least refuse to acquiesce in the tying of our hands as proposed at Berlin; or stultify that Department of the Government most concerned with the workings of Wireless Telegraphy.[55]

Cuthbert Hall was indeed correct that government contracts with the Marconi Company would conflict with proposed regulations, particularly those stipulating non-intercommunication. The Final Protocol of the conference, a draft of regulations for wireless

53 Marconi Collection MS. Marconi 175 – 8pp. typed letter from Cuthbert Hall to Guglielmo Marconi, Holland House, New York, dated 5 September 1903.

54 IET Archives UK0108 SC MSS 143/01/01 – 7pp. agreement between the Admiralty and the Marconi Wireless Telegraph Company in relation to Navy Wireless Telegraphy, dated 24 July 1903, and presented to both Houses of Parliament

55 Marconi Collection MS. Marconi 175 – 3pp. typed letter from Cuthbert Hall to Guglielmo Marconi, Holland House, New York, dated 9 September 1903.

telegraphy, was submitted to the governments concerned as a basis for international regulations. The most important and indeed the most controversial aspect of the protocols was intercommunication between coastal stations and ships which was to take place independent of the wireless system being used; additionally countries that agreed to the protocols were to publish all technical information liable to facilitate intercommunication. Additionally, and far less controversially, priority was to be given to "calls for help" transmitted by ships. The practical, administrative aspects of the St Petersburg International Telegraph Convention would also apply to wireless telegraphy, but only in areas where it did not conflict with the protocols of the International Radiotelegraph Conference. This was an indicator that Germany, as organisers of the Preliminary Conference on Wireless Telegraphy, wished to engage beyond the attendees of the initial conference (that is countries with wireless systems in place) and expand attendance of the second conference to members of the International Telegraphic Union (ITU). This move was strongly supported by Britain and other countries and contradicts how Cuthbert Hall saw the conference and its aftermath playing out.

In December 1903 and six months after the conference, the Cables (Landing Rights) Committee, very much led by the Board of Trade, produced a report entitled *Report on proposed International Convention for the regulation of wireless telegraphy as affecting the question of legislation in the United Kingdom*.[56] The committee included the President of the Board of Trade with the other committee members being A. Bonar Law (Chairman), E.A. Altham, John Anderson, F.A. Campbell, J.A. Kirk, J.C. Lamb, F.S. Parry, and T.H.W. Pelham, with R.J. Mackay as Secretary. Internal reports and other documentation stated clearly that the Post Office considered telegraphy, national and international, as a model for the transmission of messages via wireless telegraphy. The rules for telegraphy were also based on maritime regulations regarding visual signalling, both being covered by the International Telegraph Convention. This also lightly touched on the issue of standards and intercommunication between different wireless telegraphy systems and raised the question whether this too also a problem for early telegraphic systems?[57]

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56 BT Archives Post 30/1298 File II. WIRELESS TELEGRAPHY. Proposed International Conferences at Berlin. Report of the Cables Landing Rights Committee. Submitted to Postmaster General, 9-14 December 1903.

57 BT Archives Post 30/1298 File VII. WIRELESS TELEGRAPHY. Question of restricting wireless Stations to accept messages from vessels fitted with other systems to signals of International Code. 1904.

Overall, the report reached a number of different conclusions. First, with the exception of the Admiralty representative and conference delegate Captain Heath, the Committee were 'unanimously of the opinion' that the recommendations of the Preliminary Conference on Wireless Telegraphy should be accepted, including the obligation to exchange messages, where possible, with ships fitted with any form of apparatus. The Committee also adhered to the recommendation in their report of 12 March 1903 in favour of legislation, with modification of seven instead of three years as the maximum period for Licenses. Furthermore the Committee were also '...alive to the position which the Marconi Company had built up for themselves in this country, and to the situation thus created for His Majesty's Government in reference to the question of adhesion to a Convention which would restrict the Company's freedom of action; they recognised that opposition on the part of the Company might create an obstacle which would have to be overcome before the legislation which is necessary to bring wireless telegraphy under adequate control could be secured; and they saw that the Admiralty had increased the difficulties of the situation by entering into an Agreement with the Marconi Company providing for payment to the Company or compensation in the event of the Admiralty exchanging commercial messages with ships fitted with other than Marconi form of apparatus.'[58] Captain Heath stated that the Admiralty were not bound to deal with commercial messages, and that the obligation to grant compensation would not apply to Lloyd's Stations where commercial messages were dealt with by the Coast Guard. This was a view which the Committee could not adequately discuss without legal advice; but whatever might be the precise legal bearing of the Admiralty-Marconi Agreement, the Committee felt it undoubtedly recognised the principle that the imposition of an obligation to exchange messages with other systems should be accompanied by compensation.

As discussed previously, the Committee considered a lengthening of the license period from three to seven years as a possible alternative to financial compensation for the Marconi Company. The Committee justified it thus: 'the Marconi Company as first in the field would have an advantage over all newcomers, and the grant of the longer term would enable them materially to strengthen their position.'[59] The Committee adhered to the previous two resolutions despite the potential and yet-to-be-determined legal bearing of the recently concluded Agreement between the Admiralty and the Marconi Company. The Committee '...considered it important in the public interest that their recommendations should be carried

58 *Ibid.*

59 *Ibid.*

out...'[60] In addition, Captain Heath had appended a 'Minority Report' which furthermore disagreed with Captain Heath's earlier recommendations to the Committee on 12 March 1903, this being that licensees should be required to interchange messages so far as practicable with ships fitted with any form of apparatus.

5.6 The Marconi Company Responds

Through regular private correspondence between Cuthbert Hall and Marconi, it was clear that the greatest fear of the Marconi Company and its Managing Directors at the turn of the twentieth century was that of rules and regulations relating to wireless telegraphy being introduced in Britain and hence curtailing the company's activities. Regulations introduced in Britain – the company's potentially most lucrative market and the centre for the existing telecommunications network which spanned the empire and the globe – would severely curtail the Company's 'natural' monopoly and activities. Limitations, possibly even as far as legislation, might even go so far as to nationalise the industry and hence close the domestic market to all private wireless companies. It was fear of nationalisation of the domestic British wireless telegraphy network potentially achieved through the 1868 & 1869 Telegraphy Acts and 1880 Edison judgement rather than patent litigation that concerned the Marconi Company during its early years.[61]

In a worst case scenario, Marconi and Cuthbert Hall feared a complete nationalisation of wireless telegraphy in Britain. In regular correspondence between the two, concerns about nationalisation was a serious and frequent preoccupation. Issues of patent litigation were barely discussed until the lead-up to the 1906 International Radiotelegraph Conference when they were raised in relation to intercommunication. Cuthbert Hall's deep-seated fear of nationalisation superseded any concerns over patent rights and litigation and these were not a serious concern for him during this period. If the domestic wireless telegraphy network was nationalisation then patents (or at least British ones) would become irrelevant and the Marconi Company's biggest and most potentially lucrative market would disappear overnight. Despite the seriousness of these concerns, Cuthbert Hall remains typically upbeat and even sometimes blasé about the possibility of the outcome being anything but in the Marconi

60 *Ibid.*

61 See **Chapters 1 – Introduction** for a more in-depth discussion of earlier, nineteenth-century telecommunications legislation in Britain.

Company's favour. However, the frequency with which Cuthbert Hall returns to this topic in correspondence with Marconi between 1901 and 1904 seem to indicate that the issue was more serious than Cuthbert Hall assumed it to be. Cuthbert Hall believed there was little risk of the government nationalising the British domestic wireless telegraphy network and stations because, in the past, the government had waited until new inventions were proved through 'private enterprise [and] commercial successes.'[62] Cuthbert Hall gave the inland telegraph network along with the telephone network as examples of the power of private enterprise over the desire to nationalise. Cuthbert Hall concluded with his fears that nationalisation would mean the Marconi Company being taken over - ' if the Government did take over wireless it meant that they would take over us' – but that he felt that the strength and validity of their patents was enough to counteract this.[63]

As discussed earlier in this thesis, the nationalisation of the British domestic telecommunications network had its origins with the 1880 judgement of *Attorney General v Edison Telephone Company of London Ltd* which concluded that the monopoly of the 1868 and 1869 Telegraph Acts also applied to the 'speaking telegraph' (telephone) and furthermore would also apply to any (then potential) wireless telegraphy systems.[64] And so the Marconi Company, with the memory of the *de facto* monopolisation of telephonic communication in 1880 still fresh, had a strong and reasonably founded fear of government intervention and national regulation. In a best case scenario, this might offer increased support for other private companies. In a worst case scenario, this might lead to the dissolving of the company and the complete nationalisation of wireless telegraphy in Britain. From 1900 onwards, the Marconi Company focused its efforts on combating government-led initiatives to control and curtail wireless telegraphy. However in this chapter I discuss the political context to these developments and demonstrate how changes in wireless telegraphy rules and regulations were very much led by institutions within the government such as the Admiralty, the Post Office, the Board of Trade, and others rather than explicit government-level policy. To be sure, the political context and changing governments at the turn of the twentieth century were influential but this did not extend as far as having or indeed implementing official policy. To

62 Marconi Collection MS. Marconi 175 – 4pp. typed letter from Cuthbert Hall to Marconi at Poldhu Hotel and dated 25 July 1901.

63 *Ibid.*

64 Preece's personal annotated copy of the judgement can be found at IET Archives UK0108 NAEST 039/3 – The Attorney General v The Edison Telephone Company of London Ltd: Arguments and Judgement in Exchequer Division, High Court of Justice (1880).

look at the situation with a small dose of humour, it was hard enough getting the different government institutions to agree let alone to develop a coherent strategy and policy on wireless telegraphy.

5.7 The 1904 Wireless Telegraphy Act[65]

The aftermath of the preliminary conference appeared to be a mild and short-term advantage conferred upon the Marconi Company. Neither the conference nor its outcomes were discussed in either of the Houses of Parliament. Discussions of wireless telegraphy in parliament remained, as they had since wireless telegraphy was first discussed in this public arena, focused on the use of wireless telegraphy for lighthouses and lightships along with more mundane matters such as administration and expenditure.[66] However this period of calm, at least for the Marconi Company did not last for long. In February 1904 parliamentary papers presented during recess were presented to the government including a Copy of Procés-Verbaux and Protocole Final of the Preliminary International Conference at Berlin on Wireless Telegraphy.[67] A month later, Lord Stanley (Postmaster General, October 1903-December 1905) recommended to the government that they license all wireless stations and bring Britain in closer alignment with other governments.[68] While Britain was the first nation to formally legislate wireless telegraphy, informal regulations existed in other wireless-equipped nations.

In contrast to the 1903 Preliminary Conference on Wireless Telegraphy, the Wireless Telegraphy Bill was discussed in great detail in the public sphere, in particular in the Houses of Parliament. This is almost a complete inverse of the preliminary original conference which was discussed in great detail at institutional level and not at all at government level. The Wireless Telegraphy Bill was enacted as the 1904 Wireless Telegraphy Act and came into effect on 1 January 1905. The Bill and later Act were discussed, argued over, and analysed in much detail at parliamentary level. The contrast between the level of parliamentary discussion of the preliminary international conference and domestic legislation is suggestive of a discontinuity or

65 Or, to give it the correct legal terminology: 4 Edw 7, ch 24.

66 See **Appendix 3: "Wireless" in Hansard, the official report of debates in British Parliament, 1898-1914** for further analysis and details.

67 Hansard HC Deb 02 February 1904 vol 129 cc82-94 - PARLIAMENTARY PAPERS (RECESS.) URL: http://hansard.millbanksystems.com/commons/1904/feb/02/parliamentary-papers-recess#S4V0129P0_19040202_HOC_60

68 PRO Cab 37/69 No. 39 - Memoranda of March 7 and 8 1904. Quoted in Headrick (1988), 120.

change of focus between the 1903 conference and the Bill of the following year. This further questions the rhetoric used by the delegates in the immediate aftermath of the conference that domestic legislation was required before international rules and regulations could be agreed and hence a continuation of the conference. The introduction of domestic wireless legislation in Britain was proposed prior to the 1903 Preliminary Conference on Wireless Telegraphy when in May 1903 Lord Stanley made a dramatic statement of his intent to legislate wireless telegraphy:

> Later in the session [Lord Stanley] hoped to be able to give more definite information to the House … as to the future organisation and administration of wireless telegraphy. [Lord Stanley] hoped that he should be able to assure the House that the Post Office were arriving at a conclusion which would prevent the growing up in this country of a monopoly such as there had been experience of in the past. At the same time, he should be able to show that he was not dealing unfairly with those who had made wireless telegraphy a possibility.[69]

A few months later in July of the same year, Lord Stanley presented the genesis of the Wireless Telegraphy Bill 'to provide for the regulation of wireless telegraphy', and supported by fellow Conservatives Gerald Balfour and E.G. Pretyman, along with Unionist politician H.O. Arnold-Forster.[70] The Postmaster General also had the full support of the Prime Minister, Arthur Balfour, who in early August firmly stated that he thought the Bill would 'not … raise any opposition on either side [of the House] … [dealing] with an important problem of national defence and … of great importance to national interests.'[71] Despite the Prime Minister's reassurances, the Bill (and the Postmaster General himself) faced a strong degree of criticism from certain opposition politicians within the Houses of Parliament and raised a great deal of antagonism with Marconi Company.

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69 Hansard HC Deb 12 May 1904 vol 134 cc1221-1223 - REVENUE DEPARTMENTS. (Lord Stanley). URL: http://hansard.millbanksystems.com/commons/1904/may/12/revenue-departments#S4V0134P0_19040512_HOC_247

70 Hansard HC Deb 18 July 1904 vol 138 col 295 - WIRELESS TELEGRAPHY BILL. URL: http://hansard.millbanksystems.com/commons/1904/jul/18/wireless-telegraphy-bill#S4V0138P0_19040718_HOC_230

71 Hansard HC Deb 02 August 1904 vol 139 cc541-601 - BUSINESS OF THE HOUSE (GOVERNMENT BUSINESS)—SUSPENSION OF THE TWELVE O'CLOCK RULE. URL: http://hansard.millbanksystems.com/commons/1904/aug/02/business-of-the-house-government#S4V0139P0_19040802_HOC_192

The immediate aftermath of the 1903 conference was, at least in terms of parliamentary debates, silence. Instead the House of Commons and the House of Lords remanded focused (as they had since wireless telegraphy was first discussed in this sphere) on the practical use of wireless telegraphy for lighthouses and lightships along with more mundane matter like administration and expenditure. However this period of calm, at least for the Marconi Company did not last for long. In February 1904 parliamentary papers presented during recess were presented to the government including a Copy of Procés-Verbaux and Protocole Final of the Preliminary International Conference at Berlin on Wireless Telegraphy.[72] A month later, Lord Stanley (then Postmaster General) recommended to the government that the government license all wireless stations and bring Britain in closer alignment with other governments.[73] While Britain was the first nation to formally legislate wireless telegraphy, there were clearly informal regulations existing in other wireless-equipped nations.

In August 1904 Lord Stanley was forced to defend the Bill on a number of different counts with two principal reasons – at least according to Lord Stanley – that argued for wireless telegraphy legislation on a national level: national security and the prevention of a monopoly. The latter reason concerned the government and particularly Lord Stanley because, as had been the case with the earlier examples of electrical telegraphy and telephony, a large monopoly might lead to the system being purchased by the state and nationalised, at a not inconsiderable expense to the Treasury and to the British taxpayer. Lord Stanley went on to face up criticism coming from within the Houses of Parliament and elsewhere: those who wished to use wireless to conduct scientific experiments would merely be required to register. Furthermore, Stanley openly stated:

> ...the Act should be administered as liberally as possible, and I shall certainly do my best in that direction. For what it is worth I will give an undertaking that no request for a licence for experiments shall be refused unless the refusal has been approved by me personally.[74]

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72 Hansard HC Deb 02 February 1904 vol 129 cc82-94 - PARLIAMENTARY PAPERS (RECESS.) URL: http://hansard.millbanksystems.com/commons/1904/feb/02/parliamentary-papers-recess#S4V0129P0_19040202_HOC_60

73 PRO Cab 37/69 No. 39 - Memoranda of March 7 and 8 1904. Quoted in Headrick (1988), 120.

74 Hansard HC Deb 10 August 1904 vol 140 cc137-8 – WIRELESS TELEGRAPHY BILL (SECOND READING).

However Lord Stanley concluded with some concerns about the timespan of the then Bill (later Act), which was limited in operation to a period of two years. The practical experience gained from these two years could be then used to create amendments and alterations, as necessary. The Bill faced a number of questions and clarifications in the month of August, including a strong anti-legislation argument from Lord Selborne, the First Lord of the Admiralty and a strong supporter of the Marconi Company. Selborne argued strongly that the Bill being only temporary and less than two years in scope did not match the needs of the wireless community nor did it deal with a number of sensitive issues raised by the introduction of wireless telegraphy such as 'the defence of this country, the trade and internal communications of this country, and the progress of invention.'[75] Despite these strong reservations, the Bill became an Act on 1 January 1905 but remained on the parliamentary agenda in the lead-up to the second International Radiotelegraph Conference in 1906. The Act's initial period of two years was extended, much to the relief of the Marconi Company as this gave them the time to make the most of the opportunity of their three-year *de facto* monopoly over long-distance wireless telegraphy in Britain, a concession demanded by the Admiralty themselves. The outcome of the 1903 conference and relatedly the 1904 Wireless Telegraphy Act managed to, despite their different aims and agendas, please both the Marconi Company and the British government but for very disparate reasons indeed.

The aftermath of the 1903 Preliminary Conference on Wireless Telegraphy in tandem with further internal departmental discussions led to the 1904 Wireless Telegraphic Act, a concentrated legislative step towards national wireless regulations, control, and licensing.[76] While the British regulations were closely observed by other nations, quite a different debate was taking place on the international stage. This debate on wireless intercommunication is frequently portrayed as a battle between Germany (represented by Telefunken) and Britain

URL: http://hansard.millbanksystems.com/commons/1904/aug/10/wireless-telegraphy-bill#S4V0140P0_19040810_HOC_350

75 Hansard HL Deb 13 August 1904 vol 140 cc512-4 - WIRELESS TELEGRAPHY BILL (SECOND READING).
URL: http://hansard.millbanksystems.com/lords/1904/aug/13/wireless-telegraphy-bill#S4V0140P0_19040813_HOL_52

76 See BT Archives Post 30-1203 – Wireless telegraphy patents, part 1 (1892-1902); BT Archives Post 30-1204 – Wireless telegraphy patents, part 2 (1904-1912), and IET Archives UK0108 SC MSS 143 Collection – Papers of Sir Henry Norman (1903-1939) for further details of internal discussions and legal agreements.

(represented by the Marconi Company). The 1904 Wireless Telegraphy Act was the legislation which enabled potential ratification of international wireless regulations and so marked a long-term and significant challenge for the Marconi Company in terms of preventing the outcomes of the 1903 Preliminary Conference on Wireless Telegraphy and eventually the subsequent 1906 International Radiotelegraph Conference. As such, there were a number of concessions to the Marconi Company including a three-year *de facto* domestic monopoly, as demanded by the Admiralty, and that pleased Cuthbert Hall and the Marconi Company immensely:

> It goes frightfully against the grain with me to give way, in any respect, to the Berlin proposals; on the other hand there is a certain advantage in what the Post Office would describe as a partnership with the British government: and although the fifteen years for the long-distance is only as to three years exclusive, the twelve-year extension will be practically exclusive because the Admiralty certainly do not want anyone else to start long-distance stations except our Company, and the Post Office can always refuse to connect to the land system. The Government will favourably entertain a general arrangement with us for all the Departments – War Office, Board of Trade, Post Office (other than this agreement).[77]

More importantly the Wireless Telegraphy Act was a temporary measure which required renewal from year to year, and was intended to be valid for less than two years until 31 July 1906. However it was renewed in the form of the Wireless Telegraphy Act 1906 [6 Edw 7 Ch 13] and by a series of Expiring Laws Continuance Acts, it remained in force until being repealed by the Wireless Telegraphy Act 1926.[78] However the regular renewal meant that at any stage the Act and the wireless licenses granted would be revoked. Even at this stage the government was reluctant to engage with policy-related problems which arose out of wireless telegraphy. Finally the Act merely regulated transmission and there were questions as to whether a holder of a wireless receiver required a license, a topic which was not properly dealt with until the advent of national broadcast radio in Britain and the final repeal of the 1904 Act with the introduction of the Wireless Telegraphy Act of 1926.

Finally although the Wireless Telegraphy Act of 1904 (as it was enacted in Britain) offered a short-term domestic monopoly this was very much a short-term advantage and the

77 Marconi Collection MS. Marconi 204 – 3pp. typed letter from Cuthbert Hall to Guglielmo Marconi, Villa Griffone, Pontecchio, Prov. Bologna, dated 29 March 1904.

78 Hall (1993), 450.

initial two-year period of the Act meant that even the enticing three-year monopoly offered to the Marconi Company could be curtailed. In the medium- to long-term, the Act offered a level playing field and the opportunity for other wireless commercial endeavours to obtain licenses for their stations, in contrast to previous more *ad hoc* arrangements. To this end, it offered a transition into a more open commercial sphere for wireless companies and hence offered up the possibilities for increased commercial competition. More importantly, it offered guidance to other nations in terms of wireless telegraphy legislation. Foreign nations, both of and external to the British commonwealth, could and would follow Britain's example in terms of wireless rules and regulations with absolutely no guarantee that they would offer such friendly terms as Britain did to the Marconi Company.

At the 1907 Select Committee into the ratification of the Convention of the 1906 International Radiotelegraph Conference, a number of different witnesses were called including G.W. Johnson, one of the Principal Clerks of the Colonial Office and someone who had 'cognisance of practically all the correspondence which has passed through the Colonial Office in connection with the establishment of wireless telegraphy in the Colonies.'[79] Johnson reported that at the time he gave witness in April 1907 the various colonial governments, that is the governments of colonies within the British Commonwealth, had enacted wireless telegraphy legislation similar to Britain's Wireless Telegraphy Act and full government control and license over wireless telegraphy in their countries. In effect, these Acts were the same as Britain's 1904 Act but with one major difference – they were all unlimited in period of enactment, in contrast to the British version which was initially limited to two years. While this might have offered some glimmer of hope to the Marconi Company, Johnson (representing the view of the Colonial Office) stated that in the case of the Crown Colonies controlled by the Secretary of State any idea of a monopoly in wireless telegraphy was vigorously opposed by the present Secretary of State and by his predecessors.[80] Additionally the larger colonies particularly Canada and the Cape and possibly also Australia were 'wholly opposed' to any monopoly.[81] He went on to state that the sole colony where a monopoly had been granted was Newfoundland, then a self-governing colony of the British Commonwealth and independent of Canada, where the Marconi Wireless Telegraph Company of Canada has been granted a ten-year monopoly. But to reiterate the point, this was very much the exception to the rule and, in the case of all the other British colonies, the Marconi Company's plan for

79 *Report from the Select Committee on Radiotelegraphic Convention* (1907), 142.

80 *Ibid.*

81 *Report from the Select Committee on Radiotelegraphic Convention* (1907), 143.

monopoly had come to naught. Indeed the governments of countries such as Canada, the Cape, and Australia that held strong connections with the telegraph network and industry, a wireless telegraphy monopoly was 'wholly opposed'.[82] To conclude, the 1904 Wireless Telegraphy Act was originally enacted in Britain but also extended to her colonies and members of the British Commonwealth within a few short years. However in the case of most countries and governments it offered a template for wireless regulations and licensing and one which galvanised and cemented a firm opposition to wireless telegraphy monopolies.

