‘To Strive, To Seek, To Find.’
The origins and establishment of the British Post Office Engineering Research Station at Dollis Hill, 1908-1938

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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

The Post Office Engineering Research Station at Dollis Hill, or just ‘Dollis Hill’ as it was most often called, was the UK’s principal research centre for its postal and telecommunication systems in the early to mid-twentieth century. This thesis offers the first thorough account of the research station’s origins, establishment and interwar history. At its core is a discussion of the motivations and agendas of the successive Post Office Engineers-in-Chief, Heads of Research, senior government administrators and figureheads, and Treasury officials who influenced the decisions to propose, fund and design a centralised research station. The core questions of the thesis are: What was the British General Post Office (GPO) trying to achieve by building and promoting Dollis Hill, and what or who were the influences behind its establishment?

Using archival material and contemporary media sources, I chart and explain the growth of research activity within the GPO’s Engineering Department; from a basement experimenting room to several makeshift wartime laboratories across London, to Dollis Hill’s initial temporary laboratory huts and the opening of the permanent research station. I identify the key personalities, their influences and their motivations for a centralised research facility. The thesis includes an analysis of the design and layout of the site, the reasons behind choosing a suburban “vibration-free” London location and the resulting benefits and limitations of assimilation into the urban landscape. Finally, a section on the public promotion of Dollis Hill in the 1930s shows how the Post Office used newspapers and other media outlets to endorse its services and justify its expense during the post-war recession. Whilst the majority of the research output of Dollis Hill was testing and calibration, the research engineers’ response to the Holborn Gas Explosion (1929) is given as an example of a creative ethos that had been fostered through having to work in challenging circumstances.

I argue that the temporary hutment beginnings of the research station as in the 1920s proposed by William Noble both helped it reach its first transitional stage of development, but also hindered the station’s final transition to permanency. Although the scheme enabled the build of a “new wonder house of experiment and invention” that became a useful tool for the GPO’s rebranding as a modern, forward-thinking institution grounded in scientific research, the scheme ultimately delayed the project’s completion so that the Post Office researchers were forced to adapt their building plans to fit the constraints of a fast-changing urban environments that was building up around the emerging research station.

Overall, this project adds to the understanding of the history of British state-funded science and technology and shifts the historiographical centre of gravity towards the Post Office and its narratives of innovation in telecommunications.

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Note

In this thesis, any reference that includes a Uniform Resource Locator (URL) for a website is a reference to that website as accessed on 30th November 2020.

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Dramatis Personæ

The following people are listed in the order that they appear within the thesis.

William Preece (1834-1913) was the Post Office's third Engineer-in-Chief and is mostly a background figure to this thesis, eventually becoming the face of the history and success of the Engineering Department.[1] Born in Wales and educated at King's College London, Preece began his career in telegraphy at the Electric Telegraph Company with a job secured by a family friend. Upon the nationalisation of the British telegraph network in 1870, he was part of the transfer of staff from the Electrical Telegraph Company to the Post Office and eventually became "electrician to the Post Office system" in 1877 (Hunt, 2011). In 1892 he was appointed the Engineering Department's third Engineer-in-Chief. I argue that it was Preece who initiated a formalised research culture within the Department and put Post Office research on the map within engineering societies. His notoriety was largely due to his own self-promotion, which went against civil service principles and eclipses that of subsequent Engineers-in-Chief and Heads of the Research Section who acted more administratively (Baker, 1976).

Charles Hobhouse (1862-1941) was Postmaster General from the 10th February 1914 to 28th May 1915. Before this he chaired the Committee on Wireless Telegraphy Research. Although his time as Postmaster General was relatively short in office, he had a strong personal interest in telecommunication technologies—wireless in particular—and was influential in initiating the establishment of the Research Station due to his cabinet-level position. His supposed visit to the Engineering Department's research facilities in 1914 was used as a way of explaining the impetus behind the project to establish a Research Station. However, I suggest that William Slingo, the Engineer-in-Chief at the time, had a role in persuading Hobhouse towards the idea of a separate dedicated research station. When Hobhouse was forced to resign as Postmaster General in 1915 due to political difficulties, Slingo lost an influential advocate for the Dollis Hill scheme (David, 1978).

Major Walter O'Meara (1863-1939) was the sixth Engineer-in-Chief from 1907 to 1912. He is unusual compared to the other featured Engineers-in-Chief in that he had a military and colonial administration career before joining the Post Office. I argue that it was this background that explains why O'Meara established a designated Research Section within the Engineering

[1] Preece is the only Engineer-in-Chief referenced in E. C. Baker's (1939) GPO-published history of the Department and his portrait takes over a full page on the inside cover.

Department of the Post Office in 1908. Born in India to Irish parents, O'Meara began his career in the Indian civil service. After receiving military training in England, he was posted to the Bengal Sappers and Miners and fought in the Third Anglo-Burmese war. In 1889 he joined the Telegraph Battalion of the Royal Engineers and in June 1899 was sent to South Africa as an Observation Officer in intelligence and secret service work. Upon the outbreak of the Second Boer War in October that year, O'Meara was sent to defend the diamond mining city of Kimberley that was under siege.[2] After the war he worked in senior administration roles in Johannesburg. During a period of leave in England he was offered the role of Assistant Engineer-in-Chief to the Post Office and he joined the Department in October 1902 ('T. F. P.', 1940). O'Meara is pictured in Figure 1.3, along with William Slingo and William Noble.

William Slingo (1855-1935) followed O'Meara as the seventh Engineer-in-Chief from 1912 to 1919. Slingo began his career in the Post Office as a telegraph clerk in 1870. Self-educating himself in electrical engineering, he began a teaching career just four years later by starting evening classes and later, in 1876 a "Telegraphists' School of Science" in the Central Telegraph Office of the Post Office.[3] He joined the Engineering Department of the Post Office as a technical officer in 1898, working his way up to Assistant Engineer-in-Chief in 1911, and soon promoted to succeed O'Meara in 1912, taking the reins during the transfer of the telephone system to the state. He was the first Engineer-in-Chief to be knighted whilst in office, in 1915. Slingo launched the campaign for a centralised research station just before the First World War. His persistent attempts to secure Treasury approval for the project during wartime are ignored in the secondary literature on the early history of Dollis Hill, although he was ultimately unsuccessful with his endeavours ('E. H. S.', 1935).

William Noble (1861-1943) succeeded Slingo as Engineer-in-Chief in 1919, spending exactly three years in the post until retiring in 1922. He had a remarkably similar career to Slingo; he began his Post Office career as a telegraph messenger boy and rose through the ranks to the very top of the Department. His first appointments were in Aberdeen, where he also taught at Gordon's College. In 1897 the Post Office's first Engineer-in-Chief, Robert Culley, personally selected him to become part of the staff at the London headquarters. In 1912 he became Assistant

[2] O'Meara (1926) wrote about his experiences in Kimberley.

[3] This School was a huge success for the Post Office. Slingo started it with only five students but by 1898 when he stepped down from the post of Principal it had grown to 850. In 1894 the Post Office was able to launch a large expansion to their trunk telephone system because of the numbers of technically trained men qualified through the School, who then transferred to the Engineering Department.

Engineer-in-Chief and was promoted to Engineer-in-Chief seven years later. I argue that Noble had a tactical approach to the Dollis Hill scheme and he used this to persuade the Treasury to progress with the project. An important part of this was Noble's idea to use a collection of former Army huts as temporary accommodation as a way of saving costs in the long run when it came to the construction of permanent buildings at Dollis Hill. I argue that this had the benefit of getting the Research Section on-site quickly, but it also had an unforeseen adverse consequence: by the time the permanent buildings were constructed the Dollis Hill site was hemmed in by residential developments and so unable to expand. Even so, I argue that Noble was the most influential individual in the establishment of Dollis Hill (Anon, 1943).

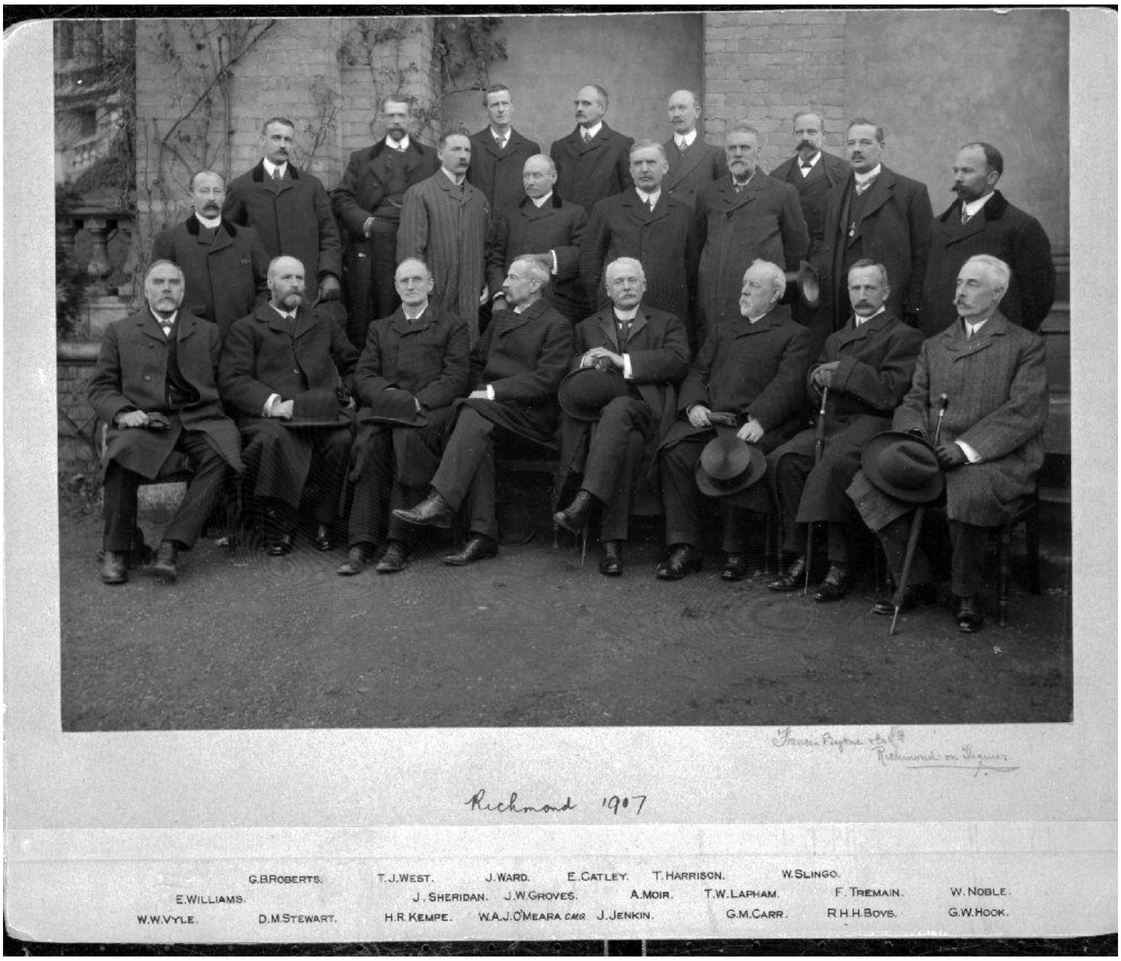
Sam Pollock (dates unknown, born c.1870) was the staff engineer in charge of the Research Section under Slingo and Noble. He began his Post Office career 1889 working in the telegraph service in Belfast and joined the Engineer-in-Chief's Office as a second-class technical officer in December 1902 (PMA: POST 58/98). In 1909 he was promoted to Assistant Superintending Engineer to the central Metropolitan district (Anon. 1909). By 1914 he was head of the Research Section of the Engineering Department where he worked with Slingo to produce the first proposal for a centralised research station, then later worked closely with a government architect over the design of the Research Station. He resigned from the Post Office in 1930, despite being a few years away from retirement age and subsequently filed a request to receive compensation for his work on the hot wire microphone; a sound ranging device that he developed into something feasible for trench warfare during the First World War. The Post Office continued to manufacture hot wire microphones until 1935 (BTA: POST 33/4780).

G. Evelyn P. Murray (1880-1947) was the last and longest serving Secretary to the Post Office from 1914 to 1934 and was also the son of a previous Post Office Secretary, George Murray. Educated at Eton and Oxford, he worked as an examiner in the Board of Education before becoming Private Secretary to a succession of high-ranking Liberal peers and MPs. Before his Post Office appointment he was Commissioner of Customs and Excise (Anon. 1914). In 1927 he published a book on the Post Office as part of a series on government departments, in which he underwhelmingly refers to the Research Station as "not the least important branch of the Engineering Department" (Murray, 1927, p. 183). Although he reportedly took a general interest in telecommunications, he developed a reputation for being overly bureaucratic and obstructive. I argue that Murray's unwillingness towards change was an added difficulty for Slingo from within Post Office administration in his attempts to set up a centralised research station (Daunton, 2004).

Captain Bertram "Bertie" S. Cohen (1876-1943) succeeded Pollock as Head of the Research Section in 1930. He received his training in London polytechnic and engineering schools and joined the National Telephone Company in 1897, becoming head of the company's research section in 1904 where he worked in conjunction with Post Office engineers on the transfer of the telephone systems to the state. He then transferred to the Post Office Engineer-in-Chief's office as an Assistant Staff Engineer to the Research Branch in April 1912 (PMA: POST 58/107). He earned his captaincy during the First World War when he was given a Commission in the Royal Navy Air Service and worked mostly on aircraft communications. Cohen delivered papers on the work and facilities of the Dollis Hill Research Station years before its official opening in 1933 and so was one of its first promoters before the reinvention of Post Office public relations ('A. S. A.', 1943).

H. Kingsley Wood (1881-1943) was Postmaster General from 1931 to 1935 during most of the National Government. Wood was born in Hull and moved to London when his father, a Methodist minister, was appointed to serve at Wesley's Chapel in Finsbury. Wood initially trained as a solicitor and established up own practice before entering the world of politics. His first national achievement was organising a proposal to form a ministry of health, which was subsequently adopted by the then Prime Minister, David Lloyd George, in 1918. Wood was knighted and elected MP for West Woolwich the same year. As Postmaster General Wood took a very commercial approach and worked to improve the image of the Post Office as a source of national pride. As such it is not surprising that it was under Wood's jurisdiction that the Dollis Hill Research Station was officially opened in 1933, despite already being in existence for over a decade (Peden, 2011).

J. Ramsay MacDonald (1866-1937) was the Prime Minister who officially opened the Research Station at Dollis Hill in the opening ceremony of 1933. MacDonald was born in Lossiemouth, north Scotland, the illegitimate son of working-class parents; a maid and farm labourer. MacDonald had an ambition for a career in science but was unsuccessful in these endeavours. In London, MacDonald threw himself into left-wing politics and was one of the founders of what would become the Labour party. This was a successful enterprise and MacDonald became Prime Minister in 1924 and again in 1929. The consequences of the Great Depression lead MacDonald to form a National Government in 1931 with members of the Conservative and Liberal parties. During his career, MacDonald continued to express an interest in science and I argue that he was the perfect figurehead to champion and publicly launch Dollis Hill in 1933 (Marquand, 2004).



0.1 - Group portrait of Post Office superintending engineers at their annual conference, 1907 (BTA: TCE 361/ARC 147).[4]

[4] Along with Major O'Meara seated centre facing left, there are two other future Engineers-in-Chief pictured in this photograph: William Slingo (back row, farthest right) and William Noble (middle row, farthest right), as well as the popular 'Electrician to the Post Office', Harry Kempe (front row, third from left). O'Meara suffered serious injuries to his jaw and right hand when he fought in the Third Anglo-Burmese war, which explains why he always sat in profile in photographs.

Chapter 1.
Introduction.

1.1—*A Glimpse of the Wireless Station, Dollis Hill*, artist unknown, c.1930.[5] (BMA: 2010.80)

There is an oil painting held in the collections of the London Borough of Brent's Museum titled 'A Glimpse of the Wireless Station, Dollis Hill' (Figure 1.1). Slightly larger than an A4 sized piece of paper, it is a landscape picture of an autumnal scene: the foreground is framed by trees

[5] Image courtesy of Brent Museum & Archives. Unfortunately the museum holds no information about the painting or how it ended up in their collections other than its title and the artist's initials, A.W.B. The suggested dating of circa 1930 is my own, based on what is and is not present in the scene: it looks to predate the 1938 erection of two steel radio masts which became landmark features of the Research Station, but as there are several huts present it would have been painted later than the 1926 request for additional accommodation for the radio site.

and foliage either side of a small lake or pond, beyond which, in an open field, are several slightly obscured wooden huts. The composition enables the viewer to journey towards these huts, starting along a leaf-strewn path that begins in the bottom right-hand corner and leading them around the back of the lake through marshy ground, along the way encountering industrial debris such as a large cog or wheel amongst the long grass. The first hut they would encounter—a distinctively tunnel-shaped Nissen hut—has its door open, and what could be a person sitting in the doorway. It is a curious painting of a not particularly beautiful scene, but one which I feel appropriately illustrates the somewhat obscured but in plain sight nature of the Post Office's Research Station at Dollis Hill, its wartime beginnings, and the missing presence in history of the people both behind its establishment and who inhabited it.

The general research block building of the Research Station is still *in situ* today, sitting atop the north side of Gladstone Park and making an impressive sight as it rises into view when walking the 20 minutes uphill from the Dollis Hill London Underground station (see Figure 1.2). It is now a Grade II listed block of expensive residential flats advertised as a "gated development" because the original boundary walls and security gates are still in use (Ellis & Co.). As a result, not many indications of the building's original occupants or their activities are available to the casual visitor. If you can make it past the security gates into the driveway, there are still a few details leftover from its heyday: "RESEARCH IS THE DOOR TO TOMORROW" and "TO STRIVE, TO SEEK, TO FIND" are inscribed into the stonework above the parapet, and the radio waves inspired weathervane has been kept by renovation architects. There have been some brief attempts at acknowledging the building's history: a weathered brass plaque next to the main entrance inaccurately announces the building as the site where the first programmable computer was built.[6] Inside, a few small reproduction photographs of the original laboratories are framed and hung around the foyer, and an access road behind the building is named Flowers Close after its now most famous engineer.

[6] This is in reference to Tommy Flowers' codebreaking Colossus machine that was built at Dollis Hill and transferred to Bletchley Park. Computer historians generally agree that it is more correct to call it the world's first *semi*-programmable computer, but there are some who would not consider it the forerunner to computer at all. Jacob Ward (2017) has discussed this in his thesis.

1.2—The main building of the Post Office Engineering Research Station at Dollis Hill, now a block of residential flats (author's own, 2014).

No modern historian has looked into the history of the Post Office Engineering Research Station at Dollis Hill. There is a simple narrative of the establishment of the Dollis Hill Research Station that has been repeated in various Post Office—and subsequently BT—publications. These publications were usually compiled to celebrate a significant milestone of the Research Department, and so are written to celebrate its achievements without any investigation into its more complex and partially secret wartime history, such as the First World War. The earliest example of this is a 1939 *Green Paper* on the history of the Engineering Department, written by the Department's war historian and archivist E.C. Baker. Baker provides a succinct summary of the Research Station's history, but does not mention anyone other than the Prime Minister Ramsay MacDonald in connection to it,

> The research branch is housed in a very fine block of modern buildings at Dollis Hill, northwest London. Early research work was carried out in a room in the Central Telegraph Office building. A great deal of fine work was done with very limited resources. As early as 1908 the use of thermionic valves for telephone amplifiers was being experimented with and cathode-ray phenomena studied. In 1921 the research staff was accommodated in army huts on a part of the Dollis Hill site while the station was being built. The Research Station was formally opened by the Prime Minister, Mr. Ramsay MacDonald, on November 23, 1933.[7] Here are the central engineering training schools. Here also the radio branch carries out much of its research (Baker, 1939, p. 37).

Other examples that repeat this narrative include an article from a 1956 special edition of the *Post Office Electrical Engineers' Journal* (POEEJ) compiled to commemorate the 50-year jubilee of the Institution of Post Office Electrical Engineers (Anon, 1956), and one written to celebrate the transfer of the Research Department from Dollis Hill to Martlesham in the 1970s. I shall discuss the origins of the Institution of Post Office Electrical Engineers later in this thesis. The most recent publication to focus solely on the Research Department of the Post Office and its premises was written by BT's Departmental Record Officer in June 1984, celebrating the 76th anniversary of the Research Department (Panton, 1984). Its author provides a few more details such as the designation of a separate Research Section within the Engineering Department in 1908 and gives 1904 as the earliest evidence of research work carried out in the Post Office's Central Telegraph Building. However, some turns of phrase are lifted completely from Baker's 1939 publication, suggesting that it is not the most independently researched account.

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[7] This date is inaccurate: MacDonald opened the Research Station on 23rd October 1933.

The Research Station at Dollis Hill is not that well known about outside of engineering circles today, perhaps simply because it is no longer in operation.[8] However, it does get referred to in histories of other Post Office institutions, such as Rugby Radio Station (Hancock, 2017, p.70), and further British state-run research institutions, such as the National Physical Laboratory (Magnello, 2000, p.140). Secrecy is an important theme in this thesis: the Station's links with the excitingly covert Bletchley Park is often the reason why it is referred to in any history, either directly with Tommy Flowers' codebreaking 'Colossus' machine, and indirectly because the first research engineers on site also worked in temporary army hut accommodation, and as such, the history of the Research Station at Dollis Hill is an important missing precursor to the Bletchley Park narrative. Intriguingly, Post Office telephone specialists are mentioned in the history of MI6 for collaborating in 1930s investigations (Jeffery, 2010, p.317), and Peter Wright's *Spycatcher* novel explicitly describes a basement experiment laboratory that ran special investigations on behalf of the secret services, suggesting that the Research Station had a secret history beyond—and before—Second World War codebreaking (Wright, 1987, pp.45-6). However, this thesis will demonstrate that the Post Office administration used the existence of the Research Station at Dollis Hill and the projects of engineers as an important part of its rebranding during the interwar period, and that points towards a delicate co-existence between its public facing image and its unpublicised activities. This balance is a vital part of understanding why the Research Station at Dollis Hill is so little known about today, while also being such an important part of the lineage of Bletchley Park.

In the most recent authorised history of the Royal Mail by Duncan Campbell-Smith, the Research Station is first mentioned in the chapter covering the Post Office's activities from 1939-1949. There is no mention of the technological aspect of the Post Office's involvement in the First World War and nearly the first two decades of the Research Station's existence are neatly skipped over in a sentence to introduce the exciting Second World War link between the Post Office and Bletchley Park: "originally founded in 1921 and greatly expanded by Kingsley Wood in 1933, it had already achieved a string of significant technical advances by 1939" (Campbell-Smith, 2011, p. 343). My aim in this thesis is to delve into the history that this sentence overlooks in order to explain how the Research Station at Dollis Hill came into being and why, showing that 'Dollis Hill' (as the Research Station was often referred) was a well-known government facility by the end of the 1930s, whilst avoiding the teleology of looking towards the Second World War as its purpose.

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[8] I have also found that when discussing this thesis with peers who are not familiar with the history of the Post Office, the idea that the Government used to run the telecommunication services of the country is now an alien concept.

In writing institutional histories there is a risk of personifying various institutions and treating them as homogeneous single entities. I do use the term ‘Dollis Hill’ to refer to the Research Station itself but this should not be construed as personifying it.[9] My overall argument concentrates on the agency of individuals: I shall uncover the various Post Office researchers, administrators and figureheads missing from the standard narrative of Dollis Hill, their motives, and the influences behind their decisions to seek and strive to make it happen. I demonstrate the role of individuals in developing a proposal for a dedicated research site with greater space and better conditions, alongside the wider efforts of the GPO to improve its public image. I shall set out the various motivations and roles of the engineers, administrative heads of the Post Office, the Treasury, and other government figures; their various ambitions and agendas. By doing so, I answer the two overall questions of this thesis: What exactly was the British Post Office trying to achieve by building and promoting its Research Station, and what or who were the influences behind its establishment and what were their motivations?

In relation to the first question, I will show that one primary objective of the Engineering Research Station at Dollis Hill that was shared by all of its directors was to ensure the revitalisation of the fortunes and reputation of the Post Office through the pursuit of research. I will demonstrate that a wide range of research was carried out at Dollis Hill, much of which was undertaken to improve the customer telephone service provided by the General Post Office. I will trace the preceding history of its wider Engineering Department to provide context to the establishment of the Research Section that was eventually housed at Dollis Hill, and explain how the difficult relationship between the Post Office and the Treasury impacted proposals for such a dedicated research site. In relation to the second question, I will identify the key individuals involved in the establishment of the Dollis Hill facility and explore their motivations and methods. I particularly highlight the role of William Noble who was able to secure funding for the project from the Treasury by proposing a low-cost temporary precursor to a permanent building. However, I will explain that Noble’s influence cut both ways: the implementation of his proposal effectively postponed the eventual construction of the building at Dollis Hill, by which time the conditions of the site had evolved from an ideal remote and spacious setting to being significantly encroached upon by suburban housing. Above all, I shall show how the Research Station at Dollis Hill was more than just an expensive new arm of Post Office bureaucracy: as the Tennyson quotation above the portico indicates, the individuals involved in creating the research station saw its engineers as striving towards and seeking a better future for

[9] This should not be confused with Dollis Hill the area or the London Underground station, and I make sure to specify to what I am referring to in each instance.

the whole nation through their research efforts, and this was therefore the identity presented to any member of the public who saw the Dollis Hill research station.

This study provides the first thorough account of the reasons behind Dollis Hill's establishment and launch. It is the first instalment of a three-thesis project on the history of Post Office and BT engineering research, co-supervised by the Science Museum, London, in conjunction with BT Archives. Rachel Boon of Manchester University has written the second thesis which deals with the activities of the Research Station during the Second World War and its aftermath (2020). Jacob Ward of University College London has written the third thesis: he investigated the research station's move from Dollis Hill to Martlesham Heath in the context of the privatisation of the UK's telecommunications industry (2017). The project was originally conceived by BT's Head Archivist David Hay, now retired, who learnt about Dollis Hill soon after first joining BT because of its close association with the current research facilities at Adastral Park. The Dollis Hill research reports—discussed in the following section—were originally housed in their Library, and moved to the BT Archives in 1991 with other surviving historical records. In 2011 Hay and his team successfully submitted the reports to UNESCO to be registered on the UK Memory of the World programme, and they contributed to the BT Archives achieving Arts Council Designation status application in 2012 (BT, *Significance of our archives*). According to Hay, these external accreditations have acted as a means to draw attention to the collection with academic partners, with a main research theme of innovation throughout BT's history, of which Dollis Hill was a key part. The Dollis Hill project joins a series of PhD theses on this theme undertaken in the past 10 years: Bruton, 2012; Kay, 2014; Moyle, 2015; Fava-Verde, 2016; McGuire, 2016.

1.1 Sources

The majority of sources used for this study are housed in the BT Archives (BTA), with some additional material found in the Postal Museum and Archives (PMA). Originally the contents of these two repositories would have been held together, but they were separated due to organisational changes and the eventual privatisation of the Post Office in 1975. In general, records associated with the telecommunications function of the Post Office are held at BTA, and the postal administration records are held at PMA. However, during my own research I have found this demarcation to be less straightforward and it has been intriguing to discover relevant sources, such as Engineer-in-Chief annual reports and notes on the early history of Dollis Hill housed in the PMA (PMA: POST 76). I am grateful for the help of David Hay at BTA for his assistance in locating a range of sources, some of which had yet to be catalogued such as the printed minutes of the Holborn Gas Explosion inquiry.

Most of the records held at BTA are research reports. These many hundreds of reports are evidence of the scale and variety of projects undertaken by Post Office research engineers; however, they are limited in showing the decision-making processes that led to the individual projects. I have managed to source a few first-hand accounts of life as a Post Office research engineer which have proved helpful in illuminating the culture and ethos of Dollis Hill. However, ascertaining the agency of individuals in relation to key decisions has presented a challenge for this thesis. My solution to this has been to focus systematically on the successive Engineers-in-Chief and Heads of Research to establish what aspects of their agenda was implemented, as well as other important key figures in government. This provides a basis for concluding which individuals had the most influence over the shaping of Dollis Hill. As well as the BTA and PMA, I consulted the National Archives and Brent Museum and Archives for additional relevant material on a national and more local scale.

I have investigated histories of the Post Office that were contemporary to the period that this thesis covers. In particular, the 1938 history of the GPO by Ernest Tristram Crutchley has proved invaluable. I also performed searches for contemporary material in The British Newspaper Archive, The Times Digital Archive and The Illustrated London News Historical Archive using a variety of search words such as “Dollis Hill”, “Post Office engineers”, and “research station”, as well as more specific examples of research projects such as “speaking clock” and “galloping Gus”. These searches provided evidence to show the role that Dollis Hill played in the GPO’s wider public relations activities. For material relating to how Post Office research and Dollis Hill was represented in Parliament, I searched *Hansard* for records of relevant parliamentary debates.

1.2 Structure

This thesis principally covers a 30-year period; from the 1908 decision by Engineer-in-Chief Major O’Meara to designate a separate research branch within the Post Office’s Engineering Department, to 1938: taking a publication by the Post Office’s Public Relation Officer as my endpoint, where the Research Station at Dollis Hill is named, situated and described as an integral function of Post Office engineering. I also explore the roots of the Engineering Department’s research culture, which can be traced back to the 1870s.

Various people were thwarted in their mission to establish Post Office research as a recognised vital function of the Engineering Department, with its own Research Station. I shall reveal these characters and explain how the experiences of the First World War both helped and hindered their cause. An important focus in this thesis is on the Engineers-in-Chief of the Engineering Department as they had overall responsibility for the direction of the Department.

The first occupant of that role that the thesis focuses on is William Preece who encouraged a more formalised approach to research within the Post Office and who ultimately secured his place in the history of telecommunications through his own self-promotion. As a result, successive Engineers-in-Chief such as Major O'Meara, William Slingo and William Noble, have been eclipsed by Preece's fame, though they all deserve the credit for the establishment of Dollis Hill. Another focus is on the Heads of the Research Station, Sam Pollock and Capt. Cohen. Once the Research Section moved away from central Post Office headquarters in 1921, it was Pollock and Cohen who had the most influence on its activities. I include a *dramatis personæ* at the beginning of this thesis of the main "players" of the narrative, as well as a timeline in the Appendix of how these various people overlapped and succeeded each other in their positions of office (see Appendix 1).

Chapter 2 provides a review of the current literature that has informed this thesis. As this is the first historical study of the Post Office's Research Station at Dollis Hill, I have had to use the current literature to construct a lens though which the primary source material can be viewed. There are four main objectives: a review of existing scholarship on the history of the growth of state-funded science in Britain and how Dollis Hill fits into this history; histories of the Post Office and the importance placed on Post Office engineering research; how the history of Dollis Hill relates to existing scholarship on the history of engineering and engineers; and a more specific discussion on how Dollis Hill featured in the histories of public relations in the Post Office.

The rest of this thesis takes a narrative approach and plots the background and history of the establishment of Dollis Hill. Chapter 3 describes the formation of the Engineering Department in 1870 following the nationalisation of the telegraph network. I explain that research had been undertaken by the Department since at least 1878 and that Preece appears to have been responsible for formalising these activities. By reference to the Engineer-in-Chief's annual reports to the Postmaster General I am able to trace the gradual emergence of research as an important function of the Engineering Department. In 1908, Major O'Meara oversaw the establishment of a Research Section and a move of that Section to a new experimenting room into the Post Office's Central Telegraph Building. The chapter concludes by introducing Slingo and establishes that a merger with a private company, the National Telephone Company, as part of the nationalisation of the telephone network resulted in crowded research conditions. Slingo used this as an opportunity to argue the case for a separate, dedicated research site. However, the outbreak of the First World War stalled any such plans.

Chapter 4 explores the activities of the Engineering Department and the Research Section during the First World War. During the War, Slingo repeatedly sought to revive the Dollis Hill plan but without success. However, his Department had many successes during the War. In operational terms, the Post Office was responsible for providing and maintaining the telecommunications infrastructure for the armed services both at home and abroad. This also included dangerous sabotage work such as the cutting of enemy submarine cables. In research terms, I describe the breadth of the Research Section's work and then focus on two case studies regarding hypersensitive transmitters and hot wire microphones, both of which played a significant role in military intelligence. This level of success meant that the Treasury was able to rebuff Slingo's repeated requests because his Department was clearly able to function despite the difficult wartime conditions. Having said that, this chapter explains that the First World War allowed the Research Section to demonstrate that it could provide practical and innovative solutions to difficult wartime problems.

Chapter 5 explains how the Dollis Hill plan was eventually implemented. Noble was appointed Engineer-in-Chief in 1919 and he changed tack with the Treasury by arguing that a separate, dedicated research station was needed to improve the services provided by the Post Office. After the War, the reputation of the Post Office suffered as its services were generally considered poor quality. An important part of Noble's argument was that it would be cheaper to get the Dollis Hill site occupied by temporary huts and then only look to construct permanent buildings when the country had fully financially recovered from the War. This worked and the 'hutment scheme' was implemented and the site was operational by the second half of 1920. The scheme worked well, and staff members recorded enjoying life in the huts despite occasional inconveniences when the weather was too hot or too cold. Research work grew and slowly the permanent buildings were constructed alongside. They would not be completed until 1935. Much of the research that occurred at Dollis Hill was testing and evaluating, and I highlight the variety of projects undertaken throughout this thesis. I finish this chapter by exploring the architecture and layout of the site and use the example of the quartz crystal laboratory group to show how the new buildings encouraged an interdisciplinary approach. However, an unexpected encroachment was suburbia which quickly surrounded the Dollis Hill site thereby undermining a principal advantage of it; lack of vibrations and other interference, both electrical and human.

Chapter 6 describes the official opening ceremony of Dollis Hill in 1933 and puts this in context of the time. It explains why Ramsay MacDonald, the then Prime Minister, was a particularly appropriate choice of speaker. The opening ceremony was widely reported, and I attribute this to the public relations work of Stephen Tallents, appointed by the Postmaster General, Kingsley Wood. I proceed to explain how the opening of Dollis Hill formed a part of a much larger campaign to improve the image of the Post Office. The product of research done at Dollis Hill was an important element of this campaign although I note that a significant amount of research was not the subject of the Post Office's public relations machine.

Chapter 7 concludes this thesis and returns to the two central questions of this thesis: What was the British Post Office trying to achieve by building and promoting its Research Station, and what or who were the influences behind its establishment? In doing so, I pull together the threads of the arguments made in the preceding chapters and I conclude that Dollis Hill owes much to the Post Office’s attempts to improve its image and that Dollis Hill provided a way of improving the service it provided to its customers. I attribute this to the efforts of William Noble, but I argue that his ‘hutment scheme’ may have ultimately undermined the Dollis Hill project.

Chapter 2.
Dollis Hill: a review of secondary literature.

> At the back of all the activities which have been described, ubiquitous but generally invisible, are the Post Office Engineers (Crutchley, 1938, p.170).

There is surprisingly little literature in the history of science and technology that mentions The Post Office Engineering Research Station at Dollis Hill. Despite being the primary research facility of the largest bureaucracy in Britain for the first half of the twentieth century, Dollis Hill has been generally overlooked by historians of state science, telecommunications and even of the Post Office itself. Post Office engineers were responsible for developing, building, installing, and maintaining a reliable communications network throughout the country. This would have been (and still is) a challenging and expensive endeavour, requiring scientific investigation. However, as the above quote indicates, Post Office engineering was considered a behind-the-scenes activity by its own senior management: as such, the term “invisible technicians” can be applied centuries later (Shapin, 1989). Yet this attitude does not explain nor excuse why historians have missed reporting on the research function of Post Office engineering, especially since it was not a hidden enterprise: the obvious evidence being that it was discussed openly in Crutchley’s 1938 book on the GPO quoted above. This chapter shall therefore explain the *context* that gave rise to the establishment of Dollis Hill and its beginning years, rather than using secondary sources to reveal it. In doing so this chapter triangulates the various factors that went into the development of the Post Office research department.

These factors come under four headings. First, a discussion of the literature of state science and engineering, focusing mainly on Edgerton’s ‘Warfare State’ thesis. I show that my thesis builds upon and sharpens Edgerton’s conclusion that British state-sponsored innovation was driven by military aims, and this motivation has its roots in the efforts made by research institutions created during and as the result of the First World War. However, one reason why Dollis Hill has been missed from histories of state science is its hybrid nature: its output was to provide a civilian communications service on one hand, as well as to provide military equipment support in both design and manufacture on the other.

The second section shall examine histories of the Post Office itself and situate the telecommunications function of Post Office engineering amongst the most well-known accounts. I show that these histories have glossed over the research contributions of Post Office engineers during the interwar years or else ignored them completely in favour of employment conditions or the wider postal service, and more obvious world events involving the Post Office such as the Irish Uprising of 1916 and its operational role in the First World War as these are more visible in archival sources.

The third section focusses on the engineers themselves. Post Office engineering emerged as a necessary and specialist mix of several science disciplines since there was no existing scheme fit for purpose. By investigating the histories of other strands of engineering, such as civil and aeronautical engineering, I shall show how the training of telecommunications engineers at Dollis Hill developed from the tension between apprenticeships and academia.

The fourth and final section shows how Dollis Hill's activities were selectively presented to the wider world. Even though it is missing from the history books, the presence of Dollis Hill was not kept hidden. In fact, it was used as an advertising tool as part of the rebranding of the Post Office to a more open and commercially-minded enterprise during the 1930s. However, by carefully selecting what information was released to the media, Post Office management pursued projects of manifest public benefit as a distraction technique to draw public focus away from Dollis Hill's ongoing military-related activities.

2.1 State science and engineering and the Warfare State thesis

Philip Gummett's *Scientists in Whitehall* claims to be the first definitive survey of the relationship between science and British government administration (Gummett, 1980). Although his work is not intended as a historical analysis, Gummett draws upon work by historians of scientific institutions, and his second chapter reviews the government of science in Britain from the nineteenth century onwards. However, he states at the outset that the story about science and government only really takes off after the Second World War: this is a view that this thesis shall contest and argue otherwise. Focussing on his pre-Second World War analysis, Gummett highlights the establishment of National Physical Laboratory (NPL) in 1899 as a turning point in state-science relations. Before, science policy was based on three elements: grants awarded to individuals for "pure research" such as expeditions or specific projects; funding provided by the Royal Society, supported by the Treasury (despite its general reluctance to invest in scientific research) that was limited in its reach due to a concern of being labelled politically partisan; and funding towards utilitarian research such as the Ordnance Survey and technical branches of government departments. The NPL, founded following its German equivalent, was designed to bring scientific knowledge to everyday industrial and commercial practice, opening the way for state support of research rather than the routine application of scientific techniques, and conducted in state-owned laboratories.

Gummett shows how the First World War brought "a tightening of the bonds between science and government" (1980, p.22). The first months of the war brought on a realisation that the country was dependant on Germany for materials necessary to the war effort. This realisation sparked the setup of the government's Advisory Council on Scientific and Industrial Research in 1915, leading to the formation of a separate state department in 1916: the Department of Scientific and Industrial Research (DSIR). Gummett summarises the interwar period as seeing a steady build-up in government support for research: he thus includes the Post Office in a list of government departments that strengthened their research facilities (1980, p.27). However, a consequence of the post-First World War research councils, who acted autonomously from the government, meant that an "intellectual barrier" developed between the Royal Society, research councils and universities on one side, and government department's scientific laboratories and industry on the other, with the former being considered higher in prestige. According to Gummett there was little complaint over this divide as most government departments were run by men without much background in the sciences, and by modern standards government expenditure on science was tiny. However, it was high compared to international equivalents, and by the start of the Second World War Britain was on a par with other Western countries in the institutionalisation of science.

Gummett does not mention the British Post Office in his survey, despite its research section being an 'in-house' example of the (sometimes tense) relationship between science research and government administration. For example, in Chapters 3 and 5 I will show how two successive Engineers-in-Chief, William Slingo and William Noble, repeatedly attempted to persuade Treasury officials to support a scheme for a centralised research station at Dollis Hill over a number of years. Their communications were channelled via the Post Office's Secretary G. Evelyn Murray who did not have any technical background and was criticised for being averse to change. Gummett's nod to Germany being an influence on British institutions is also demonstrated by the history of Post Office research and the establishment of Dollis Hill. In Chapter 3 I show how the Postmaster General, Charles Hobhouse, visited Germany in 1914 to investigate their approach to wireless telegraphy research and whether it could be replicated in the UK. I will show that by the end of the 1930s, Dollis Hill was a major contender in international conferences and hosted large-scale open days to showcase its government-funded laboratories and products of its utilitarian researches to the UK's scientific community and public alike.

Charlotte Sleigh and Don Leggett's edited collection of essays are more recent scholarship on the history of the relationship between science and the British state. They provide further twentieth-century case studies on British "scientific governance": a form of conflict of governance *of* science and governance *by* science. These include Leggett's analysis of the Admiralty's Board of Invention and Research as an example of the governance of science through official committees, and Ralph Desmarais' study of BBC science programming in the 1930s as an example of governance by science, where attempts to manage the public understanding of science cemented the authority of science in twentieth-century society. Leggett and Sleigh claim to offer a "new historiographical cohesion in the study of twentieth-century British science in which technical experts, policy makers and administrators can be analysed alongside popularisers, mediators and the users of scientific knowledge" (Leggett and Sleigh, 2016, pp.5-6). My thesis is a similar study: throughout the narrative there is a clear tension between the agendas of successive Engineers-in-Chief, Post Office administration, and the Treasury and there is an important ambiguity as to who is actually in charge. This is most clearly demonstrated in Chapter 6 where I describe the research station's official opening ceremony of 1933. The ceremony provided an ideal opportunity for the scientifically-inclined Prime Minister of the time to espouse his scientific mission from a public platform and demonstrate his authority when it was being questioned over an unstable government. However, Dollis Hill only became part of public spectacle after its public opening, which coincided with the beginning of a rebranding of the Post Office service. The people coordinating this rebrand were in place before: namely Postmaster General Kingsley Wood and Public Relations Officer Stephen Tallents, and so I argue that the Prime Minister was instead caught up in their agenda and used as a way of showcasing the research station as an example of Post Office progress.

Examples of histories of the National Physical Laboratory (NPL) are the obvious parallel to Dollis Hill. Like the Post Office, the NPL acted as consultants to other government departments and performed research investigations on behalf of other institutions. However, these histories of the NPL (Magnello, 2000; Moseley, 1978) hardly mention Post Office research or Dollis Hill at all—if they do, it is in relation to the Second World War Colossus machine (Magnello, 2000, p.140). This is despite the fact that researchers at the NPL and the Post Office collaborated and consulted each other on various projects: in 1910 Post Office telegraph researchers visited NPL to witness their system of investigating dry battery cells; after the First World War, Post Office engineers assisted the NPL with erecting two masts and an aerial at their site in Teddington for radio research work; and in 1934 a Dollis Hill engineer and staff from NPL worked together on calibrating condenser microphones (BTA: TCB 422/55; POST 30/2591; TCB 422/8644). Magnello's history of the NPL (2000) is a succinct illustrated summary covering 100 years from its origins to the present-day activities of its researchers, and written to celebrate its centenary, so its focus is limited.

However, its brief chapters on the NPL's activities during the First World War and the effect of the War's aftermath on its business administration make an interesting comparison with the Post Office Research Section. Magnello notes how the NPL assisted the War Office and Admiralty in researching "several critical cases of grave importance" in the first two months of the War (Magnello, 2000, p.59) and from 1915 performed its own independent projects related to improving technical warfare. It had a close working relationship with the Ministry of Munitions, eventually taking over all of the Ministry's gauge-testing work (Magnello, 2000, p.60) and carrying out other testing research programmes. As I will show in Chapter 4, Post Office researchers were heavily involved in the war effort from the very beginning; experimenting with, inventing and manufacturing new equipment on behalf of other government departments. Magnello also explains how the NPL faced critical financial concerns before and after the War, primarily over the salaries it could offer its staff, which lead to a series of embarrassing resignations amongst its senior staff members who were attracted to higher pay in industry. The policy of the NPL's Executive Committee was to cultivate an academic atmosphere, for example by investing in university pension schemes, so as to enable and encourage its staff to move to and from universities. Even though they were technically still government employees, Magnello explains that this attitude meant NPL staff were not regarded as civil servants (2000, p.72). Whilst the Post Office's Research Section faced similar financial constraints as explained in Chapter 5, the Post Office as a whole, with its reputation as Britain's largest bureaucracy of the first half of the twentieth century, was able to steadily recruit and retain research technicians and engineers throughout the 20s and 30s despite challenging economic times. The Post Office's makeshift basement laboratories and early temporary hutments of Dollis Hill were a far-cry from the NPL's purpose-built laboratory buildings, and graduate employment was unusual: technical staff were mostly trained inhouse and many of its senior staff members, including several Engineers-in-Chief, rose through the ranks from humble telegraph boy beginnings.

The first half of the twentieth century was a period in British history where the remedy for any criticism of quality of service or outputs was research. Two more government institutions of relevance founded upon this basis are the Board of Invention and Research (BIR) and the Department of Scientific and Industrial Research (DSIR). The BIR was formed in 1915 as a committee of civilian scientific experts brought together to evaluate new ideas and inventions on behalf of the Admiralty. Roy MacLeod and Kay Andrews give the history of the BIR as a case of the imperative of state funding of science (MacLeod and Andrews, 1971). They demonstrate that, though troubled with antipathy on the part of the Admiralty, the experimental work of the BIR laid the foundations for future research procedures of the British navy. The funding of the BIR was heavily dependent on the politics of the time. Similarly, as introduced above, the DSIR was a government department set up in 1916 to fund research proposals and support other related initiatives in private industry and academia in order to lessen British dependence on foreign industries. Sabine Clarke has discussed the rhetoric of individuals associated with the DSIR and shows how their language, specifically the use of the term "fundamental research" was used as a means to justify the DSIR's legitimacy, policies and expense (Clarke, 2010). I will show in my thesis how various actors used similar techniques and language to persuade the Treasury for funding the Dollis Hill proposal.

Unlike Gummett who presents a somewhat global overview, Peter Alter differentiates between countries and looks in detail at the civil service support of science in the UK (Alter, 1987). In slight contrast to Gummett, Alter states that "in the two decades prior to 1917, an administrative structure was created for science which remained essentially unchanged until after the Second World War" (Alter, 1987, p.7). For Alter, the First World War was not a turning point; rather there was already a recognition from some British political leaders by the turn of the century that the state should provide financial long-term support for scientific research, both for military application as well as for “pure” science. He demonstrates this pre-War increase of state patronage of science by examining the establishment of three institutions who all originated before 1914: the NPL, the Imperial College of Science and Technology, and the Medical Research Committee. It is in this demonstration of a pre-War transition period towards state support of science that Alter mentions the Post Office, albeit only once in a passing comment. The Post Office comes last in a list of British civil service institutions that introduced special departments to set up, carry out and monitor routine scientific tasks during the nineteenth century (however, for the Post Office, he notes that this occurred in 1904) (Alter, 1987, p.64).