In late 1904 when the Act was about to come into enforcement, private correspondence between Cuthbert Hall and Marconi articulated their concerns about how this might affect the reliability of wireless communications especially in relation to their contract with the Admiralty.[83] As highlighted in the previous chapter, the Admiralty was the Marconi Company's earliest and most important customer and resulting from this there was mutual mistrust between the two; this was a lukewarm alliance of convenience and converging needs. At this point, Cuthbert Hall viewed the Wireless Act as a form of political interference by the government, in particular, the Post Office. Cuthbert Hall was hopeful that the key government departments involved, namely the Post Office and the Admiralty, would in practice manage things differently.

5.7 Conclusion

The introduction of domestic wireless legislation in the form of the 1904 Wireless Telegraphy Act might have resulted in a period of calm and a negation of the previous tensions between commercial and national wireless interests. These conflicting concerns, which had been escalated and exasperated by the earlier 1903 Preliminary Conference on Wireless Telegraphy and the resulting aftermath, however were not be calmed. Rather the controversial and interlinked topics of intercommunications and patent rights came to a head, dominating discussion of wireless telegraphy, both domestically and internationally. After 1904 and in the lead-up to the rescheduled 1906 conference, there was an increased level of tension between the Post Office and the Admiralty who had serious reservations about

82 *Ibid.*

83 Marconi Collection MS. Marconi 176 – 2pp. typed letter marked 'Private and Confidential' from Cuthbert Hall to Guglielmo Marconi at the Haven Hotel, Dorset, dated 29 August 1904; 1pp. typed letter from Cuthbert Hall to Guglielmo Marconi at Holland House, New York, dated 14 September 1904.

enforced intercommunication. Over the period covered by this chapter, the Admiralty adapted their view on intercommunication. Initially they sided with the Marconi Company and shared the same perception of intercommunication as being detrimental to the security and privacy of wireless communications. They believed it would open up British airwaves to foreign wireless companies and was beyond the untuned spark gap wireless sets then commonly used, in particular by the navy. However in the aftermath of the 1903 Preliminary Conference on Wireless Telegraphy, the Admiralty held an internal conference (sometimes referred to as the 1904 Conference) in February 1904. At this meeting, the policy of the Admiralty with regard to intercommunication was changed. The Admiralty still did not support general intercommunication, this being enforced intercommunication with all systems. Instead they began to support the idea of conditional intercommunication whereby certain stations, most probably those used for military communications, were exempt from enforced intercommunication. This was the article that made it through the Final Protocol of the 1906 International Radiotelegraph Convention and was passed by the British governments, and indeed by most other governments.

At the beginning of the twentieth century and as discussed in the previous chapter, the Admiralty was one of the Marconi Company's earliest customers and established the credibility of the fledgling company. Despite some rather serious reservations – never expressed outside of internal correspondence – the Admiralty remained one of the Company's most influential supporters and customers up until about 1904. During this period, the policies of two powerful government departments, the Post Office and the Admiralty, was communicated only internally through a series of increasingly heated private correspondence and memos. Although never formally quantified, the Post Office's attitude to wireless telegraphy was regularly at odds with the line taken by the Admiralty in relation to this technology. Both institutions had different needs and regard for wireless communications, and points of commonality were few and yet both had a role in moulding the development of wireless in ways not envisaged or relished by the Marconi Company.

Hence this clash of interests led to the introduction of wireless regulations in Britain in the early twentieth century, and had national and international repercussions. On a national level this took the form of the 1904 Wireless Telegraphy Act and, with it, the possibility of increased private competition from wireless companies such as the Lodge-Muirhead Syndicate. The mere possibility of commercial competition – no matter how remote – furthermore removed the potential for the Marconi Company to establish itself as the standard and indeed sole wireless system available. To be sure, the Marconi Company was granted a temporary three-year domestic monopoly in recognition of their contribution to the field. But this was not to their satisfaction – rather than being granted a complete domestic monopoly, as they so desired, the outcome was instead rules which gave a temporary and reversible monopoly. The stations of the Marconi Company was licensed by the Post Office and with the 1904 Wireless Telegraphy Act, the Marconi Company's attempt to circumvent the state-controlled telecommunications monopoly held by the Post Office were dead in the water.

Despite the short-term success and a common approach to wireless telegraphy, this period was fraught with tension between the British government and the Marconi Company with the former mostly articulating its strategy through the best-placed and best-suited government departments such as the Post Office and the Admiralty. The Marconi Company had some degree of support – albeit not unconditional – from the British government and so the Marconi Company might have expected the same for the second conference held eventually in Berlin in 1906 and the subsequent Select Committee hearings in 1907. In conclusion, both this chapter and the next examine an unexpected role of government in supporting technological systems, not through technical innovations but through legislation, a more subtle form of institutional innovation that was not (entirely) aligned with the Marconi company's wishes. It was with legislation that they dealt with complex technological issues such as intercommunication. The government's attitude and related legislation actively encouraged the security and privacy and arguably the success of wireless technology and systems whilst also discouraging monopoly. The government did not restrain technological development but did constrain the activities of the Marconi Company. In conclusion, these powerful government departments promoted innovation to meet their national interests, and strategic and military needs rather than commercial concerns.

Chapter 6: 'A question for commercial adjustment, and not for international legislation': wireless rules and regulations, 1905-1908[1]

6.1 Introduction

On 1 January 1905 the Wireless Telegraphy Act in Britain was introduced and was begun to be put into practice by the Conservative government. As elaborated upon in the previous chapter, in the short-term it provided a temporary commercial monopoly to the Marconi Company but in the long-term it cemented the telecommunications monopoly of the Post Office, which was in charge of the wireless licensing scheme. This domestic legislation created a system which enabled the licensing of commercial competition to the Marconi Company and was only passed after much discussion in the Houses of Parliament. It also offered up two limitations to the monopolistic goals of the Marconi Company: in the overall balance of power, it increased the status and control of the Post Office thereby threatening the power wielded by the Marconi Company; secondly, the introduction of domestic legislation enabled the possibility of international regulation and the lack of domestic licensing was the main reason given by the British delegates at the 1903 Preliminary Conference on Wireless Telegraphy for being unable to sign the convention. Although offering potentially favourable terms to the Marconi Company, the introduction of Britain's 1904 Wireless Telegraphy Act – the world's first wireless legislation – raised the possibility of less propitious outcomes for this wireless company. First, this legislation offered a template to other countries, who might not offer such favourable terms to the Marconi Company. Further to this, this legislation removed a significant obstacle in Britain's path to ratification of the Radiotelegraph Convention at the forthcoming and much-delayed 1906 International Radiotelegraph Conference. Both of these activities granted more power and agency to these two potentially powerful government institutions – the Admiralty and the Post Office – whilst also offering up increased commercial competition to the Marconi Company, home and abroad.

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1 Chapter title quotation comes from a letter from a letter from Cuthbert Hall, Managing Director of the Marconi Company between 1902 and 1908, and Marconi explaining his view of the 1906 International Radiotelegraph Conference as a clear threat to the commercial interests of Marconi Company and their distinct dislike for international wireless regulation. See BT Archives Post 30/1298 File XVI – 2pp. typed (semi-unofficial) letter from Henry Cuthbert Hall (Managing Director of the Marconi Company) to John C. Lamb (Second Secretary of the Post Office), dated 10 October 1904.

Unlike the Preliminary Conference on Wireless Telegraphy in 1903, the 1906 conference more openly challenged the Marconi Company's attempt at global wireless domination by using international regulations to tackle the company's refusal to intercommunicate with any other system. This pivotal and influential conference is frequently presented as a battle between the commercial interests of Germany and Britain: a challenge to the British telecommunications hegemony, particularly their extensive global cable network, by Germany. Instead I will demonstrate that the conference can be better understood in relation to a divergence of opinion between state and commercial interests within the British contingent. The central role played by the Post Office and the Admiralty in the conference is well-documented but not well-known: there is significant, previously "confidential" information on the politics and manoeuvring at the conference held by the Royal Naval Museum, Portsmouth and an extensive body of material in relation to the Post Office held by the BT archives. The events surrounding the international conference and the subsequent ratification reveal the deeply political nature of discussions, the complex tensions between the British delegates (or at least most of them) and the Marconi Company, and an outcome which places institutional and national interests above commercial interests and technological concerns.

The twelve-page Service Regulations annexed to the main Convention of the 1906 International Radiotelegraph Conference were the first ever set of service regulations for wireless communications and the 1906 Conference – which may or may not have been the first wireless conference recognised by the then International Telegraph Union (ITU – renamed the International Telecommunication Union in 1932) – is celebrated as the introduction of the first wireless regulations.[2] The Convention itself marked the first international agreement over wireless governance. In Britain and indeed elsewhere the Convention was remarkably controversial with ratification being deferred until July 1908, nearly two years after the Conference had met. In Britain the ratification of the Convention and related concerns led to a Select Committee being appointed to enquire upon the Convention with institutional witnesses from the Post Office and Admiralty coming to the fore. And yet despite the potential national and international ramifications of these events over a condensed two-year period, they are notably absent from most wireless and telecommunications scholarship and literature and are,

2 Timofeev, V. "From Radiotelegraphy to Worldwide Wireless: How ITU Processes and Regulations Have Helped Shape the Modern World of Radiocommunications." *International Telecommunication Union News* 3 (2006): 5-9.

in essence, dismissed within the pages of Marconi's official biography.[3] In this chapter I will utilise a multitude of unpublished documentation – Post Office memoranda and documents, private Marconi Company correspondence between Cuthbert Hall and Marconi, conference documents, and others – to draw out the more subtle yet richer story of wireless regulations and governance that emerges from the conference and the subsequent British Select Committee report into the ratification of the Convention, published in July 1907.[4]

Both the conference and the aftermath, that is the Select Committee report, were very much led by two government institutions within this thesis, the Post Office and the Admiralty. The British Delegates at the 1906 conference consisted of three Post Office employees, three Admiralty officers, and three War Office representatives and seven of these men gave witness statements before the Select Committee hearing to decide the ratification of the Convention. In contrast, much of the Marconi Company's activities during the conference and Select Committee hearings were in the background with the agency and desires of the government institutions coming to the forefront. With the sensitive and controversial topic issue of wireless intercommunication being under consideration at the conference and considering how this threatened – or was perceived to threaten – the Marconi Company's protection of their patent rights and the desire for a global telecommunications monopoly, it is unsurprising that the events within this chapter was downplayed in Marconi-centred histories. Furthermore the events contained within this chapter and the one before are political and legislative rather than technological and therefore are, for the most part, omitted from straightforward technical histories of wireless.

The prelude to the 1906 Radiotelegraph Conference was marked by increasing levels of tension between the two lead British government departmental representatives, the Admiralty and the Post Office. As elaborated upon in the previous chapter, the Admiralty had aligned its interests with those of the Marconi Company. The Admiralty was forced to contend with issues of communication interference and military security in relation to this new, innovative, and dramatically insecure communication medium. In order to protect its interests and its need for a secure and private mode of wireless communications for use by the Royal Navy, the Admiralty formed an informal and temporary alliance with the Marconi Company. A notable

3 Jacot de Boinod and Collier (1935).

4 See *Report from the Select Committee on Radiotelegraphic Convention; Together with the Proceedings of the Committee, Minutes of Evidence, and Appendix*. Vol. 246, House of Commons Reports of Committees. London: Printed for His Majesty's Stationery Office, 1907.

shared interest between the Admiralty and the Marconi Company was intercommunication and both supported the Marconi Company's strong refusal to intercommunicate with other wireless systems – an issue spanning the previous chapter along with this one. In public-facing communications, the Marconi Company claimed intercommunication related to technological and security issues while in private correspondence the issue was related to themes of monopolisation and protection of Marconi 'intellectual property' (to utilise a modern theme) in lieu of a proactive strategy to protect Marconi patents.

In contrast to the experiences of the Admiralty, the Post Office had the longest experience with wireless communications, establishing experiments with wireless systems dating back to the early 1880s and had supported Marconi upon his first arrival in Britain in 1896. After the formation of the Marconi Company in 1897, the interests of the Marconi Company and the Post Office quickly diverged and the two would have a sometimes antagonistic relationship. The intense and passionate differences between the two different government departments – the Post Office and the Admiralty – were only worsened and not resolved by the 1904 Wireless Telegraph Act. As a result, antagonistic and divisive negotiations in the lead up to the conference were inevitable; complex political discussions and negotiations took place between the two departments almost right up until the beginning of the conference. It was not until two weeks prior to the conference began that the Admiralty and the Post Office were able to compromise on a single "Instructions to Delegates" to be sent to the British contingent.

After such intense and passionate discussions within the British representatives prior to the conference, much of the controversial issues were agreed upon and the conference itself can be seen as a bit of an anti-climax. The British delegates agreed upon the proposals and, along with most of the attendees, signed the agreement of the conference in December 1906. One of the clauses declared that the Convention was not be ratified until nearly July 1908 with countries being given nearly two years to decide upon ratification and implementation. In the case of Britain, ratification was decided by Select Committee hearings held between March and May 1907. The final decision with regard to ratification was formally declared through the publication of the Select Committee's report in July 1907 and subsequent approval by both Houses of Parliament. When ratification of the Convention was agreed to, the position of Henry Cuthbert Hall, managing director of the Marconi Company since 1902, became less tenable and in early 1908 he resigned. At this point, it was apparent that the interests of the Admiralty, the Marconi Company's key and perhaps sole ally in the British government, and the

Marconi Company were no longer aligned. More generally the Marconi Company can be considered to no longer be a priority of the British government thereby marking a significant change in the relationship between the company and the government. This shift was further cemented by the Marconi Scandal in 1911 and 1912 but the outcome of the Select Committee hearings in 1908 marked the end of an era with the British government and her miscellaneous institutions firmly and irrevocably establishing their active role and agency in the field of wireless telecommunications.

6.2 Prelude to the 1906 International Radiotelegraph Conference

In this section, I will consider the distinct goals of the Post Office and the Admiralty and how these are shaped and changed by the on-going and at times passionate discussions which take place during negotiations prior to the conference. These complex and at times fraught negotiations have been completely ignored in the limited scholarship on the conference. Even the relatively contemporaneous 1907 Select Committee hearing report on the conference and pre-conference negotiations, which took place but two years previously, presented the British representatives as having a common and uncontroversial agreement on the conference. This is challenged by contemporary material about the pre-conference discussion which demonstrates the continued tension between the Post Office and the Admiralty with disagreement centred about the issue of exchange of messages across different wireless systems.[5] Through a close reading of the pre-conference documentation, I will consider the needs and demands of the Post Office and the Admiralty and consider how this might lead to potential conflict. Further to this, I will consider how these goals change, or not, during the negotiations prior to the international conference.

Returning briefly to the concluding section of the previous chapter, at the end of the 1903 conference it was made clear that the conference protocols were considered more of a starting point for negotiation rather than protocols to be legitimately ratified. The second, more serious and legislative conference originally planned to be held in Berlin a year later in October 1904. However, this date was deferred by British government, asking for some time to introduce domestic wireless regulations and also to extend an invitation to other countries. Additionally the relationship between the Marconi Company and the British government, in

5 See BT Archives Post 30/1347 – International Wireless Telegraph Conference at Berlin, 1906, part 2 (1906) for further details.

particular some of her departments including the Admiralty, needed to be clarified and formalised before any international conventions and regulations could be approved. The former was dealt with through the passing of the 1904 Wireless Telegraphy Act and the opening up of the second conference to all members of the International Telegraph Union. In terms of the latter, this required modification to the carefully drafted contracts with the Marconi Company. But this all took time and, as a result, a new date was proposed for the conference: April 1905. With Russia and Japan both invited the conference, a conflict between the two – the Russo-Japanese war between February 1904 and September 1905 – led to the conference being further deferred until October 1906.[6] Britain did not have an entirely neutral role in this conflict, being an ally of the Japanese, and war was nearly declared between Russia and Britain in October 1904 when the Russian Baltic Fleet mistook British trawlers for an Imperial Japanese Naval Force in an incident known as "the Dogger Bank incident". Meanwhile Germany did hope to use the now-extended interim between the two initial conferences to implement a temporary measure to apply the principle of interchange of wireless messages between coast stations and ships regardless of the system used.[7] Intercommunication was a key element of the Convention for the forthcoming conference and this temporary albeit ultimately successful temporary measure by the Imperial German government was an overt indicator of its importance. Enforced intercommunication was the most discussed and most controversial of the conference's Convention and so it is not unexpected that the principle was under discussion in the prelude to the conference. International wireless regulations were a serious worry for Cuthbert Hall, Managing Director of the Marconi Company, with the principle of intercommunication being of particular concern.

As soon as plans for the second conference were proposed, Cuthbert Hall began serious attempts to influence and manipulate the conference and its attendees. Cuthbert Hall kept Marconi well-informed of the conference and the likely attitudes of the British representatives as soon as the second conference was first proposed in 1904. Cuthbert Hall had an almost intimate degree of knowledge as to the proposed conference – noting the deferral by the British government along with the list of suggested attendees – through correspondence

6 See BT Archives Post 30/1299 – Proposed international conference for wireless telegraphy at Berlin, part 1 and BT Archives Post 30/1299 – Proposed international conference for wireless telegraphy at Berlin, part 2 (1904-1906).

7 BT Archives Post 30/1299 File XXVII – 3pp. typed and translated copy of letter sent from the Imperial German Embassy to the Foreign Office, dated 23 February 1905.

obtained from the Italian government.[8] While correspondence from Marconi to Cuthbert Hall does not feature strongly (or sometimes at all), Marconi was kept very well informed of the upcoming conference including Cuthbert Hall's regular reports on developments. There was some ambiguity as to whether Marconi agreed or disagreed with Cuthbert Hall on the matter or indeed condoned his approach. However, Marconi could certainly not plead ignorance nor could he present Cuthbert Hall's strategy as being inconsistent. Cuthbert Hall's strongly stated and frequently voiced opinion on the second conference was continuous and unambiguous; he viewed the 1906 International Radiotelegraph Conference as an overt threat to their commercial interests of the Marconi Company. Moreover Cuthbert Hall felt strongly that matters such as intercommunication should not be settled internationally, in particular at a conference organised by and held in Germany. Instead Cuthbert Hall felt this should be settled by a working agreement between the different wireless companies. In private correspondence to Marconi, Cuthbert Hall had the following to say about the forthcoming International Radiotelegraph Conference:

> If a working partnership is to be achieved it is eminently a question for commercial adjustment, and not for International legislation. … The German Government proposes by International legislation to settle a commercial questions (a working partnership between a number of different wireless telegraph companies) while ignoring all those considerations which commonly determine the terms of such an arrangement.[9]

Further institutional discussion was too taking place in private although with completely different conclusions reached to those of Cuthbert Hall and the Marconi Company. With much of the interdepartmental discussion taking place in private meetings and being solely recorded in secret memoranda, the debate between the Post Office and the Admiralty remained behind the scenes, being recorded in private and unpublished memorandum.[10] In the prelude to the

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8 BT Archives Post 30/1298 File XII. WIRELESS TELEGRAPHY. Proposed International Conference at Berlin. Enquiry by Italian Ambassador as to Department's attitude. 1904 – 3pp. typed copy of letter sent from the Postmaster General to the Italian Ambassador (Signor Pansa), dated 25 August 1904.

9 BT Archives Post 30/1298 File XVI. WIRELESS TELEGRAPHY. Proposed International Conference at Berlin. Correspondence between Mr. Lamb and Mr. Cuthbert Hall. 1904 – 2pp. typed (semi-unofficial) letter from Cuthbert Hall (Managing Director of the Marconi Company) to John C. Lamb (Second Secretary of the Post Office), dated 10 October 1904.

10 See BT Archives POST 30/1299 - Proposed international conference for wireless telegraphy at Berlin, part 2 (1904-1906).

conference and in negotiating a common "Instructions to Delegates", there was a strong degree of antagonism between the Post Office and the Admiralty centred upon the issue of intercommunication. The Admiralty was against general intercommunication for two reasons. First, the Admiralty was concerned about interference between naval and non-naval wireless stations and the wider impact upon the security and privacy of naval wireless systems. Secondly, the Admiralty-Marconi Company contract signed two years earlier in 1903 contained a stipulation about non-intercommunication with other wireless systems.[11] Adhering to this contract and maintaining the mutually beneficial albeit potentially temporary allegiance with the Marconi Company was of importance to the Admiralty. Standing in opposition was the other government departments led by the Post Office, who were strongly in favour of enforced and general intercommunications. This led to increased tension between the Admiralty and the Post Office, with the Admiralty attempting to get the upper hand in negotiations by knowingly and purposely releasing their Memorandum to Delegates on 18 August whilst interdepartmental discussions were on-going, to the surprise and obvious annoyance of the Post Office.[12] This was an overt attempt by the Admiralty to supersede the authority of the Post Office with the latter being the lead government department of the British delegation and being represented by three of the six delegates.

The Admiralty claimed the early release of their Memorandum was on the instructions of Liberal MP and then Foreign Secretary, Sir Edward Grey, but nonetheless this caused no end of consternation at the Post Office with the PMG himself issuing a "Secret" Memo just over a week later noting that some further amendments have been made to the Post Office Memo on the subject in order '...to meet, as far as may be, the objections of the Admiralty in order that, if possible, mutually agreed on Instructions can be issued to the Delegates...'[13] The Post Office, in its own words, attempted to accommodate the demands of the Admiralty so that the British

11 See **Section 4.4 - Contracts and Contradictions: The Admiralty as a customer for wireless** for further details.

12 See BT Archives Post 30/1347 File 8. WIRELESS TELEGRAPHY. Berlin Conference 1906. Admiralty forward their Memo (August 20). Foreign Office forward print of (August 29). Memorandum on Admiralty Case. August 1906.

For confirmation of the timing and further details, see BT Archives Post 30/1348A File 17 – 3pp. typed letter from Mr. R.J. Mackay (a senior member of the Secretary's Office at the Post Office) to Mr. Babington Smith (Secretary of the Post Office), dated 18 August 1906 and 1pp. handwritten letter from Mr. R.J. Mackay (a senior member of the Secretary's Office at the Post Office) to Mr. Babington Smith (Secretary of the Post Office), dated 20 August 1906.

delegates could present a united front at the conference and focus on getting the overall needs and demands of the British delegation met at the conference. In order to achieve a single “Instructions to Delegates”, a series of revised draft Instructions to Delegates was exchanged until almost right up to the conference itself.[14] An additional outcome was a joint Post Office-Admiralty Conference held on 17 September 1906 with the purpose of resolving the differences between the two institutions.[15] The meeting was attended by many powerful figures within the two institutions including those who represented the British delegation at the upcoming conference.[16] Attendees included First Lord of the Admiralty Lord Tweedmouth, Postmaster-General Sydney Buxton, Secretary of the Post Office and Chief British delegate Babington Smith, Assistant Director of Ordnance and Admiralty delegate A.E. Bethell, Engineer-in-Chief of the Post Office and Post Office delegate John Gavey, Private Secretary to the First Lord of the Admiralty V.W. Baddeley, and Private Secretary to the Postmaster-General R.D. Denman. The outcome of this conference was a compromise in relation to intercommunication. The call for general intercommunication was dropped by the Post Office. Instead all three government departments represented – the Post Office, the Admiralty, and the War Office – agreed to support partial intercommunication with military wireless stations being exempt from enforced intercommunication. On 18 September 1906 and a mere few days before the conference began a still further revised joint Memorandum to this effect was issued by Lord Tweedmouth and Sydney Buxton and was accompanied by the final published version of the “Instructions to Delegates” for the British delegation.[17]

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13 BT Archives Post 30/1347 File 10. WIRELESS TELEGRAPHY. Berlin Conference 1906 - 5pp. handwritten memorandum on the proposed Amended Instructions to Delegates marked 'Secret' from the PMG (Sydney Buxton), dated 27 August 1906; Memorandum from PMG on proposed amended Instructions to Delegates (27 August 1906); Memorandum on the subject prepared by Mr. Mackay and sent to the PMG (27 August 1906); Notes by Mr. Gavey on Admiralty Memorandum (31 August 1906).