Alter’s international comparisons are helpful for this thesis. He shows how the British state was relatively late in beginning to systematically promote science compared to that of Germany. Alter tentatively concludes that the reason for this lay in the British political system of the nineteenth century: liberal political and social theories of the time placed obstacles in the way of state initiatives; and private patronage of science was prominent enough to allow the state to avoid using its own expenditure (Alter, 1987, p.251). However, he more cogently demonstrates that it was only until the backwardness of certain aspects of British industry compared to that of Germany and the United States was highlighted by the science lobby that arguments for state intervention were taken more seriously by the British government. Initially, the German model of science was the most influential in Britain, whilst the First World War saw the United States system emerge as one to emulate once trade relations with Germany ceased. Alter focuses on the British chemical industries to illustrate this point: since the 1880s, Germany had invested in large chemical research laboratories that vastly outperformed its British counterparts. Until the outbreak of War, stable trade agreements with Germany meant there was little incentive for the British chemical industry to compete. Once these ceased, the British Board of Trade negotiated to build up an efficient British dye industry, and German models were used to develop small already existing aniline dye companies using government funding. Further government interventions and mergers resulted in the formation of the government-controlled British Dyestuffs Corporation, which ran three-quarters of the British dyestuffs market (Alter, 1987, pp.194-195). As a result of the First World War, both the British press and scientific journals rejected German industry and its scientific system; instead it began holding up the United States as a world centre for science. Alter admits that his focus is on the decline of German influence on British science policy rather than how and why the United States itself became the forerunner for scientific and industrial endeavour. He also implies that it was a strong media influence that saw the United States' organisational model become the basis for British science, but he goes no further to discuss the importance of public opinion in affecting policy decisions.

Alter's wartime chapter is a discussion of the organisation of science in the civilian sector, though he acknowledges how the British state's interest in science concentrated mainly on military research. He explains both the formation of the Department of Scientific and Industrial Research (DSIR) as Britain's foremost body for the promotion and coordination of civil research, and how it directly controlled other 'special institutions' such as the NPL, Geological Survey of Great Britain and the Chemical Research Laboratory. It is remarkable then that in this context Alter completely ignores the British Post Office, and telecommunications in general, as an example of state-funded civilian science. This could be because telecommunications was not the main government enterprise of his international comparisons, and the British state's takeover over of the telephone network and the resulting necessity to collaborate with and transfer the work of the researchers of the privately-owned National Telephone Company was an unusual facilitator for state-sponsored science. The history of Post Officer research also does not support his argument that there was a growing pre-War subsidising of scientific research by the British government. Importantly for the story of Dollis Hill, as I show in Chapter 5 it is only in the aftermath of the First World War and the Armistice when Post Office officials successfully negotiated and secured sufficient funding from the Treasury to build a dedicated research station. As the biggest bureaucracy of the twentieth century prior to the NHS, it is curious that an important element of its history has been largely ignored by Alter and other historians investigating science and the British state.

David Edgerton discusses the attitude of the interwar British government towards scientific research, especially in relation to military technologies, in his warfare state thesis. He shows how the country continued to be heavily militarised despite seeming demilitarised and pacifist, and claims to put "the history of war and the military into the history of industry, science and technology in new ways" by demonstrating how state and military laboratories, design centres and workshops were ultimately responsible for the major innovation in the military technology of the Second World War (Edgerton, 2006, p.13). He gives details of the expenditures on arms and armaments across his selected time period, the sites where military research took place and the numbers of scientific and engineering staff involved. Dollis Hill, however, is not mentioned. Edgerton does not promote the idea that Britain was more of a warfare state than a welfare state, rather that it was both, and his concern is with the relationship between the two. His final two historiographical chapters show how the history of Britain has been written from a civilian perspective, which has downplayed the role of the military and military institutions. He focusses on large technologies such as tanks to prove his argument—of which Britain was the leading power in the 1920s—and criticises histories of armaments and military technology for routinely excluding warships and aeroplanes (Edgerton, 2006, p.306).

The story of Dollis Hill supports Edgerton's view and adds another layer: telecommunications. There has been a recent interest in the importance of sensitive listening technologies in the First World War such as sound ranging and wiretapping. I shall show in Chapter 4 how Post Office researchers were heavily involved in the war effort and adapted pre-existing civilian technologies such as hearing aid transmitters in developing secret listening devices, thus showing the clear relationship between warfare and welfare state research. Edgerton demonstrates that the promotion of a more pacifist-seeming society during the interwar period stemming from political and cultural attempts to distance Britain from the evils of Germany's scientific warfare methods eventually lead to the invisibility of the warfare state: one example being how the Royal Navy, despite being a key British arsenal in the First World War, became a more of a "global policeman of trade" in 1930s school textbooks (Edgerton, 2006, p.276). This is also demonstrated at a micro level in the history of Dollis Hill: as I show in Chapter 6 whilst the GPO promoted its research into producing the "perfect" telephone for publicity, engineers at Dollis Hill continued to manufacture sound ranging devices on behalf of the military until the mid 1930s. On a more macro level, the infrastructure of telecommunications and the British state's control over it is another civilian infrastructure/military interdependency.

In Chapter 3 I explain the government takeover of the British telegraph and telephone systems and how as a result, it quickly gained a responsibility over a civilian technology and network. Patrick Joyce, a major historian of the British civil service, recognises that political and state histories have missed just how crucial the concept of "connectivity" is for analysing state control, and he uses the history of the British Post Office and the early history of communications to demonstrate this claim (Joyce, 2013, p.13). As he explains, this permeation of the state in everyday life through background infrastructure and symbols such as red GPO post-boxes, and the normalising of the technical expert in government decision-making lead to a "technostate-cum-warfare state" (Joyce, 2013, p.317). A major theme of my thesis is to demonstrate the dual role of Post Office research in enhancing a civilian service while supporting military requests, thus supporting an extended version of Edgerton's warfare state thesis and encompassing state infrastructure and "invisible" technologies of telecommunications. Primarily, this first account of the origins and establishment of Dollis Hill shows how the Post Office Engineering Research Station at Dollis Hill has been unjustifiably omitted from the literature of British state science and technology.

2.2 Histories of the GPO

Joyce (2013) is original in using the British Post Office as a model for his historical analysis of state control. Whilst the history of the Post Office as a supporting example has often been ignored or missed by historians such as those previously mentioned, similarly the research and engineering function of the Post Office has been overlooked by Post Office historians. For example, the only history dedicated solely to Post Office engineers is Frank Bealey's work on the Post Office Engineering Union, yet this work focusses on how the Post Office engineers negotiated pay and conditions in postal and telegraphic services, and mostly on front-line service workers such as technicians rather than behind-the-scenes researchers. 'Dollis Hill', therefore, is only mentioned once and only in passing as a Training School (Bealey, 1976, p.225).[10]

With the more general histories, the dual post/telecommunications functionality of the Post Office has led some historians to favour one over the other. There are four standard institutional histories of the Post Office: Robinson (1948), Daunton (1985), Perry (1992), and Campbell-Smith (2012). Robinson and Daunton both focus solely on the postal history of the Royal Mail and say very little, if anything, on telecommunications thus ignoring Dollis Hill completely. Perry writes on the governance of the Post Office and discusses the two nationalisations of the telegraph and telephone networks. He does cover the introduction of telecommunication technologies to the Post Office, such as the now more widely known account of the Post Office's Engineer-in-Chief and Electrician William Preece's championing of Guglielmo Marconi's long-range radio transmission inventions. However, Perry is more concerned with the wider bureaucracy of the Post Office rather than its workers at the system's coalface, and Preece's own researches are not mentioned nor any further developments made by Post Office engineers. Lastly, though its title suggests that it is another history solely on the postal service, it is Campbell-Smith's most recent authorised account of the history of the Royal Mail that actually references and introduces Dollis Hill as the Post Office's Engineering Research Station. However, Campbell-Smith skips over the early history of Dollis Hill in order to stress its connection to and involvement with the often-glamorised world of Bletchley Park and its code breaking activities. The history of the station's establishment and early years are summed up in just one sentence: "Originally founded in 1921 and greatly expanded by Kingsley Wood in 1933, it had already achieved a string of significant technical advances by 1939" (Campbell-Smith, 2011, p.343). Campbell-Smith's only reference for these technical advances is A. J. Gill's post-Second World War survey of the Engineering Department (BTA: POST

[10] Rachel Boon discusses the Dollis Hill Training School in more detail in her thesis (2020, pp.92-94).

56/115). He suggests that the vagueness of Gill's survey is due to the secretive nature of its war involvement and provides no further detail, instead proceeding directly to the story of Tommy Flowers and the building of the Colossus machine. Campbell-Smith does confess in his foreword that the book is "mostly about the mail services—though telephones before the establishment of British Telecom play a part in the story", and whilst it is understandable that writing a complete history of an institution that satisfies all interested parties is an almost impossible task, the repeated spelling error of an Engineer-in-Chief's name demonstrates a particular lack of attention to the Post Office's engineering element (Campbell-Smith, 2012, xxiii).[11] As I will demonstrate in this thesis, although the work of Post Office Engineering Department focused around its telecommunications technology, it also investigated how to improve postal efficiency through mechanisation and science.

As I have already indicated, the importance of Dollis Hill is often only given as the location for Tommy Flowers creating his Colossus codebreaking machine during the Second World War. The tantalisingly secret nature of the Colossus project that had been kept classified by the British government until the 1970s as well as other, later clandestine inventions have distracted historians from looking at what else researchers at Dollis Hill were doing both at the time and beforehand. Flowers features several times in Corera's work (2016) about spies and computers as the clichéd lone, struggling genius despite being able to assemble a team of 50 Post Office engineers to work on his project (Corera, 2016, p.30). Dollis Hill itself is introduced as a suburban "large, bureaucratic-looking brick building" containing eccentric characters and conservative colleagues (Corera, 2016, p.17). In Wright's salacious *Spycatcher* account, Dollis Hill in the 1950s is considered by him to be a "rather ugly Victorian building in North London" where work done on behalf of MI5 and MI6 occurred in basement rooms that were "dark and overcrowded, and thoroughly unsuitable" (Wright, 1987, p.46). Wright singles out another Dollis Hill lone figure, John Taylor, painting him as a Fleming-esque "Q" character who ran the secret basement laboratory that designed gadgets that could activate telephones through walls or improving upon hidden microphone technologies (Wright, 1987, p.47). Looking further back, there is then a large jump between accounts such as these and other more general secondary literature that feature Post Office telecommunications or its research engineers—back to the First World War. Hall (2017) has written a well-researched account of British military communication technologies used during the First World War which demonstrates the importance of human agency and behaviour in their development. The relationship between the British Army's Signal Service and the Post Office is of particular relevance: Hall shows how the Director of Army Signals, John Fowler, was particularly willing to seek out civilian expertise

[11] Engineer-in-Chief William Slingo is called "Sligo" throughout. This may be more a mistake on the editor's part than Campbell-Smith's.

in order to improve the British Expeditionary Forces' (BEF) communications systems. In early 1915, Fowler approached the head of the Design Section at the GPO—and future Engineer-in-Chief—Colonel Thomas Purves for assistance in providing new and specialist equipment for trench warfare. According to Hall, this was the beginning of an extremely important relationship, and by the end of the war, "Post Office methods and Post Office material were adopted as standard in the Signal Service, while the training of its personnel was very largely based on Post Office practice" (Hall, 2017, p. 58). Similarly, Ferguson (2012) uses first-hand accounts to show how crucial telecommunications—the severing and restoration of them—were for the Irish Post Office workers involved in the planning of the 1916 Easter Rising. The rebels cut the city's telegraph cables and planned on capturing the Central Telephone Exchange, and also sent out the first Irish radio broadcast to announce the declaration of an Irish Republic (Ferguson, 2012, p.63). As in the rest of Britain at the time, the Post Office was the largest employer in Ireland yet also had the reputation for being a power for the surveillance of Irish civilians by the British government (Ferguson, 2012, p.26). As a result, the Post Office was of particular importance to the rebels: the GPO building in Dublin became the rebellion's headquarters and its takeover was a powerful symbol of resistance.

Looking at the secondary literature cited above, there is significant gap of historical interest in the GPO and its engineers between the two World Wars, which this thesis shall address. However, an especially useful resource in demonstrating the range and scope of the interwar GPO is Crutchley's book from 1938. Although a contemporary source rather than recent work, it is useful to include here to show how a history of the GPO written in the 1930s includes Dollis Hill and the Post Office's research function as a vital element of the Post Office's wider workings. Crutchley describes the Post Office as a machine and explains how it works to a newly sprung up "mechanical-minded generation" (Crutchley, 1938, p.1). Four out of thirteen chapters are dedicated to telecommunications and the engineers that enabled it, meanwhile Dollis Hill is introduced as a place where "Post Office engineers live constantly and excitingly on the very edge of knowledge" monitoring new international developments in science which "must all be gathered and absorbed at the Dollis Hill laboratories" (Crutchley, 1938, p.181). He explains further how these developments are then fed back into and used by the Post Office for its service; in doing so he highlights the public benefits of inventions such as the photo-electric cell for 'TIM' the Speaking Clock and amplified telephones for the hard of hearing. Crutchley's work is in stark contrast to the recent, standard histories of the GPO, which have either focussed on staff employment conditions or the wider bureaucracy of the service; those histories have thus leant towards reporting on its postal functions over the more recent telecommunications history. This is perhaps down to availability and visibility of archival sources, though as Corera and Wright show, there is an interest in the secret nature of some Post Office research activities. Looking outside of the standard GPO histories we can see how Post Office telecommunications engineering had a greater significance for Britain and its empire than previously suggested. My thesis addresses the clear gap in the literature between the two World Wars. In Chapter 4 I build upon Hall's work to show how in particular the Post Office's Research Department and precursor to Dollis Hill contributed to the war effort. Overall, like Crutchley I demonstrate how this seemingly dull bureaucratic institution was actually a crucial location for innovation and strategic policy. A fundamental element of an institution is its staff and so the next section shall introduce the Post Office engineers and demonstrate how their story fits into the broader history of engineering.

2.3 Engineers, their identity and training

In Crutchley's *G P O*, in his chapter 'More About the Engineers', he explains how the launch of the Post Office's Engineering Department's research section and training school at Dollis Hill was closely linked with the boom of mass telephony and automated exchanges in Britain from 1919 onwards (Crutchley, 1938, pp.170-84). He stresses the importance and great extent of the department's function despite its invisibility, in terms of its geographical reach and amount of infrastructure to maintain as well as developments of specific technologies. The nature of these technologies meant that Post Office engineers who trained at Dollis Hill specialised in a 'niche' mixture of electrical science, materials, telecommunications technology and mechanical engineering. However, although he details statistics and costs, Crutchley rather cryptically brushes over the specifics of the training as "knowledge of the handling of complicated apparatus" (Crutchley, 1938, p.184). Since he is clearly not averse to explaining engineering complexities such as TIM the speaking clock, we might infer that he felt the need (or was advised) to exercise some discretion about the more covert aspects of the work of the engineers at Dollis Hill. Despite his silence and the difficulties of recovering full details of the training work at the Dollis Hill laboratories, in this section we can situate the role of the Post Office training regime in a longer-term trajectory of the evolution of engineering training over the previous century.

The establishing of such a specialist form of engineering at Dollis Hill directly relates to the emergence of other new specialised engineering sub-disciplines—which then required their own dedicated training—that developed over the course of the First World War and its aftermath: examples being aeronautical, automotive and radio engineering. This is in contrast to the launch of the Post Office Engineering Department itself in 1870, upon the peacetime nationalisation of the land telegraph network (Kieve, 1973, p.119). At least initially, the routine practice of installing and maintaining the country's nationalised telegraph system was learning mostly on the job in an apprenticeship scenario rather than dedicated training classes, as was the case for so much else in engineering practice.

In comparison, the university engineering degree programmes that had begun in Britain in the 1830s were a controversial intervention for a technological world in which training prerogatives had still yet to be formalised and agreed upon. Marsden and Smith (2005) explain how university courses for civil and railway engineering in the 1840s created friction against the disciplines' long-established apprenticeship and pupillage schemes for generating a new cadre of engineer (Marsden and Smith, 2005, pp.160-61). Debates between the two groups resulted in a not entirely comfortable symbiosis where on one side academia served to teach the broader systemic features of planning railway technology and new scientific developments, whilst on the other it was still necessary to learn the harsher practical challenges and tacit knowledge of engineering in situ. As Don Leggett (2015) shows, the conservative forces of the Victorian Royal Navy were often initially sceptical of the value of new engineering expertise, yet were still able to eventually accept and assimilate new technologies such as the high-power Parsons steam turbine after its efficacy was proven in successful sea-trials of turbine-driven boats (Leggett, 2015, pp.241-45). In the context of the gentlemanly practice of colonial railway engineering for the British Empire, Casper Andersen demonstrates how localised topographical and cultural challenges of tropical climes did little to damage the self-esteem of the Institution of Civil Engineers (ICE) in central London, who's council reserved the right to overlook the required academic achievements of potential members (Andersen, 2011, pp.87-112).

The ICE did not welcome the breakaway Society of Telegraph Engineers (STE) set up in 1871 to deal with the new and globally important specialist sub-profession of international submarine telegraphy, even though the civil engineers' training for bridge-building and railway-laying were very different to the requirements of training for international oceanic cable telegraphy. This new Society welcomed the telegraph engineers and professional electricians recently employed in the Post Office nationalisation of their industry. These practitioners were both military and civilian and would move frequently between the Post Office and military employment. Telegraphy was a rapidly developing technology with ever new techniques and instruments. In order to meet the need of the Post Office's new cohorts, the adventurous William Slingo set up a Telegraphists' School of Science in 1876 in the London Central Telegraph Office building to train the many disparate entrants into the field (Gooday, 1991, p.73). However, whole new forms of electrical engineering developed with the arrival of technologies such as the telephone in the late 1870s and the incandescent electric light in the early 1880s. These overshadowed the decades old practice of telegraphy to the extent that the STE was forced to add 'and Electricians' to its name in 1882, then change it completely to the Institution of Electrical Engineers in 1888.

As Gooday (1991) has analysed, the arguments for and against shop culture versus school culture was just as prominent in the training of electrical engineers as it had been for railway engineers several decades previously. William Ayrton partially resolved the discussion around the usefulness of the academic training of engineers through his efforts to create a practice at the Finsbury Technical College of only teaching that which could not be learned on the job, such as detailed measurements and diagnostic practices. It was on this basis that much of the training in new communication technologies developed: courses were short and often only lasted no more than a year in order to meet the demands of the fast-changing and rapidly-growing industries of telegraphy and later wireless telegraphy. Once the technologies of telegraphy, telephony and radio became widespread and internationally used in both civilian and military life, the old seven-year apprenticeships were no longer viable as the demand for specialist technicians grew. Even Sir William Preece, Engineer-in-Chief and Electrician to the Post Office who was himself apprenticed into telegraphy after a brief period of study with Michael Faraday, dedicated himself to ensuring systematic training for Post Office practitioners in the science and arts of telegraphy (Baker, 1976).

There is, however, no detailed account of how the Dollis Hill engineering cohort came to be developed—with the sole exception of Tommy Flowers, its most famous alumnus. Flowers, although an exceptional individual, was still a product of Post Office training. Instead of focusing on the now well-known case of Flowers, who is covered by both Rachel Boon (2020) and Jacob Ward's (2017) theses, my thesis will reconstruct the kind of research and specialist training environments in which the many other Post Office research engineers acquired and used their skills in developing and managing telephonic systems, their construction, automation, and monitoring. Overall I show how Dollis Hill Post Office engineering emerged as a specialist form of telecommunications expertise for the GPO, requiring dedicated new premises and training schemes beyond the Martin-le-Grand headquarters and with little discernible connection to the civil engineering elite discussed by Andersen. I will show how the experience of warfare shaped the demands of telecommunications as much as the nationalised telephone market; with Post Office discipline being combined with research on the most up-to-date communications techniques. We can thus see how the training and work of Dollis Hill engineers exemplifies Edgerton's 'Warfare State' thesis.

2.4 Openness and public relations

Although it is missing from current histories, the presence of Dollis Hill during the period this thesis covers was never kept hidden: contemporary newspapers and newsreels reported on its official opening in 1933, and even an article from Meccano magazine shows how the next generation of engineers were inspired and potentially recruited through stories of Post Office research "wizards" (Haydon, 1939). The 1920s and 30s are known for their visual culture as design and aesthetics became integral features of industry and company branding, and film became an increasingly popular medium enjoyed by the masses in public cinemas. This was especially characterised by the British Post Office at that time and there is a wealth of literature that demonstrates the public relations activities of the rebranded "GPO" and its firm place amongst British design and film history. For example, Paul Rennie's book on the posters of the GPO features as part of the 'Design' series that includes works on well-known designers and events such as Aleksandr Rodchenko and the Festival of Britain (Rennie, 2010). Rennie explains that due to the very nature of the Post Office's operations, the "public" that it needed to appeal to and serve was effectively the entire population of Britain and, during the interwar period, the Empire and Commonwealth. In order to grow its telecommunications network and gain subscribers, public relations became an essential consideration for Post Office management so that its services could be more widely understood and thus more appealing (Rennie, 2010, p.5). In Chapter 6 I will show that during the 1930s, the activities of the Research Department and the new facilities at Dollis Hill became advertising tools themselves, showcasing the efforts made to build reliable and investment-worthy telephones so as to attract new customers.

Numerous sources identify Stephen Tallents as the key figure in this history of Post Office marketing. Considered the father of modern public relations, Tallents was instrumental in rebranding the Post Office as a relevant and modern British institution through the use of posters, iconography and most importantly, film, and the GPO Film Unit, headed by Tallents, has an important place in the history of British documentary filmmaking. Scott Anthony has shown how Tallents had a particular enthusiasm for science—both in his professional and personal life—mostly in relation to his work at the Empire Marketing Board (Anthony, pp.16-17). He includes Tallents' pamphlet, *The Projection of England*, in full where he argues that England was responsible for communicating the results of scientific research to both the colonies and the dominions of the British Empire (Anthony, 2018, p.217). However, he does not make the link of this enthusiasm for science with his work at the GPO Film Unit, whose first film produced, *The Coming of the Dial* (1933) features the research laboratories of Dollis Hill in its beginning scenes. Timothy Boon's focus, in contrast, is on the science portrayed in British documentary films and so introduces the GPO Film Unit because of their new approach to represent modern industry, technologies and methods of communication (Boon, 2008, p.39). He explains how *The Coming of the Dial* demonstrates the Post Office's "neotechnology"; science-rooted technology that would transform and homogenise the world (Boon, 2011, p. 29). My thesis adds to both Boon and Anthony's work by pointing out the timing of *The Coming of the Dial* in relation to the official opening ceremony of Dollis Hill, which was also scheduled for

1933. I will show that it was not just Tallents who saw the potential of Post Office researches and the facilities of Dollis Hill as advertising tools. Rather, it was likely to have been Postmaster General, Kingsley Wood, who coordinated the "opening" of Dollis Hill as part of the rebranding of the Post Office. Despite it having operated for over a decade, Wood choreographed a filmed and broadcast ceremony involving Prime Minister Ramsey MacDonald—who had a scientific background himself and was a champion of British industry as part of his socialist vision—and invited reporters to visit and comment on the research activities of Dollis Hill.

However, not all of the activities of Post Office researchers at Dollis Hill made the public sphere. It is not surprising that the technologies Post Office engineers developed during the First World War—such as sensitive microphones, submarine detectors and sound-ranging devices—were not publicised; yet there are clear indications that subsequent peacetime researches and activities were kept out of the press by senior figures such as Wood. Brian Balmer has demonstrated that there are varying degrees of secrecy in the practice of scientific research that act as a form of control: secret science is not the same as open science done behind closed doors, rather it is the selective access to knowledge which creates confidentiality (Balmer, 2016, p.147). I will show that by releasing certain utilitarian projects to the public sphere—such as testing the durability of various materials used in making subscriber telephones—the Post Office was able to use this sense of openness to draw attention away from its other more sensitive activities. As such I argue that the Research Station itself was part of a plan to showcase the modernisation of the Post Office and the activities of Dollis Hill were selectively presented to the wider world, so that its presence and usefulness were known but not all of its missions.

2.5 Conclusion

Through setting out the context surrounding the history of Post Office engineering research, I have shown that despite its significance as the primary research establishment of the UK's largest state employer during the interwar years Dollis Hill has been overlooked by historians of state science. Its hybrid nature of both a military and civilian research establishment, as well as its multi-discipline training scheme does not fit well with histories such as Alter's and Gummet's. However, it is an important addition to Edgerton's more nuanced Warfare State thesis, which allows for a military influence on civilian research during peacetime Britain.

It can be argued that historians of the Post Office such as Robinson, Daunton, Perry, and Campbell-Smith have favoured other more obvious aspects such as the bureaucracy of the postal system or First and Second World War operations over interwar engineering research since they are more present in archival sources. However, not only is Dollis Hill not well documented but its prerogatives are also unclear. As I will demonstrate in Chapter 3 even within the Post Office the value of establishing a centralised research station was questioned by senior management. Crutchley's contemporary account written in 1938 can thus show how this apparently conservative institution was a crucial location for strategic policy and technological innovation during the interwar years.

An important element of Dollis Hill was that it eventually had onsite training facilities, but this was not part of its original pre-First World War rationale. The previous apprenticeship programmes and academic courses were unsuitable for the mass training of engineers required to maintain an increasingly developed telecommunications network. As warfare shaped the demands of telecommunications as much as the free market, once the permanent buildings were in place at Dollis Hill engineering recruits began a more formalised regime of military discipline combined with research on the most up-to-date communications techniques. Before this, new training recruits experienced a more informal in-between period of schooling whilst working alongside researchers in the temporary hutment laboratories. As such, Dollis Hill cannot be treated purely as a generator of Tommy Flowers' genius, rather he is a product of Post Office training. Using first-hand accounts I shall describe the working environment of the hutment laboratories and how this encouraged an adaptive and creative research ethos. These specialist issues have not been identified in any previous accounts of engineering and thus need a dedicated telling in this thesis, whilst Rachel Boon's subsequent thesis shall introduce the permanent Training School and its context (2020, p.92-94).

Whilst this thesis will mostly portray the public face of Dollis Hill, there are indications of more secret projects. However, the secrecy/open-ness dichotomy is too binary a concept to deploy here: Dollis Hill acted to shield strategic operations from public scrutiny and effectively to hide research in plain sight. Meanwhile, the public promotion of Dollis Hill was a useful advertising tool for Kingsley Wood, who used carefully selected projects to promote a rebranding of the Post Office as a reliable and future focussed service.

In summary, I have shown that the story of Dollis Hill is an important example of government science and research that has been largely ignored in literature. The chapters that follow will demonstrate that the early twentieth century Post Office was a major function of the British state, therefore one cannot understand the full scope of government research without also looking towards the now almost-forgotten Post Office research station at Dollis Hill.

Chapter 3.
Cultivating Post Office Research, 1908-1914.

> In writing about the activities of the General Post Office, it is difficult to know where to stop, or in that slaughter of the innocents which must always take place when space is not available, to decide who is to be spared. We certainly cannot leave out the Post Office engineer. He often works unseen and unappreciated by the general public, but he has this consolation, that he is indispensable, and in the Post Office of the future he may become the most important man in the service (Bennett, 1912, p.195).

3.1 Introduction

On 1st January 1912 the British Post Office took on its new role of operating most of Great Britain's telephone network, completing the state's control over the three communication enterprises: the post, telegraph and telephone networks. In the space of just over 40 years since its takeover of the telegraph network in 1870—a relatively short span of time compared to its centuries long history of operating the postal service—the Post Office had gained a well-established technological string to its bow, along with an Engineering Department to maintain it. It is not surprising that Edward Bennett's large tome on the history and operations of the Post Office, published in the same year as the telephone network transfer, bears a crest of a telegraph pole on its cover (Bennett, 1912). The image and activities of the British Post Office now involved wires and electricity as well as stamps and letters. As evidenced by his quotation above, Bennett identifies the Post Office engineer as an integral, albeit mostly invisible, member of its staff. His prediction that the engineer might become the most important man in the service reflects the feeling of the time towards the growing presence of machines in everyday life.

The aim of this chapter is to chart the development of a research culture within the Engineering Department of the Post Office, until the 1914 proposal to build a centralised research facility in Dollis Hill. The common narrative about the beginnings of Dollis Hill focuses on a 1914 visit to the research facilities by Charles Hobhouse, the then Postmaster General, who then initiated a scheme for a centralised research station. However, not much has been written about Post Office research before 1914. This chapter attempts to address this gap and argues that a research culture had existed for much longer than has been previously understood.

I begin with providing some context to the Engineering Department's formation, which also provides an explanation for the tense relationship between the Treasury and the Post Office.

Although he can be credited with helping to build a culture of research within the department, the Engineer-in-Chief and Electrician William Preece has a lasting legacy that eclipses other individuals who are just (if not more) important in establishing disciplined research as an accepted function of Post Office engineering. I shall identify these largely unrecognised individuals, namely Major O'Meara, William Slingo and Charles Hobhouse, and show how their respective backgrounds and ambitions shaped the Engineering Department and contributed to developing a culture of formalised research.

The year 1912 was a turning point for Post Office research due to the transfer of the telephone network to the state and the subsequent merger with the National Telephone Company's own research section. This added to the need for more space for an already cramped Research Section. Meanwhile, wireless telegraphy had become a high-profile pursuit and was the subject of a report laid before Parliament by the Committee of Wireless Telegraph Research. This added support for the idea of a separate research facility. The appointment of Charles Hobhouse as Postmaster General in 1914, having already been Chairman of the Committee, created a further opportunity for change.

I conclude this chapter with an explanation of how a figure such as Preece has taken much of the credit for the Post Office's research work whilst other key individuals have been largely forgotten until now.

3.2 The Post Office Engineering Department, 1870-1908

The Post Office's Engineering Department began life on 5th February 1870 upon the transfer of control of the inland telegraph network from private companies to the state. This state takeover had been proposed in journals as early as 1854 by academic social commentators who Kieve describes as "dissatisfied intellectual non-conformists", and engineers who were concerned by the amount of power held by the Electric Telegraph Company—the leading telegraph company of the time—and the high charges and delays faced by its customers (Kieve, 1973, p.119). Initially, action came from Scotland: in October 1865, a committee arranged by the Edinburgh Chamber of Commerce published a report on the telegraph system of Great Britain that compared the British system with those of the United States, France, Switzerland and Belgium. The report found that, based on population, the United States used three times the number of telegrams per capita compared to Britain. The other countries provided lower rates and wider reaching facilities, and all were run by the state. The Committee were of the view that, whilst all of these countries' postal communications were inferior compared to that of Britain, their telegraphic systems served their populations better. The Committee concluded that in order to progress as a nation and reassert its position amongst international competition, Britain needed to invest in its electrical communications. The Committee's conclusions inspired a series of petitions to the House of Commons supporting a plan to combine the country's post and telegraph systems under the Post Office's jurisdiction. Meanwhile, the Postmaster General instigated a report into whether the Post Office could feasibly control the telegraph network, and how cost effective such a purchase would be for the Government. The report, drafted by the Assistant Secretary to the Post Office, Frank Ives Scudamore, reported favourably on such a takeover, confidently concluding that the proposed transfer could happen without loss to the Government, and eventually turn a profit (Kieve, 1973, pp.119-37).

Understandably, opposition to the takeover scheme came from the telegraph companies themselves putting pressure on Members of Parliament (MPs). A concerned MP questioned how the Post Office, used to running the less technologically involved postal service, would administer a system "that it did not understand" (Hansard HC Deb. 21 July 1868). However, discussions in the House of Commons showed that there was general support for the scheme from all parties, believing that it was in the public's best interests. This debate reflected a changing attitude towards state control during the Victorian 'Age of Reform', which culminated in the Great Reform Act 1832. This Act had set a course towards greater enfranchisement of the population and a change in the distribution of political power towards a more administrative civil service.[12] By pushing for a Post Office takeover, fiscally-minded middle class MPs were using the state to further their own interests for a cheaper, more efficient telegraph system (Kieve, 1973, p.152).

The Telegraph Act 1868 became law on 31st July of that year. For the next two years, Post Office officials surveyed Britain's telegraph system and arranged for whichever was the leading telegraph company in a particular area to develop and extend its network to more remote locations, thus enabling more potential customers to use its service (Baker, 1939, p.5). Between October 1869 and October 1870, engineers installed roughly 15,000 miles of iron wire, 2,000 miles of gutta-percha covered copper wire and 100,000 telegraph poles (Fari, 2015). By the end of 1870 nearly 2,000 new telegraph offices had been opened in post offices all over the country, almost doubling the pre-nationalisation network.

However, this was not an entirely smooth process. Scudamore's report displayed some hubris and had grossly underestimated the cost of improving and extending the telegraph system. His financial naivety has been well documented in the secondary literature: Campbell-Smith dedicates a sub-section of his book to 'Frank Scudamore and the Telegraph Scandal' where he explains that the high stock purchase prices agreed between Scudamore and the five telegraph companies did not leave sufficient funds for the planned development work (Campbell-Smith,

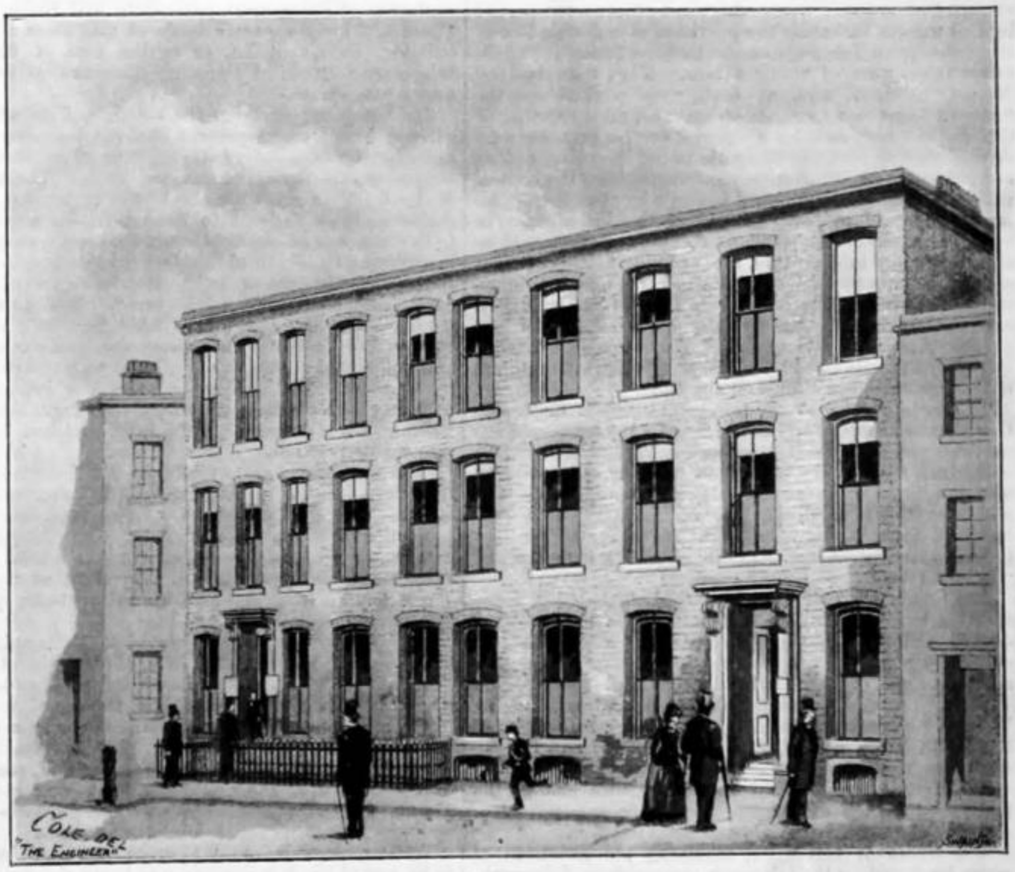
[12] See Burns and Innes (2003) for a recent historiographical re-examination of "reform" during the early nineteenth century that focuses on the origins of such political and social movements.

2011, pp.175-82). On top of this, generous contracts with the country's railway and newspaper companies meant that the Post Office missed out on much-needed revenue as their usage of the network increased. As a result, Scudamore twice approached the Treasury for large top-up loans, and resorted to illegally channelling funds from the Post Office Savings Bank and other various departmental accounts into the Telegraph funds. According to Kieve, this had important long-term consequences because it demonstrated to the Treasury that the Post Office could not be trusted to spend public money on technology and its infrastructure (Kieve, 1973, p.152). This episode provided the Treasury with a precedent against unguarded funding for the future engineering endeavours of the Post Office. As I will show later in this thesis, the mistrustful relationship between the Treasury and the Post Office would create an important obstacle for the establishment of the Research Station at Dollis Hill.

As part of the telegraph takeover, the Post Office employed most of the technical staff of the private telegraph companies to form its new Engineering Department in 1870. This led to the creation of a new post within the Post Office hierarchy; the Engineer-in-Chief. On 29th January 1870 the chief engineer of the Electric Telegraph Company, Robert S. Culley, who had previously reviewed the Government's telegraph takeover plan, became the first Engineer-in-Chief of the Post Office. Although a senior administrative position, Culley was clearly considered an expert in the field: his book, *A Handbook of Practical Telegraphy*, first published in 1863, reached at least eight editions (Culley, 1885). Culley set an early precedent for his successors to the position as being a technical expert as well as an administrator. Years after his retirement in 1878 Culley continued to take a technical interest in telegraphy as evidenced by having a letter published in a leading journal (Culley, 1895). This was not unusual and would become a trend for many of the succeeding Engineers-in-Chief as several of them embarked on consultancy careers after their mandatory retirement from the civil service upon turning 65. Whilst still Engineer-in-Chief, Culley continued to be an active member of the Society of Telegraph Engineers, even exhibiting inventions to the society on behalf of the famous engineer and entrepreneur, Thomas Edison (Anon, 1874).

The new Engineering Department, along with Culley, consisted of 108 inspectors and 374 mechanics and linesmen (BTA: POST 30/358B). Interestingly, the appointment of these new telegraph employees had an effect on the recruitment policy for the whole of the civil service. Four months after the nationalisation of the telegraph network, an Order In Council made open competitive examinations the basis for all further recruitment to the civil service (TNA: CSC 3/163). From then on any prospective employees, or current civil servants applying for a promotion, had to be tested by the civil service commissioners and deemed qualified for admission or promotion on probation. This was a considerable step towards a more meritocratic system and a move away from the old system of patronage and nepotism where many civil service posts were obtained by MPs for their own political supporters, often regardless of whether or not they were suitable for the job. As Frank Bealey notes in his history of the Post Office Engineering Union, the mass recruitment of suitably qualified engineers "signalised the acceptance by the Civil Service of entirely new values of efficiency and rationality. […] Patronage was giving way to meritocracy" (Bealey, 1976, pp.15-16). Bealey points out that in an argument over employment rights in such a meritocracy, Culley was at pains to stress that his linesmen staff were more than just day-labourers but were skilled in their own right with considerable technical expertise (1976, p.19; BTA: POST 30/262C). Correlatively however, Culley was also a strict disciplinarian towards members of his own department and advocated heavier-than-normal punishments for any Post Office engineers that breached the expectations of proper conduct in their highly skilled work. Culley's reasoning was as the engineers were often required to work in remote locations, any misdemeanours were therefore more able to escape the notice of their seniors. Culley drew up a list of suggested fines for various offences, however the Secretary at the time argued they only required reprimands (BTA: POST 30/262C).

The Post Office's telegraph takeover occurred before suitable government accommodation was ready to house the equipment, administration staff and the new Engineering Department. Initially the new department operated from the Electric Telegraph Company's Telegraph Station on the aptly named Telegraph Street in central London, near to the Bank of England (Figure 3.1).



CENTRAL TELEGRAPH STATION, TELEGRAPH STREET, 1873

3.1—An artist's rendition of the first Central Telegraph Station as it appeared in 1873 (Anon, 1891).

In 1870 the Post Office commissioned the architect James Williams to design a new building. It was to be built opposite Post Office Headquarters on St. Martin's le Grand and in keeping with the grandiose neo-Classical style favoured by Robert Smirke, a prominent architect of the Government's Board of Works who designed many major public buildings including the façade of the British Museum, and the Post Office headquarters building in 1825. This new building would not only house the new telegraph section but had to accommodate the registered-letter business, the Money-Order Department, and the Savings Bank as well as new accommodation for the Postmaster General and various officials and their staff (Anon, 1870). It opened in November 1874 as the Central Telegraph Office Building, later to be known as GPO West (Figure 3.2).

3.2—The Post Office's Central Telegraph Building or 'GPO West', circa 1874 (BTA: TCB 475/ZE/ZE12).

3.3 The Experiment Book and the self-promotion of William Preece

It was almost 40 years after the creation of the Post Office's Engineering Department in 1870 when the Engineer-in-Chief Major O'Meara oversaw the restructuring of the department in 1908 to include a designated Research Section. However, there is evidence to suggest that a tradition of research work existed long before. As I have discussed in the previous chapter, for the purposes of this thesis I consider "research" to include the testing of technologies as well as investigations into its redesign, manufacture and the scientific principles of its workings. This means that although certain activities would not have been labelled as "research" by future Post Office engineers, I argue that anything considered to be "testing", "investigation" or "experiment" work should be considered forerunners to the department's systematic research activities.

In his 1927 book on the Post Office, the Secretary to the Post Office Evelyn Murray admits a sombre picture of telegraph finance but credits "the progress of electrical invention" with helping the system to keep afloat (Murray, 1927, p.76). Duplex technology, where telegraphic messages could be sent simultaneously in opposite directions along the same wire became commonplace after 1870 and was soon superseded by quadruplex and multiplex systems.[13] It is uncertain how much original investigation work the staff from the new Engineering Department carried out on these technologies under Culley. He was known to have been initially dismissive of duplex technology and was later ridiculed by the mathematician and physicist Oliver Heaviside for considering it "impractical" (Hunt, 2005, p.59).

The earliest evidence of systematic research in the Post Office dates back to 12th June 1878, which was after Culley had retired and four months into the appointment of Edward Graves as the Department's second Engineer-in-Chief. This date is derived from an experiment book held at the BT Archives which holds notes on experiments that were mostly carried out by engineers Matthew Cooper, William Preece, William Brown, Harry Kempe and James Taylor on a range of technologies including circuitry, transmitters, induction coils and receivers (BTA: TCB 556/1). It is not a personal notebook: the later additions of an alphabetical index and pages cut from a notebook of Cooper's suggest that staff used it as a work of reference. All of the five entry-makers of the experiment book reached senior positions of the Engineering Department, with Preece becoming the Post Office's third Engineer-in-Chief in 1892. Kempe is present in the 1907 photograph of superintending engineers (Figure 0.1). Taylor is known for his involvement in the 1912 'Marconi Scandal' when he was discovered to have invested a large sum of money in shares of the Marconi Company. Questions about his employment were asked in the House of Commons and he was subsequently demoted but ultimately reached a regional superintending engineer position. William Brown was a first-class staff engineer who served on the Telephone Valuation Committee from 1908 to 1911. Less is known of Cooper, although papers show he worked closely with Preece in investigating long-distance telephony whilst the latter was Engineer-in-Chief (BTA: TCB 556/2).

Preece's earliest entry in the experiment book is 21st June 1881, by which time he would have been an Assistant Engineer-in-Chief to Graves (BTA: TCB 556/1, p.11). Compared to the others' entries, Preece's notes are succinct and methodically ordered according to a suggested "order of entry": date, those present, object of experiment, apparatus used, observations made, and inferences therefrom (BTA: TCB 556/1, p.7). As a result, the rest of the entries of the book become much more structured and formalised. This suggests that it was Preece, as Assistant Engineer-in-Chief, who initiated a more organised attitude towards investigations. His entries in the experiment book can be used, therefore, to show the early years of a research culture within the Post Office.

The experiment book contains another indicator of the beginnings of a different tradition within Post Office engineering. On page 32 is the first reference to a 'Press Copy Book'. The entry's author, William Brown, indicates that a more detailed report of the system that he was

[13] For a useful description of duplex systems and their development, see Andrew Wheen (2010, pp.22-24).

investigating (in this instance, crossing wires on telephone circuits) exists in the Press Copy Book, dated 5th January 1885. This suggests that, under the auspices of Graves, Post Office engineers were keeping abreast of technological developments reported in newspapers or journals, which could also be an indication of how the Post Office engineers at that time decided on what to investigate. Recorded instances of inventors presenting their devices or writing directly to the Post Office have already been the subject of historical study: Coreen McGuire (2016) has investigated how deaf and hard-of-hearing telephone subscribers presented their own modified telephones back to the Post Office during the interwar period. However, this entry in the experiment book is the earliest indication of Post Office research engineers using the press as a source of inspiration. The relationship between the Post Office and the press, and the use of newspapers by senior officials of the Engineering Department is a consistent theme throughout this thesis.

The last dated entry of the experiment book is an investigation into a 'Kilduchevsky transmitter' from July 1899 (BTA: TCB 556/1, p.130). This means that Preece and other Post Office engineers continued to contribute to the experiment book throughout Preece's appointment as Engineer-in-Chief from 1892 to February 1899. Preece is nowadays most well-known amongst historians of technology for using his influence as the engineering representative of the British Post Office to promote Guglielmo Marconi's wireless telegraph system and, alternatively, to play down the work of Oliver Heaviside (Arapostathis and Gooday, 2013(a), pp.141-75). Any contributions that Preece himself made to the field of wireless telegraphy have been eclipsed by Marconi's subsequent fame. However, as Elizabeth Bruton has demonstrated in her thesis (2012), several Post Office engineers, fronted by Preece, independently experimented with and trialled wireless systems from the early 1880s.

Upon his promotion to the position of Engineer-in-Chief, Preece insisted upon the addition of the word 'Electrician' to his title (Bruton, 2012, p.51). At this time, the term 'electrician' had a pluralistic meaning involving "many kinds of electrical practice, technological and otherwise, embracing new kinds of electrical technology as they appeared" based on the image of Benjamin Franklin as the ideal (Arapostathis and Gooday, 2013(b), p.203). By officially describing himself as an electrician and thus invoking the legacy of Franklin in his role, Preece signalled the value of scientific investigation to improve technological performance, making himself—as head of the Post Office's Engineering Department—a figurehead for these responsibilities. Preece was known to have been an excellent orator and presented hundreds of papers on the Engineering Department's behalf about the research he and others produced, becoming a celebrity amongst engineering circles and beyond. For example, Elizabeth Bruton in writing her thesis found instances of Preece recording the various experiments and investigations that he had done personally: after his retirement, his name was struck through and replaced with “the Post Office”. Nevertheless, he received a knighthood upon his retirement in February 1899 and continued as a government consultant.

Subsequent Engineers-in-Chief and their subordinates do not have the profile that Preece achieved both in life and posthumously. After his death, a Post Office engineer and historian, E.C. Baker wrote an almost hagiographical biography about Preece which further contributed to Preece’s reputation (Baker, 1976).[14] However, it would be wrong to suggest that Preece’s status was unearned even if he had an unconventionally high profile for a civil servant. His short-term legacy included the additional role title of joint Engineer-in-Chief and Electrician which continued for the next two appointees to the post; John Hookey in 1899 and John Gavey in 1902, who had both previously been his assistants (Bruton, 2013, p.138). By contrast, his long-term legacy was the recognition of the importance of systematic research as a function of the Engineering Department and raising the publicly perceived profile of the Post Office and its staff as agents for scientific progress.