14 For examples, see BT Archives Post 30/1347. International Wireless Telegraph Conference at Berlin, 1906, part 2. 1906 and BT Archives Post 30/1348A International Wireless Telegraph Conference at Berlin, 1906, part 2. 1906.

15 BT Archives Post 30/1348A File 15. WIRELESS TELEGRAPHY. Berlin Conference 1906. Report of Post Office-Admiralty Conference (17 September 1906). 20 September 1906.

16 *Ibid.*

17 BT Archives Post 30/1348A File 16. WIRELESS TELEGRAPHY. Berlin Conference 1906. Revised Draft of Instructions to Delegates (17 September 1906) with accompanying Memo. (I. cancelled 18 September 1906; II. Revised 18 September 1906). 17-18 September 1906.

The Admiralty and the Post Office, the two lead institutions representing British interests at the conference, had moderately different demands going into the pre-conference discussions. The Admiralty was against enforced and general intercommunications mostly on grounds of military security. However, their contract and close relationship with the Marconi Company further complicated matters. In contrast, the Post Office and the War Office were broadly in support of enforced intercommunication with both institutions less engaged with wireless communications than the Admiralty. Furthermore the needs of the Post Office in relation to wireless communications were very much centred upon their role in managing the 1904 Wireless Telegraphy Act, enacted less than two years previously in January 1905.[18] Enforced intercommunication would impact upon wireless licensing in a positive manner with potentially the need for fewer wireless stations and less duplications if wireless stations were forced to intercommunicate. However, the Post Office and the Admiralty came to an eventual compromise on the matter with intercommunication being supported across the British delegation however with exceptions made for military wireless stations. During these complex negotiations, the Post Office and the Admiralty had different agendas and very different needs and demands. However, they adapted and compromised accordingly and immediately prior to the conference the British delegation presented a common and unified front on wireless communications and intercommunication. The compromises made resulted mostly from internal, institutional needs and demands with Marconi Company demands and contracts being very much secondary.

6.3 1906 International Radiotelegraph Conference

After multiple postponements, the 1906 International Radiotelegraph Conference finally took place in Berlin for a month from 3 October to 3 November.[19] As was common practice of the time, the official conference documents were printed in French, the language of diplomacy, and unlike the original 1903 conference an official English translations of the conference documents were not provided. In some ways this conference can be seen as a continuation of

18 See **Section 5.7 - The 1904 Wireless Telegraphy Act** for further details.

19 A digital copy of *Documents de la Conférence radiotélégraphique internationale de Berlin (1906)*. Publiés par le Département des postes de l'Empire d'Allemagne. Berlin : [Reichsdruckerei], 1906 is available on the ITU website at http://www.itu.int/dms_pub/itu-s/oth/02/01/S020100000104803PDFF.pdf A copy is available from the author. An English translation is not available and so I have utilised my basic French skills along with much-appreciated assistance from Google Translate. All errors in translation are mine.

the 1903 Conference. Like the Preliminary Conference, it was chaired by Mr. Sydow, Under-Secretary of State of the German Imperial Postal Department and again head of the German delegation. It was also held in Berlin and continued some of the discussions about wireless telegraphy which had taken place at the Preliminary Conference three years earlier. However, in other regards, it was very much a separate and distinctive entity. In contrast to the preliminary conference in 1903, the 1906 conference was open to all members of the International Telegraph Union (ITU) rather than being solely by invitation of the Imperial German government. The preliminary conference was attended by those countries with wireless telegraphy systems in place, and in 1903 this numbered nine countries. Contrastingly the 1906 conference was expanded beyond this original, exclusive remit and was attended by thirty countries. There is some ambiguity as to whether the 1906 conference was an official ITU conference or was merely recognised by the ITU but nonetheless the Service Regulations, an important outcome of the conference, were accepted by the ITU and, as such, were recognised by the union as the first international wireless regulations.[20] The ITU Union had its origins in the original international telegraphic conventions in Paris in 1865 followed by Vienna in 1868, held to standardise and agree telegraphic operating practices, administration, and rates. Radiotelegraph conferences were held separately to the main Telegraph Conferences until the first joint International Telecommunication Union conference held in Madrid in 1932. However, elements of the Radiotelegraph Conventions including those from 1906 were based on earlier Telegraphic Conventions. However, in one important regard, the 1906 conference diverted from the protocols and practices of the ITU: voting.

Prior to the conference, the Imperial German government decided that colonies and dependencies of the British Empire were not to be represented at the 1906 International Radiotelegraph Conference despite being represented at the Cable International Telegraph Convention, a somewhat unseemly inconsistency.[21] The lack of representation on behalf of

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20 The ITU webpage on the 1906 Radiotelegraphic Conference claims the conference was not an official conference - http://www.itu.int/en/history/Pages/RadioConferences.aspx?conf=36&dms=S0201000010 but the page on Radio Regulations at http://www.itu.int/en/history/Pages/RegulationsCollection.aspx#tab1 recognises the Service Regulations Annex to the Convention of the 1906. It may be that the conference was "recognised" by the ITU but not an "official" ITU conference.

21 *Report from the Select Committee on Radiotelegraphic Convention; Together with the Proceedings of the Committee, Minutes of Evidence, and Appendix*. Vol. 246, House of Commons Reports of Committees. London: Printed for His Majesty's Stationery Office, 1907, 243.

the British colonies was noted with some bitterness by Henniker Heaton who had been appointed by New Zealand as their representative at the conference.[22] This did make some sense, at least in terms of conference administration. In terms of representation of British colonies this was also quite practical; as discussed in the previous chapter, all but one of the British colonies had enacted wireless telegraphy legislation almost identical to the 1904 Wireless Telegraphy Act. Hence it would be unsurprising and indeed complicated to manage if they did not follow the lead of their "mother country" in relation to the Convention of the International Radiotelegraph Conference too.

The British delegation was eight in number, the largest in number after Germany. Britain was represented by three delegates from the Post Office; three from the Admiralty; and two from the War Office. The delegation was led by Henry Babington Smith, First Secretary of the Post Office between 1901 and 1909. Three British delegates from the 1903 conference also returned in 1906; they were John Gavey, Engineer-in-Chief of the Post Office; R.J. Mackay, Principal Clerk in the Post Office; and Colonel R.L. Hippisley (Royal Engineers) of the War Office.[23] These representatives were joined by Captain A.E. Bethell, Assistant Director of Naval Ordnance; Colonel J.F. Daniell, Assistant Director of Naval Intelligence; Lieutenant F.G. Loring of the Royal Navy; and Colonel F.J. Davies, Assistant Director of Military Operations. However, not all delegates, British or otherwise, got to vote. It had been decided early on that each country was allocated a single vote with imperial nations being allocated the votes of their colonies up to a cap of six votes. In theory, Britain should have held seven votes but was capped at six votes. This voting protocol broke away from that of the International Telegraph Conference, which allowed a vote for any colony or dependency which possessed a separate telegraph administration.[24] This system enabled votes to be claimed on behalf of colonies that were not of sufficient size and importance to justify a vote. Instead the International

22 BT Archives Post 30/1488B File VIII. Select Committee on Radiotelegraphic Convention. Papers relating to evidence given by Captain Inglefield, Mr Owen Phillips, Mr Henniker Heaton, Sir Oliver Lodge, and Mr Maskelyne (5-23 April 1907).

23 BT Archives Post 30/1299 File XX. WIRELESS TELEGRAPHY. Proposed International Conference at Berlin. British Delegates appointed. 1904 – Minute No. 21550. Wireless Telegraph Conferences at Berlin, Proposed appointment of Post Office delegates, dated 5 November 1904 and 2pp. typed letter sent on behalf of the Postmaster General to the Under Secretary of State at the Foreign Office, dated 11 November 1904.

24 *Report from the Select Committee on Radiotelegraphic Convention; Together with the Proceedings of the Committee, Minutes of Evidence, and Appendix*. Vol. 246, House of Commons Reports of Committees. London: Printed for His Majesty's Stationery Office, 1907, xvii.

Radiotelegraph Conference followed the protocol of the International Postal Conferences which allowed colonies to be represented and voted only if 'considered of sufficient importance to claim a vote.'[25] With regards the protocol of representation, the conference followed the protocol of the initial two International Telegraphic Conferences held in Paris in 1865 and Vienna in 1868 in forbidding private companies to attend and vote at the conference.[26] Hence it was national interests – represented by institutional, military, and government delegates – that came to the fore, both in the British contingent and indeed more generally. However, other, more commercial interests attempted to have their voices heard, internally and externally. The Marconi Company took to the public press to have their views heard while also arranging to have Cuthbert Hall to attend the conference, initially as an unofficial attendee and later as the delegate.

At the opening session on 3 October, delegates from twenty-seven countries were listed: Germany, United States of America, Argentina, Austria, Hungary, Belgium, Bulgaria, Chile, Denmark, Egypt, Spain, France, Great Britain, Greece, Italy, Japan, Mexico, Monaco, Norway, the Netherlands, Persia, Portugal, Romania, Russia, Siam (Thailand), Sweden, and Uruguay. These countries were joined by Cuthbert Hall, who was nominated and accepted as the sole delegate for Montenegro, along with delegates from Brazil and Turkey at the fifth conference session on 8 October bringing attendance up to the full thirty countries.[27] However, these three nations were not included in the official list of delegates hence the regular confusion as to the numbers of countries represented at the conference. Cuthbert Hall was very much an exception amongst the attendees and delegates of the conference which mostly consisted of members of the military, diplomatic corps, Post Office or national equivalent, usually the director of telegraphs.

The first session dealt mostly with administration of the conference with discussions of the draft Convention being delayed until the second session on 4 October. At this session,

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25 *Ibid.*

26 See International Telecommunication Union. "International Telegraph Conference (St. Petersburg, 1875)." http://www.itu.int/en/history/plenipotentiaryconferences/Pages/1875StPetersburg.aspx and International Telecommunication Union. "International Telegraph Conference (Paris, 1865)." http://www.itu.int/en/history/plenipotentiaryconferences/Pages/1865Paris.aspx. Both accessed 2012-08-29.

27 *Documents de la Conférence radiotélégraphique internationale de Berlin, 1906*. Publiés par le Département des postes de l'Empire d'Allemagne. Berlin: [Reichsdruckerei], 1906, 90.

Babington Smith (the Post Office delegate and head delegate of the British contingent) opened up the general discussion on the draft Convention. Babington Smith declared that British delegation had been authorised to provisionally accept intercommunication between coastal and ship wireless stations subject to a number of strict conditions.[28] First, these regulations would have to be introduced in a strict and efficient manner and would take care to minimise interference. Secondly this would have to be enforced as strictly in relation to on-board wireless stations as it did to coastal stations. Babington Smith was careful to note that enforcing intercommunication would be a difficult task and, apropos of this, each government would reserve the right to designate some stations omitted from the obligation to intercommunicate. Continuing on from this a more in-depth discussion of articles one to fourteen of the draft Convention took place at the second session. The most important and indeed most controversial article under discussion was article three: 'The coastal stations and the stations on shipboard shall be bound to exchange radiograms without distinction of the radio system adopted by such stations', that is intercommunication.[29] Babington Smith cautiously and perhaps tactically suggested that there was not sufficient time to discuss the article and agreed to accept the article temporarily in principle but proposed to postpone the vote until the end of the first reading of the Convention and Regulations.[30] His proposal was supported by France and Italy and endorsed by the Conference. At this time, it was also agreed upon that intercommunication would only apply to communications between ship and shore stations and would not apply to ship-to-ship communication. This led to much discussion at later sessions of the conference.

As part of the administrative activities of the conference which continued beyond the preliminary session, a request from the Chinese government was read out and approved at the second session of the conference on 4 October. This requested the attendance of a Chinese electrical engineer by the name of Kuei Ling Wu not as an official delegate but rather as an attendee who could sit in on the sessions and meetings of the Conference.[31] This was not uncommon and at the fifth session held on 8 October it was noted that Marconi Managing

28 Documents de la Conférence radiotélégraphique internationale de Berlin (1906), iii.

29 International radio telegraph convention of Berlin, 1906 and propositions for the International Radio Telegraph Conference of London (1912). (US Navy Department), 5.

30 *Convention radiotélégraphique internationale avec Engagement additionnel et Règlement de service y annexés*, 1906. Publiés par le Département des postes de l’Empire d’Allemagne. Berlin : [Reichsdruckerei], 1906, 55-56.

31 Documents de la Conférence radiotélégraphique internationale de Berlin (1906), 50.

Director Cuthbert Hall had been sitting in on the conference sessions before being officially recognised as the sole Delegate for Montenegro; at the next session on 16 October it was further noted that Cuthbert Hall was taking Marconi's place.[32] Additionally, delegates from Brazil and Turkey had been added along with a replacement for one of the delegates from Monaco bringing attendance up to the full thirty countries.[33] For obvious reasons, China was not included in the official list of delegates nor were the delegates from Brazil, Montenegro, and Turkey hence the occasional confusion about the numbers of countries that attended the second conference. Originally Cuthbert Hall or possibly Marconi had attempted to become one of the Italian delegates but this was not agreed to by either the Italian government nor by the German government who insisted upon no commercial interests being represented at the 1906 conference, something which was changed for the subsequent conference in London in 1912. Instead Cuthbert Hall managed to persuade the Montenegrin government to nominate him as their sole delegate with the Italian Foreign Office providing some assistance in this regard and so Cuthbert Hall was belatedly accepted to conference upon the arrival of his credentials around 9 or 10 October although he did not appear in the official list of delegates.[34] Prior to becoming an official delegate, Cuthbert Hall was still able to receive delegates' information and noted in correspondence to Marconi that discussion on the issue of intercommunication had been deferred until the end of the conference.[35] It appeared that the confidentiality proposed by the conference organisers was not adhered to. For example, despite Cuthbert Hall's initial lack of credentials, he was able to attend conference sessions and keep informed if he was initially, to his much frustration, unable to influence discussions and decisions.

The sixth session of the conference, held on 16 October, was given over to administration with discussion of the articles of the convention continuing at the seventh session on 25 October with articles three, eleven, thirteen, and fifteen along with article I of the Final Protocol being discussed. At the following session on 27 October, articles one, three, and nine of the Convention being discussed. Subsequently article three and article II of the

32 *Ibid.*, 77, 90.

33 *Ibid.*, 90.

34 Marconi Collection MS. Marconi 205 – 3pp. typed letter from Cuthbert Hall, Hotel Kaiserhof, Berlin to Guglielmo Marconi, London, dated 12 October 1906 and 4pp. typed letter from Cuthbert Hall, Hotel Kaiserhof, Berlin to Guglielmo Marconi, London, dated 13 October 1906.

35 Marconi Collection MS. Marconi 205 – 3pp. typed letter from Cuthbert Hall, Hotel Kaiserhof, Berlin to Guglielmo Marconi, London, dated 12 October 1906.

Final Protocol were discussed on 29 October, along with many of the articles of the Service Regulations. Henceforth all aspects of the conference documents – the Convention, the Final Protocol, and the Service Regulations were under discussion until the terminus of the meeting.

In terms of the overall and final amendments suggested for the Convention, the British Delegates suggested amendments to three articles. For article eight, which required wireless stations to give priority to distress signals and to action if required, the British delegates suggested a minor grammatical change to make it clear that stations were not responsible for calls they did not receive due to interference or other reasons.[36] The British delegates also proposed an amendment to article ten which laid out the charges for wireless messages to bring it in line with International Telegraph Regulations.[37] The British delegates also suggested an amendment to article eleven so that only conferences of plenipotentiaries could amend the Convention or Service Regulations of the conference and that these could not be amended merely by an administrative conference. All other articles passed without amendment. This included articles three and four which together met the needs of the British delegation, especially the Admiralty. Article three was the intercommunication article stating that 'the coastal stations and the stations on shipboard shall be bound to exchange radiograms without distinction of the radio system adopted by such stations.'[38] This article was the most-discussed article of the Convention, being discussed at nearly half of the total conference sessions; the article was discussed at seven of the thirteen conference sessions, on 4 October, 8 October, 25 October, 27 October, 29 October, 31 October, and 1 November. Article four was essentially an amendment to Article three, as proposed by the Admiralty, stating that 'Notwithstanding the provisions of article 3, a station may be reserved for a limited public service determined by the object of the correspondence or by other circumstances independent of the system employed.'[39] According to Cuthbert Hall, the Convention, in particular the intercommunication regulations introduced in articles three and four narrowly passed by delegates' vote – it is unclear whether Cuthbert Hall is referring to the British delegates or the delegates in general – at the conference. However, there is no documentary evidence from the conference to suggest that this might be the case. To be sure, there was much discussion about these two articles but since it had been agreed at the first session that all voting took place in secret with

36 *International Radiotelegraph Convention Of Berlin: 1906 And Propositions For The International Radiotelegraph Conference Of London*. Washington: Government Printing Office, 1912, 6.

37 *Ibid.*, 7.

38 *Ibid.*, 5.

39 *Ibid.*

only official delegates along with their officials and secretaries in attendance there are no records of the voting with regard to individual articles.[40] Hence although the articles were passed by delegates' votes, there is no surviving evidence to say whether they were or were not passed narrowly.

The primary outcome of the conference was obligatory intercommunication in relation to ship-to-ship wireless communication. However, it was not until the 1912 Radiotelegraph Conference held in London and hosted by the Institution of Electrical Engineers that absolute recognition of the principle of freedom of intercommunication, that is ship-to-ship and ship-to-shore, was recognised and enforced.[41] In relation to the Service Regulations of the 1906 conference, the International Bureau of Telegraph Administrations was asked to take on several administrative tasks arising from the Berlin agreement; this included the establishment of a list of wireless stations and two frequencies – 500kHz and 1000kHz – were established for public communication.[42] The conference also resulted in an agreement on the charges for wireless messages, in line with existing charges under International Telegraph Regulations. Finally, it was decided that priority was to be given to the distress signal with much discussion as to the format. The German contingent proposed "SOS", this being an adaptation of their original distress signal "SOE" with the terminal "S" (3 dots) making a more distinctive signal; "SOS" had been regulated by the Germans as the nationally recognised distress signal a year before the conference in April 1905.[43] The British delegates proposed "CQD" which may or may not have its origins in telegraphy and which was utilised and supported by the Marconi Company, this having been regulated by the company as its distress signal in February 1904.[44] The delegates from the United States suggested "NC", this being shorthand for "Call for help without delay" was not widely considered but continues to be used as the international flag signal for distress.[45] In the end "SOS" was decided upon although many nations continued

40 Documents de la Conférence radiotélégraphique internationale de Berlin (1906), 39-49.

41 International Telecommunication Union. "International Radiotelegraph Conference (London, 1912)." http://www.itu.int/en/history/radioconferences/Pages/1912London.aspx. Accessed 2012-08-28.

42 Lawry (2008), 5.

43 "German Regulations for the Control of Spark Telegraphy." *The Electrician* 55 (1905): 94.

44 "[Untitled Circular on Distress Signals Regulating CQD to Be Used from February 1904 Onwards]." In *Marconi International Marine Communication Company Circular* No 57 (7 January 1904). London: Marconi International Marine Communication Company, 1904.

45 McEwen, Neal. "'SOS,' 'CQD' and the History of Maritime Distress Calls." *The Telegraph Office Magazine* 2, no. 1 (1997).

with their own variations and "SOS" did not enter common usage until around 1912 and thereafter. Last and most definitely not least, it was decided that government licensing was required to establish and operate ship wireless stations, this being in line with Britain's 1904 Wireless Telegraphy Act. This further demonstrated the growing influence of this ground-breaking wireless legislation, which was providing a template for wireless legislation, domestically and internationally.

At the end of the conference, the Convention and the Final Protocol were agreed to by the vast majority of the delegations, twenty-seven out of the thirty countries: Germany, the United States of America, Argentina, Austria, Hungary, Belgium, Brazil, Bulgaria, Chile, Denmark, Spain, France, Great Britain, Greece, Italy, Japan, Mexico, Monaco, Norway, the Netherlands, Persia, Portugal, Roumania [sic], Russia, Sweden, Turkey, and Uruguay.[46] With regard to the Convention and the Final Protocol, this was signed by the three chief British delegates, Babington Smith from the Post Office, Bethell from the Admiralty, and Hippisley from the War Office. The Supplementary Agreement, sometimes referred to as the Service Regulations, was signed up to by fewer countries but still by over two-thirds of the delegations, twenty-one out of the thirty; Germany, the United States of America, Argentina, Austria, Hungary, Belgium, Brazil, Bulgaria, Chile, Denmark, Spain, France, Greece, Monaco, Norway, the Netherlands, Romania, Russia, Sweden, Turkey, and Uruguay but was not signed up to by Britain or Italy.

The Supplementary Agreement was concerned with administrative aspects to wireless communication such as the form of wireless telegrams, rates and payments of charges, the structure to transmission, and the international bureau.[47] It did not relate at all to the issue of intercommunication which was dealt with in the Convention and Final Protocol. This has, however, caused some confusion with historian of technology Daniel Headrick claiming erroneously that, in not signing up to the Service Regulations, Britain along with Italy, Japan, Mexico, Portugal, and Persia were opposing free marine intercommunication; this was not the case at all.[48] In reality it was only the delegates of Montenegro (represented by Cuthbert Hall),

URL: http://www.telegraph-office.com/pages/arc2-2.html

46 International Radiotelegraph Convention Of Berlin: 1906 And Propositions For The International Radiotelegraph Conference Of London (1912), 3.

47 International Radiotelegraph Convention Of Berlin: 1906 And Propositions For The International Radiotelegraph Conference Of London (1912), 25.

48 Headrick (1991), 120.

Egypt, and Siam (Thailand) that did not sign up to the Convention and Final Protocol and hence not agree to the principle of intercommunication. With regards to the Supplementary Agreement it was delegations from Egypt, Great Britain, Italy, Japan, Mexico, Persia, Portugal, Siam (Thailand), Montenegro that did not sign up to the Supplementary Agreement. Overall this showed a strong level and support with, after a month of intense debate and discussion, the Convention, Final Protocol, and Supplementary Agreement being agreed to by the majority of delegates and countries in attendance. Hence the delegates were required to return to their home nations and were given two years until July 1908 to ratify the Convention and, in some cases, related Service Regulations before they came into operation.