3.4 Reporting on research

The experiment book would not have been considered an official departmental record, and whilst it is a detailed resource for the type of research work that Post Office engineers were doing, it does not show how this work fitted in with the Engineering Department’s other activities and responsibilities. For this bigger picture I have looked into the annual general reports of the Engineer-in-Chief, copies of which are held at the Postal Museum’ Archives dating from 1893 to 1967 (PMA: POST 76). These reports were written for the Postmaster General, who would not necessarily have had an engineering background or an understanding of the science or technologies involved. As a result, the Engineer-in-Chief’s reports provide clear and succinct summaries of the Department’s activities without delving into much technical detail and jargon. By assessing the reports as a whole, the Department’s growth and the changing emphasis of what the Engineers-in-Chief chose to report on can be mapped and identified.

Alongside technical innovation, a tradition of systematic testing of instruments for quality control purposes is evident from the earliest report for the year ending 31st March 1897. This took place in the Electrician’s Room at the Post Office’s Instrument Factory in Islington, north London, where “the employment of a carefully devised scheme of testing ensured that no fault of any kind could escape detection”. Supervision from Headquarters staff was necessary as “the working conditions have been so various and so complex that any development which had

[14] For a list of Preece's main lectures and papers see Baker (1976, pp. 355-62).

not been carefully checked by someone thoroughly conversant with all the details could not safely be issued". The factory tested over 105,000 instruments that year (POST 76/15).[15]

In addition, early reports refer to international research collaborations as well as military commissions, which indicates that activities of this nature clearly have a history longer than has been previously credited. The 1897 report tells of experiments carried out in collaboration with officers of the German Telegraph Administration on the Bacton-Borkum cable "which showed that the increased margin for adjustment resulting from the new type of core adopted led to an improvement in the working which amply confirmed the theoretical anticipations." The first instance of a project commission by the War Office appears in the report for the year ending 31st March 1898 under "Position Finding and Command Lines" (PMA: POST 76/15, 1898, p.18). This report also mentions experiments on wireless telegraphy apparatus (PMA: POST 76/15, 1898, p.17) as well as "an extremely ingenious Electrically-driven Quarter-minute Telephone Clock" invented by one of the engineering officers (PMA: POST 76/15, 1898, p.12).

By 1900 the reports to the Postmaster General contain sections titled "Investigation & Experiments", initially just within the sections on telephone technology (PMA: POST 76/15, 1900, p.8). As already noted, Preece retired as Engineer-in-Chief in February 1899, therefore it was his successor John Hookey who was the first Engineer-in-Chief (and Electrician) to report on research as an element distinct from the rest of the Department's activities. In 1900 this section included mention of tests of transmitters sent in to the Post Office by members of the public. Wireless technology was still an important investigation, in particular, "experiments with forms of receiving apparatus other than that patented by Marconi … and a promising amount of success has been achieved" (PMA: POST 76/15, 1900, p.20). This suggests that the Post Office was actively trying to find alternatives to the Marconi Company which was at that time the dominant force in the wireless technology market. On 28th November 1902, by which time it would be John Gavey as the Post Office's fifth Engineer-in-Chief and Electrician, a separate special report on wireless telegraphy was written for the Postmaster General. This was likely a briefing for the newly appointed J. Austen Chamberlain who had been promoted to Postmaster General less than two months before.

Overall, these reports provide evidence of the Engineering Department's increasing focus on research. For example, the frequency of the use of the word "experiment" increases over the years and the reports themselves become longer: the 1897 report is 19 pages long; by 1904 it is 55.

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[15] One of the themes of the Post Office's increased publicity and 1930s advertising campaigns was its policy on thoroughly testing the resilience of its manufactured products. I discuss this in Chapter 6.

The year 1904 is often given as when Post Office staff were specifically allocated to research work and provided with accommodation for research purposes at the department headquarters building, GPO West, on St. Martins-le-Grand (Panton, 1984, p.1). The source for this date is never referenced and might be stated in error as 'Experiment Room' reports, describing experiments undertaken at the GPO West building date back to before 1901 and end in 1908 (BTA: TCB 710/72-111).[16] However, the set of engineering reports that do start at 1904 were instead produced by the privately owned National Telephone Company (NTC) that was based at Telephone House. As I shall describe further on in this chapter, the question of a state takeover of the telephone system had been raised by then, with Parliament agreeing in 1905 on the eventual merger of the two institutions. In 1904 Post Office staff therefore were allocated to work alongside NTC researchers in anticipation of the planned takeover in 1912, which is the likely source of confusion. However, it is not clear from the reports from 1904 whether the experiments were conducted by Post Office or NTC staff.

What these reports to the Postmaster General demonstrate is that the research being conducted by the Engineering Department was being reported on long before there was a designated research section, which came about in 1908, and even before the quoted allocation of Post Office staff research in 1904. Together with the experiment book discussed above it is clear that research was an important part of the Engineering Department's activities not long after it was founded in 1870. This is further supported by the international collaborations that were undertaken in addition to commissions for the War Office: two strands of work that demonstrate that the research being done by the Engineering Department was significant and taken seriously beyond the Post Office.

Research was clearly a well-established activity of the Engineering Department before the 1912 takeover of the NTC telephone system. However, as with the transfer of the inland telegraph network in 1870, the added responsibility of NTC takeover presented a major challenge not only to engineering administration but also to technical improvement and research.

3.5 Major O'Meara and the establishment of the Research Section, 1908.

The first mention of a designated research section of the Engineering Department appears in the Engineer-in-Chief's Annual Report for the year ending 31st March 1908: "a research section has

[16] It is not known when these reports first started being produced as a note from 1901 states that earlier reports had been missing for several years. They have never been found.

recently been established and a great deal of experimental work carried out which promises good practical results” (PMA: POST 76/17). Within this same report year on 16th April 1907, Major Walter O’Meara became the sixth Engineer-in-Chief to the Post Office. O’Meara is a figure who hardly appears in the literature on Post Office history, however his appointment is an important turning point for the Engineering Department and its research activities. As I shall show in this section, he left a lasting mark on the organisation and encouraged a more disciplined and structured approach to research, which was down to his extensive military background and years of experience in senior colonial administration positions.

One of the earliest indications of O’Meara’s reorganisation is the separation of the titles of ‘Engineer-in-Chief’ and ‘Electrician’. As I have mentioned earlier, William Preece insisted on the additional title of Electrician when he headed the Department 15 years earlier, and the two subsequent Engineers-in-Chief carried on the tradition. Instead, on 1st August 1907 Harry Kempe had his role title changed from ‘Principal Staff Engineer’ to ‘Electrician’ and the term was removed from the ‘Engineer-in-Chief’ title (‘A. J. S.’, 1912, p.503; Anon, 1907).

Kempe was one of the authors of the aforementioned experiment book and can be seen sitting to the left of O’Meara in the Superintending Engineers group portrait (see Figure 0.1). Although it was not a promotion, the act of further distinguishing Kempe was perhaps a strategic move for O’Meara, who initially faced opposition from staff when he was first appointed to the Post Office as an Assistant Engineer-in-Chief in 1902. Kempe was a hugely popular figure: there are records of lengthy applauses after his being introduced at departmental dinners and a particularly emotional seven-page tribute to him on his retirement describes his “quality of loveableness” as his outstanding characteristic (‘A. J. S.’, 1912, p.498). For O’Meara, whilst giving Kempe his new title might have been a popularity tactic, there was also no real need to emphasise the technical interests and responsibilities of the role of Engineer-in-Chief. Unlike Preece, O’Meara seemed not to have engaged in any scientific or technical experiments of his own but performed a more supervisory role. His projects and papers were on large-scale infrastructure, such as investigations into submarine and underground cables and the telecommunication systems of other countries. As a result, the role of Engineer-in-Chief became a purely administrative and project management position.

With the launch of the Research Section, it was under O’Meara that one of the most useful sources for this project came into being; the *Post Office Electrical Engineers’ Journal* (the *POEEJ*). Its history might also be a reason as to why O’Meara was chosen to be Engineer-in-Chief, despite his initial unpopularity. According to his obituary, O’Meara recognised that a request for Post Office engineers to form their own society had the makings of becoming a trade union, which would have had the potential to destabilise the Engineering Department and, possibly, the rest of the Post Office because of the prospect of collective bargaining and industrial action. O’Meara managed “with great skill and tact” to handle this request and instead of suppressing it, he suggested and encouraged the formation of an association focussing on scientific and technical achievements ('T. F. P.', 1940, p.712).[17] As a result, the Institution of Post Office Electrical Engineers formed in June 1906, with Gavey as the then Engineer-in-Chief, as its first President. It was perhaps this insight and diplomacy of O'Meara's that secured his succession as Engineer-in-Chief.

In 1909, a year and a half after his appointment as Engineer-in-Chief in April 1907, the first volume of the quarterly *POEEJ* launched as the Institution's official mouthpiece. This approached research as an integral part of Post Office engineering—the first specific mention of the work of the Research Section occurs in the October 1909 issue in a paper on the degradation of bridging-coils (Addey, 1909). The proposed aims and readership of the journal were ambitious: the foreword to its first issue suggested that there were five concentric circles of readership with the last being "all inhabitants of this world who are interested in telegraphs or telephones" (Anon, 1908).

Whilst O'Meara was Engineer-in-Chief, the very first "Research Branch Report" was published on 24th February 1910 (BTA: TCB 422/1). This likely coincided with the relocation of the Experimenting Room to another location within GPO West. An experimenting room had been in existence in the basement of GPO West since at least 1902 and this is likely to have been a renaming of Preece's basement workshop, where he conducted his experiments on circuitry and wireless telegraphy.[18] The building, however, was not designed as a research centre. The basement area was originally 15 feet tall and also had to accommodate stores and two steam engines that powered the building's pneumatic communication tubes (Anon, 1870). In 1909 after a trip to the United States, O'Meara had installed a working Strowger automatic telephone exchange for engineers to study and so conditions became even more cramped.[19] Although being

[17] The movement to form a trade union of Post Office engineers did not die. The Post Office Engineering and Stores Association (E&SA) had been in existence since 1901. Before then however, a series of Parliament select committees investigated Post Office engineers' wage grades and various Engineers-in-Chief, beginning with Culley, were summoned to comment. After the nationalisation of the telephone network the Amalgamated Society of Telephone Employees merged with the E&SA in 1915, becoming the Post Office Engineering Union in 1919 (Bealey, 1976).

[18] There are at least four reports from 1902 of telephone tests involving a London-based experimenting room and Post Office equipment (BTA: TCB 710/89; 90; 106; and 108).

[19] The Strowger automatic exchange was the first commercially successful electromechanical telephone switching system. It was invented by an undertaker from the United States whose business was suffering because the wife of a competitor was a telephone operator who redirected calls towards her husband's company. Almon Strowger's invention did away with

situated in one of the Post Office's headquarters buildings would undoubtedly have had some advantages, given its proximity to the other parts of the organisation, the central London location came with problems beyond being cramped. For example, vibrations caused by traffic would interfere with delicate measuring equipment. A solution was to suspend certain instruments: various instruments such as reflecting galvanometers were attached to square felt-covered platforms that were then hung using thick rubber bands from brass supports at each corner. According to Addey, writing in the *POEEJ*, "this arrangement [had] been found to overcome all difficulty arising from vibration caused by traffic" (Addey, 1910, p.3).

Figure 3.3 provides a plan of the Experimenting Room in 1910. It is notable that the telegraph experimenting table is centre-stage and dominates the space. In comparison, the telephone experiment table is less than a quarter of the size and placed out of the way. It is also worth noting that there is a chemical bench and a fume cupboard that would have been used for chemistry experiments; this suggests that the Post Office did not need to rely on the Government Laboratory for some experiments that involved chemicals. For example, there are records of tests of chemical fire extinguishers in 1904 and a chemical analysis into the colours uses in switchboard wires and cables in 1906 (BTA: TCB 710/133; TCB 22/T249). The Experimenting Room was therefore a place where niche work was done and appears from the plan to have used virtually all of the space available. As the *POEEJ* put it in 1913, the Research Section was undertaking "special investigation work, in association with other sections concerns" and carried out "important quantitative tests" (Anon, 1913).

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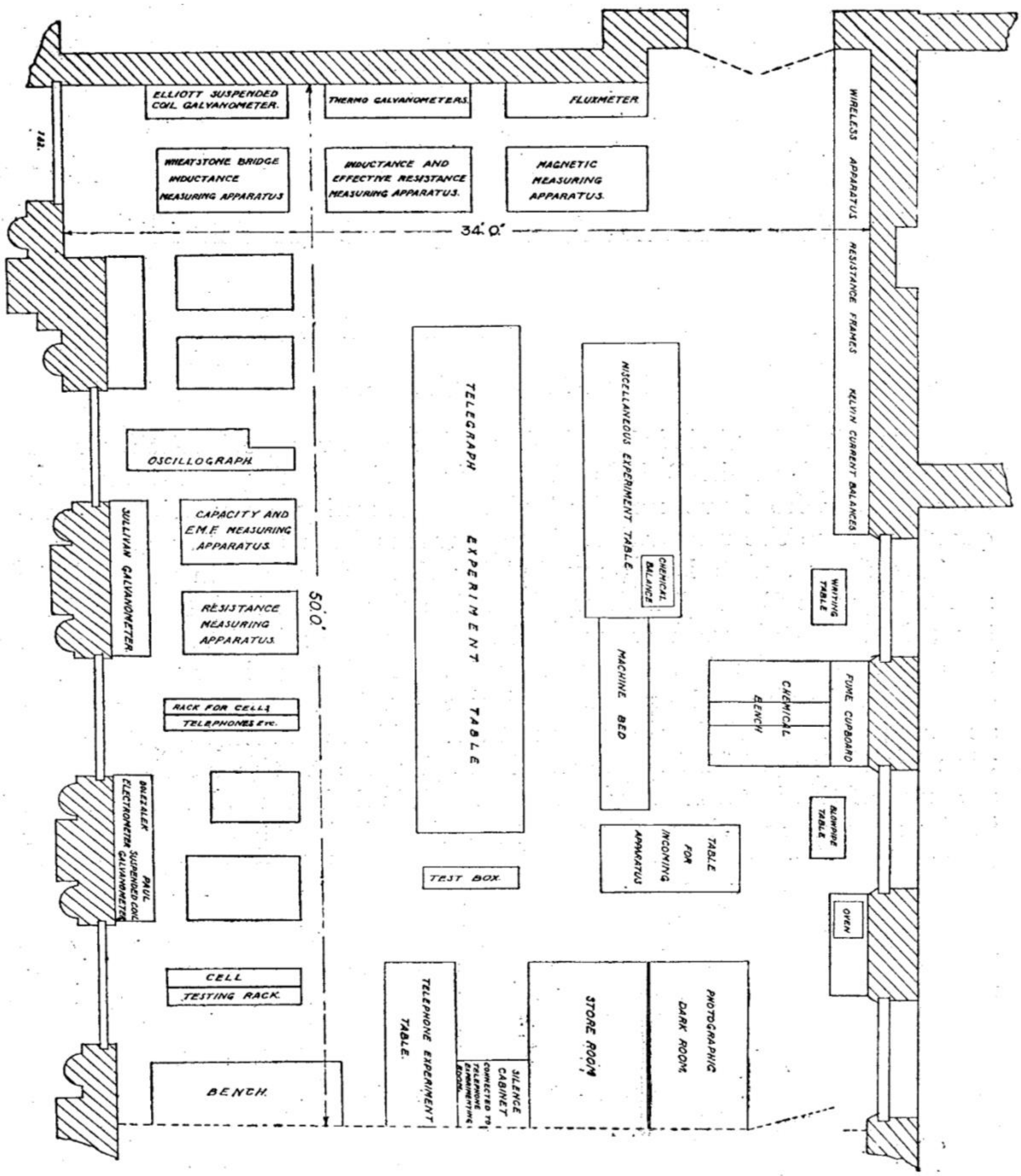
the need for telephone operators: as such the Post Office would have been interested in a technology which had the potential to save them money through automation over wages.



3.3—Plan of the new Experimenting Room, showing the layout of apparatus, 1910 (Addey, 1910, p.2).

O'Meara appreciated the value of organised administration and the legacy of his Post Office career demonstrates this. For example, as an Assistant Engineer-in-Chief he codified the regulations of the Engineering Department into one single publication (BTA: POST 30/1624C). In 1909 he moved the K Signal Company of the Royal Engineers (of which he used to be a member) from the south of England to the south of Ireland as there was more suitable terrain for telegraph training (BTA: POST 30/3693, 22 May 1915).[20] Perhaps also due to his military intelligence background, O'Meara recognised the importance of wireless telegraphy and oversaw the opening of the Post Office's own wireless telegraphy station at Bolt Head, on the south coast of Devon, in December 1908 (BTA: TCB 276/4).

His frustrations with the attitudes of the British civil service towards engineers and its stifling bureaucracy are somewhat evident in his report of his trip to North America in 1909. Speaking at the seventh annual dinner of the Engineering Department, O'Meara announced that he felt that the success of the American telephone and telegraph systems were down to the organisation and the power of administration possessed by their officials (Anon, 1910). He stressed how many of these officials had been engineers themselves and so it was in every engineer's best interests to develop their own administration skills. His report on his trip, published in the *POEEJ*, included diagrams of the staff structure of organisations of several telegraph and telephone companies (O'Meara, 1910). He was impressed with how even very junior staff at Bell Telephone Company in particular were given their own responsibilities, which would foster a "spirit of enthusiasm" and "broad-mindedness" so that "high administrative talent is developed to perfection" (O'Meara, 1910, pp.106-7).

O'Meara's approach to technological developments appears to have been to focus on what other countries were doing in relation to their telecommunications infrastructure. His view was that there might be valuable lessons in learning how other countries were tackling the same sorts of problems faced in Britain. However, despite writing a series of reports on the telegraph and telephone systems of European countries and his trip to the United States, O'Meara was faced with a civil service that was marked by a sense of stasis and underlying opposition to change. In the end, this inertia frustrated O'Meara to the extent that he resigned as Engineer-in-Chief in 1912. After his resignation he appeared before a Select Committee in Parliament and was asked why he resigned. The following is taken from a report of the proceedings,

> Giving evidence before the Select Committee on the condition of the telephone service, Lieut. -Col. O'Meara, formerly Engineer-in-Chief to the Post Office, gave as his reason for relinquishing the post the fact that he could not achieve any useful work in the organisation as it then was.
>
> He had come to the conclusion that the Department's methods were fundamentally wrong. He attributed the main defects of the system to the attempt at combining under the direction of a single permanent head, the Secretary of the Post Office, three such diverse undertakings as the Post Office Savings Bank, the postal service, and a highly

[20] Being of Irish heritage, this might also have been a more personal request of O'Meara's.

> technical business such as the telegraphs and telephones. Other contributory causes were the over-centralisation of control, and considerable duplication of work, the poor status of the technical officers, and the failure to recruit for the engineering department men of sufficiently high technical education and attainments. In general, he advocated the separation of the telephones from the Post Office, and their administration by a board as in Sweden (Anon, 1921).

O'Meara's complaints of the organisation of the Post Office were wide-ranging and he made a specific complaint about the calibre of the staff of the Engineering Department. As a result, it is unsurprising that O'Meara has been regarded as an unpopular Engineer-in-Chief. It may be that his unpopularity, combined with a lack of tangible new innovations from the Engineering Department during his tenure, has resulted in his role being overlooked by the secondary literature. However, a description of the Post Office's developing research culture would be incomplete without referring to O'Meara's contribution. Without him the Institution of Post Office Electrical Engineers (and its important publications) may not have materialised. In addition, he moved the role of Engineer-in-Chief towards a more administrative and supervisory role. Whilst his role may have been previously overlooked, it is clear that O'Meara did have an important influence in the development and, crucially, administration and formalisation of a culture of research within the Engineering Department.

3.6 William Slingo and the National Telephone Company merger, 1912

Following O'Meara's resignation, William Slingo was promoted to Engineer-in-Chief. By contrast to the militaristic and unpopular O'Meara, Slingo was a popular Post Office man who was held in high regard by his colleagues. He had risen through the ranks from the position of telegraph clerk and was mostly self-taught: during his late teens he is recorded to have "attended lectures by Tyndall, Huxley, Frankland and Guthrie and made full use of the South Kensington museum and library" ('E. H. S.', 1935, p.898). His Obituary Notice records that,

> the facilities for technical education were very meagre, but with his characteristic energy and ability he applied himself to the acquisition of general scientific and engineering knowledge and, in particular, to such electrical engineering knowledge as was available at that time ('E. H. S.', 1935, p.898).

At the age of twenty-one he founded the "Telegraphists School of Science" within the Post Office. It started with five students and twenty years later had over 850. As a result of the School, when the Post Office launched a rapid expansion of the trunk telephone system in 1894 a large number of technically-trained qualified men in the Central Telegraph Office were immediately available for transfer to the Engineering Department to perform this urgent task. Slingo was a remarkable autodidact as during this time he also became head of the Electrical Engineering Department of the People's Palace where he also installed their electric lighting (now Queen Mary University of London) and head of the Electrical Department of a residential school in Kent. On top of this he was a consulting engineer for several companies.

Slingo entered the Engineering Department of the Post Office in 1898 as a technical officer and brought with him considerable knowledge of electrical engineering developed through his eagerness to learn, and then later teach, the subject. He went to Liverpool as superintending engineer in 1903, returned to London as Assistant Engineer-in-Chief in 1911, and was appointed as Engineer-in-Chief on 1st March 1912 following the resignation of O'Meara.

On his appointment Slingo would have had to deal with the 1912 merger with the National Telephone Company (NTC), which had officially amalgamated with the Post Office two months before his appointment. This was a massive undertaking. The Post Office inherited 9,000 new employees, 1,500,000 miles of wire, and 1,565 telephone exchanges. As a result, added stimulus was given to research into telephonic communications. The Post Office had been accused of suppressing previous investment into the telephone industry by prioritising its telegraph network because it owned it completely (Campbell-Smith, 2011, p.265). In addition, as the NTC knew as far back as 1905 that it would eventually be bought out by the state, it had no incentive to push forward its technical development. This meant that by 1912 the British telephone system was years behind international standards.

The poor reputation of Britain's telephone network is reflected in Bennett's 1912 book on 'The Post Office and its Story' which seems to have been written to appease and hopefully inspire the public who would otherwise have been disgruntled with the service provided by the Post Office. Bennett explains that he is attempting to "give the reader the impression that the Post Office is alive, that it is in close touch with the needs of the nation, and is in less danger of being strangled with red-tape methods than at any time of its existence" (Bennett, 1912, v). Bennett himself is a mystery figure: he does not write from his own personal experience and his author's note suggests that he is not employed by the service when he refers to being indebted to its staff. He also does not claim to be a serious historian and in his writing it is clear that he is very nostalgic of the “old romance” of the Post Office’s past of mail coaches and postboys.[21] However, he is keen to stress the humanity of the Post Office “worked not by machinery but by human beings” (Bennett, 1912, p.346). His concluding remarks hint at the frustrations felt by some towards what he labels “the system” and its “red tape” (a sentiment that O’Meara would have probably agreed with).

These frustrations were not new. In 1877 Alexander Graham Bell approached the Post Office with the offer of exhibiting his telephone to the department, hoping that it would adopt the technology and construct a network of exchanges. Culley, the Engineer-in-Chief at the time, could not see much commercial value in the telephone and refused Bell’s proposal on the basis that the future use of such a technology would not be sufficient to warrant such a scheme. This is an example of what Douglas Pitt identifies as a dualism in Post Office policy towards the telephone throughout the end of the century: “early on the realisation developed among certain cadres that an expansionist Post Office policy was required encompassing the possibility of wholesale nationalisation. But alongside there existed a more restrictionist outlook, largely based on a policy of protectionism towards the telegraph” (Pitt, 1980, p.26). The latter view prevailed for many years.

As previously noted, the process of nationalising the county’s telegraph system was not a particular success: it was marked by financial mismanagement and the misuse of public money that resulted from Scudamore’s poor estimates of the costs involved (Hemmeon, 1912, p.215). Once a merger with a private company like NTC happened, the Post Office’s internal culture worked to hinder the development of the telecommunications service. As Pitt explains, a laissez-faire attitude to organisational change permeated the Post Office (as it did in other areas of Victorian Britain) and that,

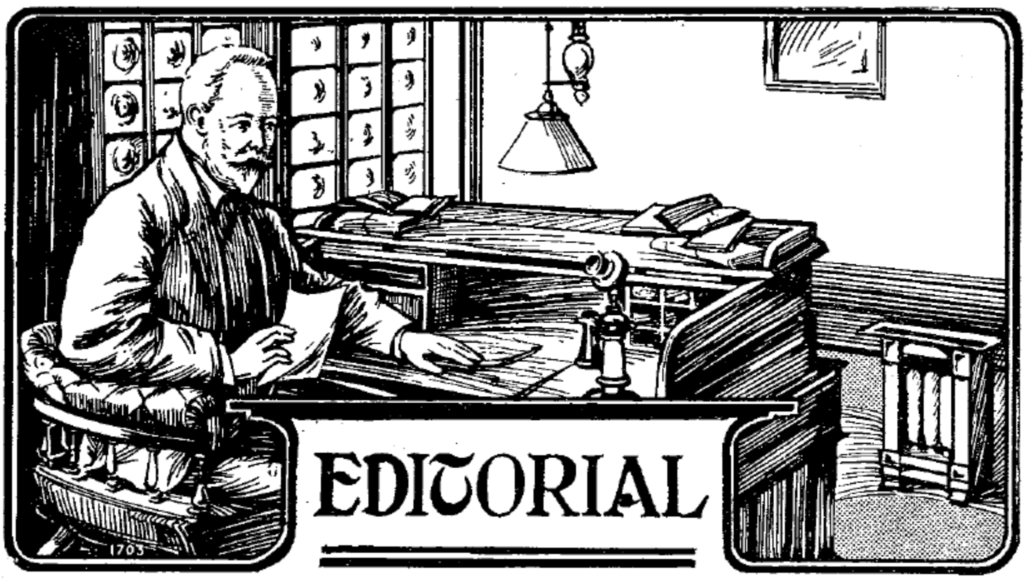
> …the resulting conservative and over-cautionary approach to telephone problems produced bad habits in the top echelon of the department, inducing it to seek the solace of ‘mechanistic’ organisational procedures in favour of a more open ‘organic’ management system. Such a process led to the encouragement of two endogenous problems which were to plague the Post Office for many years to come. First, it was pervaded by too high a degree of administrative centralisation; secondly, there was a linked failure to recognise that, while a bureaucratic organisational structure might be consistent with good management practice in a labour-intensive function such as posts,

[21] Bennett also wrote a book aimed more at older children titled, *The Romance of the Post Office. Describing in an interesting manner the working of the British Post Office* (1919).

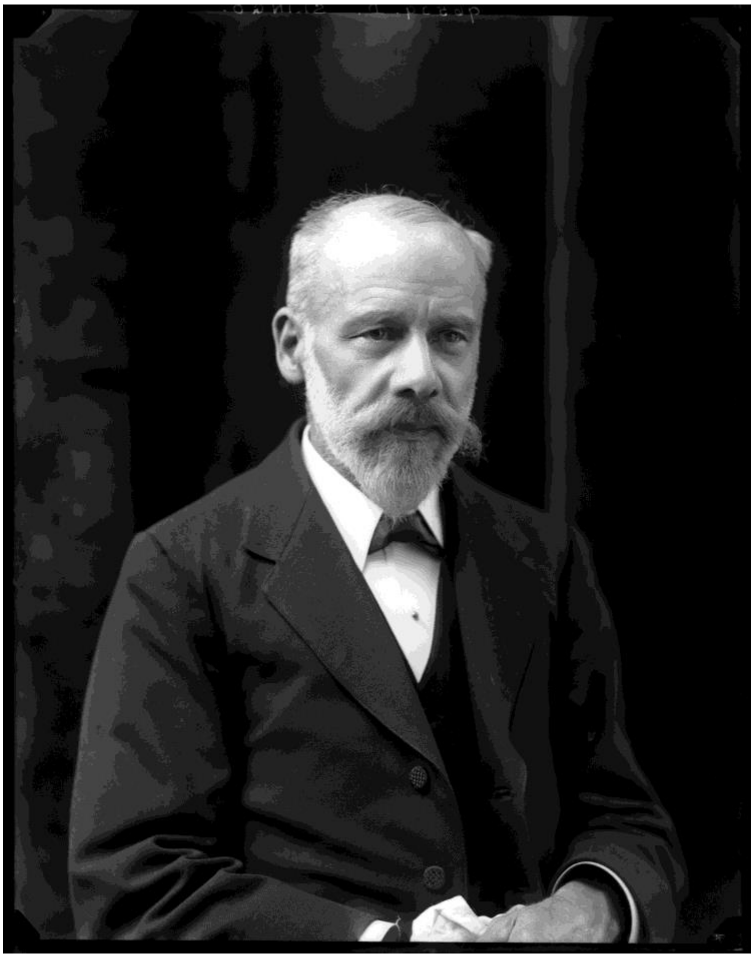
> it might be inadequate and ultimately prejudicial to sound administration in a growing capital-intensive function such as telecommunications (Pitt, 1980, p.41).

This approach appears to at least partly explain the resignation of O'Meara and, given his background and attitude, almost certainly would have frustrated Slingo. Even though both men have different reputations and legacies, it is reasonable to assume they would have had a shared view about how the Post Office handled the nationalisation process and the development of the telephone network. This is because both men were passionate advocates for developing new engineering solutions to the problems raised by the nationalisation process. As noted previously, O'Meara had researched ways of improving the service through his trip to the United States and Canada for four months in 1909 and visiting several telephone organisations. The next year, as an experiment, he initiated the installation of a Strowger automatic exchange in the basement of GPO West for the research section to monitor (Liffen, 2012, p.214).

Slingo's status was recognised in rather more high profile ways. For example, there is a cartoon in several editions of the *POEEJ* from 1912 onwards that bears an uncanny resemblance to him with his distinctive beard and moustache (see Figure 3.4).



3.4—A possible rendition of William Slingo as newly appointed Engineer-in-Chief (Anon, 1912b).



3.5—Photograph of William Slingo, 1919, © National Portrait Gallery (Stoneman, 1919).

Slingo received a knighthood in 1915 and was the only person to receive the honour whilst still serving as Engineer-in-Chief. In 1919, the year he retired, he was photographed as part of a series of important British individuals for the National Photographic Record (see Figure 3.5).

Slingo's obituary notice credits Slingo with facilitating the merger with NTC and says that he "was mainly responsible for the compilation of the inventory and valuation of [NTC's] plant, taking a leading part in the arbitration proceedings relative to the acquisition of that plant by the State" ('E. H. S.', 1935). However, when it came to the merger of the NTC's research station it proved impossible to physically merge this new acquisition with the Post Office's research section due to insufficient space at GPO West. As a result, NTC research staff were forced to remain working where they were on the fourth floor of the Telephone House building on the Embankment. Telephone research therefore had to be split between the two sites. This formed a key part of the argument that Slingo would later make for a dedicated centralised research station.

3.7 Charles Hobhouse and the Committee on Wireless Telegraphy Research

As Engineer-in-Chief, Slingo reported directly to the Postmaster General; until 1914 this was Herbert Samuel, who was then replaced by Charles Hobhouse. Though Hobhouse was primarily an establishment politician—he had been the Liberal MP for East Bristol from 1900—he had a reputation for management and administration of the Post Office before he was appointed to Postmaster General. More unusually, he had a recognised technical understanding and a keen interest in wireless telegraphy. In 1906 he had been appointed chair of the Government Select Committee of Inquiry on the Post Office to "enquire into the wages and position of the principal classes of Post Office servants" (Middleton-Smith, 1931, p.80). In August 1913 he chaired the Committee of Wireless Telegraph Research which had been set up by Samuel to investigate wireless telegraphy of which Slingo was an expert member (Hansard HC Deb., 19 March 1918). The Committee was a source of pressure for better research facilities that came from outside the Post Office. Its terms of reference were to consider the extent to which the state should support research into wireless telegraphy. Hobhouse was chair until his elevation to Postmaster General in 1914. He can therefore be considered an outside influence who put pressure on the Post Office to improve its technological outputs.

The topic of wireless telegraphy was particularly important given its potential to provide new modes of communication for both the state and the public, as well as the prospect of radically changing how the country's infrastructure might operate. The potential applications of wireless telegraphy for military and naval communications was clear ever since Guglielmo Marconi's first patent on Hertzian-wave telegraphy was accepted in 1897. However, Marconi's patent was thorough enough to give his company a monopoly on most wireless systems yet invented. Since 1903 the Post Office was accumulating reports and papers on foreign advances in the field, including the French 'Lepel' and 'Rouzet' systems, Italian 'Galetti' system, and the Czechoslovakian inventor Johann Saçek's device for preventing interception in wireless. Some inventors approached them directly in the hope that their system would be bought.

In May 1914, the Committee laid its report before Parliament. To compile the report, the Committee conducted two inquiries. The first concerned the current state of the country's research capability. The Committee noted the role of the Admiralty and the War Office but also highlighted the role of the Post Office's Engineering Department and said,

> Valuable work in the way both of experiment and research has for some time past been and is now being done in the Engineering Department of the Post Office. Such department, however, is sometimes hampered by insufficiency of funds, and the matters

> it investigates are unavoidably such as have an immediate bearing on service problems rather than on the principles which underlie wireless telegraphy on its scientific side (Farrer, 1914, p.3).

The second inquiry undertaken by the Committee was into how the United States and Germany were approaching their research into wireless telegraphy. Both countries were found to be making much "more liberal and extensive" provision in terms of funding and facilities for their research than in Great Britain.

Around the time of Hobhouse's appointment as Postmaster General on 11th February 2014, he and Henry Norman visited Berlin in February 1914 to investigate the approach being taken to wireless telegraphy. A scandal almost arose in relation to this, because it was claimed in legal proceedings brought by the Marconi Company that Hobhouse had visited Berlin to encourage the Telefunken Wireless Company to come to England in order to start a rivalry with the Marconi Company. In a statement to the House of Commons in March 1918, Hobhouse denied the allegations (Hansard HC Deb., 19 March 1918). In doing so he mentioned that Slingo had suggested the trip to Berlin as "the German Administration is the only one in which any serious effort has been made to investigate systematically the problems of telegraphy and telephony by means of a Research Department." Hobhouse describes visiting a Telefunken wireless station in Nauheim, where it was claimed that they were able to wirelessly communicate with Togoland (Hobhouse describes this as "a complete fiasco. But I spoke on the wireless telephone to Boulogne and was heard well enough."). Hobhouse then says something rather curious,

> When I came back to this country I initiated a considerable scheme for research in wireless telegraphy on behalf of the Post Office. I bought a site, drew up plans, and obtained the leave of the Treasury to spend a considerable sum of money. All that, of course, came to an end with the War (Hansard HC Deb., 19 March 1918).

If Hobhouse is referring to Dollis Hill, he rather oversimplified the process. Whilst there was an agreement in principle to purchase the land that was reached before the First World War, the land was not actually purchased until after the War. Nevertheless, Hobhouse's statement shows that he was convinced that a new research station should be part of the Post Office rather than a separate institution.

This is slightly different to what was recommended by the Committee of Wireless Telegraph Research. The Committee recommended that a National Committee for Telegraphic Research should be formed which would "coordinate and supplement" the research currently being done into telegraphy, as well as direct the activities of a new National Research

Laboratory. A very similar function would later be performed by the Department of Scientific and Industrial Research (DSIR) which was established in 1916 (see Chapter 2). It seems that Hobhouse was persuaded that the new research laboratory should form part of the Post Office, but that he reached this conclusion after his time on the Committee and after his trip to Berlin.

In detailing its proposed scheme, the report is clear that any members of the proposed new Committee should generally not "give advice connected with telegraphy or telephony to any commercial firm" and the President of the Committee may need to "acquaint himself with the nature of [any] advice" given by a member of the Committee to a private firm or individual; and the Committee had the power to request such a member withdraw from discussing matters of which he or she might have an interest. There was clearly a concern that the new Committee should not be used as a vehicle to further help firms such as the Marconi Company: the underlying theme of the Committee's report is how the country can develop its own wireless telegraph network particularly in light of the failure to agree a contract with Marconi in 1912 because of allegations of corruption and insider trading.[22]

In terms of the new National Research Laboratory, the Committee suggested a site at the National Physical Laboratory in Teddington. The report says that "arrangements should be made for erecting and equipping at the laboratory the necessary new buildings and plant" and estimated the running costs to be £4,800 a year, with an initial capital expenditure of £7,300. The report makes the point that even with these costs, the amount of funding would still be significantly less than in the United States or Germany. The Committee then finishes the report by suggesting that a certain amount of "interim work" could be undertaken whilst the proposed scheme was being implemented and the necessary laboratories built.

However, because of the intervention of the First World War, the implementation of the scheme was not to happen. Nevertheless, it is a good example of the increasing value that was being placed on wireless research; an acknowledgment that other countries were more advanced in their researches and that Britain needed to catch up. At the core of the proposals was a new site dedicated to telegraphic research. It is interesting to speculate whether Slingo's suggestion to Hobhouse to visit Berlin was a tactic to demonstrate to Hobhouse the value of a research department that was embedded within an organisation, in that case, the Telefunken Company. With Hobhouse's appointment to Postmaster General, Slingo would have had opportunities to informally press the case for a Post Office research department with a dedicated site.

[22] For an interesting description of the Marconi Scandal and the role of anti-Semitism in the episode, see Kenneth Lunn (1978).

3.8 Sam Pollock and the Dollis Hill proposal

The first written evidence for the idea of establishing a separate, enlarged research facility for the Post Office is a letter dated 19th March 1914 (BTA: POST 121/347/1/5-8). It was written by the telegraph engineer, Sam A. Pollock, at the instigation of Slingo. Little is known of Pollock other than that he became head of the Research Branch after Harry Kempe's retirement, and eventually Staff Engineer in charge of Dollis Hill. An anonymous memorandum recounts a few amusing anecdotes about him including the fact that he often communicated with a colleague, also an ex-telegraph engineer, in Morse code (BTA: BT1-CEN15/4/3: Anon, 1985, p.3). Slingo specially commissioned Pollock to propose a viable solution for accommodating research so it is safe to assume that Pollock was senior enough at this time to have had an understanding of the facilities that would be required by a combined team from GPO West and the NTC (BTA: POST 121/347/1/5). His letter begins:

> In accordance with your instruction I have considered various means of providing accommodation for the Research Section of your office to enable the staff which at present is divided between Telephone House, Victoria Embankment and the General Post Office (West), to work together under more favourable conditions and to take in hand the large number of outstanding problems affecting efficiency of plant which urgently call for attention, but which cannot be dealt with under existing conditions for want of room. The impossibility of extension within the General Post Office (West) has been so obvious for years that demands for further Research accommodation have not lately been made except for the purpose of combining the Staff.

This letter confirms the point that William Slingo had been frustrated by lack of space for some years and that the need for new accommodation was exacerbated by the addition of the NTC staff.

Before describing the details of his proposal in his letter, Pollock took care to stress just how important and necessary adequate space was for Post Office research. His particular concern was how the lack of space at GPO West prevented the department from experimenting with "heavy or bulky telephone exchange equipment" on site. The Strowger telephone exchange installed by Major O'Meara was serving the Post Office staff and therefore did "not provide an opportunity for investigating the efficiency of design or construction of new systems or apparatus unhampered by traffic conditions." To push his point even further, Pollock included a list of other lines of investigation that required considerable amounts of space. Pollock claimed that his scheme "would provide accommodation for dealing with every telegraph and telephone problem which … has any importance to this Department". As a final push, he made sure to explain that "if adopted in its entirety" his scheme would be economically rewarding, as "even slight improvements in efficiency of apparatus" of the telecommunications networks of the United Kingdom would more than justify the cost (BTA: POST 121/345/1/4).

It was Pollock who first identified the site in Dollis Hill, northwest London, as a suitable location for building the research station. His reasoning for choosing suburbia rather than the city centre was mostly based on economic considerations: as well as the land itself being much cheaper to buy, the building could be simpler and plainer in design if built in a suburban or rural site as it would be less on show. Pollock also considered the need to balance "the essential feature of accessibility" with finding a place "free from vibration and noise of traffic".[23] He explains that as the Dollis Hill site was five miles from both GPO West and Charing Cross station, transport to the site from GPO West would take 40 minutes by train on the Metropolitan Railway, or 30 minutes by taxicab. Pollock considered this commute satisfactory "for frequent visits on the part of … officers to witness the results of experiments in progress". The site had "an elevation of about 240 feet" and was located within "a superior and healthy neighbourhood" (BTA: POST 121/345/1/5). Pollock made private enquiries about the price of land without revealing that he was acting on behalf of the Post Office. Considering eight acres to be sufficient for the Post Office's outdoor experiments, he estimated the approximate total cost of purchasing the land and building the site at £55,215. The proposal included a set of plans with a possible arrangement of office, laboratory and workshop buildings.[24]

About two weeks after Pollock's letter Slingo took over the initiative and sent a letter on 3rd April 1914 to the Secretary to the Post Office. In order to emphasise the importance of the plan, Slingo begins his letter by recounting an earlier visit the Postmaster General made to the experimenting rooms of the Research Section. According to Slingo, upon "noticing their very crowded condition and the very inadequate facilities for conducting the experimental and research work of the Department [the Postmaster General] requested that a scheme be prepared and submitted for making better and more ample provision for the work". Like Pollock, Slingo stresses how the scheme would be an investment opportunity, mentioning one example in particular of how recent research conducted by the department had resulted in a 50 per cent increase in cable efficiency: "this great advantage is obtained at only a very small factional additional cost". Slingo went on to explain that the lack of sufficient space restricts further promising experiments in the field "until those at present being dealt with have been disposed of" (BTA: POST 121/345/1/7). Slingo continued his letter by paraphrasing Pollock's original

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[23] As I have argued in Chapter 2, this is a recurring theme in the setting up of laboratories and scientific institutions: see Jon Agar (1998) and David Cahan (1989).

[24] These have since been lost.

proposal, only adding that the testing and chemical work carried out at the Mount Pleasant sorting office could also transfer to the new laboratory.

Before sending Slingo's letter on to the Treasury for approval, the Secretary passed it on to the head of the Telegraph Branch, Arthur Bingham Walkley, for his opinion on the matter.[25] Walkley make three points in reply: firstly, his understanding of the process of Post Office innovation was that the telegraph research department's role was to "examine the results of other persons' experiments, that is to encourage inventors rather than itself to invent". Secondly, he though the present facilities for this were adequate. Lastly, the new research facility was not needed for the evaluation and testing of cables, as "extensive tanks [had] been constructed for storage purposes at Woolwich" and the testing of the cables in any case, took place "partly at the Contractor's works and partly after the cable has been laid" (BTA: POST 121/345/1/12-13).

Walkley's rather negative response might be explained by the prevailing Post Office culture that tended to resist change or perhaps by his apparent lack of interest in his role as a civil servant. According to his obituary in the *Times*, he did not seek further promotion, preferring to put his energies into a parallel career as a drama critic (Anon, 1926). In addition, Walkley's attitude might indicate that the research culture of the Engineering Department had not filtered through to the rest of the Post Office. However, he did recommend that the proposal be forwarded to the head of the Telephone Branch, W. Ogilvie, for his comment. Ogilvie's reaction was much more positive. He replied to Walkley the same day saying that he had already discussed the proposal with the Secretary, who had agreed that it should be put to the Treasury in a slightly modified form. Ogilvie reduced the estimate of the total costs to £31,000, and suggested that some of it (half, if not two-thirds) might "be charged to Telephone Capital" (BTA: POST 121/345/1/13). On 12th May 1914, the Secretary drafted a proposal to the Treasury, based on Slingo's recommendations and in Hobhouse's name. However, before the final submission, several alterations were made, most noticeably on the inclusion of the discussion of wireless telegraphy.

It is remarkable that in previous correspondence, Slingo and Pollock made no mention of the fact that the Engineering Department was also carrying out research on wireless telegraphy at this time. Slingo had been on the Committee of Wireless Telegraph Research that Hobhouse

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[25] Secretaries to the Post Office were senior civil servants who were not expected to have a scientific background, and so he might not have had the confidence to evaluate the proposal himself. In addition, the Secretary at this time was (Sir) Alexander F. King, who, according to Campbell-Smith, was not enthusiastic about his promotion to this position as he "[had] no ambition and [was] naturally lazy; at any rate mentally" (Campbell-Smith, 2011, p.200, footnote).

had chaired in 1913 to discuss wireless telegraphy and its applications. Hobhouse had to resign chairmanship after being appointed Postmaster General but had visited Berlin soon after his appointment on the recommendation of Slingo in order to investigate Germany's wireless research facilities.[26] In a note dated 15th May 1914, Hobhouse suggested adding the results of the Committee (Farrer, 1914), which was by then led by Lord Parker, to the proposal for Dollis Hill. On 2nd July, the Secretary submitted the final version of the proposal to the Treasury in which the subject of wireless telegraphy appeared even before any mention of telephones (BTA: POST 121/347/1/24-29). Referring to the Committee's findings, the Secretary stated that:

> There is urgent need of further experiment and research in matters of general principle, some of which can only be studied in a laboratory, while for others a fully equipped telegraph or wireless station is necessary.

Three weeks later the Treasury replied indicating that the cost of the building work was too expensive and questioned the relationship between the proposed research establishment and the National Physical Laboratory's own wireless research interests at Teddington, southwest London (BTA: POST 121/347/1/30-31). This suggests that there was a debate as to whether research actually would be better done at the NPL.[27] However, they were willing to fund the purchase of the land valued at £3,200. On 30th July 1914, the Engineering Department sent a letter to the Office of Works at the request of the Treasury to inspect the site and offer their advice (BTA: POST 121/347/32-34).

Five days later, war was declared with Germany.

3.9 Conclusion

In this chapter, I have explained that the Post Office's Engineering Department was originally formed in 1870 as the result of the merger with the Electric Telephone Company. However, the merger was troubled with scandal arising from the Post Office's mismanagement of public money, including Scudamore's illegal appropriation of money to fund the project. The

[26] This was the aforementioned visit that later gave Hobhouse trouble. The Marconi Company accused Hobhouse in 1919 of surreptitious dealings with Germany's Telefunken Company in order to undermine the Marconi monopoly on the wireless network.

[27] The relationship between Dollis Hill and the NPL is not clear from the sources I have looked at, however it has been suggested to me that at times it was quite fraught due to the overlap of each institution's researches. This could form the basis for further research (see Section 7.4).

consequence of this was that the Treasury became particularly reluctant to provide money to the Post Office for engineering developments.

Not long after the foundation of the Department, there is evidence of research work being undertaken. The first example of this is the experiment book that was used from 1878 which recorded a range of experiments and tests that were performed in a systematic way. This is supported by the various reports produced by the Engineer-in-Chief which show that from at least 1897 research was recognised by the Engineering Department as being worth raising with the Postmaster General. With further reports there is a greater emphasis on the Department's research work which indicates the increasingly important role research began to play as part of the department's overall output. This demonstrates that the claim made by Panton that research by the engineering department started in 1904 is false (Panton, 1984, p.2).