6.4 Aftermath of the 1906 International Radiotelegraph Conference

The Select Committee had its origins in questions asked about the international conference and congress in the House of Commons. As the 1906 International Radiotelegraph Conference reached its terminus at the end of October 1906, questions began to be asked in parliament as to the outcome of the conference and the power of the delegates. On 25 October, the Postmaster-General Sydney Buxton was asked by Claude Hay, MP for Shoreditch Hoxton, whether the actions of the British delegates at the conference could be discussed.[49] A few days later on 29 October Major-General John Seely, then Liberal MP for the Isle of Wight although he had formerly been a Conservative MP, asked whether the British delegates could sign a binding agreement or whether it would be open for parliamentary debate.[50] The Prime Minister, Henry Campbell-Bannerman, replied that any convention agreed to by the delegates would be subject to subsequent ratification but that parliamentary debate of the matter had yet to be decided. A week later and two days after the conference had reached its end, more questions were asked in parliament by John Henniker Heaton, MP for Canterbury, and Sir Edward Sassoon, MP for Hythe, Kent.[51] Both Henniker Heaton and Sassoon were considered sometime allies of the Marconi Company. Both of their questions were answered by Sydney

49 Hansard HC Deb 25 October 1906 vol 163 c421 – Berlin Conference on Wireless Telegraphy. URL: http://hansard.millbanksystems.com/commons/1906/oct/25/berlin-conference-on-wireless-telegraphy#S4V0163P0_19061025_HOC_149.

50 Hansard HC Deb 29 October 1906 vol 163 c719 – Wireless Telegraphy. URL: http://hansard.millbanksystems.com/commons/1906/oct/29/wireless-telegraphy#S4V0163P0_19061029_HOC_205.

51 Hansard HC Deb 05 November 1906 vol 164 cc98-9 - British Delegates at the Berlin Conference on Wireless Telegraphy.

Buxton, the Postmaster General, who stated that the Convention would be discussed prior to ratification. In his reply to Henniker Heaton, Buxton was firm and perhaps a little testy. He unambiguously stated that the British delegates were 'instructed to carry out that which was the policy of the late, as well as of the present, Government in regard to the matter. They were instructed not to agree to the principle of intercommunication, nor to sign the Convention, unless specific and adequate securities for British interests, naval and commercial, were obtained.'[52]

Parliamentary debate on the matter reached a climax in December 1906 when Sir Edward Sassoon put forward a motion inviting the government to withhold ratification of the Convention due to its potential effects on the still experimental science of wireless.[53] Shortly thereafter he recast the motion as a request for a Select Committee hearing on the topic with the move being seconded by Major-General Seely. This led to much discussion including extensive feedback from the Postmaster General. The motion was agreed to and Sassoon was nominated as one of the Select Committee members to meet after the Christmas recess. Sassoon's primary role in the demand for a Select Committee on the Radiotelegraphic Convention is worthy of further explanation.

Sir Edward Sassoon was a Liberal MP for the constituency of Hythe on the coast of Kent from 1899 until his death in 1912. A mere twelve miles down the coastline and within the borders of his constituency was Folkstone, where early telegraph cable experiments were conducted across the harbour and also home to one of the cross-channel telegraph cables connecting the town with Boulogne, France and on to Sweden.[54] Also nearby on the Kent

URL: http://hansard.millbanksystems.com/commons/1906/nov/05/british-delegates-at-the-berlin#S4V0164P0_19061105_HOC_45.

Hansard HC Deb 05 November 1906 vol 164 cc131-2 - Wireless Telegraphy.

URL: http://hansard.millbanksystems.com/commons/1906/nov/05/wireless-telegraphy#S4V0164P0_19061105_HOC_195.

52 Hansard HC Deb 05 November 1906 vol 164 cc98-9 - British Delegates at the Berlin Conference on Wireless Telegraphy.

URL: http://hansard.millbanksystems.com/commons/1906/nov/05/british-delegates-at-the-berlin#S4V0164P0_19061105_HOC_45.

53 Hansard HC Deb 18 December 1906 vol 167 cc1290-328 - RADIO-TELEGRAPHIC CONVENTION.

URL: http://hansard.millbanksystems.com/commons/1906/dec/18/radio-telegraphic-convention.

54 Glover, Bill. "History of the Atlantic Cable & Submarine Telegraphy - British Submarine Cable Manufacturing Companies." http://www.atlantic-cable.com/CableCos/BritishMfrs/. Accessed:

coast were Dover, the hub for cross-channel telegraph cables providing communication with the European mainland through Calais (laid in 1850/1851) and Sangatte in France (laid in 1851) and Ostend in Belgium (laid in 1853).[55] These telegraph cables formed key parts of the North Atlantic telegraph cable network and connected Britain eastward to the European mainland. Many of the telegraph cables entered the sea at South Foreland which was also home to many early wireless demonstrations and experiments, both by the Post Office and by the Marconi Company. Thus the geographical placement of Sassoon's constituency influenced and informed Sassoon, leading to a strong interest in telecommunications, both submarine cable telegraphy and maritime application of wireless telegraphy. One of Sassoon's earliest contributions to House of Commons debates was on the topic of Foreign Telegraphic Rates in August 1899 and less than six months after he had first been elected.[56] Much of Sassoon's contributions to the House of Commons focused on cable telegraphy and in 1901 Sassoon was invited to give evidence before Lord Balfour's Committee on Cable Communications; Sassoon also contributed to Select Committee hearings on Telegraph Cables.[57] It was during his time on the former committee that Sassoon's strong opinion against international conventions was crystallised when it was suggested by the Chairman that international conventions was one of the great obstacles in the way of a reduction of the Anglo-Indian telegraph rate, an outcome in which Sassoon had great interest and hoped to achieve change.[58] It was these concerns that

2012-08-20.

55 For a map of the North Atlantic telegraph cable network c.1897, see Plate IX - “General European Connections of Atlantic Cables (from the Map published by the International Telegraphic Bureau, Bern, 1897) in Bright, Charles. *Submarine Telegraphs; Their History, Construction, and Working*. London: C. Lockwood and Son, 1898: 144-145. This map can also be found online at http://atlantic-cable.com/Maps/BrightMap.jpg. Accessed 2012-08-20.

See also Glover, Bill. "History of the Atlantic Cable & Submarine Telegraphy - British Submarine Cable Manufacturing Companies." http://www.atlantic-cable.com/CableCos/BritishMfrs/. Accessed: 2012-08-20.

56 Hansard HC Deb 08 August 1899 vol 76 c164 - FOREIGN TELEGRAPHIC RATES. URL: http://hansard.millbanksystems.com/commons/1899/aug/08/foreign-telegraphic-rates.

57 For a summary of Sassoon's contributions to House of Commons between 1899 and 1911 and a yearly break-down of these contributions, see http://hansard.millbanksystems.com/people/sir-edward-sassoon.

58 BT Archives Post 30/1488B File X. Select Committee on Radiotelegraphic Convention 1907 – Memorandum on Sir Edward Sassoon by R.J. Mackay? Dated 18 March 1907.

shaped Sassoon's response to the wireless convention and explained his occasionally belligerent attitude to adherence to and ratification of the Convention.

The Select Committee was also considered by Cuthbert Hall to be an outcome which matched Cuthbert Hall's goals for the Marconi Company. Indeed Cuthbert Hall took a small degree of credit for Sassoon's questions in the House of Commons.[59] In the aftermath of the 1906 conference, Cuthbert Hall was determined that the views of the Marconi Company and, more widely, their opposition to ratification of the Convention, would be heard in the public arena that was the House of Commons. Not being a member of parliament, Cuthbert Hall was unable to put forward his views and those of the Marconi Company before this august body. Instead Cuthbert Hall implied that his behind-the-scenes manipulations had a role in Sassoon's questions. His claims are unverified and quite possibly unverifiable. Nonetheless the end result of a Select Committee hearing with the opportunity to provide evidence to be considered by the House of Commons was an outcome which matched the goals of Cuthbert Hall and the Marconi Company.

At this point it is worth highlighting that a Select Committee hearing was not normal protocol after telecommunications conferences. Previous Select Committee hearings on telegraphy related solely to domestic legislation with four Select Committees reports on telecommunications published in the late nineteenth century.[60] None of these were held in response to the two major international telecommunications conferences of this era: the first International Telegraph Conference held in Paris in 1865 which established the International

59 Marconi Collection MS. Marconi 205 – 7pp. typed letter from Cuthbert Hall, London to Guglielmo Marconi, Grand Hotel, Pisa, dated 8 November 1906 and 2pp. typed letter from W.H. Smith (Secretary to Cuthbert Hall) to Guglielmo Marconi, Milan, Italy, dated 14 December 1906.

60 Cavendish, Spencer Compton. "Report from the Select Committee on the Telegraph Acts Extension Bill; Together with the Proceedings of the Committee and Minutes of Evidence." In *House of Commons Reports of Committees*. London: House of Commons, 1870; Cavendish, Spencer Compton. "Report from the Select Committee on the Telegraph Bill; Together with the Proceedings of the Committee and Minutes of Evidence." In *House of Commons Reports of Committees*. London: House of Commons, 1868; Playfair, Lyon Sir. "Report from the Select Committee on Post Office (Telegraph Department); Together with the Proceedings of the Committee, Minutes of Evidence, and Appendix." In *House of Commons Reports of Committees*. London: House of Commons, 1876; and Russell, George William Erskine. "Report from the Select Committee on Telephone and Telegraph Wires; Together with the Proceedings of the Committee, and Minutes of Evidence." In *House of Commons Reports of Committees*. London: House of Commons, 1884.

Telegraph Union and the basic elements of the Union's structure, nor the subsequent 1875 International Telegraph Conference held in St. Petersburg. However, the conventions of both of these conferences were enacted within a year of the conference being held with neither of the conference Conventions requiring ratification. In contrast, the convention of the 1906 conference was not be enacted until July 1908, nearly two years after the conference, with ratification by individual countries required.

Subsequently to the announcement of a Select Committee on the ratification of the Radiotelegraphic Convention on 18 December 1906, two important changes took place. First, almost all political enquiry about British ratification of the Convention moved from the public and transparent arena of parliamentary debate to the limited and less accessible sphere of the Select Committee. This state of affairs continued until the publication of the report in late July 1908. As a result the format of discussion changed: a smaller number of individuals were controlling the debate and setting the agenda in terms of the evidence being contributed and the resulting discussion. Secondly, a mere three days after it was agreed in the House of Commons that a Select Committee was appointed in the next parliamentary session, an informal and private Interdepartmental Committee was formed consisting of members of the Post Office, Admiralty, War Office, Board of Trade, and Colonial Office.[61]

The remit of this private, indeed potentially secret, committee was to consider the selection of witnesses to represent 'the point of view of national and public interests' before the Select Committee. [62] Further to this, the direction and content of their evidence was shared, discussed, and amended accordingly. The committee was led by Babington Smith, the chief British delegate at the 1906 conference and the Secretary of the Post Office. The first meeting of this Interdepartmental Committee was scheduled for 11 January and in total six meetings were held between early January and mid-March with the final meeting being held

61 See BT Archives Post 30/1488B File II. Select Committee on Radiotelegraphic Convention. Inter-departmental Committee to prepare evidence. Correspondence with Admiralty, War Office, Board of Trade and Colonial Office as to appointment of representatives (21 December 1906-24 January 1907); BT Archives Post 30/1488B File III. Select Committee on Radiotelegraphic Convention. Interdepartmental Committee to prepare evidence. Records of the first three meetings. (11 January-8 February 1907); and BT Archives Post 30/1488B File IV. Select Committee on Radiotelegraphic Convention. Interdepartmental Committee to prepare evidence. Records of the last three meetings (22 February-13 March 1907).

62 BT Archives Post 30/1488B File IV – 9pp. typed report of the fourth meeting of the Interdepartmental Committee on 22 February 1907.

on 13 March. Prior to these meetings, an initial letter sent by Babington Smith at the Post Office declared that the Post Office representatives would be those who had acted as delegates at the 1906 conference; Babington Smith himself along with John Gavey and R.J. Mackay.[63] In a reply sent the same day, Lord Tweedmouth (First Lord of the Admiralty) agreed with the Post Office nominees and in turn appointed Colonel Daniell and Lieutenant Loring, also British delegates from the 1906 conference, as the Admiralty's representatives before the Select Committee.[64] In late December, Babington Smith sent letters to the War Office and the Board of Trade discussing their proposed witnesses for the upcoming Select Committee hearings.[65] For the War Office, Babington Smith suggested Colonel F.J. Davies, stating 'he [had] the whole matter at his fingers' ends, and would make an admirable witness if the Committee should want one from the War Office.'[66] Babington Smith did not have a representative in mind from the Board of Trade but suggested that if the Board of Trade were called to provide evidence it would be better if their representative 'would be able to give evidence with fuller knowledge if he had discussed the matter beforehand.'[67] On 2 January 1907 Babington Smith sent a more formal invitation to the War Office requesting a representative from the War Office at an Interdepartmental Committee for 'preparing the evidence to be laid before the Select Committee.'[68] On 4 January the Colonial Office confirmed their appointment, G.W. Johnson, especially in light of his role on the Cables (Landing Rights) Committee.[69] By the first meeting in early January, the Admiralty representatives were expanded to include Captain Currey, the successor to the remaining naval delegate from the 1906 conference, Captain Bethell.[70]

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63 BT Archives Post 30/1488B File II – 1pp. copy of letter from Babington Smith to Baddeley [Secretary to Lord Tweedmouth], dated 21 December 1906

64 BT Archives Post 30/1488B File II – 3pp. letter from Baddeley [Secretary to Lord Tweedmouth] to Babington Smith, dated 21 December 1906.

65 BT Archives Post 30/1488B File II – 2pp. copy of letters sent to Sir Edward Ward at the War Office and H. Llewellyn Smith at the Board of Trade from Babington Smith, dated 27 December 1906.

66 *Ibid.*

67 *Ibid.*

68 BT Archives Post 30/1488B File II – 1pp. typed letter sent to the Secretary of the War Office from Babington Smith, dated 2 January 1907.

69 BT Archives Post 30/1488B File II – 3pp. handwritten letter from Earl of Elgin at the Colonial Office to Babington Smith dated 4 January 1907.

70 BT Archives Post 30/1488B File II – 2pp. typed letter to Garnham Roper (Board of Trade) from R.J. Mackay at the Post Office, dated 21 January 1907.

Babington was quite firm in how he thought the Select Committee should operate and outlined these at the fourth meeting of the committee in late February.[71] He believed that the Reference of the Select Committee – 'to consider the [1906] Radiotelegraphic Convention ... and to report what, from the point of view of national and public interests, would in their opinion be the effect of the adhesion or non-adhesion of this country to the Convention' – should not be informed by their opinion on ratification. Ratification was a matter for the government. Rather the committee should focus, Babington Smith proposed, on how adherence to the Convention would impact upon the nation as a whole, including strategic and colonial interests and the interests of limited sections of the community, for example shipping interests. This closely matched the division of categories under consideration by the Select Committee, described in more detail in the next section. Additionally Babington Smith believed that the Reference of the Select Committee did not mention private wireless interests, in particular those of the Marconi Company. Hence Babington Smith believed that private wireless companies such as the Marconi Company should not be represented before the Select Committee. These points were agreed to by the other government representatives that made up the Interdepartmental Committee.

The demands of the Interdepartmental Committee were generally met by the Select Committee. Their selection of witnesses matched closely those who gave evidence before the Select Committee. Furthermore this powerful yet secret committee was able to ensure that the different government departments represented before the Select Committee – the Post Office, the Admiralty, the War Office, the Colonial Office, and the Board of Trade – presented a unified response. With regard to the Select Committee hearings, the Interdepartmental Committee was setting the agenda, sometimes quite literally. It was this committee rather than the Select Committee selecting the witnesses and shaping the evidence provided. Through their activities, the Interdepartmental Committee guaranteed that institutional representatives were the foremost witnesses at the Select Committee hearings and that public and national interests were positively and widely represented. However, the power wielded by Babington Smith and the Interdepartmental Committee was insufficient to prevent parties with private interests, in particular the Marconi Company, having their say before the Select Committee. Nonetheless they were able to ensure institutional views representing the national and public interests more than outweighed those of private interests and other parties opposed to adherence to the Convention.

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71 BT Archives Post 30/1488B File IV – 9pp. typed report of the fourth meeting of the Interdepartmental Committee on 22 February 1907.

6.5 1907 Select Committee Hearing

On 8 March 1907 *the Report from the Select Committee on Radiotelegraphic Convention* along with the proceedings of the committee were ordered to be printed by the House of Commons. The committee was appointed 'to consider the Radiotelegraphic Convention, signed at Berlin on the 3rd day of November 1906, and to report what, from the point of view of national and public interests, would, in their opinion, be the effect of the adhesion or non-adhesion of this Country to the Convention.'[72] The committee consisted of eleven members: William Adkins, Sydney Buxton, John Dickson-Poynder, Enoch Edwards, Stephen Gwynn, William Holland, George Lambert, Colonel Arthur Lee, John Macpherson, Horatio Parker, and Edward Sassoon.[73] With the Liberals back in power after the 1906 election with 379 seats and an overwhelming majority of 88 over all other parties, it was unsurprising that the committee had a significant majority of Liberal members with the committee being composed of eight Liberals MP, two Conservative MPs, one Labour MP, and one Irish Parliamentary Party MP. The committee had the power to send for witnesses, papers, and records and had a quorum of four.[74] The committee held thirteen meetings and examined witnesses at twelve of the meetings held between 19 March and 28 May 1907.[75] The final meeting held on 2 July 1907 when the draft report was further considered by the committee and it was put to the committee as to whether the report was to be recommended to the House of Commons.

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72 *Report from the Select Committee on Radiotelegraphic Convention; Together with the Proceedings of the Committee, Minutes of Evidence, and Appendix*. Vol. 246, House of Commons Reports of Committees. London: Printed for His Majesty's Stationery Office, 1907, ii-iii.

73 Further details of the committee membership are: (later Sir) William Adkins (Liberal MP for Middleton 1906-1918); Sydney Buxton (PMG 1905-1910 and Liberal MP for Tower Hamlets Poplar 1886-1914); Sir John Dickson-Poynder (Chairman and Liberal MP for Chippenham 1892-1910 although Dickson-Poynder had switched from the Conservative to Liberal party in 1905); Enoch Edwards (Liberal MP for Hanley 1906-1912 although Edwards stood as a Labour candidate in 1910); Stephen Gwynn (Irish Parliamentary Party MP for Galway 1906-1918); Sir William Holland (Liberal MP for Salford 1892-1895 and Rotherham 1899-1910), George Lambert (Civil Lord of the Admiralty 1905-1915 and Liberal MP for South Molton 1891-1924 and 1929-1945); Colonel Arthur Lee (Conservative MP for Fareham 1900-1918); John Macpherson (Labour MP for Preston 1906-1910); Sir Horatio (Gilbert) Parker (Conservative MP for Gravesend 1900-1918); and Sir Edward Sassoon (Liberal MP for Hythe 1899-1912)

74 *Report from the Select Committee on Radiotelegraphic Convention* (1907), ii.

75 *Report from the Select Committee on Radiotelegraphic Convention* (1907), lvi.

6.5.1 Overview

In terms of the committee's general approach to the history of wireless telegraphy, they divided it into distinct stages: first, the invention and development of wireless telegraphy from a scientific discovery to an applied art; and secondly, its political history and International recognition; it is notable that both sections were of roughly equal length and were given equal weight in terms of content and importance.[76] Much of the early scientific history and political history of wireless communications are contained within earlier chapters of this thesis but a few points raised before the Select Committee are worth highlighting, especially in relation to the political history of this innovative technology. The political history of wireless technology emphasised the government control over and governance of wireless and how this influenced the early history of wireless communications during this formative period in its history. In contrast to commercially focused histories of wireless, this contemporary material established institutional innovation in the field of wireless with particular emphasis on governmental institutions such as the Post Office, the Admiralty and Lloyd's insurance company. In this history of wireless communications, the Marconi Company very much took a secondary and indeed subservient role in the history of wireless. Instead it was government contracts and henceforth legislation which shaped the direction of wireless telegraphy. The political history section concluded with the 1903 and 1906 Conferences along with the 1904 Wireless Telegraphy Act before analysing the Convention of the latter conference in more detail.[77]

It was noted by Babington Smith and Daniell in their respective testimonies that a proposal was introduced by the United States to include ship-to-ship communication under the Convention of the Conference but this was rejected by Britain who insisted that be sectioned off into a separate Additional Undertaking which Britain did not sign.[78] The remainder of the material on the Convention was provided through evidence of the attendees and described in detail certain highlighted articles from the convention although, for obvious reasons, the article of most importance relates to intercommunication. In his evidence, Smith noted that many of the articles of the convention were adaptations of the early Telegraph Convention but that further provisions were required relating to specific aspects of wireless telegraphy so as to

76 *Report from the Select Committee on Radiotelegraphic Convention* (1907), iii.

77 *Report from the Select Committee on Radiotelegraphic Convention* (1907), viii-x.

78 *Report from the Select Committee on Radiotelegraphic Convention* (1907), 100, 820.

avoid interference and confusion.[79] These six conditions were also covered by other attendees of the conference and were excess of power; uniformity in methods of working traffic and use of International Code; efficiency of apparatus and operators on ships; control of operators; appropriation of specific wave-lengths; and general obligation not to interfere.[80]

These aspects of the Convention and hence the overall enforcement of the Convention was discussed both by commercial and institutional witnesses including Cuthbert Hall, Marconi, Daniell, and Gavey.[81] The Marconi Company representatives primarily objected to the technical workings of these additional obligations. When considering the ratification of the Convention, the committee divided this up into four areas: imperial interests, naval interests, commercial interests, and the position of the Marconi Company. The evidence on imperial interests could be summarised thus: the colonies would have a vote at the next conference, then planned for London in 1911 although it did not take place until 1912. This would have the effect, according to Babington Smith, of enabling colonies to have separate representation at subsequent conferences and to give full effect to their views.[82] In relation to naval interests, the committee was satisfied that the naval interests were fully protected and provided for by the Convention.[83] Article twenty-one placed naval stations outside of the convention which mean they did not need to adhere to intercommunication except in the case of emergencies. Additionally secrecy and privacy aspects of naval wireless stations and their workings were to remain confidential.[84] With regard to British commercial interests, the committee and assorted witnesses somewhat controversially concluded that the Convention would be of benefit as it would promote 'the freest utilization of wireless telegraphy', this being in the best interest of commerce and the merchant navy with the single exception being the Marconi Company.[85] Institutional witnesses such as Davies, Daniell, and Gavey argued that “free intercommunication (properly safe-guarded) and international control … [would] become inevitable.[86] If Britain were to opt out of the Convention then she might be forced to join at a

79 *Report from the Select Committee on Radiotelegraphic Convention* (1907), 141.

80 *Report from the Select Committee on Radiotelegraphic Convention* (1907), xii-xiii.

81 *Report from the Select Committee on Radiotelegraphic Convention* (1907), 667, 1373-1377, 1613, 1812, 3127.

82 *Report from the Select Committee on Radiotelegraphic Convention* (1907), xviii, 378.

83 *Report from the Select Committee on Radiotelegraphic Convention* (1907), xviii.

84 *Ibid.*

85 *Report from the Select Committee on Radiotelegraphic Convention* (1907), xx.