William Preece is often considered to be mainly responsible for developing the Engineering Department's approach to research. This is not wholly untrue, as his contributions to the experiment book demonstrates—his methodical approach seems to show how research ought to be done within the Department. However, the role of Major O'Meara and William Slingo are often overlooked when the history of research within the Engineering Department is discussed. O'Meara oversaw the establishment of a dedicated research section in 1908 and encouraged the formation of the Institution of Post Office Electrical Engineers, which particularly celebrated the research work done by the department. He focused on the administrative aspects of running the Engineering Department and can be credited with introducing a more structured and disciplined working style. He pursued change following his researches into how other countries managed their telecommunications, however, his tenure as Engineer-in-Chief was cut short by his resignation in response to the intransigence he encountered when trying to implement his ideas. In my view, O'Meara's resignation is a reason why his role within the Engineering Department has been forgotten since for many there was little to celebrate about his contribution. However, as I have demonstrated, it is strongly arguable that the reverse is true.

William Slingo's role at Engineer-in-Chief was initially to oversee the merger with the National Telephone Company. He encountered a problem that had become a consistent theme since the formation of the Engineering Department; a lack of space and unsuitable accommodation. The building the department was based in—GPO West—was shared with numerous other parts of the Post Office. Even though research was recognised as an important enough activity for a move into larger accommodation within GPO West in 1910, the central London location came with vibration interference problems. The lack of sufficient space became much worse with the merger in 1912 with the NTC and resulted in the department being spread out over a variety of locations. This coincided with increased interest in wireless technology and encouraged expansion in Post Office research work.

This led to Slingo beginning to advocate for a single, purpose-built site for the research work being done by his Engineering Department. An important prelude to any concrete proposals was the report by the Committee on Wireless Telegraphy Research, on which Slingo served. The report that was published in 1914 recommended that a new research laboratory should be set up that would be overseen by a committee dedicated to wireless telegraphy research. It was clear that the idea for a new research site had a consensus amongst the Committee, but Slingo appears to have wanted any new laboratory to form part of the Post Office. I suggest that Slingo's encouragement to Hobhouse to visit the Telefunken Company in Germany was an attempt to persuade the Postmaster General of the value of telecommunications research being conducted by a telecommunications service provider.

After the Committee's report, the timing seemed right for Slingo to begin to make representations within the Post Office and then to the Treasury for a new research site for the Engineering Department. Slingo's assistant, Pollock, had found a suitable site in Dollis Hill for this purpose. This location was chosen for its transport convenience, but also it was far enough away from central London that interference both physical, and possibly administrative, would be less of an issue. After some refinement of the argument, the proposal was submitted, and the Treasury issued a qualified response. At this stage, in the middle of 1914, everything seemed to point in favour of the Dollis Hill plan progressing, but then war broke out and the project stalled.

Chapter 4.
Putting plans on hold. The Post Office at War 1914-1918.

> Many problems arising out of the War and involving much Research work have been referred by the War Office and Admiralty to this Department for consideration, and notwithstanding the very limited laboratory accommodation at our disposal we have succeeded in many cases in obtaining excellent results (BTA: POST 30/4304A, 1919, 'Research').

4.1 Introduction

This chapter looks at the how the First World War affected William Slingo's plans to build a centralised research station in Dollis Hill. As I have described in Chapter 2, it is a consistent theme in what has already been written about the early history of Dollis Hill that the First World War was disruptive to the plans to build a centralised research station. I begin this chapter by showing that war was given as a reason for not progressing Slingo's proposal and so his repeated attempts to secure Treasury funding between 1914 and 1918 were ultimately unsuccessful. Along with it not being a priority for the Treasury, which was concerned with the war effort, there was also no operational need for larger Post Office research facilities. It was also not a priority for Post Office administration that now included the new Secretary, Evelyn Murray, who even though he was reportedly a champion of technological development, ultimately gained a reputation for being bureaucratic and obstructive to change. Slingo's approach of emphasising the Research Section's less-than-adequate facilities in order to persuade Treasury officials to support the plan would ultimately backfire. Since he was also keen to stress how well the Engineering Department was meeting wartime demands, this approach provided the Treasury a straightforward counterargument: as the Post Office engineers were clearly able to perform well under exceptional circumstances, there was no need to invest in better facilities given that these pressures would lessen once the war was over and life returned to normal.

The centenary of the First World War has renewed a general interest into the experiences of those involved both directly in battle and on the Home Front, and the Post Office had a huge operational role managing British communications both at home and abroad. However, the role that Post Office researchers made has not been yet been fully investigated. As I will demonstrate in the middle section of this chapter, the Engineering Department acted as consultants to the War Office, Admiralty and the newly formed Royal Air Force, who all asked the Department's researchers to investigate a wide variety of projects that were often highly secret. The technological developments that came out of these projects have not yet been written about or if they have—such as the invention of the Fullerphone—the Post Office's involvement is often ignored. I shall present two contrasting case studies of military projects that depended on the work of Post Office research engineers: the hypersensitive transmitter and the hot wire microphone. Whilst some projects such as the hypersensitive transmitter have understandably never before been investigated by historians due to their confidential nature, not all of these developments were kept secret: the hot wire microphone, developed by Sam Pollock and a team of Post Office researchers in order for it to be mass-produced and able to withstand trench warfare conditions, was written about in national newspapers as an example of British technological success and superiority. This is the first time that these technologies have been studied in an academic context and they reveal the variety and importance of Post Office research as part of the war effort.

In the final section to this chapter, I shall discuss how the overall experience of the First World War affected Post Office research. As I have shown in Chapter 2, the First World War is often overlooked as having as large an impact on British science and technology compared to the Second World War. However, recent literature on the 'listening' element of trench and submarine warfare has raised the profile of the First World War as an important factor in British technological developments during the first half of the twentieth century (Bruton and Gooday, 2016; Bruton and Coleman, 2016; Judkins, 2016).

4.2 Plans on hold

On 30th July 1914, the Secretary of the Post Office, under the direction of Postmaster General, Charles Hobhouse, sent a memorandum to the Office of Works summarising the situation regarding the purchase of land for a new centralised research station (BTA: POST 121/345/2). As it stood, the Treasury had written to the Secretary a week earlier granting permission in principle for the Government to purchase the Dollis Hill site (BTA: POST 121/345/2). However, even though the letter reported the good news of the Treasury's approval, there is a definite sense of urgency in the Secretary's message to the Office of Works. It is brief and to the point, and ends with a request to arrange an inspection of the Dollis Hill site to decide whether it was suitable or not, urging them to prioritise this task "as the risk of the site being otherwise disposed of is considerable". In anticipation of a successful inspection, the Secretary then asks if the Office of Works would nominate an agent to negotiate with the landowners so as not to disclose the Government as being the prospective buyer. Five days later, on 4th August 1914, Britain officially declared war against Germany.

The Secretary's request for speediness is therefore understandable considering the tense international political situation. Their concern about losing the site could be due to pre-empting British involvement in serious foreign affairs and so losing the Treasury's approval and forward momentum for the Dollis Hill scheme. Only two days before the Secretary sent the memo, Archduke Franz Ferdinand of Austria was assassinated by a Bosnian Serb activist. This triggered a succession of diplomatic crises and a chain of army mobilisations of the world's major powers because of various international alliances that had been forged at the beginning of the century. By the time of the Secretary's memo, Russia had mobilised its army in retaliation to Austria-Hungary declaring war on Serbia. As the position of Postmaster General was a Cabinet-level position, Hobhouse was involved in the Government's critical decision-making and had a voice in deciding whether the country ought to go to war. In fact, according to his private diaries, Hobhouse was in favour of war if Belgium's neutrality was violated (David, 1978, p.179).[28] On 3rd August 1914 Germany invaded Belgium and, in response, Britain declared war on Germany the next day.[29]

However, despite the country's new wartime status, there is nothing to suggest in any of the surviving transcripts about the Dollis Hill scheme from this point onwards that dissuaded Slingo from arguing for a centralised research centre. In fact, he continued to push for Treasury approval despite, and indeed because of, the War. There is an increased sense of urgency in the tone of Slingo's correspondence on the issue even though the wait between replies became slower. Importantly, Slingo's reasoning for a centralised research centre remained the same: Post Office researchers needed more space and better facilities to conduct their business. Correspondence between Slingo, the Secretary, agents of the Office of Works, and solicitors acting on behalf of the Dollis Hill landowners continued regularly for at least another year into 1915.

Budgeting was always an issue and in order to keep costs as low as possible, alternative sites were investigated and building plans reduced. Still intending to go ahead with the original plan, the Office of Works appointed the architect Sir Alexander Stenning to negotiate with the Dollis Hill landowners in order to hide the fact that this was to be a government purchase. On

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[28] In his private diaries Hobhouse recorded a very candid account of Cabinet meetings and was amusingly perceptive of the characters of his now more well-known colleagues. In 1915 he described Winston Churchill as being "nervous, fretful, voluble, intolerably bumptious and conceited" and Lord Kitchener as "a snob… remarkably astute and untruthful, in all matters big and small" (David, 1978, p.231).

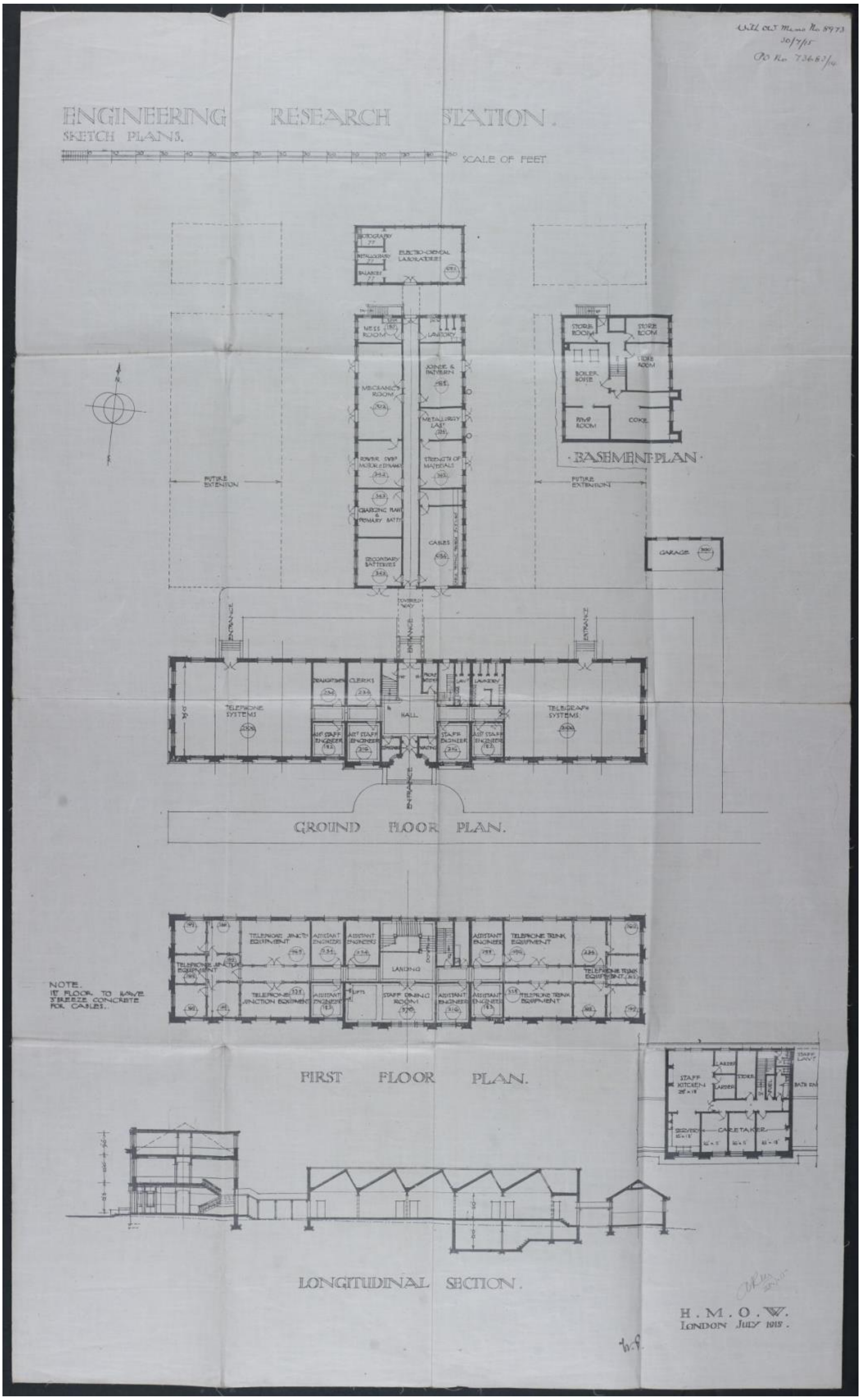
[29] The last direct message to Berlin for the next four years was sent at midnight on 4th August from the Post Office's Central Telegraph Office. It simply said "G.N."—the telegram abbreviation of "Good Night".

the 30th July 1915 a land deal was agreed between the Office of Works and the Dollis Hill landowners for £4,000, although there were still hanging questions about the cost of building and equipment. In the same month, Stenning produced a sketch plan of the proposed engineering station (Figure 4.1). This is the first indication of the T-shape of the permanent site, which I shall discuss in more detail in the next chapter. However, it is interesting to note that at this point telephony and telegraphy sections are well separated but given an equal amount of space at either end of the main building. Another important observation is the absence of dedicated training facilities on the plan. It is therefore clear that the formalised training of engineers was not part of the original rationale for the research station.

Despite this apparent progress, Slingo suffered a series of setbacks to his ambitions during the war period that were not directly war-related. On 24th August 1914 G. Evelyn Murray became the new Secretary of the Post Office. The son of a previous Post Office Secretary, Murray would be the longest serving holder of the post when he retired in 1934, with the position changing to 'Director General' as part of an administration re-structuring. As the overseer of the postal, telegraph, and telephone systems, as well as the savings bank and other Post Office activities the position of Secretary was one of huge influence and was the centre of Post Office decision-making. As a result of his length of service, Murray became known as *the* Post Office (Jago, 2014).

Unfortunately for Slingo, Murray also gained a reputation for being bureaucratic and obstructive to change. According to socialist political theorist Harold Laski, Murray "could be fairly described as belonging spiritually to the era of Lord Melbourne when to get things left alone was a supreme object of official policy" (Laski, 2014).[30] Coupled with Murray's appointment, in May 1915 Hobhouse, the most politically powerful supporter of the Dollis Hill scheme, was asked by the Prime Minister Herbert Asquith to resign as Postmaster General. This was due to rising political tensions that resulted in a precarious Liberal leadership: Asquith did not want to risk calling and losing a general election and so instead chose to form a coalition government. This was much to the chagrin of Hobhouse who recorded in his diaries that "the disintegration of the Liberal Party is complete. We shall not return to power for some years" (David, 1978. p.247).

[30] Lord Melbourne was the Whig Prime Minister in 1834 and 1835 to 1841, and was famous for being the political tutor of the young Queen Victoria. His saying, "Why not leave it alone?" became his legacy.



4.1—Sketch plans of the engineering research station, July 1915 (BTA: POST 121/345/1).

As a result of both of these events, progress on the Dollis Hill project slowed and eventually stalled completely. The situation at the end of 1915 is summarised in a minute from the Secretary, now Murray, dated 15 December 1915, which effectively suspended the Dollis Hill proposal,

> I should be sorry to see the scheme for the laboratory definitely abandoned but I am afraid that it cannot be classed as urgent, more especially as the building would not be ready until after the War. It is possible that even then funds may not be forthcoming to proceed with the scheme and in the circumstances I recommend that the purchase of the site be also postponed. I doubt if the Treasury would agree to the expenditure at present (BTA: POST 121/345/5).

Slingo took it upon himself to pursue this line of inquiry and wrote many letters to various departments of the War Office asking whether suitable land and accommodation could be released as an alternative to the Dollis Hill site. On 16th November 1916 he received an answer from the War Office stating that nothing suitable could be found within a 15-mile radius of London (BTA: POST 121/345/5). A week later he heard back from them again, saying that nothing could be found within a 40-mile radius (BTA: POST 121/345/5). Months passed, but on 2nd July 1917 Slingo tried again and wrote a three-page report for the Treasury; this time backing up his argument with information on how Post Office research had already greatly assisted the war effort. He requested the immediate purchase of the site, as it "would be very useful for out-of-doors experimental work with portable huts for which no land is at present available" (BTA: POST 121/345/5). Slingo's suggestion of portable huts is prescient, as this is how Dollis Hill would eventually start life.

However, the Treasury still did not find Slingo's reasoning strong enough and refused his request on the grounds that there was not sufficient evidence "on the degree of public advantage likely to result from the experimental research in question and the practicality of carrying the research out effectively under present conditions". Murray suggested to Slingo that he should try to bring up the case again six months later (BTA: POST 121/345/5). He waited for a year until 1918 before asking Slingo whether he had any additional comments to make before he re-submitted the proposal to the Treasury. Slingo replied in perhaps rather muted terms stating that "the position is unchanged so far as this Department is concerned". There is no evidence to suggest that Murray did re-submit the proposal and there is no further correspondence on the subject until 1919 (BTA: POST 121/345/5).

In early 1914 it appeared that the circumstances were right for a separate research station like Dollis Hill. The Committee on Wireless Telegraph Research had come out in favour of such an idea, and Hobhouse was promoted to Postmaster General, thereby giving him a Cabinet position from which he was able to push the idea of a new research station that would form part of the Post Office. The Treasury's agreement in principle was an encouraging start, but the outbreak of war would mean that the plans would be shelved. In some respects, Slingo was not assisted by the achievements of his Engineering Department that proved themselves to be able to work in wartime conditions with limited resources. It is easy to sympathise with the Treasury's perspective that it was unnecessary to provide the Post Office with further resources as it was meeting the demands placed on it during an otherwise extremely difficult situation.

Given this, it is not unexpected that the First World War would mean that the Dollis Hill plan was put on hold. The appointment of Murray certainly did not help, and the absence of Hobhouse's shared vision for the site would have meant that no-one at the Cabinet level was arguing for a new research station like Dollis Hill. Accordingly, by the middle of 1915 the project was clearly not going to go ahead despite Slingo's repeated attempts to revive the project throughout the war. Perhaps by 1918 Slingo had finally been persuaded that the Dollis Hill project was not going to proceed: it would have seemed like a relative luxury given the death and devastation that had torn Europe apart.

4.3 The Post Office at war

The First World War was not the first conflict where the Post Office has used its telecommunications capabilities to assist with the war effort. On 6th January 1900, during the Second Boer War, the Home Secretary issued a warrant to the Post Office to intercept any telegrams passing through the Central Telegraph Office "which there is reason to believe are sent with the object of aiding, abetting, or assisting the South African Republic and the Orange Free State" and to pass them to the Intelligence Department of the War Office (TNA: WO 33/280). The Second Boer War was the first time that wireless telegraphy was used to communicate over short distances in a combat situation between headquarters and the front line. When the First World War started it would have been clear that telecommunications were going to form an important factor in the war effort. The Zimmerman telegram sent in January 1917 by Germany to Mexico is a particularly important example given the role it played in encouraging the United States to join the war.

As the operators of Great Britain's telecommunications network, it would also have been clear to the Post Office that they would form a key part of the war effort. In some respects the Post Office's role in the war is already well recognised; however, it is the Post Office's postal activities that have been particularly well-documented. Campbell-Smith gives a thorough account of its wartime functions and chronicles how the various stages of the war affected Post Office activity (Campbell-Smith, 2011, pp.213-57). A recent resurgence of interest in the First

World War due to its centenary, and the increasing recognition of how much of a role Post Office had in everyday life for many British people has led to a variety of news articles and even public exhibitions explaining its involvement in the war effort, albeit mostly from a postal perspective (Lydall, 2018). It was the Post Office that orchestrated the sending of letters to whole country urging men to enlist, and the Post Office Rifles—a volunteer group of Army reserves, who were amalgamated into the Territorial Force in 1908—fought in many of the major battles, and earned distinction and prestige.

This focus on the Post Office's postal activities has meant that the role of the Engineering Department has been less well examined. I will demonstrate in this section just how much the Engineering Department was involved in the war effort, specifically from a telecommunications perspective. This demonstrates the point made above that the Department met the demands that were made of it, and this actually provided the Treasury with an argument against pursuing the Dollis Hill project during the war.

The British armed services and the Post Office's Engineering Department had a good working relationship that was of mutual benefit, stemming from the 1870 government takeover of the telegraph network when the War Office suggested a loan of sappers to the Department so as to alleviate their shortage of technicians, and in return, the military would have a team of trained telegraphists (Beauchamp, 2008, p.126).[31] Over the course of the First World War over 50% of the total engineering staff of the Post Office were "liberated entirely" for war purposes (Baldwin, 1938, p.631). The Royal Engineers Signal Service grew from fewer than 6,000 men at the start of the war to 70,000 four years later (Bridge and Pegg, 2001, p.41). Even though electrical communications had been employed in previous conflicts, it was during the First World War that its military utility became vital.

At first, the Signals Service was purely telegraphic but by 1918 the telephone was the main means of communication on the Western Front and wireless played a major part in military signalling.[32] Meanwhile, throughout the War on the Home Front the Engineering Department ran the country's telecommunications systems under wartime conditions only two years after taking control of the telephone networks. The telephone system suddenly became vital to the country's "Home Defence" in alerting authorities to zeppelin air raids as well as servicing the military, naval and air forces. Eventually, as more and more women operators left the service to work in other important war-related roles, telephone exchanges started to recruit younger girls in order to function. These girl operators were later written about in glowing terms, for example, Crutchley wrote in 1938 that,

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[31] A "sapper" was a soldier trained to perform military engineering duties.

[32] For a discussion on why the British Army were at first reluctant to realise the benefits of the telephone, see Brian Hall (2008). Similarly for wireless, see Hall (2012).

> …the girl operators were frequently called upon to carry on to the accompaniment of exploding bombs and anti-aircraft barrage. They did so with splendid gallantry (Crutchley, 1938, p.111).

Telegraph interception formed an important part of the Post Office's work and the bulk of the early intercepted messages came from Eastern Telegraph Company cables (Gannon, 2010, p.26). The Post Office also set up a telephone exchange in Admiralty House during the war. It is plausible to assume they also had a hand in telegraph interception equipment that was being operated from 'Room 40', the section of the Admiralty that undertook a great deal of cryptanalysis (the interception and decoding of enemy messages).

Hobhouse in his diary recorded the level of activity during the early stages of the War,

> Our work in the Post Office was very heavy before the outbreak of hostilities, the numbers of telegrams being in excess of any previous record, and some of the staff working for 36 hours continuously. Ten thousand of the Postal Staff were mobilised as reservists, 6,000 as Territorials, and about 500 for postal work. I gave orders for the reductions of postal facilities all over the Kingdom and particularly London, and stopped any recruitment for the staff, so that after the war we might have as many places as possible vacant for discharged soldiers (David, 1978, p.181).

Beyond the postal and telegram services that were maintained during the war, the other activities of the Post Office are less well known. An example of this is the use of the Fullerphone: a device that was first invented by Captain A. C. Fuller and improved upon by Post Office engineers. Sometimes known as the "Power Buzzer", it provided a secure method of telephonic communication at the Front. It was first introduced in 1916: before then, it was clear from German sources that they were easily intercepting supposedly secret messages, such as troop movements, sent by the British and French armies via their conventional telephones (Gooday, 2013, p.253). Whilst the Fullerphone is well known amongst both academic and enthusiast literature on First World War telecommunications, the Post Office's involvement is often ignored (Bridge and Pegg, 2001, p.43).

4.3.1 The operational role of the Engineering Department during the War

This section highlights the extent of the involvement of the Post Office's Engineering Department in relation to the *operations* of the First World War.[33] The next section describes the *research* role of the Department during the war.