86 *Report from the Select Committee on Radiotelegraphic Convention* (1907), xxi.

later date under considerably less favourable circumstances. Finally (at least in relation to potential interests), the committee considered the position of the Marconi Company, these noted as being “subsidiary” to imperial, naval, and national interests and also being the sole opponents to the Convention.[87] Essentially the committee acknowledged that the interests of the Marconi Company would potentially be threatened by enactment of the Convention and so, in reward for adhering to the stipulations of the Convention, the Marconi Company would be given financial compensation for three years after the Convention came into effect.[88]

Subsequently, the committee considered the different options available: rejection along with an additional section on injurious effects of non-ratification, postponement, or ratification. Rejection was, to excuse the pun, quickly rejected – this option was supported by Cuthbert Hall, Marconi, and Fleming with limited support from Henniker Heaton; it was believed by the committee that this was solely in consideration of the commercial interests of the wireless company.[89] Furthermore the committee considered the various negative effects of non-ratification including the potential to cause offence considering Britain's strong role in the 1906 Conference and hosting of the subsequent conference; the potential erection of wireless stations in foreign territories outside of British control during time of war; potentially interference from foreign wireless stations and vessels; the administrative complications of collections charges and payments outside of the Convention; and other minor considerations.[90] In relation to postponement, this would be essentially non-ratification and would, according to the committee lead to a period of uncertainty.[91] It was further noted that, with twelve months' notice, the British could withdraw from the Convention and so the committee concluded that 'from the point of view of national and public interests, rejection [presented] serious drawbacks, and that postponement [was] even less defensible.'[92]

In arguing for ratification, the committee listed four main benefits.[93] First, the Convention provided facilities and administrative framework for the working of wireless telegraphy, domestically and internationally. Secondly the Convention provided a method of

87 *Report from the Select Committee on Radiotelegraphic Convention* (1907), xxi.

88 *Report from the Select Committee on Radiotelegraphic Convention* (1907), xxiii.

89 *Report from the Select Committee on Radiotelegraphic Convention* (1907), xxiii-xxiv.

90 *Ibid.*

91 *Report from the Select Committee on Radiotelegraphic Convention* (1907), xxiv.

92 *Report from the Select Committee on Radiotelegraphic Convention* (1907), xxv.

93 *Ibid.*

avoiding interference and confusion, something almost impossible to attain without international agreement. Thirdly, the Convention offered freedom of communication, an advantage of all British vessels fitted with wireless apparatus. Finally and in direct contradiction to claims of the Marconi Company and her allies, the previous three advantages especially freedom of operation and freedom from confusion would 'tend to the encouragement and progress of invention in connection with Wireless Telegraphy.'[94]

94 *Ibid.*

6.5.2 Witnesses

Schedule of witnesses
Tuesday 19 March 1907
Henry Babington Smith, Secretary of the Post Office – **Post Office representative**.
Thursday 21 March 1907
Henry Babington Smith recalled – **Post Office representative**.
Colonel F.J. Davies, Assistant Quartermaster-General, Western Command, British Army and Assistant Director of Military Operations – **War Office representative**.
Tuesday 26 March 1907
Colonel J.F. Daniell, assistant Director of Naval Intelligence – **Admiralty representative**.
Commander C.R. Payne, Commander-in-Chief of Wireless Telegraphy Department, HMS Vernon – **Admiralty representative**.
Tuesday 9 April 1907
Lieutenant F.G. Loring, commander of Admiralty shore wireless telegraph stations – **Admiralty representative**.
George W. Johnson, one of the Principal Clerks at the Colonial Office – **Colonial Office representative**.
Tuesday 16 April 1907
Henry Cuthbert Hall, Managing Director, Marconi Company.
Thursday 18 April 1907
John Gavey, Engineer-in-Chief and Electrician, Post Office – **Post Office representative**.
Captain E.F. Inglefield, office of the Royal Navy and Secretary of Lloyd's – **Admiralty representative**.
Tuesday 23 April 1907
Sir Oliver Lodge, physicist, early wireless pioneer, and co-founder of the Lodge-Muirhead Wireless Syndicate.
Henry Muirhead, giving evidence on behalf of his brother, Alexander Muirhead, co-founder of the Lodge-Muirhead Wireless Syndicate.
Thursday 25 April 1907
Nevil Maskelyne, early wireless pioneer and technical assistant of the Amalgamated Radiotelegraph Company.
John Henniker Heaton, MP and expert on the telegraph network.
Tuesday 30 April 1907
Owen Philipps, MP and managing director of the Royal Mail Steam Packet Company.
Guglielmo Marconi, early wireless pioneer and founder of the Marconi Company.

Tuesday 7 May 1907
Sir William H. Preece, early wireless pioneer and former Engineer-in-Chief and Electrician of the Post Office.
Dr J.A. Fleming, Scientific Advisor to the Marconi Company and Professor of Electrical Engineering at University College, London.
Tuesday 14 May 1907
Commander C. R. Payne recalled – **Admiralty representative**.
Captain Bethell, Assistant Director of Naval Ordnance – **Admiralty representative**.
Henry Babington Smith recalled – **Post Office representative**.
Tuesday 28 May 1907
Henry Cuthbert Hall recalled.
Charles Bright, world-renowned telegraph engineer and son of Charles Tilston Bright, chief engineer of the first successful transatlantic cable.

A mere glance at the schedule of witnesses shows that the thorough preparation of the Interdepartmental Committee had paid off with institutional representatives dominating the list of witnesses particularly in the key opening and closing stages of evidence. The pre-hearing committee had decided the witnesses they would call in addition to the content that they would present, an approach which would guarantee a unified approach from the pro-ratification witnesses, in particular the institutional witnesses.

As might have been expected given the subject of the select committee, several of the British delegates from the two International Radiotelegraph Conferences in 1903 and 1906 were called to give evidence. As per the conferences, the delegates were also representatives of their respective government departments: the Admiralty, War Office, Post Office, and Colonial Office. The following representatives from the conferences were called to give evidence: Henry Babington Smith – Post Office representative at 1906 conference; John Gavey – Post Office representative at 1903 and 1906 conferences; Commander R. Payne – Admiralty representative at the 1903 conference; Captain A.E. Bethell – Admiralty representative at the 1906 conference; Colonel Daniell – Admiralty representative at the 1906 conference; Lieutenant F.G. Loring – Admiralty representative at the 1906 conference; and Colonel F.J. Davies – War Office representative at the 1906 conference. It is worth noting that the delegates for the most recent and important conference in 1906 were divided up as follows: three for the Admiralty; three for the Post Office; and two for the War Office – and yet it was two of the Post Office delegates, all three of the Admiralty delegates plus one Admiralty delegate from the 1903 conference, and one of the War Office delegates who were invited to give evidence before the Select Committee.

In contrast to the governmental and institutional witnesses, other witnesses (both pro- and anti-ratification) were scattered throughout the proceedings with, as might have been expected given their diversity, a distinct lack of unity. The non-governmental witnesses represented the interests of merchant shipping, different modes of wireless telegraphy including those of the Marconi Company, and scientific witnesses. Merchant shipping interests were represented by a witness from Lloyd's and one from a steamship company while different systems of wireless telegraphy were represented by assorted witnesses: scientific and other witnesses explained non-Marconi wireless systems; the Marconi Company was represented by its Managing Director, Cuthbert Hall, its Scientific Advisor, Dr J.A. Fleming, and indeed Marconi himself. It was later pointed out in the House of Commons by Stephen Gwynn, a member of the committee, that only one of the scientific witnesses called could claim not to be representing the interests of one company or another.[95] Nonetheless scientific witnesses such as Lodge and others were called to give evidence in relation to the scientific standing of wireless systems belonging to Marconi and non-Marconi wireless systems alike and to provide the context of the scientific history of the technology.

6.5.3 Evidence

The evidence provided by the witnesses stretches for hundreds of pages and provided intricate details of the workings of various wireless systems and their relationship with national, maritime, imperial, and commercial interests stretching from Preece's early wireless experiments in the 1880s and 1890s through to the then contemporary systems of Marconi, de Forest, the Lodge-Muirhead Syndicate, and others. An entire thesis could be written on the contents of the Select Committee hearings but instead, I shall offer a summary of the evidence given in order to demonstrate how institutional witnesses came to the fore in terms of giving evidence. Further to this, it was the assorted and interlinked institutional and national interests which were most prominently represented. Unlike most other public presentations on the subject of wireless communications up to this point, the views of Marconi and the

95 Hansard HC Deb 30 July 1907 vol 179 col 857 - ADJOURNMENT (UNDER STANDING ORDER No. (O.) RADIOTELEGRAPHIC CONVENTION).
URL: http://hansard.millbanksystems.com/commons/1907/jul/30/adjournment-under-standing-order-no-o#S4V0179P0_19070730_HOC_383

Marconi Company did not come to the fore, nor did they shape the Select Committee's overall response.

The first witness called to give evidence was Henry Babington Smith on Tuesday 19 March and Thursday 21 March. Babington Smith was providing evidence in his role as Secretary of the Post Office from October 1903 – a post he remained in until December 1910 – and was also the principal British Delegate and a representative of the Post Office at the 1906 International Radiotelegraph Conference.[96] Babington Smith provided a list of the chief systems in use and divided the main types of wireless modes: ship-to-ship and ship-to-shore with shore-to-shore being a distant second to cable telegraphy.[97] Babington Smith further noted that the 1903 Conference could not be signed until domestic legislation was introduced in the form of the 1904 Wireless Telegraphy Act and also further noted that the Post Office was generally in favour of general intercommunication and hence of ratification despite not having control of ship-to-ship wireless communication, this being beyond the Post Office's monopoly. Babington Smith very much stood in opposition to the Marconi Company monopoly and strongly supported ratification of the Convention. Babington Smith proposed that a monopoly would be objectionable from scientific, strategic, and economic points of view and that furthermore a Marconi Company would not guarantee wireless communications remaining under British control.[98]

Another Post Office witness, former Engineer-in-Chief and Electrician John Gavey, was called to give evidence on the sixth day, 18 April. Gavey was Engineer-in-Chief and Electrician of the Post Office from April 1902 to April 1907 but had retired a mere four days before giving evidence on 18 April 1907.[99] He was a past President of the Institution of Electrical Engineers in 1905 and a member of the Institution of Civil Engineers. As part of his role at the Post Office he had studied the development of wireless telegraphy from 1886 onwards. Gavey represented the Post Office in the British Delegates at the 1903 and 1906 conferences. Gavey was strongly supportive of ratification – he felt that it would not be detrimental to the Marconi Company whilst being of benefit to the British nation. Gavey very much saw international regulations as a desirable inevitability and that to be left out would leave British isolated and in a weak position.

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96 *Report from the Select Committee on Radiotelegraphic Convention* (1907), 57.

97 *Report from the Select Committee on Radiotelegraphic Convention* (1907), 2-3.

98 *Report from the Select Committee on Radiotelegraphic Convention* (1907), 81-83.

99 *Report from the Select Committee on Radiotelegraphic Convention* (1907), 184.

The interests of the Admiralty were represented by four witnesses, all delegates from the 1906 Conference. On the third day of evidence on 26 March, Colonel J.F. Daniell RMLI was called to give evidence. Colonel Daniell was assistant Director of Naval Intelligence in the Admiralty.[100] He had been a member of the Naval Intelligence Division since June 1903 and dealt with wireless telegraphy since October 1905; he was also one of the Admiralty delegates at the 1906 International Radiotelegraph Conference. In the introductory section of his testimony on 26 March 1907, Daniell noted that Captain Bethell, the Senior Admiralty Delegate at the 1906 International Radiotelegraph Conference, was unable to attend due to taking command of battleship in the Channel and so Daniell was representing the Admiralty's views. However, Bethell's availability changed and so Bethell gave testimony on the second last day of evidence on Tuesday 14 May 1907.[101] In his evidence, Daniell described the relationship between the Admiralty and the Marconi Company and how this related to their response to the two conferences and the Convention of the latter. According to Daniell, the Admiralty-Marconi contract along with specific military and naval demands caused problems with agreeing a common “Instructions for Delegates” for the second conference. However, subsequently the British delegates were in complete agreement and the Admiralty offered its full support for ratification of the Convention.

Also giving evidence on 26 March was Commander C.R. Payne of the Royal Navy. Commander Payne was appointed Commander-in-Chief of Wireless Telegraphy Department of HMS Vernon in March 1906.[102] Based in Portsmouth, HMS Vernon was the Admiralty torpedo school and in charge of naval wireless telegraphy system training and design. Payne was commenting solely in relation to technical details.[103] Payne noted that any problems relating to intercommunication and interference could be easily solved using technical solutions. He also noted that the Admiralty had not received any new technical developments from the Marconi Company since 1905. Payne noted that the Navy would benefit from ratification for a number of different reasons, *viz.* freedom from commercial interference; easier communication with other ships and ability to utilise merchant maritime wireless systems in time of war; and so on. Payne concluded that the regulations were sufficient and capable of being enforced.

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100 *Report from the Select Committee on Radiotelegraphic Convention* (1907), 105.

101 *Ibid.*

102 *Ibid.*

103 *Ibid.*

On the fourth day of evidence, 9 April, another Admiralty witness Lieutenant F.G. Loring of the Royal Navy was called to testify. Lieutenant Loring had been in command of Admiralty shore wireless telegraph stations since October 1902 and represented the Admiralty in the British Delegates at the 1906 International Radiotelegraph Conference.[104] Prior to 1902, Loring had two years' experience with wireless telegraphy in the Royal Navy fleet. Loring was authorised by the Board of the Admiralty to give evidence on the probable effect of the Convention of the 1906 conference on wireless telegraphy in and near the UK and also a general but not highly technical or scientific overview of the general practice of wireless telegraphy.[105] Loring suggested that with an increasing number of wireless stations, interference was becoming a problem and that the only solution to this problem was international regulations in the form of the 1906 Convention. Furthermore the beneficial effects of the Convention would be felt by naval and commercial wireless stations alike.

The interests of another government department, the War Office, were represented by Colonel F.J. Davies, called to give evidence on the second day. Colonel Davies was Assistant Quartermaster-General, Western Command, British Army and Assistant Director of Military Operations.[106] He served on the wireless telegraphy section of General Staff of the War Office from January 1902 to November 1906 and represented the War Office on Cable Landing Right Committee since about 1905 and also represented the War Office as part of the British Delegates at the 1906 International Radiotelegraph Conference. Colonel Davies noted that he had attended all but one of the interdepartmental meetings relating to the 1904 Admiralty Conference on Intercommunication and the 1906 International Radiotelegraph Conference; he also attended both conferences as a representative of the Admiralty.[107] In his testimony, Colonel Davies noted that his views represented those of the War Office and he was the sole War Office representative called to give evidence.[108] In his testimony, Davies noted that the interests of the War Office were very much secondary to those of the Post Office and the Admiralty and that furthermore their interests were only in consideration of imperial interests. Overall the War Office was in support of ratification and considered rejection to be potentially detrimental to British national and imperial interests.

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104 *Report from the Select Committee on Radiotelegraphic Convention* (1907), 132.

105 *Ibid.*

106 *Report from the Select Committee on Radiotelegraphic Convention* (1907), 100.

107 *Ibid.*

108 *Ibid.*

On 14 May two former witnesses, Commander C.R. Payne and Babington Smith, were recalled. In addition and as mentioned previously, Captain Bethell, CMG of the Royal Navy was called to give evidence. Captain Bethell was commander of HMS Hindustan and Assistant Director of Naval Ordnance.[109] Between April 1903 and December 1906, he worked with the Director of Naval Intelligence advising the Admiralty Board on wireless telegraphy policy. Bethell was also principal delegate for the Admiralty at the 1906 Conference. Bethell noted that although the Admiralty had decided to support a non-general form of intercommunication from 1904 onwards, they supported the Marconi Company's opposition to universal intercommunication in the lead up to the 1906 conference because they sympathised with the Marconi Company and furthermore wished to utilise Marconi wireless stations; they did oppose universal intercommunication on technical grounds.[110] Furthermore, the Admiralty had concerns about security and privacy which were not entirely met by the initial "Instructions to Delegates" or the proposed Convention.[111] To conclude, Bethell (with some personally held reservations) was in support of ratification of the Convention.

On the fourth day of evidence, 9 April, a representative of the Colonial Office G.W. Johnson, CMG was called to testify. Lieutenant Loring was in command of Admiralty shore wireless telegraph stations since October 1902 and represented the Admiralty in the British Delegates at the 1906 International Radiotelegraph Conference.[112] Prior to 1902, Loring had two years' experience with wireless telegraphy in the Royal Navy fleet. Loring was authorised by the Board of the Admiralty to give evidence on the probable effect of the Convention of the 1906 conference on wireless telegraphy in and near the UK and also a general but not highly technical or scientific overview of the general practice of wireless telegraphy.[113] Loring suggested that with an increasing number of wireless stations, interference was becoming a problem and that the only solution to this problem was international regulations in the form of the 1906 Convention. Furthermore the beneficial effects of the Convention would be felt by naval and commercial wireless stations alike. Johnson was one of the Principal Clerks of the Colonial Office and had also served as the Colonial Office representative on the Cables' committee (which also dealt with wireless telegraphy) for nine months in 1901 and between

109 *Report from the Select Committee on Radiotelegraphic Convention* (1907), 305.

110 *Report from the Select Committee on Radiotelegraphic Convention* (1907), 305-307.

111 *Report from the Select Committee on Radiotelegraphic Convention* (1907), 308.

112 *Report from the Select Committee on Radiotelegraphic Convention* (1907), 132.

113 *Ibid.*

1905 and 1907.[114] Johnson had read most of the correspondence on wireless telegraphy that passed through the Colonial Office and was the sole witness called from the Colonial Office. He succinctly suggested that all of the British colonies except for Newfoundland opposed any form of domestic monopoly and furthermore the Colonies had enacted forms of the 1904 Wireless Telegraphy Act without the advantages given to the Marconi Company by the original template.

On the sixth day a representative of Lloyd's, Captain Inglefield, was called to give evidence. Inglefield was an officer in the Royal Navy at the time of giving evidence and was also Secretary of Lloyd's having succeeded the late Colonel Sir Henry Hozier KCB as secretary of Lloyd's on 1 October 1906.[115] Inglefield described how Lloyd's used wireless for maritime intelligence gathering and that the refusal of the Marconi Company to intercommunicate with other wireless systems was causing Lloyd's problems due to a strict contract with the wireless company. Inglefield concluded that ratification was in the best interests of the British nation and in the best interests of Lloyd's.

On the fifth day of evidence, Cuthbert Hall was called to give evidence. Cuthbert's testimony before the Select Committee was reported upon in *The Times* which had previously been supportive of the Marconi Company and had regularly published letters from Cuthbert Hall and the Marconi Company. In evidence that was described in *The Times* as 'hostile', Cuthbert Hall defended the company's policy of non-intercommunication saying that it was justified by results, and also discussed the legal and patent aspects of the Convention.[116] Cuthbert Hall's rhetoric echoed that which he had used in private correspondence with Marconi and in public statements – intercommunication would be technically difficult; a Marconi wireless monopoly would be good for the British nation; intercommunication ignored issues relating to patents and associated rights of exploitation. Furthermore ratifying the Convention would retard the technical development of wireless communications. On numerous occasions, Cuthbert Hall referred to private communications and correspondence with conference delegates which directly contradicted the voting record of the conference and evidence provided by other witnesses. When Cuthbert Hall was recalled to give evidence, he was strictly forbidden from referring to alleged private communications of any form. In

114 *Ibid.*

115 *Report from the Select Committee on Radiotelegraphic Convention* (1907), 200.

116 "Parliamentary Committees." *The Times*, 18 April 1907, 15.

conclusion, Cuthbert Hall aggressively cleaved from the view of the Admiralty and opposed ratification of the Convention.

On the seventh day of gathering evidence, 23 April, Oliver Lodge and John Muirhead, on behalf of his brother Alexander Muirhead, gave testimony. Lodge was testifying as a relatively neutral scientist, apparently independent of his commercial background despite giving evidence alongside a representative of the co-founder of his wireless syndicate – a not indelicate balance! Lodge had previously provided evidence for government enquiries into early wireless telegraphy.[117] Nonetheless, it would appear difficult for him to maintain his neutral scientific stance on wireless telegraphy and its history considering his intimate involvement along with his complex relationship with Marconi, his wireless patenting and furthermore his establishment of the Lodge-Muirhead syndicate in order to exploit his aforementioned wireless telegraphy patents for commercial gain. Lodge's evidence was direct and to the point: he opposed any form of wireless monopoly especially that of the Marconi Company and supported ratification of the Convention. Furthermore Lodge proposed that interference and intercommunication could be dealt with in a technical manner that would offer improvement to various systems of wireless communications. Alongside Lodge, Henry Muirhead was giving evidence on behalf of his brother and co-founder of the Lodge-Muirhead Wireless Syndicate, Alexander Muirhead.[118] This was due to Alexander Muirhead's deafness and as a result he was always represented by one of his brothers, either Henry or his eldest brother John.[119] Muirhead noted problems with the Post Office licensing scheme and how this might be improved through ratification of the Convention. Muirhead concluded that the Convention and the Ratification would be entirely in the best interests of Britain and of non-Marconi wireless systems.

On the eighth day of gathering evidence, 25 April, two witnesses were called - Nevil Maskelyne and Henniker Heaton. Nevil Maskelyne was an early wireless pioneer probably best known for his early opposition to Marconi and his notorious prank interfering with a 1903 demonstration by Marconi before the Royal Institution. Maskelyne was testifying before the Select Committee in his role as Technical Assistant of the Amalgamated Radiotelegraph

117 See BT Archives POST 30/1203 – Wireless telegraphy patents, part 1 (1892-1902) which contains a copy of the report by Professor Oliver Lodge regarding the validity of the Marconi Company's wireless telegraphy patents.

118 *Report from the Select Committee on Radiotelegraphic Convention* (1907), 220.

119 For further details, see Muirhead (1926).

Company which represented a number of different wireless systems including Poulsen's system and others.[120] Maskelyne suggested that ratification of the Convention would lead to more rapid development of continuous wave wireless telegraphy and better technical developments in the field. He also contradicted technical evidence given by Cuthbert Hall and made a strong case for the practical implementation of the Convention. Henniker Heaton was an Australian-born MP and had in-depth knowledge of the telegraphy network, and had requested to give evidence before the Select Committee.[121] He had made this request because he had been appointed as a delegate for New Zealand for the 1906 Conference but was unable to attend when the German government decided not to allow colonies and dependencies of the British Empire to attend.[122] However, private correspondence between Babington Smith and G.W. Johnson of the Colonial Office reveals that Henniker Heaton had offered up his own nomination to the 1906 conferences and had offered to pay his own expenses.[123] That is not to imply that Henniker Heaton was a fraud but rather that he may not have been a neutral representative of the New Zealand nation, as he had claimed. Instead Henniker Heaton was representing other interests, most likely those of the Marconi Company. Nonetheless Henniker Heaton did give evidence before the committee and was able to get his opinion as a strong ally of the Marconi Company across; Henniker Heaton was the only non-Marconi Company member to side with the company against ratification of the convention. Henniker Heaton felt that the Marconi system worked well and offered the chance for cheap communication, in direct contrast to the expensive cable telegraph charges between Australia and elsewhere. In particular Henniker Heaton voiced strong opposition to enforced communication.

On the ninth day of evidence, 30 April, two witnesses were called, Owen Philipps and Guglielmo Marconi. Owen Phillipps (1863-1937) was a Liberal MP for the constituency of Pembroke and Haverfordwest District of Boroughs from January 1906-December 1910.[124] He gave evidence before the committee in his role as managing director of the Royal Mail Steam

120 *Report from the Select Committee on Radiotelegraphic Convention* (1907), 232.

121 BT Archives Post 30/1488B File VIII – 2pp. typed letter to Sir John Dickson-Poynder from J. Henniker Heaton dated 11 April 1907.

122 *Report from the Select Committee on Radiotelegraphic Convention* (1907), 243.

123 BT Archives Post 30/1488B File VIII – 2pp. typed letter to G.W. Johnson at the Colonial Office from Babington Smith, dated 20 April 1907.

124 For the full details of Phillipps' contribution to parliamentary debate, see http://hansard.millbanksystems.com/people/sir-owen-philipps.

Packet Company.[125] Phillips supported ratification on humanitarian, commercial, and general grounds. Phillips went on to suggest that licensing was not sufficient to limit the monopoly of the Marconi Company and that furthermore intercommunication would be of benefit to Lloyd's and the British nation. Marconi had requested to give evidence on the technical, scientific, and commercial aspect of the Marconi Company system of wireless telegraphy.[126] Marconi's testimony reads in contrast to the earlier, antagonistic evidence of his colleague Cuthbert Hall. Marconi was far more conciliatory in tone and even directly contradicted the earlier evidence given by Cuthbert Hall. Marconi suggested that ratification of the Convention would limit the technical development of wireless and indeed the future developments in wireless would hinder practical enactment of the Convention. Additionally Marconi proposed that ratification of the Convention would be against the best interests of Britain although he did not elaborate on this point convincingly.

On the following day of evidence, 7 May, two early wireless pioneers, William Preece and J.A. Fleming were called to testify. William Preece was the former Engineer-in-Chief and Electrician of the Post Office and was giving evidence with regard to his early systems of wireless communications and his relationship with Marconi.[127] In his testimony, Preece was keen to emphasise the distinction between Marconi the individual and inventor and the Marconi Company.[128] Preece proposed that regulations would improve the organisation and administration of wireless stations and that furthermore enforced intercommunication would offer the opportunities for technical improvements to wireless systems. Going even further, Preece proposed that non-ratification would support a wireless monopoly, and relatedly go against national interests. Fleming was Scientific Advisor to the Marconi Company in addition to holding the position of Professor of Electrical Engineering at University College, London as well as being a Fellow of the Royal Society and past Vice-President of the Institution of Electrical Engineers.[129] Fleming provided a brief testimony suggesting that enforced intercommunication would come at a cost of certain specific features of individual wireless systems. Furthermore Fleming proposed a number of reasons for non-ratification, namely the freedom to use any wavelength; a possibly global monopoly; and the encouragement of technical improvements.

125 *Report from the Select Committee on Radiotelegraphic Convention* (1907), 251.

126 *Report from the Select Committee on Radiotelegraphic Convention* (1907), 254.

127 *Report from the Select Committee on Radiotelegraphic Convention* (1907), 282.

128 *Ibid.*

129 *Report from the Select Committee on Radiotelegraphic Convention* (1907), 298.

On the final day of evidence, Cuthbert Hall was recalled and additionally Charles Bright FRSE was called to give evidence. Charles Bright was a Fellow of the Royal Society of Edinburgh and member of the Institution of Electrical Engineers and Institution of Civil Engineers. Bright was called in relation to his authorship of the standard text on submarine telegraphy and was giving evidence with regard to telecommunications governance. Bright strongly supported international regulations for wireless telegraphy and opposed the Marconi Company monopoly; hence he was in support of ratification.

6.5.4 Conclusions about the 1907 Select Committee

From the private documentation showing how the Interdepartmental Committee was arranged in advance of the Select Committee, it appears that the Post Office, quite possibly representing the interests of the government, was arranging witnesses and their evidence in advance in an endeavour to present a unified, pro-ratification, institutional front. However, this was not entirely successful. The initial draft report prepared by Sir John Dickson-Poynder differed significantly from the published version and initially recommended that the government should sign the Convention but would avail itself of Article 18 and postpone ratification until the next conference then planned for 1911.[130] Discussion continued through the next meeting of the committee on 24 June with assorted amendments agreed, including an important amendment at the end of the discussion where the conclusion was amended by the suggest of Adkins that stated the government should arrange for simultaneous ratification by all countries involved; this being agreed to by all of the committee present.[131] At the final meeting of the committee on 2 July a further but important amendment was made and the amended draft report was put to the committee with the vote passing by a single vote – five ayes (Adkins, Buxton, Holland, Lambert, and Parker) to four noes (Gwynn, Lee, Macpherson, and Sassoon). The Chairman, John Dickson-Poynder, and Enoch Edwards abstained from voting. The narrowness of the vote was a notable contrast to the near-agreement of the British delegation at the conference and the strong anti-Marconi stance of many of the witnesses providing evidence before the Select Committee. However, a quick study of the political allegiances shows that the votes were mostly along political lines. The two abstaining voters, Dickson-Poynder, and Edwards, were both Liberal MPs. Furthermore, the five ayes consisted of four Liberal MPs and one lone Conservative MP, Sir Horatio (Gilbert) Parker.

130 *Report from the Select Committee on Radiotelegraphic Convention* (1907), lii.

131 *Report from the Select Committee on Radiotelegraphic Convention* (1907), lv.

Parker was a strong Imperialist which may have encouraged him to cross party lines and vote in favour of Britain's adherence to the Radiotelegraphic Conventions. The noes featured a mixed bag of political allegiances: John Macpherson, a Labour MP; Stephen Gwynn, an Irish Parliamentary Party MP; and Colonel Arthur Lee, a Conservative MP. Only one Liberal MP, Edward Sassoon, crossed party lines and vote against Britain's adherence to the Radiotelegraphic Conventions. However, Sassoon had been vigorously opposed to British adherence to and ratification of the Radiotelegraphic Conventions from the immediate aftermath of the conference and his reasons for this opposition have been explained earlier in this section.

In the aftermath of the publication of the Report of the Select Committee hearing, an adjournment would take place in the House of Commons with Sir Edward Sassoon leading the charge for non-ratification of the Convention.[132] The Postmaster General was not present for the debate but nonetheless much discussion took place with contributions from both sides of the house. However, when the question was put as to move to adjourn and discuss the Select Committee report prior to ratification, the adjournment was 'negatived' and so the House of Commons followed the advice of the Select Committee and agreed to ratify the Radiotelegraphic Convention.

In summary, the purpose of the Select Committee hearings was to gather evidence from a selection of experts in the field of wireless and to decide how adherence to the Radiotelegraphic Convention might affect Britain's national and public interests with regard to wireless communication. Experts called included a selection of government and military representatives, early wireless pioneers, scientists, and men of commerce. The main body of witnesses consisted of wireless pioneers who were united in their dual purpose utility of this public forum. First, they argued strongly for ratification of the Convention and whole-heartedly supported the notion of enforced intercommunication between different wireless systems. This was the most important and controversial aspect of the convention and one vehemently opposed by Marconi himself and Cuthbert Hall, the Managing Director of the Marconi Company, during their evidence. However, the evidence provided by these two Marconi Company representatives also revealed a degree of tension between the two men.

132 Hansard HC Deb 30 July 1907 vol 179 cc841-847 - ADJOURNMENT (UNDER STANDING ORDER No. (O.) RADIOTELEGRAPHIC CONVENTION).
URL: http://hansard.millbanksystems.com/commons/1907/jul/30/adjournment-under-standing-order-no-o#S4V0179P0_19070730_HOC_371

Marconi's evidence, provided after that of Cuthbert Hall, was a marked contrast to Cuthbert Hall's hostile witness statements which were deeply antagonistic towards certain government departments and state-sponsored institutions. Indeed, at times, Marconi's testimony read like an apology for Cuthbert Hall's earlier evidence. Further to this, Marconi's evidence offered a conciliatory tone and was a clear attempt to placate the Marconi Company's institutional customers and sometime supporters.

Meanwhile evidence provided by early wireless pioneers and institutional representatives also held a secondary purpose – to publicly express the role they and their institutions had in early wireless and to provide evidence of state-sponsored expertise and innovation in wireless communications. The key institutions represented were the Admiralty and the Post Office, whose institutional innovations had been mostly hidden in private reports and secret memoranda. As representatives of their institutions and as individuals they had presented limited details of the practice and outcome of their scientific research in this field before scientific societies such as the British Association for the Advancement of Science, the Royal Institution, the Royal Society, the Institution of Electrical Engineers, and others. However, the 1907 Select Committee was the first time they were able to move beyond scientific research and articulate their roles and agency in the embryonic history of wireless communications. Their evidence moved beyond mere technical and scientific advances to a more detailed précis of their development of institutional wireless policy that embraced early demands for wireless systems, wireless legislation and regulations, along with technical innovations.

6.6 The Marconi Company and the Aftermath of the Select Committee Hearings

After significant debate in the House of Commons – both before and after the Select Committee hearings and the subsequent publication of their report – along with a marginal passing vote by the Select Committee themselves, the government voted to ratify the Radiotelegraphic Convention and hence bind Britain to international wireless regulations which included enforced intercommunication between different wireless systems. The Marconi Company opposed enforced intercommunication as it went against their monopolistic goals and alleged concerns about patent infringement. These politically charged events brought the government institutions involved – the Post Office and the Admiralty – and indeed governmental policy on wireless itself into conflict with the policies of the Marconi Company.

The approval by the Select Committee of the Conventions of the 1906 International Radiotelegraph Conference by a margin of one vote was 'a considerable setback' for the Marconi Company, particularly in relation to maritime communications.[133] As mentioned above, the vote in favour of British adherence to the Radiotelegraphic Convention was narrowly passed despite the almost overwhelmingly anti-Marconi rhetoric employed during the Select Committee hearings. The committee members had voted almost entirely along political lines with Conservatives mostly opposing adherence to the Conventions and the Liberals being mostly in favour. It is uncertain whether Cuthbert Hall's behind the scenes manipulations had any effect. But Cuthbert Hall's public-facing testimony did have at least one effect, upon the working relationship between Marconi and Cuthbert Hall. The distinct divergence between Cuthbert Hall's passionate and at times antagonistic evidence before the Select Committee and Marconi's more conciliatory response led to increased tension between the two men. The division of responsibilities within the company with Cuthbert Hall responsible for the administrative, publicity, and financial aspects of the company and Marconi responsible for technical developments and obtaining more sales made the allocation of blame and failure relatively straightforward. By February 1908, Cuthbert Hall's position at the company was no longer tenable and Marconi himself wrote a letter to the Chairman of the Board, Colonel Sir Charles Euan Smith, requesting that Cuthbert Hall resign.[134] In the letter, Marconi held Cuthbert Hall singularly responsible for the failure of the Marconi Company's strategy at the 1906 International Radiotelegraph Conference and the subsequent 1907 Select Committee hearings; the subsequent unpopularity after the 1906 conference of the Marconi Company with various governments; the inefficiency of the company's technical operations; and the company's dire financial situation with very few new contracts being signed.[135] In a slight contradiction to this, Baker 1970 claimed that 'differences of opinion over the attitude to be taken over patent infringements had been one of the causes contributing to Cuthbert Hall's resignation in 1908'.[136] On 2 March 1908, Cuthbert Hall relinquished his position at the Marconi Company and retired from the Board; in return for present and future earnings lost,

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133 Baker (1970), 125.

134 Marconi Collection MS. Marconi 177 Correspondence concerning Hall's employment with and resignation from the company, 1906-8 – Letter from Guglielmo Marconi to Colonel Sir Charles Euan Smith, Chairman of the Marconi Company, dated 12th February 1908.

135 Some of this material is based on private electronic correspondence with Graeme Gooday on 28 March 2010. Copy of correspondence available from author.

136 Baker (1970), 130.

Cuthbert Hall was offered 10,000 fully paid-up shares in the Company then valued at £1 a share totalling £10,000.[137] For a short period of time, Marconi himself would act as Managing Director of the Company until a replacement, Godfrey C. Isaacs, was found in January 1910.

The one-sided correspondence held in the Marconi Collection archives with only Cuthbert Hall's letters surviving means finding solid evidence for or against Marconi's accusations is unlikely. With only Cuthbert Hall's correspondence surviving, it was easy to make him the villain of the piece and to absolve Marconi of any blame and this was the approach taken by the Marconi Company and subsequent pro-Marconi histories.[138] However, the sheer volume of correspondence from Cuthbert Hall to Marconi alone means it is hard to support Marconi's claims that being away from London working on the transatlantic service for the two-year period prior to Cuthbert Hall's resignation had kept him ignorant of Cuthbert Hall's decisions. While responsibility for the failed strategy at the 1906 Conference and subsequent Select Committee hearings can be mostly laid at the feet of Cuthbert Hall, there is insufficient evidence to place all blame with the former Managing Director. In his personnel file from the Marconi Company, Cuthbert Hall was described as being responsible for the 'fighting attitude which has been almost constantly persisted in by the Companies and has so alienated the British Government in particular and other Governments in general.... It is undoubtedly the Companies [sic] defiant tactics which impel governments to adopt an attitude that particularly impairs our financial credit and hampers our financial operations.'[139] This description would form a distinct contrast to a more public report of Cuthbert Hall made at the company's AGM but three years earlier in April 1904. At that public meeting, Cuthbert Hall's unique role in negotiating contracts with the Admiralty and the Post Office had been acknowledged and he was credited with a significant role in the success of the Marconi Company. Back then Cuthbert Hall had been celebrated as having 'an intimate knowledge … of the whole working' of the company, a man with ' a devotion to the interests of the company … [who spared] no time or trouble in the prosecution of this object ...'[140]

However, these public celebrations of Cuthbert Hall by the Marconi Company were not to last and accusations made by Marconi are further supported by much of the surviving

137 "Marconi's Wireless Telegraph Co. (Ltd.)." *The Electrician* 61 (1908): 70-72.

138 Baker (1970) and Jacot de Boinod and Collier (1935).

139 Marconi Collection MS. Marconi 177 Correspondence concerning Hall's employment with and resignation from the company, 1906-8 – File HIS .121 H

140 "Marconi's Wireless Telegraph Company, Limited." *The Economist*, no. 3162 (1904): 581.

documentation, in particular correspondence between Colonel Sir Charles Euan Smith and Cuthbert Hall in the aftermath of Cuthbert Hall's offer of resignation from the company Board in April 1908.[141] In this correspondence Cuthbert Hall threatened to attend the Board meeting on 23 April and '[attack] the Board, principally as regards their change of policy in endeavouring to arrive at a basis for loyal cooperation with His Majesties' Government.'[142] No record survives of whether Cuthbert Hall attended the meeting and realised his threats but he continued to cause trouble for the Marconi Company and in July 1909 he began a case against the Marconi Company.[143] In *Cuthbert Hall v. Marconi's Wireless Telegraph Co. (Ltd.)*, Cuthbert Hall sought £2583. 6s. 8d. damages for alleged breach of contract in relation to the allocation of his shares at the end of his contract in April 1908; the case was dismissed. The new co-Managing Director, Godfrey Isaacs, was appointed jointly into the role with Marconi but became sole Managing Director of the Company in August of the same year and began a more aggressive defence of the Marconi Company patents.

Nonetheless with the resignation of Cuthbert Hall and the eventual hiring of Godfrey Isaacs, the Marconi Company began a new, more conciliatory era of relations with the British government and indeed governments in general. Utilising non-intercommunication and exclusive contracts to enforce their patent rights led to justifiable claims of monopolistic behaviour leading to potentially antagonistic relationships with governments, foreign and domestic. The Final Protocol of the 1906 International Radiotelegraph Conference in combination with the outcome of the 1907 Select Committee hearings marked this strategy as a failure. Instead the company had a change in management and henceforth made a change in policy. At the end of the first decade of the twentieth century they began to sue other companies for patent infringement thereby shifting the arena of conflict from government policy and international governance to the commercial sphere and the law courts. Now the Marconi Company was forced to align their interests with those of their governmental customers rather than attempt to do the reverse, and so a period of bridge-building was to begin and a closer relationship with the British government and her departments. This relationship was sometimes too close as the “Marconi Scandal” in 1911 and 1912 showed. With the relationship between the government and the Marconi Company clarified, the Post

141 Marconi Collection MS. Marconi 177 – Letters from Cuthbert Hall to Sir Charles Euan Smith, dated 10 April 1908; letter from Sir Charles Euan Smith to Babington Smith dated 13 April 1908.

142 Marconi Collection MS. Marconi 177 – Letter from Sir Charles Euan Smith to Babington Smith, dated 13 April 1908.

143 "Cuthbert Hall v. Marconi's Wireless Telegraph Co. (Ltd.)" *The Electrician* 63 (1909): 599.

Office signed a fourteen-year contract with the Marconi Company in September 1909.[144] A few months later in December of the same year, the Post Office signed a further, related contract with Lloyd's insurance company in order to purchase their wireless telegraphy stations; in doing so, the Post Office cemented its domestic wireless monopoly.

6.7 Conclusion

After significant debate in the House of Commons – both before and after the Select Committee hearings and the subsequent publication of their report – along with a marginal passing vote by the Select Committee themselves, the government voted to ratify the Radiotelegraphic Convention and hence bind Britain to international wireless regulations which included enforced intercommunication between different wireless systems. These dramatic and deeply politically charged hearings mark a beginning and an ending and indeed bring this thesis full circle. They marked the first time that members of the Admiralty and Post Office were able to publicly and collectively articulate their contribution to the development of wireless communications, individually and institutionally. Their evidence presented an institutionally focused narrative of early wireless communications stretching from the work of the Post Office in the early 1880s to their present day. It is an analysis of this narrative which informs the arguments presented here. These events also mark the end of the formative period of wireless communications. Recognition of the importance of wireless communications would be achieved through the introduction of international wireless rules and regulations through the effective ratification of the Radiotelegraphic Convention on 1 July 1908.

The aftermath of the conference, particularly in Britain, marked a turning point in the marketplace for wireless communications with an open albeit narrowly won acknowledgement of the power held by the government and her departments. When the British government disagreed with the Marconi Company, it was the latter which was forced to change. Moreover, evidence provided by representatives of the Admiralty and the Marconi Company gave notice of wider changes, in particular the termination of the informal alliance between the Marconi Company and the Admiralty. The two parties no longer shared an interest in arguing against enforced intercommunication with the Admiralty accepting intercommunication on principle

144 IET UK0108 SC MSS 143/01/02 – Copy of an Agreement between the Postmaster General and the Marconi Wireless Telegraph Company, issued 2 December 1909.

with exceptions provided for military wireless stations. The loss of the support of the Marconi's Company earliest and most prominent customer was a tough blow for the Marconi Company and led to wider changes within the company. One further aspect of this change was a change of management with the ejection of Cuthbert Hall as Managing Director and the temporary instatement of Marconi in this key role until a suitable replacement could be found. When Godfrey Isaacs began as Managing Director of the Marconi Company in February 1910 it was with a new agenda and one which fitted in with the plans of the government, the Admiralty, and the Post Office. The concerns of the Post Office had been met with the introduction of the 1904 Wireless Telegraphy Act and furthermore with the outcome of the 1906 International Radiotelegraph Conference. One of the main outcomes of the Convention, government licensing being required to establish and operate ship stations, satisfied the demand for the novel 1904 Wireless Telegraphy Act. From the point of view of the Admiralty, their interests and concerns were met through technological change rather than non-intercommunication and a *de facto* domestic monopoly.

Within the pages of this chapter, I give a voice to other characters, institutions, and concerns and not just Marconi and his wireless company. This rich and mostly ignored material and related analysis can be utilised to demonstrate that, although the Marconi Company and other commercial wireless endeavours were active, there were not in charge and it was institutions within the government especially the Post Office and Admiralty that were setting the agenda. This chapter challenges the hubris of the Marconi Company – both contemporaneously and in later wireless historiography – and ably demonstrates how the company was outmanoeuvred by the institutions of the British government and indeed the government itself.

Chapter 7: Conclusion

This thesis is motivated by an absence of research into institutional invention and innovation in early wireless communications. [1] In contrast to the huge amount of Marconi-centred research, I offer a detailed consideration of the roles of state and technical institutions in the early history of British wireless communications using the original concept of "institutional innovation". I use this concept to explain and interpret the engagement of three institutions – the Admiralty, the Post Office, and the Institution of Electrical Engineers (IEE) – with the formation of wireless communications. Moreover, I have examined the external influence of these institutional innovations upon the development of embryonic wireless technologies and upon the actions of the Marconi Company. My research question was divided into three interconnected questions, as outlined in the introductory chapter. Which British state and technical institutions were influential in wireless innovation and why? My thesis explains and interprets the engagement of three particular institutions – the Admiralty, the Post Office, and the Institution of Electrical Engineers (IEE) – with formative wireless communications. What was the role of those institutions in the early history of British wireless? And finally, how did these institutions influence wireless technology so as to constrain the activities of the Marconi Company? It became clear upon examination of these questions that it was necessary to also consider the nature of British state and technical institutions in order to understand their response to and engagement with innovation. In order to address these considerations I put forward the original concept, "institutional innovation", to show how key developments in early wireless communications were enabled and supported through "institutional innovations". In addition to this, I consider the constraining influence of the three institutions upon wireless technologies and, in particular, the activities of the Marconi Company. I show that institutions are capable of both supporting and constraining innovation and invention and, more importantly, institutions can be sources of innovation and innovations themselves.

Through this thesis, I have made three significant contributions to the historiography of wireless communications and more generally to the history of technology. Firstly and most importantly, I have laid essential groundwork for a broadening of the history of wireless in order to recognise the contributions made by institutions and institutional innovation to the early history of wireless communications. For too long this field of study has been dominated

1 See **Section 1.2 – Heroes, Hagiography, and Historiography** for a more detailed discussion of historiography on wireless communications.

by writings that focus unduly on the commercial development and, to a lesser degree, the scientific research into wireless communications.[2] As a result less accessible locations for invention and innovation such as laboratories, government departments, scientific institutions, and the military have been marginalised and unexamined. This thesis takes an important step in rectifying these omissions. Secondly, this thesis offers the first acknowledgement and recognition of the far-reaching and decades-long contribution of the Admiralty and the Post Office to the field of wireless communications. In the case of the Post Office, institutional demands were centred upon the state-controlled domestic telecommunications monopoly they were allocated, beginning with the 1868 and 1869 Telegraphy Acts and later extended to telephony by the judgement of *Attorney General v Edison Telephone Company of London Ltd* in 1880.[3] The outcome was a fifteen-year period of experimental practice and trials with a pre-Hertzian wave wireless system conducted by the Post Office Engineering Department between 1884 and 1899. Beyond the development of a pre-Hertzian wireless system, the Post Office played an active role in internal government discussions and national regulations. In contrast, the Admiralty had a more practical demand – for a system of long-distance and mobile signalling suitable for maritime usage. Hence their initial engagement with wireless communications was a purely technical one and resulted in an internally developed Hertzian wave wireless system designed specifically for naval signalling. In the early twentieth century the Admiralty set a different agenda as a wireless consumer and extended its role to incorporate government strategy on wireless. This was a role they shared, sometimes uncomfortably, with the Post Office. Although the two government departments possessed different needs and made differing demands, both asserted strong roles in the creation of government policy and international regulations on wireless communications resulting in tensions between these two powerful state-controlled institutions.

Finally, my third contribution is a consideration of institutional influence upon the activities of the Marconi Company. I have argued that institutional activities enabled and constrained the activities of the Marconi Company in equal measure, in both cases in order to meet the demands of the state. Without these institutional needs and the related expectations and demands established for wireless communications, the development of the Marconi Company and their wireless system could have been very different indeed. I have argued that by taking into account the enabling and constraining effects of these institutions

2 Examples include Aitken (1976), Appleyard (1930), Coe (1943), Garratt (1994), Geddes (1974), Jacot de Boinod and Collier (1935), Jolly (1974), Rowlands (1994), and Weightman (2004).

3 See **Section 2.2 – The Post Office and Telecommunications Legislation** for further details.

we can form a better understanding of the activities and operation of the Marconi Company. Further, institutional innovations, especially the contributions of the Post Office and the Admiralty, in the field of wireless communications can be considered a pre-condition of later wireless systems and successes, such as those of Marconi and his eponymous company. This is a powerful explanatory analysis and one which forms a missing part of existing company histories. The concept of institutional innovation was also profitably employed in an earlier chapter in which I established the more subtle role of the Institution of Electrical Engineers in early wireless developments. The IEE provided support for a community of wireless pioneers and offered a neutral, more gentlemanly space for debates and discussion about wireless, a space somewhat insulated from the "rough and tumble" of the commercial world.[4] Throughout the chapters of this thesis, I have argued that the different characteristics of these institutions help to explain their differing roles in and responses to wireless communications. Through these three significant and original contributions to wireless historiography, I show how far the agendas and strategies of early historical development of wireless communications lay in the hands of these powerful institutions and was, quite literally, beyond Marconi.

In the next section I provide a brief summary of my thesis and offer some remarks on the concept of "institutional innovation" and, further to this, institutional restraint upon the Marconi Company. Following this I synthesise the main findings of my thesis and draw out various thematic elements found throughout the preceding chapters. I then offer some comments on the influence of institutional innovation upon the Marconi Company. I conclude this discussion with some remarks on the historiographical implications arising from this thesis. In doing so, I resolve questions first articulated in the introduction and move on to consider future areas for research. Finally, I reflect on my potential contribution to my field of study and the application of the themes within this thesis to a broader history of science, technology, and wireless.

7.1 The role of institutional innovation in early wireless

This thesis begins chronologically with the early investigations and experiments conducted by the Post Office, its Engineering Department, and William Preece in the early 1880s. These initial investigations were a response to the limitations of existing modes of

4 See **Chapter 3 – Electrical Potential: Wireless and the Institution of Electrical Engineers, 1898-1908** for further details.

telecommunications with one of these systems (telephony) being a mere five years in use. The wireless systems that emerged were directly linked, literally and figuratively, to the electrical telegraph network that was being developed domestically and internationally. At this time, the Post Office was the sole institution experimenting with systems of telegraphy without wires and the underlying scientific theories were as yet unexplained. Hertzian waves were not discovered and published upon until six years later and notions of a wireless system capable of communicating over distances further than five miles was but a dream.

Just over twenty-five years later, in the years marking the chronological end of my thesis, things had significantly changed, mostly due to the institutional innovations and activities outlined in my research. By the first decade of the twentieth century, the Post Office was one government department amongst many – the War Office, the Admiralty, and the Board of Trade – with a broad interest and involvement in wireless. The Admiralty and Royal Navy were actively invested in wireless communications. A significant amount of the navy and the merchant navy vessels were equipped with wireless sets and these were setting the agenda for the maritime world. Naval officers were being trained at HMS Defiance, the navy's torpedo school, in wireless signalling. Additionally, the navy was perhaps the most technically advanced in wireless with a significant amount of innovation coming from within the institution itself. Meanwhile the Post Office now managed a licensing scheme for wireless transmitters and receivers, an outcome of the 1904 Wireless Telegraphy Act. Along with the Admiralty, it shared a prominent role in international regulations in the form of the 1906 International Radiotelegraph Convention. The Institution of Electrical Engineers had a less prominent role but had established the Institution as a nucleus for a community of early wireless pioneers. Further to this, the institution provided a forum for a number of early and innovative wireless papers presented in the late nineteenth century and early twentieth century. Dramatic change had taken place in the wireless world and many of these were due to these institutions and their innovative roles in wireless communications.

These wide-ranging examples of “institutional innovation” in the field of wireless communications between 1882 and 1908 form the core of this thesis and offer an opportunity to widen the scope of wireless history beyond its traditional focus on commercial development and, to a lesser degree, scientific research. In the introduction to this thesis I defined the different elements that form “institutional innovation”: research, expertise, agendas, resources, publicity, and need and demand. To these elements I shall now return to compare and contrast the changing role of the different institutions studied within this thesis. The Post

Office, the Admiralty, and the Institution of Electrical Engineers shared a number of these elements and yet each institution had a different role in and response to wireless communications. These differing roles and responses were shaped by their assorted institutional properties and their diverse needs for and demands upon these innovative technologies.

Overall the Post Office provided institutional support, technical expertise, access to resources, and publicity, both internally and externally. That its institutional support was available both internally and externally is evidenced by contemporaneous memoranda and correspondence and followed from their wider agenda as a state-controlled and state-mandated institution. The Post Office was home to expertise and practice in the field of telecommunications, especially telegraphy. These skills were brought to bear in early forms of electrical wireless communications that had their origins in 'crosstalk' (interference between telegraph cables and telephone wires). This inheritance from existing modes of telecommunications was radically transformed into new and innovative forms of telecommunications. Thus these novel modes of wireless communication – inductive and conductive telegraphy – straddled the new and the old. They were integrated into existing systems of telecommunications, such as telegraphy, while also meeting the demand for a new, wireless mode of communication that could go beyond the traditional spaces of telegraphy and telephony. These two wireless systems laid the foundation for the publication of the discovery of Hertzian waves at the end of the 1880s and Marconi's wireless experiments and systems in the mid-1890s.

Spanning the river Severn in the late 1890s – consequently creating the world's first practical wireless system – the Post Office’s wireless systems established a demand for wireless communications as well as establish the potential for such modes of communication. In doing so, they laid the foundation for the later successes of wireless communications. In interrogating the early work of the Post Office I have established a pre-existing community of wireless practitioners and experimenters whose work took place within the practical demands of a state-run institution rather than within the commercial concerns of a private company. These early forms of wireless telegraphy were not merely responding to the changing world and its changing technological demands but were shaping them. For they created a demand in the process of satisfying a perceived need, a demand which was later so cleverly appropriated and exploited by Marconi upon his arrival in Britain in 1896. In this regard, the Post Office can be seen to have supported the commercial development of the Marconi Company, an agenda which the 1904 Wireless Telegraphy Act further perpetuated.[5]

In contrast to the Post Office, its fellow state-sponsored government department, the Admiralty, had a different institutional agenda and hence a different demand for wireless communications. These differences led to tensions between the two government departments, centred on their roles in wireless in the early twentieth century and their strategies for its future development. The demands of the Admiralty and the Royal Navy were shaped by their need for an effective means of signalling beyond the range of traditional visual and audio methods. The Admiralty had pre-existing technical and signalling expertise located in HMS Vernon, their centre for torpedoes and other forms of electrical engineering. Established in 1876, HMS Vernon was originally intended for the development of torpedoes and mining but soon moved beyond this remit to the wider field of electrical engineering. As a result by the mid-1890s, HMS Vernon had become a centre for the internal development of a wireless system suitable for maritime signalling. The development of this novel wireless system continued into the twentieth century and ran parallel to early tests with Marconi wireless apparatus. My portrayal of the Admiralty and the Royal Navy as active innovators rather than passive consumers, particularly during this formative period in wireless history, is in marked contrast to earlier narratives of wireless development. Standard narratives of wireless have traditionally emphasised the power and control of wireless companies, particularly the Marconi Company, over their institutional customers.[6] Moreover this active role continued even as the Admiralty entered into contracts with the Marconi Company, including the 1901 Deed of Agreement and the 1903 Admiralty-Marconi contract. On the surface, these legal agreements gave a solid foundation and air of respectability to the Marconi Company and to other commercial wireless companies. However issues regarding patents and wireless regulations remained unresolved and caused continued tension between the Admiralty and commercial wireless companies. Similarly, as an early customer of the fledgling wireless company, the Admiralty took the upper hand in negotiations and managed to maintain this throughout their involvement in the early International Radiotelegraph Conferences. In particular, the Admiralty's concerns about the security and privacy of military telecommunications created technical and systematic demands that shaped the commercial

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5 See **Chapter 5 – "If the Government did take over wireless it meant that they would take over us": simmering tensions between commercial and state interests, 1903-1905** for further discussion of the details and significance of the 1904 Wireless Telegraphy Act.

6 See **footnote number 2**.

development of wireless in Britain during this formative period in wireless history. In contrast to the Post Office's interactions with the Marconi Company, the Admiralty used its agency to outmanoeuvre the wireless company and constrain it to meet the needs and demands of this powerful government department.

The more subdued role of the IEE in wireless communications offers a distinct contrast to the dramatic and sometimes polarised responses of the Admiralty and the Post Office. This institution lacked a need, demand, and place for wireless communications and until the commercial application of wireless became apparent in the late 1890s, experiments and trials of electromagnetism took place in the physics laboratory rather than the electrical engineering workshop. As I have already noted, it may be for these perfectly understandable reasons that the role of the IEE in early wireless communications has not previously been considered, either in wireless historiography or in institutional histories.[7] Yet it has been shown in this thesis that while the IEE had a more neutral response to the arrival of wireless communications, it nevertheless offered a home for a community of early British wireless pioneers, especially those working outside the commercial development established by Marconi. Here these pioneers could present their work before an audience of their peers, with public presentation of ideas and technologies being an important aspect of invention and innovation.

Although the IEE provided a platform for the promotion of invention and innovation, I have also considered whether the IEE was an obvious place for wireless. Wireless communications did not readily fit into electrical engineering practice until the late 1890s. Moreover wireless was considered by some engineers to be a toy or experiment, unfavourably compared with the massive scale and commercial development of telegraphy, electrical lighting, and other forms of electrical engineering supported and pursued by the IEE at this time As wireless made its difficult transition from physics to electrical engineering it did manage to knit together diverse fields within the IEE – distinct strands of electricity supply, telegraphy engineering, and the academic world. This multi-faceted and inter-disciplinary nature may have also contributed however to the dual challenges facing the organisation, of finding a place for wireless and its practitioners internally within the IEE while the institution simultaneously attempted to situate itself externally in the wider world of wireless.

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7 See **Chapter 3: Electrical Potential: Wireless and the Institution of Electrical Engineers, 1898-1908** for further details.

In conclusion, I offer for consideration the argument that it was these characteristic institutional differences which meant that wireless communication was a better fit within the structure of a government department, such as the Admiralty and Post Office, rather than within a member-led techno-scientific institution, such as the IEE. Furthermore, these institutional histories and analyses provide a missing component in our understanding of the development and activities of the Marconi Company. These alternative wireless histories show that Marconi's early commercial successes were achieved with the assistance and support of these institutions and was facilitated by Marconi's distinctive access to key aspects of these institutions including organisational expertise, technical resources, and administrative structures.

7.2 Institutional Influence on the Marconi Company

“Institutional innovation” is but one side of the coin in terms institutional influence and, in this section, I will consider the constraining influence of the three institutions upon wireless technologies and, in particular, the activities of the Marconi Company, the foremost wireless company during this early history. External influences are an important indicator and so I have considered the influence of the Admiralty, the Post Office, and the IEE upon the activities and strategies of the Marconi Company. This aspect has been hitherto absent from wireless histories and in particular the histories of the Marconi Company. The fraught and consistently complex relationships between the company and the Post Office and the Admiralty, the two governmental case studies of this thesis provide the principal examples of institutional influence and constraint upon the activities of the fledgling company. The Institution of Electrical Engineers (IEE) however also provides an interesting albeit secondary example. The IEE offered a lukewarm welcome to Marconi and his wireless system. While Marconi presented a well-attended paper before the Institution in March 1899, this was preceded by wireless papers delivered by more established members of the institution. Moreover these papers contradicted both the narrative of wireless history Marconi was attempting to establish and his role therein.

In previous chapters, I established that Marconi's earliest activities upon arriving in Britain involved neither patenting nor steps towards the establishment of a company.[8] Instead

8 See **Chapter 2 - “Something in the Air”: The Post Office and early wireless experiments, 1882-1899**.

Marconi used family connections to obtain letters of introduction to key figures in the War Office, the Admiralty, the Post Office, and other government departments.[9] It is open to debate whether Marconi was seeking institutional support, access to expertise, potential customers, or some combination of all three. Prior to meeting with his institutional contacts and demonstrating his wireless system, Marconi had made a provisional but ultimately unsuccessful patent application, British Patent 5028/1896, initially filed in early March 1896.[10] Marconi's earliest contact was with the War Office, specifically the Royal Engineers and the Royal Navy, but it was his connections with the Post Office that provided a wider platform for both Marconi and his wireless system. In particular, William Preece (then Engineer-in-Chief and Electrician of the Post Office) provides support for Marconi's wireless experiments and demonstrations. Preece also used the authority and reputation of the Post Office to publicly promote Marconi's systems. Although Marconi later disputed the contribution of these institutions, the evidence I have provided in this thesis suggests that he saw access to these powerful institutions as an important first step in the establishment and development of his wireless system.[11]

Between mid-1896 and mid-1897 Preece introduced Marconi to the British scientific establishment and provided a platform from which to promote Marconi's wireless systems. In September 1896 the Post Office arranged a demonstration of Marconi's wireless system on Salisbury Plain before an audience of representatives from the War Office, the Admiralty, and the Board of Trade. However, this was not just as simple as providing a platform for Marconi and his wireless system. Instead these demonstrations and further technical developments of Marconi's wireless systems were integrated into existing telecommunications systems being developed by the Post Office. The Post Office believed that it was the only organisation in Britain with the resources required to successfully develop a system of wireless telegraphy. The Post Office and in particular Preece supported Marconi's early work in order to continue

9 A copy of the letter of introduction from A.A. Campbell-Swinton, written on behalf of Marconi, to William Preece dated 30 March 1896 can be found in Marconi Collection MS. Marconi 1774 - HIS 62: Early demonstrations and tests – Marconi and Preece, 1951-89. A letter to the Secretary of State for War Affairs at the War Office from Marconi dated 20 May 1896 can be found in National Archives WO 32/8594 - INVENTIONS AND PATENTS/TELEGRAPHY: Consideration of Marconi systems of transmission of electric signals without wires. Possible military uses (1896).

10 See Marconi Collection MS. Marconi 416 – Papers relating to early patents, 1896-1907. See **Section 2.5 1896 and all that: Marconi's arrival in Britain** for further details.

11 See **Chapter 1 – Introduction** and **Chapter 2 - "Something in the Air": The Post Office and early wireless experiments, 1882-1899**.

their innovative role in wireless communications and potentially to extend their telecommunications monopoly to the sphere of wireless telegraphy. As a result, the Post Office supported early demonstrations by Marconi and provided technical expertise and practical experienced gained through their early wireless systems and experiments. It also created an expectation and demand for a form of electrical wireless communications, one which was keenly utilised by Marconi during his early years in Britain.

When Marconi established the Wireless Telegraph and Signal Company in July 1897 in order to exploit his patents, the close relationship that formerly existed between Marconi and the Post Office and in particular the relationship between Preece and Marconi ended. No longer would the Post Office provide support for the man, the company, or the wireless system. Instead its activities sought to constrain and curtail the activities of the Marconi Company. This approach came to the fore in Britain's 1904 Wireless Telegraphy Act, the first enacted wireless legislation. This institutionally shaped legislation provided a template for wireless telegraphy legislation and demonstrated how institutional activities could curtail the monopolistic aims of the Marconi Company. This legislation, whose impact continues to this day, also offers insights into the impact of the innovations of the Admiralty upon the Marconi Company.[12]

As an early customer of the fledgling wireless company, the Admiralty provided an air of respectability and stability to the company's reputation. As I have discussed previously, negotiations between the two were fraught with the Admiralty offering only a temporary alliance with the company when their needs were aligned. At the turn of the century, the maritime capability of Marconi's wireless system had been established and the Admiralty began an active programme of evaluation and adaptation. The Admiralty had a very specific set of technical demands for a system of wireless communications suitable for the vast and disparate navy and merchant fleet that existed at the end of the Victorian era. These needs required a significant change to the Marconi wireless system, one which the Admiralty forthrightly demanded whilst at the same time retaining the technical ability to adapt wireless sets themselves. Even as wireless consumers, the Navy continued to innovate technically. As both a consumer and user of wireless, the Admiralty questioned certain aspects of the fledgling Marconi Company's practices and, with the support of other government institutions, began a

12 The 1904 Wireless Telegraphy Act was considered as a basis for the regulation of digital communications – wireless technologies, digital radio, and mobile communications – at the beginning of the twenty-first century.

thorough investigation into the strength and validity of the patents held by the company. Although the Admiralty and the Navy did not support the patenting of their own wireless system, they were aware of the potential pitfalls associated with this aspect of legal and commercial practices. This led to an Interdepartmental Conference being held between 1900 and 1901. This also resulted in the origins of an informal government policy on wireless and one that, in combination with international demands, led to the world's first wireless legislation, the 1904 Wireless Telegraphy Act. While the complex relationship between the Admiralty and the Marconi Company was maintained, it continued to be shaped by the needs and demands of the government department rather than the commercial activities of the Marconi Company. In the aftermath of the 1906 International Radiotelegraph Conference and subsequent Select Committee hearings, the Admiralty continued to use Marconi apparatus but discontinued its public support for the company.

Without “institutional innovations” and the initial institutional support and access provided by both the Post Office and the Admiralty, the early development of wireless communications – and those companies who supported it, particularly the Marconi Company – could have been very different. These events thereby offer a chance to consider history counterfactually, that is to reflect on historical events that might have been in order to better understand what is, or to ask how historical events might it could have been different.[13] How might wireless have been different without the proto-wireless systems and related expectations developed by the Post Office? How would this have impacted upon the later successes of wireless technology and indeed the work of Marconi? The counterfactual history of early wireless communications offers the chance to explore an alternative history and see how wireless technology and indeed the Marconi Company might have developed without institutional innovation.[14] However counterfactualism is not the only potential application of

13 Counterfactualist considerations have been inspired by the work of Graeme Gooday and Greg Radick, both at the Centre for the History and Philosophy of Science, University of Leeds. My thoughts on this subject have been directly influenced by the work of a fellow PhD student, Michael Kay, in particular a paper he delivered on 16 October 2012 entitled “Could vs. should: the dark side of counterfactual history.” This paper discussed the counterfactual history of early telephony in Britain and I much indebted to Michael to his work on the subject of telecommunications and counterfactualism.

14 I am not the first to consider a counterfactual history of wireless communications. To this honour goes Fraction and Sanders (2006), a steampunk graphic novel about Nikola Tesla, Mark Twain and Bertha von Suttner combining forces to bring about world peace and standing against dark forces led by Thomas Edison, John Pierpont Morgan, Andrew Carnegie, and Marconi. Since this is not

the conclusions reached within this thesis. In the next section, I will explore this thesis's contributions to the wider field of study and its historiographical implications.

7.3 Beyond Marconi: Historiographical Implications

There are historiographical implications arising from the central themes and conclusions of this thesis that suggest areas for further research and that contribute to the wider field of study. The thesis conclusions open up certain events in the standard historical narrative of wireless to re-examination and offer up a revised interpretation of these events. In particular, the account of "institutional innovation" within the pages of this thesis could be extended thematically or chronologically. The conclusions regarding the nature and outcomes of institutional innovation argue for an alternative, more inclusive and more accessible narrative beyond the traditional focus on commercial development and scientific research. This parallel narrative of wireless complements existing scholarship and historiography while offering a broader history populated with government departments, military forces, scientific institutions, and electrical engineering communities. This historical narrative also moves beyond artefacts to consider the wider technological system examining elements from economics, politics, military history, and institutional studies. This broadening of the field of study of wireless communications also offers the chance to reconsider later events in light of the conclusions reached herein. In particular, the concept of "institutional innovation" invites a reconsideration of the events between the Select Committee hearings in 1908 and the beginning of World War One, and beyond. Here I will provide a single example from this period where the conclusions reached within this thesis might be extended, offering a template for further research and application.

In the standard accepted narrative of wireless history, particularly the history of the Marconi Company, the "Marconi Scandal" arises as a completely unexpected problem.[15] The

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concerned with historical accuracy and features giant robots, I do not consider it an academic study of any scholarly merit

15 For contemporaneous views of the "Marconi Scandal", see Spicer, Albert. "Special Report from the Select Committee on Marconi's Wireless Telegraph Company, Limited, Agreement." In *House of Commons Papers; Reports of Committees*. London, 1912 and Marconi Collection MS. Marconi 229 - Miscellaneous items relating to the [Marconi Scandal] Enquiry and its aftermath, 1913-23. See also Donaldson (1962). The "Marconi Scandal" was also featured in episode 2x03 of "Downton Abbey", first aired on ITV on 2 October 2011.

"Marconi Scandal" began in 1911, three years beyond the end of this thesis, but continued to impact upon the activities of the Marconi Company until the beginning of World War One. Prior to World War One, the Marconi Company developed a network of wireless stations around the British coastline and collaborated with the Admiralty on land stations as well as providing on-board wireless sets. The Marconi Company had further plans to build a chain of high-powered wireless stations in Britain and encircling the globe. This "Imperial Wireless Scheme" would be under the control of the British government and would provide quick communication throughout the British Empire to civilian, government, and military users. However this plan was thwarted by the "Marconi Scandal" when, in 1911, it was alleged that certain key civil servants and members of the government had been bribed with Marconi shares and cash in return for ensuring that the contract would not be opened to public tender, thereby guaranteeing that the Marconi Company oversight of the scheme. The "Marconi Scandal" ended all hopes of the trans-global wireless network during this period although the idea was revived in the post-war period and was built in a different form by the Marconi Company in the 1920s.

The first question these events raise relates to the stability and success of the Marconi Company during this formative period in wireless history. If the company was as successful, both financially and technologically, as it is often presented, then why would the company need to bribe government officials in order to be granted the contract?[16] Secondly, in the standard narrative of the early success of the Marconi Company, these events come completely out of the blue, with government support for the company being suddenly and somewhat inexplicably withdrawn. But when reconsidered in the light of the events and activities within this thesis, the events of the "Marconi Scandal" can be better understood as a continuation of the complex relationship between government departments such as the Admiralty and the Post Office and the Marconi Company.

To conclude, the primary focus of this thesis is an examination of institutional innovation and the impact of such institutional activities on the early history of wireless between 1882 and 1908. These innovations were not merely technological but also regulatory, legislative and consumer-driven. Secondly I examined the effect of these institutions on the commercial endeavours of the Marconi Company and the constraints these placed on the monopolistic goals of the company. More generally, I have demonstrated that early modes of wireless

16 Examples of pro-Marconi histories include Baker (1970), Donaldson (1962), Jacot de Boinod and Collier (1935), and Weightman (2004).

communications were not solely constrained and controlled by commercial concerns or, to a lesser degree, science. Rather I outlined the vital role of institutions – comprising engineers, innovators, consumers, and regulators – in the early history of wireless communications. Institutions, I argue, that have for too long been omitted or side-lined in the traditional narrative of wireless development. My narrative is not just solely about producers but also users and consumers. I have considered the roles of institutions in shaping the technology, both internally through internally produced apparatus and technological systems and also externally, incorporating their institutional expert knowledge into valuable and practical adaptations to externally produced technologies. In addition, the roles of these institutions moved beyond the physical hardware and artefacts to influencing and directing wider changes in technological systems. These changes created the demand for these technologies, shaping domestic and international legislation and regulations, establishing the work of wireless pioneers, and educating the electrical engineering community along with the wider population about wireless technologies.

My thesis has contributed to a broader understanding of the formative history of wireless communications through an original examination of the impact of institutional innovations upon the early development of wireless communications and related commercial developments. My research has wider implications, however, and indeed can be utilised to offer a better understanding of contemporary events. At the beginning of the twenty-first century there are many conversations and concerns about the future development of wireless communications – their potential form and utility, their wider impact on telecommunications, along with side issues relating to their commercialisation and regulation. Yet none of these discussions are novel and, in fact, echo earlier discussions and events surrounding wireless telegraphy over a century earlier at the turn of the twentieth century.

This thesis utilised a vast and rich resource of primary source material from multiple archives in order to establish the key role played by institutions in the control, shaping, and governance of wireless telegraphy, domestically and internationally, during this formative period in wireless history. As befits a thesis entitled "Beyond Marconi", I have taken a step back from the traditional, commercially focused narrative of wireless and instead considered a richer, parallel narrative of wireless history, one with an institutional focus. The standard and traditional wireless historiography presents these institutions as passive and unquestioning consumers, literally and figuratively, of wireless technologies. Within these pages, I have boldly challenged this argument. Instead I have argued that it was the governance and innovation practised within these institutions which exerted significant influence over wireless communications in its formative years and, in turn, led to the later successes of broadcast radio. In this thesis, I have given a voice to other characters, institutions, and concerns beyond the scope of Marconi and his wireless company. This rich and mostly ignored material and related analysis demonstrates that, although the Marconi Company and other commercial wireless endeavours were active, there were not in charge and it was institutions such as the Admiralty, the Post Office, and the Institution of Electrical Engineers that were setting the agenda. This thesis challenges the hubris of the Marconi Company – both contemporaneously and in later wireless historiography – and ably demonstrates how the company was outmanoeuvred by the British institutions, in particular institutions of the British government.

Through this study, I have provided a detailed consideration and interpretation of the roles of state and technical institutions in the early history of British wireless communications. Furthermore, I have revealed the roles and influences of three institutions – the Admiralty, the Post Office, and the Institution of Electrical Engineers (IEE) – upon the establishment of early wireless communications. I have examined their engagement with wireless communications, both internally and externally. In terms of the latter I have examined their effect upon the activities of the Marconi Company and the wider development of early wireless communications. I have considered two different aspects to institutional roles in early wireless history. I have shown how key developments in early wireless communications were enabled and supported through “institutional innovations” and I have also considered the constraining influence of the three institutions upon wireless technologies and, in particular, the activities of the Marconi Company. In conclusion, I have demonstrated that institutions were capable of both supporting and constraining innovation and invention and, more importantly, institutions can be sources of innovation and innovations themselves.

APPENDICES

Appendix 1: Key Post Office Staff, 1880-1914[1]

	Postmaster General	Secretary	Engineer-in-Chief
1880	Henry Fawcett 1833-1884 *Liberal* **May 1880- November 1884**	Stevenson A. Blackwood (later Sir S. Arthur Blackwood) 1832-1893 **May 1880-November 1893**	Edward Graves 1834-1892 **February 1878-November 1892**
1881			
1882			
1883			
1884	George Shaw-Lefevre (later 1st Baron Eversley) 1831-1928 *Liberal* **November 1884-June 1885**		
1885			
1886	Lord John Manners (later 7th Duke of Rutland) 1818-1906 *Conservative* **June 1885-February 1886**		
	George Grenfell Glyn (Lord Wolverton) 1824-1887 *Liberal* **February 1886-August 1886**		
1887	Henry Cecil Raikes 1838-1891 *Conservative* **August 1886-September 1891**		
1888			
1889			
1890			
1891	Sir James Ferguson 1832-1907 *Conservative* **September 1891-August 1892**		
1892	Arnold Morley 1849-1916 *Liberal* **August 1892-July 1895**		
1893			
1894			William Henry Preece

1 Robinson (1948), Daunton (1985), and British Postal Museum Archive (2010).

1895	Henry Fitzalan-Howard (15th Duke of Norfolk) 1847-1917 *Conservative* **July 1895-April 1900**	Sir Spencer Walpole 1839-1907 **November 1893-February 1899**	(later Sir William Henry Preece) 1834-1913 **November 1892-February 1899**
1896			
1897			
1898			
1899			
1900	Charles Vane-Tempest-Stewart, 6th Marquess of Londonderry 1852-1915 *Conservative* **April 1900-August 1902**	Sir George Henry Murray 1849-1936 **February 1899-October 1903**	John Hookey ?-? **February 1899-April 1902**
1901			
1902	Joseph Austen Chamberlain 1863-1937 *Liberal* **August 1902-October 1903**		John Gavey (later Sir John Gavey) 1842-1923 **April 1902-April 1907**
1903		Sir Henry Babington Smith 1863-1923 **October 1903-January 1910**	
1904	Edward George Villiers Stanley, 17th Earl of Derby (Lord Stanley, 1893-1908) 1865-1948 *Conservative* **October 1903-December 1905**		
1905			
1906	Sydney Buxton, 1st Earl Buxton 1853-1934 *Liberal* **December 1905-February 1910**		
1907			Major W.A.J. O'Meary ?-? **April 1907-May 1912**
1908			
1909			
1910			
1911	Herbert Samuel, 1st Viscount Samuel 1870-1963 *Liberal* **February 1910-February 1914**	1862-1939 **January 1910-October 1911**	
1912		Sir Alexander F. King 1851-? **October 1911-August 1914**	
1913			Sir William Slingo ?-? **May 1912-June 1919**
1914			

Appendix 2: Electrical Engineering Periodicals of late nineteenth and early twentieth century

Title	Dates	Further Information	Frequency of publication
American Institute of Electrical Engineers, Transactions of the	1884-1951		Irregularly – a volume a year with a varying number of issues.
Electric Light: The Journal of Electric Lighting	1882-1883	Incorporated into Electrical Engineer, the [London] (published 1883-1912).	
Electrical Engineer, The [London]	1883-1912	Incorporates Electric Light (published 1882-1883). Anteceded by Electrical Engineering (published 1907 or 1912).	Established in 1882 (according to Garcke's) as a monthly journal and published weekly since 1885. Launched "new series" in 1888.
Electrical Engineer [USA]	1888-1899	Incorporated the Electrician [USA] aka 'American Electrician' (published 1889-1895) in 1895. Merged with Electrical World (published 1883-1899) to become Electrical world and electrical engineer (published 1899-1906). Reverted to Electrical World in 1906.	Published monthly from January 1888 to March 1890 and published weekly from April 1890 to March 1899. In the case of the latter, its subtitle was "A Weekly Review of Theoretical and Applied Electricity."
Electrical Engineering	1907	Preceded by Electrical Engineer, the [London] (published 1883-1912).	
Electrical Times	1902-present	Preceded by Lightning (published 1891-1901).	Weekly (1902-1983); Monthly (1983-present).
Electrical Review, the	1892-1916	Preceded by Telegraphic Journal and the Electrical Review, the (published 1872-1891).	Weekly

Electrical World	1883-1899; 1906-?	Merged with Electrical Engineer [USA] (published 1888-1899) to become Electrical world and electrical engineer (published 1899-1906). Reverted to Electrical World in 1906.	
Electrical World and Electrical Engineer	1899-1906	Result of merging between Electrical Engineer [USA] (published 1888-1899) and Electrical World (published 1883-1899). Reverted to Electrical World in 1906.	
Electrician, The [London]	1861-1952	Originally established in 1861 but discontinued after about three years until 1878 when it was revived and hence published weekly.	Weekly
Electrician, The [USA]	1889-1895	Merged into Electrical World (published 1883-1899; 1906-?). Aka "American Electrician".	
Engineering	1866-present	Subtitled "An Illustrated Weekly Journal".	
Engineer, The	1856-present	Published in print format between 1856 and January 2012; now published in electronic format only.	Fortnightly
Journal of the Institution of Electrical Engineers	1889-1963	Preceded by the Journal of the Society of Telegraph Engineers (published 1872-1880); the Journal of the Society of Telegraph Engineers and of Electricians (published 1881-1882); and the Journal of the Society of Telegraph-Engineers and Electricians (published 1883-1888).	
Journal of the Society of Telegraph-Engineers and Electricians	1883-1888	Preceded by the Journal of the Institution of Electrical Engineers (published 1889-1963) and the Journal of the Society of Telegraph Engineers and of Electricians (published 1881-1882). Anteceded by the Journal of the Institution of Electrical Engineers (published 1889-1963).	
Journal of the Society of Telegraph Engineers and of Electricians	1881-1882	Preceded by the Journal of the Society of Telegraph Engineers (published 1872-1880). Anteceded by the Journal of the Society of Telegraph-Engineers and	

		Electricians (published 1883-1888) and the Journal of the Institution of Electrical Engineers (published 1889-1963).	
Journal of the Society of Telegraph Engineers	1872-1880	Volume 1, Issue 1 (1872) to Volume 9, Issue 34 (1880). Anteceded by the Journal of the Society of Telegraph Engineers and of Electricians (published 1881-1882); the Journal of the Society of Telegraph-Engineers and Electricians (published 1883-1888); and the Journal of the Institution of Electrical Engineers (published 1889-1963).	
Lightning	1891-1901	Anteceded by Electrical Times (published 1902-present)	Weekly
Nature	1869-Present		Weekly
Navy and Army Illustrated, the	1895-1903 (and possibly beyond)	Published as the Navy and Army Illustrated, between 1895 and 1903 and possibly also restarted briefly in 1906, and 1914/1915. Incorporated into 'The King' (published 1900-1905) to become 'The King and his navy & army'	Fortnightly
Science	1880-Present		Weekly
Telegraphic Journal and the Electrical Review, The	1872-1891	Anteceded by Electrical Review (published 1892-1916).	
Times, The	1785-Present		Daily

Appendix 3: 'Wireless' in Hansard, the official report of debates in British Parliament, 1898-1914[2]

The Hansard database does not list by topic but rather by subject. I have divided the mentions of Wireless into the following topics:

1. Electrical Communication with Lighthouses or Lightships
2. Military use of Wireless
3. Civilian maritime use of Wireless
4. Wireless telegraphy (general)
5. Marconi
6. Administration of government Wireless (e.g. expenditure etc.)
7. Radiotelegraph Conferences (1903 and 1906)
8. Wireless Telegraphy Legislation – Acts and Bills
9. Wireless Telegraphy in the Colonies

I have included the original subject(s)

Year	Keywords and topics		Notes
1898	Wireless	1	The honour of the first recorded mention of 'Wireless' in the parliamentary debates goes to Mr Charles Ritchie (President of the Board of Trade, 1895-1900) who mentions that the connection of lighthouses and lightships with shore by electrical telegraph cables has been temporarily paused "pending further results of the experiments with the system of Wireless telegraphy."[3]
	Marconi	-	
	Topics covered about 'Wireless'		
	Electrical Communication with Lighthouses or Lightships	1	
	Original subject(s) 1 mention: Electrical Communication with Lighthouses		
1899	Wireless	4	In discussing the collision of the East Goodwin Light Vessel which a steamship, Mr Robert Ascroft (MP for
	Marconi	1	
	Topics covered about 'Wireless'		
	Electrical Communication with Lighthouses or	4	

2 Available online via http://hansard.millbanksystems.com/

3 Hansard HC Deb 30 June 1898 vol 60 col636 - ELECTRICAL COMMUNICATION WITH LIGHTHOUSES. http://hansard.millbanksystems.com/commons/1898/jun/30/electrical-communication-with-lighthouses#S4V0060P0_18980630_HOC_88

	Lightships		Oldham, 1895-1899) gives first recorded mention to “Marconi” in the parliamentary debates. The MP asks whether Marconi's system of Wireless telegraphy (which had led to the rescue of the crew of the East Goodwin Light Vessel) will be installed in other lighthouses and lightships.[4]
	Original subject(s): 2 mentions: Lightships and Wireless Telegraphy; The Collision with a Lightship.		
1900	Wireless	10	In relation to wireless telegraphy and the Royal Navy (as discussed in the Naval supply reports), Sir U. Kay-Shuttleworth (MP for Clitheroe, 1885-1902) said “it was rather disappointing to read the paragraph in the [Right Hon.] Gentleman's statement relating to Wireless telegraphy. The experiments had opened up the prospect of our cruisers being able to act at a very much greater distance from the Fleet, and he hoped that the difficulties would he so overcome as to make Wireless telegraphy a necessary appurtenance to the Fleet.“[5]
	Marconi	2	
	Topics covered about 'Wireless'		
	Electrical Communication with Lighthouses or Lightships	7	
	Civilian maritime use of Wireless	2	
	Administration of government Wireless	1	
	Original subject(s): 7 mentions: Lighthouse Communication – Wireless Telegraphy; 2 mentions: Transatlantic Liners and Wireless Telegraphy; 1 mention: Supply – Navy Estimates.		
1901	Wireless	13	

4 Hansard HC Deb 02 May 1899 vol 70 col1123 - THE COLLISION WITH A LIGHTSHIP.

http://hansard.millbanksystems.com/commons/1899/may/02/the-collision-with-a-lightship#S4V0070P0_18990502_HOC_131

5 Hansard HC Deb 26 February 1900 vol 79 cc1133-1138 - SUPPLY—NAVY ESTIMATES.

	Marconi	8	
	Topics covered about 'Wireless'		
	Electrical Communication with Lighthouses or Lightships	7	
	Civilian maritime use of Wireless	2	
	Military use of Wireless	2	
	Administration of government Wireless	1	
	Marconi	1	
	Original subject(s): 2 mentions: Lighthouse Communication; Sark and Guernsey Telegraphic Communication – Wireless Telegraphy; Wireless Telegraphy and Life Saving Arrangements; Wireless Telegraphy in the Navy; 1 mention: Irish Lights – Fastnet Rock; Navy Estimates, 1901–2; Wireless Telegraphy on British Steamships; Wireless Telegraphy – Alleged Offer of Signor Marconi to the Admiralty; Wireless Telegraphy— the Tost Office and Steamship Companies.		
1902	Wireless	25	
	Marconi	19	
	Topics covered about 'Wireless'		
	Electrical Communication with Lighthouses or Lightships	9	
	Administration of government Wireless	9	
	Wireless telegraphy (general)	4	
	Military use of Wireless	2	
	Marconi	1	
	Original subject(s): 7 mentions: Revenue Departments Estimates 1902–3; 3 mentions: Electrical Communication with Lighthouses / Wireless Telegraphy for Lighthouse Communication; Wireless Telegraphy – Communication with the Highlands and Islands; 2 mentions: Light Vessels and Wireless Telegraphy; Post Office Expenditure on Wireless Telegraphy; Underground Telegraph Wires – Wireless Telegraphy; Wireless Telegraphy;		

http://hansard.millbanksystems.com/commons/1900/feb/26/supply-navy-estimates#S4V0079P0_19000226_HOC_246

	1 mention: H. M. Navy and Wireless Telegraphy; Somaliland; Wireless Telegraphy for Life-Saving Purposes; Wireless Telegraphy—Marconi's System in Cape Colony.		
1903	Wireless	36	Mini-peak for the 1903 Radiotelegraphic Conference
	Marconi	16	
	Topics covered about 'Wireless'		
	Administration of government Wireless	11	
	Electrical Communication with Lighthouses or Lightships	10	
	Military use of Wireless	9	
	Wireless telegraphy (general)	4	
	Civilian maritime use of Wireless	2	
	Marconi	1	
	Original subject(s): 7 mentions: Wireless Telegraphy for British Light Vessels/Lightships; 5 mentions: Class II [Board of Trade expenditure – wireless telegraphy]; 4 mentions: Somaliland Operations - Wireless Telegraphy; Revenue Departments; 2 mentions: Wireless Telegraphy; New Scheme of Training [for Naval Fleet]; Organisation for War [in Somaliland]; North Sea Fisheries; 1 mention: Second Reading [of Shops (Hours Of Closing) Bill]; Coastguard Signal Stations – Wireless Telegraphy; Transmission of Marconi's Messages over Public Wires; Wireless Telegraphic Communication between Dover and the East Goodwin Lightship; Admiralty Expenditure on Wireless Telegraphy; County Councils (Bills in Parliament) Bill; Wireless Telegraphy in the Navy; Wireless Telegraphy in India and the Far East.		
1904	Wireless	25	
	Marconi	4	
	Topics covered about 'Wireless'		
	Wireless Telegraphy Legislation – Acts and Bills	14	
	Wireless telegraphy (general)	4	
	Administration of government Wireless	3	
	Civilian maritime use of Wireless	2	
	Military use of Wireless	2	

	Electrical Communication with Lighthouses or Lightships	1	
	Original subject(s): 8 mentions: Wireless Telegraphy Bill; 3 mentions: Government Business – Suspension of the Twelve o'clock rule [Wireless Telegraphy Bill]; 2 mentions: Wireless Telegraphy; North Sea Fisheries—Wireless Telegraphy with the Faroe Islands and Iceland; Revenue Departments; 1 mention: Parliamentary Papers (Recess); Lighthouses and Lightships and Wireless Telegraphy; Land Judge's Court (Ireland); Russian Treatment of War Correspondents using Wireless Telegraphy; Racing News by Wireless Telegraphy; Naval Interpreters; Armenia [Wireless Telegraphy Bill]; Message from the Lords [Wireless Telegraphy Bill]; Commission [Wireless Telegraphy Bill].		
1905	Wireless	29	
	Marconi	5	
	Topics covered about 'Wireless'		
	Military use of Wireless	12	
	Electrical Communication with Lighthouses or Lightships	7	
	Administration of government Wireless	5	
	Wireless telegraphy (general)	3	
	Wireless Telegraphy Legislation – Acts and Bills	1	
	Marconi	1	
	Original subject(s): 3 Mentions: Wireless Telegraphy – Communication with Lightships; Supply (Naval Estimates); Class II [Military Use of Wireless]; Contraband of War; Wireless Telegraphy; 2 Mentions: Home/National Defence; 1 Mention: Thames Estuary (Light Vessels); Admiralty Control Of Wireless Telegraph Stations; Wireless Telegraphy in the Navy; Import Duty on, and Prices of, Wheat in England, France, Germany, and Italy [Wireless on Lightships]; Marconi Wireless Telegraphy in the Army; Repair of Cable between Tory Island and the Mainland; The Loss Of The "Khyber" [Wireless on Lighthouses and Light Vessels]; Public Bills [Wireless Telegraph Bill]; Civil Services and Revenue Departments Estimates, 1905–6; Navy Estimates, 1905–6;		

	The Navy and the Admiralty; King's Speech (Motion For An Address) [Military use of wireless Telegraphy].		
1906	Wireless	71	Mini-peak in mentions of 'wireless' due to the Wireless Telegraphy Bill and the 1906 Radiotelegraph Conference. Also first mention of 'radio', in relation to 1906 Radiotelegraph Convention, an outcome of the Berlin conference.
	Radio	6	
	Wireless or Radio	77	
	Marconi	31	
	Topics covered about 'Wireless' or 'Radio'		
	Wireless Telegraphy Legislation – Acts and Bills	31	
	Radiotelegraph Conferences (1903 and 1906)	24	
	Military use of Wireless	7	
	Wireless telegraphy (general)	4	
	Administration of government Wireless	5	
	Marconi	2	
	Civilian maritime use of Wireless	2	
	Wireless Telegraphy in the Colonies	2	
	Original subject(s): 22 mentions: Wireless Telegraphy Bill; 19 mentions: Radio-telegraphic convention; 5 mentions: Business of the House [Wireless Telegraphy and the Army]; 4 mentions: Revenue Departments [Wireless Telegraphy]; 3 mentions: Wireless Telegraphy; 2 mentions: Cable Communication with the West Indies; The "Vaderland" – Refusal to Send Information by Wireless Telegraphy; Wireless Telegraphy – Working of the Act; 1 mention: Message From Lords [Wireless Telegraphy Bill]; Navy; Private Business Bill [Wireless Telegraphy Bill]; Navy (Wireless Telegraphy); The Admiralty and the Marconi Company; Berlin Conference on Wireless Telegraphy; Wireless Telegraphy [Berlin Conference]; Merchant Shipping Acts Amendment (No. 2) Bill [Marconi Wireless Telegraphy]; British Delegates at the Berlin Conference on Wireless Telegraphy; Wireless Telegraphy [Wireless Telegraphy Act]; Return of Working of the Wireless Telegraph Act; Wireless Telegraphy in the Army and Navy; Business of the House [Wireless Telegraphy Convention]; Census Of Production Bill [Wireless Telegraphy Act]; Business of the House [Wireless Telegraphy Bill]; Education (England and Wales) Bill [Wireless Telegraphy]; Supply (Navy Estimates).		

1907	Wireless	19	
	Radio	6	
	Wireless or Radio	25	
	Marconi	7	
	Topics covered about 'Wireless' or 'Radio'		
	Radiotelegraph Conferences (1903 and 1906)	10	
	Administration of government Wireless	6	
	Military use of Wireless	4	
	Wireless telegraphy (general)	1	
	Civilian maritime use of Wireless	1	
	Wireless Telegraphy Legislation – Acts and Bills	1	
	Wireless Telegraphy in the Colonies	1	
	Original subject(s): 7 mentions: Adjournment [Radio-telegraphic convention]; 4 mentions: Naval and Marine Pay and Pensions Act, 1865 [Wireless Telegraphy Operators]; 2 mentions: Radio-telegraphic convention; 1 mention: Revenue Departments [Radio-telegraphic convention]; Wireless Telegraphy – German Operations in South West Africa; Wireless Telegraphy in India; Settings of the House [Wireless Telegraphy Sarcasm]; The Shipbuilding Programme; Home Defence; Territorial and Reserve Forces Bill; State of the Navy; Business of the Session [Wireless Telegraphy Act]; Navy Estimates, 1907–8; Supply (Army Estimates).		
1908	Wireless	31	
	Radio	2	
	Wireless or Radio	33	
	Marconi	3	
	Topics covered about 'Wireless' or 'Radio'		
	Military use of Wireless	12	
	Wireless Telegraphy in the Colonies	9	
	Wireless telegraphy (general)	4	
	Administration of government Wireless	4	
	Radiotelegraph Conferences (1903 and 1906)	3	
	Original subject(s): 4 mentions: Wireless Telegraphy [Security of Admiralty		

	messages]; 3 mentions: Wireless Telegraphy in India; Wireless Telegraphy between Demerara (British Guiana) and Trinidad; 2 mentions: Wireless Telegraphy Convention; Consolidated Fund (Appropriation) Bill [Wireless Telegraphy]; Class II [Wireless Telegraphy between Demerara (British Guiana) and Trinidad]; National Defence; Revenue Department [Wireless Telegraphy]; Navy Estimates, 1908-9; 1 mention: Fleet Exercises; Wireless Telegraphy [Admiralty]; Wireless Telephony at Paris; Wireless Telegraphy Convention; India and the Berlin Convention on Wireless Telegraphy; War Office's Stores purchased from Foreign Finns [Wireless Telegraphy]; Shetland Cable Breakdown [Wireless Telegraphy]; Naval and Marine Pay and Pensions Act, 1865 [Wireless Telegraphy Operators]; Supply (Army Estimates); Reduction of Armaments.		
1909	Wireless	61	
	Radio	6	
	Wireless or Radio	67	
	Marconi	19	
1910	Wireless	33	
	Radio	3	
	Wireless or Radio	36	
	Marconi	7	
1911	Wireless	32	There is one mention of 'Radio' but this relates to Radioactivity and not to Wireless Radio.
	Marconi	1	
1912	Wireless	200	Beginning of “Marconi Scandal“
	Radio	8	
	Wireless or Radio	208	
	Marconi	163	
1913	Wireless	256	Peak of “Marconi Scandal“
	Radio	14	
	Wireless or Radio	260	
	Marconi	358	
1914	Wireless	102	
	Radio	6	
	Wireless or Radio	108	
	Marconi	75	

Notes: It is worth noting that the term “wireless” first appears in Hansard in 1898, an indicator of the terminological shifts and standardising of vocabulary in the new field of “Wireless telegraphy.” As indicated by figures above, 'radio' did not enter popular usage (at least in Parliamentary debates) until after World War One and even then it was in reference to broadcast radio and its advent in the mid-1920s.

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	Berlin, part 2.	1906
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