This section draws heavily from a detailed confidential report written by Slingo that covers and summarises all of the Department's activities from 1914 to 1918 (BTA: POST 30/4304A). Whilst being a vital source for this thesis, the report also demonstrates Slingo's commitment to championing the work and successes of his staff. Compiled in 1919, it was perhaps a way for Slingo to further prove to the Post Office and other government administrations, namely Murray and the Treasury, that his Department was worth spending money on. Furthermore, the report almost acts as a kind of war diary for Slingo as he describes his movements and decisions in great detail, at times seeking to justify his decisions or to apportion blame for certain issues.[34] However, this does not mean that the report does not serve as reliable evidence because the report is largely factual and neutral: it provides strong evidence that the Post Office was the first port of call for help in supplying equipment, developing suitable manufacturing processes, improving on current technology and inventing solutions to telecommunication issues. As Engineer-in-Chief, Slingo had full knowledge of the various projects that were requested of the Department by the War Office, Admiralty and the Air Force.

There is no question that the Post Office's Engineering Department was heavily involved in the war effort from the beginning, and even before. Slingo dramatically begins his report with an entertaining account about the cutting of German cables in the English Channel. On the evening of the 4th August 1914, but *before* war had officially been declared, Post Office engineers on the cable ship *Alert* were standing ready to receive a pre-arranged message.[35] Upon receipt of this message, they were instructed to apply to the local Admiralty officials for an

[33] This is not to be confused with operational research, which is a type of analysis used in military decision-making that arose during the Second World War.

[34] See Slingo's report at 4(v) regarding the Peterhead cable "circumstances have fully justified my contention…" and 5 regarding the Atlantic cable "I think that in this matter the British govt played unduly into the hands of the American cable companies" (BTA: POST 30/4304A).

[35] Interestingly, Daniel Headrick points out that there is a discrepancy in the literature as to which ship cut the five German cables, with most authors saying the ship "Telconia" was the one who did the deed. Despite referencing a 1920 paper by Bourdeaux published in the *POEEJ* as an example of an account that credits the "Alert", Headrick goes with the "Telconia" (Headrick, 1991, p.150, note 7).

escort to sail out to sea, with sealed orders to undertake a special mission. However, the message was received late and no naval vessels were available to escort the cable ship. Although he was advised to wait until cover could be provided the captain of the *Alert*, Mr. J Bordeaux, heroically insisted upon the importance of his mission and proceeded to sail his ship without protection. The sealed instructions were opened and the mission discovered to be to cut five German international cables that lay along the English Channel.[36] The crew managed their task by the early hours of the next morning, only once encountering an initially hostile and unmarked war vessel that fortunately turned out to be a French ally. Similarly, that same evening, the English cables connecting Germany to England were also disconnected. Since the two countries were yet to declare war, the German authorities remonstrated and so the cables were quickly restored, only to be broken and severed below seawater-level by the Post Office engineers again the next morning. This was so as "to prevent any accidental re-establishment of communication, or the illicit use of the cables by enemy agents" (BTA: POST 30/4304A). [37]

Although this daring mission is likely to have been the Engineering Department's first task towards the war effort, it is still a dramatic opening for Slingo's report, and so a clever tactic of Slingo for engaging a perhaps uninterested reader. It is a lengthy report to read through: Slingo lists 175 difference sections complete with 29 appendices. This gives some indication as to the scale of the Post Office's work during the war which ranged from providing numerous submarine cables as well as assisting with home defence, such as providing communications for various war-related installations. This was all in addition to engineering work that was carried out during the war period that was "not directly connected with the war" (BTA: POST 30/4304A, Part B).

The submarine cable work formed a substantial part of the Post Office's work during the war. Slingo records that 271 submarine cables were laid during the war which added 8,784 miles to the cable network (BTA: POST 30/4304A, Appendix A). He highlights 14 'special' cables which included new connections with France and Russia (BTA: POST 30/4304A, Section 4). In total, 21 cable ships were used to lay the cables, in relation to which Slingo only records two accidents—the sinking of the *Monarch* in September 1915 and the damage done to the *Morsey* in March 1918. In both cases, the ships struck mines. In describing these cases, Slingo noted that,

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[36] Eliminating Germany's international cable communications forced the country to rely heavily on its wireless stations. Meanwhile, there was a lethargic attitude towards radio communications by British authorities at the start of the First World War because of the Allies' network of submarine and overland cables. See Headrick (1991, pp.138-52).

[37] Slingo humorously continues to state that apparent reports of one of the cables cut by the "Alert" being re-established were untrue as a portion of the cable was in fact lying on his table.

> The submarine cable work has, throughout the war, been carried out under exceptional difficulties owing to the presence of mines and the menace of enemy submarines which have considerably hampered and delayed ship movements and operations. The Admiralty have consistently provided escorts for the cable ships whilst at sea, and I am pleased to state that although the cable ships when at work form excellent targets, none of them has suffered attached from enemy submarine" (BTA: POST 30/4304A, Section 10).

It is worth noting the close relationship between the Post Office and the Admiralty in this work and the clear importance that was placed on the cables that were laid. For this work, Slingo records that 25 members of the submarine staff were awarded the medal of the Order of the British Empire (BTA: POST 30/4304A, Section 100).

The other important strand of operational work that Slingo highlights is home defence which he summaries as follows,

> In order to meet the necessary telephonic and signalling facilities required for Home Defence purposes special circuit designs, many of them of a complicated character, were prepared… In connection with these developments, my Department was called upon to initiate the systems of telephonic control for aircraft defence purposes.

Slingo goes on to describe that 150 "special circuit arrangements" were designed for home defence purposes (he does not specify precisely for what purposes). This was in addition to 450 telephone installations for gun stations and 600 for searchlight posts, as well as 700 circuits for gun fire observation purposes and 300 circuits for military height-finder apparatus. There were 600 telephone switchboard installations for the Air Ministry plus a number of one-off installations such as an anti-aircraft defence system installed in Admiralty Arch and a new exchange and special telegraph service in General Headquarters, Horse Guards (BTA: POST 30/4304A. Sections 13-41). Slingo also records that 114,000 emergency works were untertaken by his engineers for the War Office, Admiralty, Ministry of Munitions, National Service Department and Royal Air Force (BTA: POST 30/4304A, Section 41; Appendix G). 44,920 miles of cables were supplied for the trenches plus 97,350 trench telephones (BTA: POST 30/4304A, Section 42; Appendix H).

The report continues in a similar vein and leaves the reader with no doubt that the Post Office was principally responsible for the communication infrastructure that would support the country's war effort. As Subramanian and Gooday have argued, it is important to recognise that this communications infrastructure was focused on wired telephony rather than the emerging wireless technology (Subramanian and Gooday, 2016). In other words, the operational role of the Post Office during the war was to supply vast quantities of largely pre-existing technologies rather than using cutting-edge developments. However, as the next section demonstrates, that does not mean that the Post Office did not research and deploy the product of the Engineering Department's Research Section.

4.3.2 The research role of the Engineering Department during the War

As well as detailing the operational activities of the Engineering Department during the War, Slingo's report also sets out the research it undertook. In this section I set out the overall nature of the research that was done during the war period, and then I use two short case studies to help better understand the variety of approaches taken by the Engineering Department to its research work during this period.

Slingo lists 21 research projects that were worked on for the War Office, the Admiralty and the Air Force. There are two particularly notable features of this research: first, some of the research was highly sensitive; and, second, some of the research did not relate to telecommunications.

The sensitivity of some of the research done is evident from Slingo's description of the 'Special Apparatus for Military Intelligence Department', which he was unable to fully describe. He writes,

> A request was received from Military Intelligence for assistance in the design and manufacture of confidential apparatus for use in enemy countries. This apparatus was urgently required; its production involved a certain amount of research; a supply of special materials strictly reserved for war purposes; specialised technical skill; and manufacture under conditions of secrecy. A small building was found in a country district in an isolated position, converted into a working laboratory, fitted with electric power and an adequate supply of the required apparatus delivered to the War Office within 14 days of receiving the request. […] I understand that the first batch of these devices was sent by special messenger to France and ultimately to enemy territory where they were used to great advantage (BTA: POST 30/4303A, Section 56).

The request was made in October 1918; one month before armistice. Just what this apparatus was and how much it might have contributed to ending the war are still as yet unknown. Slingo continues to say that after the war the Military requested more research be done on the apparatus and so further improvements were made.[38] This example demonstrates that the Military would still consult and commission Post Office research even during peacetime, and thus is supporting evidence for Edgerton's 'Warfare State' thesis discussed in Chapter 2 (Edgerton, 2006).

The research that was undertaken did not exclusively relate to telecommunication. For example, the Post Office received commissions for research projects relating to aircraft. The First World War was the first European war to be fought with an "air dimension". Aerial warfare was still relatively new—the Royal Flying Corps only came into being in 1912 and even then, their role was initially limited to just reconnaissance and artillery observation. The War Office and Admiralty each controlled their own fleet of aircraft until the formation of the independent Royal Air Force in April 1918. As a result, there was no centralised centre for research into aircraft technology until the end of the war and so both the Army and Navy requested assistance from the Post Office with developing aircraft-related machinery that was, surprisingly, totally unrelated to telecommunications research. For example, one project involved "urgent tests of an exhaustive character of new types of magneto ignition machines" until the Air Board were able to establish laboratories of their own (BTA: POST 30/4304A, Section 65). The Post Office set up and standardised "a complete set of transmission apparatus" on behalf of the R.A.F. and tested telephone sets captured from enemy zeppelins. Slingo proudly states that "in connection with aircraft research one of my officers has taken part in over 100 flights in various types of aircraft" (BTA: POST 30/4304A, Section 74).

Equipment for the detection of enemy aircraft was another related issue. In November 1917, the Inventions Department of the Ministry of Munitions set up their own Acoustical Research Laboratory at Imber Court, Thames Ditton. They consulted the Post Office for supplies of "special research apparatus and sensitive microphones".[39] Slingo claims that the Post Office managed to supply about 1,000 various types of microphones for research into aircraft location. The Ministry of Munitions sent a letter of thanks to the Research Department in recognition of their help (BTA: POST 30/4304A, Section 75).

Acoustical detection was not limited to aircraft. Section 63 of Slingo's report is titled 'Submarine Hunting Research for Anti-Submarine Division' and is significantly longer than most of the other project entries (BTA: POST 30/4304A, Section 63). More unusual is that instead of responding to a request, the Post Office themselves approached the Admiralty with a

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[38] After the First World War a Directorate of Intelligence was set up under the Home Office to continue the work of the now much expanded intelligence service. Since the Russian Revolution of 1917, focus now included the threat of the communist 'Red Menace'. See Christopher Andrew (2010, pp.108-9).

scheme designed by one of the staff engineers for locating the position of hostile submarines.[40] They presented the scheme in December 1916, two months after Germany's fleet of U-boats began a heavily destructive attack on British trade cargo ships. The Anti-Submarine Division approved the scheme and requested the Research Department to develop it as well as test other inventions and proposals submitted to the Admiralty. After "exhaustive experiments" the conclusion was that the system originally developed by the Post Office and the Admiralty's own "supersonic system" fared better than any of the other devices that were tested, "including those imported from the United States".[41] Furthermore, Slingo writes that these experiments "yielded results of considerable value to the Post Office", including a microphone that would become "a practically invariable standard for speech transmission, a result which has been aimed at since telephony became a large business but which has never been realised before".

Along with detecting enemy submarines, the Post Office was also involved in attempts to destroy them. The Admiralty Board of Invention and Research asked for help in developing non-contact sea mines. The Post Office developed two working models—it is unclear whether they were ever used, however one model was modified and put into service as a ground mine. The Research Section similarly assisted the Admiralty with designing apparatus for operating moored mines using "an acoustical principle" (BTA: POST 30/4304A, Section 59).

4.3.3 Case studies

The following two case studies focus on research requests made by the armed services to the Post Office Engineering Department during the war. In both cases, the research staff investigated existing technologies in order to adapt them for use in trench warfare. Both case studies demonstrate how the Research Section of the Post Office acted as technological consultants to the military. The first, the hypersensitive transmitter, was a secret project that ultimately helped the Engineering Department with their own research into better microphone technology. The second, the hot wire microphone, is an example of a wartime project that was eventually celebrated as an example of British achievement.

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[40] The scheme was a set of specially designed microphones fixed to a weighted torpedo-shaped vessel that would be towed underwater behind a ship.

[41] The Admiralty's "supersonic system" was an early form of sonar. Both techniques complemented each other as the supersonic system worked best within a short range, whilst the Post Office microphones worked better over longer distances.

4.3.3.1 The hypersensitive transmitter

The development of the "hyper sensitive transmitter" was undertaken by the Post Office at the request of the War Office. The Department of Field Works and Fortifications of the War Office approached the Post Office for help in designing and manufacturing extremely sensitive microphones that could be secretly placed on the parapets of enemy trenches at night so as to listen in on conversations.

On 21st February 1916, Post Office research engineer B. S. "Bertie" Cohen filed a preliminary confidential report on a suitable design, this time similar to ordinary telephone microphones of the time (BTA: POST 30/4517D).[42] Previously, Cohen along with H. J. Gregory had experimented on existing sensitive transmitters, identifying the 'Acousticon' transmitter (made by the Acousticon Company primarily for the use as a hearing aid) as "by far the most sensitive and articulate" on the market. However, it was fragile, had "a tendency to instability" and was very expensive. After a series of experiments and tests varying the size and shape of the carbon granules, plates, and mouthpieces, Cohen and Gregory managed to create a microphone that performed as well as the Acousticon transmitter whilst being suitably robust and much cheaper to produce. To construct the new device, parts of an existing Nussbaum transmitter were used. In addition a cylindrical sound collector with adjustable resonance chamber was used and was made of "fibre tube 5.5 inches in internal diameter" (Figure 4.2). As well as helping to increase volume, the sound collector also allowed background noise to be reduced. The signals from the microphone could then be significantly amplified using 'gas discharge relays'.[43] The report concludes that by using the hyper-sensitive devices,

> it is possible to pick up articulate speech at distance varying from 30 feet, up to the roof limit at King Edward Building namely about 120 feet in spite of the practically continuous noise of street traffic. The variation in distance is governed under the above conditions by variation in the direction and intensity of the wind" (BTA: POST 30/4517D).

[42] Hypersensitive transmitters were carbon microphones. These worked using carbon granules loosely packed between two carbon plates: one thinner plate acted as a diaphragm, varying the pressure on the granules as it vibrated. If a direct current were passed through the system, the change in pressure would alter the granules' electrical resistance: more pressure would squash the granules together, lessening the space around each of them and so decreasing overall resistance. As a result, the current would proportionally increase simultaneously as any sound waves hitting the diaphragm.

[43] This probably refers to a triode valve, invented in 1906.

4.2—‘Sound Collector’ of hypersensitive transmitter (BTA: POST 30/4517D).

Cohen and Gregory carried out some of their tests on the roof of the King Edward Building, one of the Post Office Headquarters buildings in central London. These were only qualitative tests as according to Cohen the location was “quite unsuitable for the purposes of quantitative measurement owing to the vibration of the building and the very loud and variable extraneous noises due to street traffic”, though he admits this gave an indication of the equipment’s performance under “severe practical conditions” (BTA: POST 30/4517D).

These sensitive microphones were modified for other uses. In 1916 they were disguised within the walls of prison huts to monitor the conversations of prisoners of war. By feeding the signals from microphones in opposite walls to the same pair of headphones, the stereo sound produced enabled the listener to better identify whomever was speaking (BTA: TCB 22/T2162). This application of the Cohen and Gregory’s research is an interesting example of how the Engineering Department could be drawn into surveillance activities. This may have also been the purpose of supplying the police (both civilian and military) with similar microphones—this is recorded by Slingo, but further detail is not provided (BTA: POST 30/4304A, Section 55).

The hypersensitive transmitter is a good example of the Engineering Department undertaking applied research that amounted to exploring and extending pre-existing technology for military purposes, rather than starting from scratch and undertaking research to provide a solution. Hypersensitive transmitters were simply a modified version of technology that was already standard in ordinary telephones.[44] However, such a modification could have several uses and in the case of the hypersensitive transmitter was deployed in at least three contexts.

Cohen notes in his preliminary report that the circumstances at King Edward Building for conducting tests were less than ideal, and in a further report that was prepared in May 1916, Cohen records that tests were performed in the yard at the New Barnet Telephone Exchange. This was a significant distance away from GPO West, and as such indicates that Cohen had to be resourceful to find a location that allowed for a better test site. This provides evidence for the point that the Engineering Department was able to undertake research projects and produce tangible results, however, this research was done in sometimes awkward locations and indicates how limited space in central London was becoming for Post Office research work. As a result, it is possible to understand Slingo's argument for a new site for research and how necessary extra space would be if these types of projects were to continue. However, it is also possible to see the Treasury's perspective, that the Engineering Department was clearly able to make do with what it had and produce useful results all the same.

4.3.3.2 Hot wire microphones

Another example of a project that illustrates the importance of Post Office research to the military during the war is the development and production of hot wire microphones for sound ranging. Sound ranging was a technique to locate enemy guns (or anything creating a sudden and, crucially, low frequency noise) by using two or more sensitive microphones positioned a known distance apart. The advantage of a hot wire microphone was that it is most sensitive to low frequencies and therefore less susceptible to inference from ambient noise – they would still be able to operate in noisy wartime conditions. By accurately recording the times at which the sound reached the different microphones (electronically on photographic ribbon film) the time differences could then be used to calculate the distance and direction from where the noise first came. Alternatively, the system could also be used to calibrate the Army's own guns by locating where their shells burst on the ground.

[44] In the same way, Tommy Flowers' use of ordinary thermionic valves from automatic telephone exchanges to build the Colossus computer can be seen as an application and the adaption of a standard technology to solve a new problem.

The technology behind hot wire microphones had been invented before the war and several patents were in existence before it became a Post Office research project. One in particular had already been presented to the Post Office: the Dutch firm 'De Lange' produced one called a "thermophone", however the process used to manufacture them was kept a secret. The microphone's sensitivity depended on the fineness of the Wollaston (platinum) wire used in its construction.[45] As a result the wire was prone to burning out if overloaded with current therefore use of the microphone therefore depended on being able to readily acquire a large supply of fine wire (BTA: POST 33/4780).

In August 1916, Lieutenant W. S. Tucker of the 2nd Field Survey Co., 2nd Army approached the Post Office for assistance in developing hot wire microphones for use on the Frontline. Tucker had already experimented with the De Lange thermophone and various widths of wire, deducing the ideal size of aperture and amount of resistance required for the microphone to work. However, a viable manufacturing process was as yet still unknown. Though the department would not normally have considered a project such as this, the Officer-in-Charge of Research at the Post Office, Sam Pollock, recognised the issue as of national importance and ordered suitable equipment from Post Office Stores for experiments to begin as soon as possible.

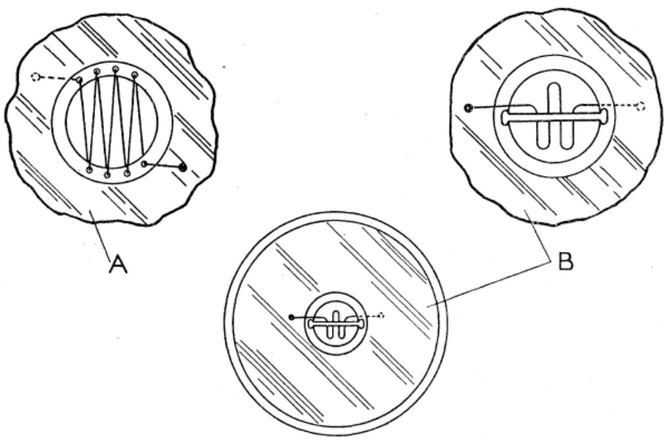

Fig. 1.

4.3—Diagram showing two forms of a platinum wire grid (Tucker and Paris, 1921, p.391).[46]

Pollock, with the help of an assistant, worked 16-hour days in order to find a practical manufacturing process. Within a month, they had designed and built a plant to produce

[45] The microphone worked by electrically heating the platinum wire, hence its name. A passing sound wave would cool the wire slightly, causing its resistance to decrease. This would cause an increase in the current passing through the wire that could be measured by a galvanometer.

[46] The B design was designed and manufactured by Pollock and the Post Office Research Department.

microphones on a scale large enough to meet the Army's initial requirement of 120 microphones (half of which were ordered as spares). Pollock kept the overall process a secret by dividing it into various stages and appointing separate research assistants and mechanics for each. From September 1916 onwards, the Engineering Department continued to supply General Headquarters ('G.H.Q.') with 70 hot wire microphones per week (BTA: POST 33/4780). By March 1917, Sound Ranging stations covered the whole of the Frontline, and by the end of the war, Post Office research workers had made, tested and delivered 13,408 microphones.[47] Slingo writes that "it was officially reported at G.H.Q. that over 80% of all enemy gun positions located were found by means of these microphones" (BTA: POST 30/4304A, Section 54).

The Post Office's involvement in the production of hot wire microphones was certainly appreciated: in a letter dated 15th September 1916, General Douglas Haig personally thanked "the officer in charge of Research in the Engineer-in-Chief's branch" for "the courtesy shown and the assistance rendered, which has been of material advantage towards furthering military operations" (BTA: POST 33/4780). Pollock continued to make improvements to the microphone and its manufacturing process. On 1st August 1918, King George V and Queen Mary visited the research laboratory at GPO West and "manifested a keen interest in the various processes of manufacture and were glad to know of the assistance we [Post Office engineers] were giving to our Armies in the field" (BTA: POST 30/4304A, Section 54). To commemorate their visit, the Postmaster General presented them with their own hot wire microphone set in crystal and platinum.

Two aspects of these events are of particular relevance here. Firstly Lieut. Tucker, whose idea it was to use the microphone in this way, was recommended by the War Office to take his idea to the Post Office for development and large-scale manufacture. Thus by 1916 the Post Office already had a reputation for being a place suitable for military research. The point to emphasise is the recognition given to Post Office research by the establishment, even including the Royal Family.

The hot wire microphone project was not a kept secret: it was mentioned in a piece in the Spectator magazine in 1921 (Howard, 1921). The *Post Office Electrical Engineers Journal* recorded what was said as part of Andrew Ogilvie's speech when he retired as Director of Army Signals (Home Defence) of the Post Office,

> I must refer specially to one more achievement of this kind. Most of you probably know more or less about "sound-ranging" and the superiority which it gave to the allied artillery in the later years of the war. It was certainly one of the factors of victory, but little could be said about its achievements while the war lasted. The method used by the

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[47] In his report, Slingo estimates this figure at 23,000.

> British Army was devised by Capt. Tucker. It was subsequently used by the American Army and also, I believe, by the French and other Allies. It is said that if a hostile heavy battery opened fire at nine or ten miles it could be located to within fifty yards in less than half an-hour, and it is easy to estimate the enormous importance of the system. Its success depended on the use of a stable but very sensitive form of hot wire microphone, and no such form was available at first. The assistance of the Post Office was sought by the inventor, and I am proud to say that Mr. Pollock, the head of the Engineering Research Section, and his assistants not only devised a successful microphone on Capt. Tucker's plan, but also manufactured many thousands in a secret factory in the General Post Office, thus making a practical success of this very important invention (Anon, 1920, p.72).

It is clear from the research work that was undertaken by the Engineering Department during the war, such as the hypersensitive transmitter and hot wire microphones, that the armed services appreciated what the Post Office had to offer, even to the extent of commissioning research for projects beyond telecommunications. In addition, the Department was also trusted to handle the design and manufacture of a secret piece of apparatus which remains unknown to the present day. The Post Office's contribution to the war effort clearly went far beyond maintaining its postal and telecommunication services, and even beyond supplying the armed services with telecommunications equipment on an unprecedented scale. It was actively involved in high calibre research that would have contributed to the Engineering Department's reputation for developing innovative solutions in exceptional circumstances. As Slingo records in his report,

> On the cessation of hostilities the Lords Commissioners of the Admiralty, in a letter to the Postmaster General, expressed their thanks to me for the special assistance given in connection with experimental and research work for the Navy during the War and to the staff of this Department for important help rendered in regard to similar matters. In addition, the Board of Invention and Research and the Air Board have expressed their appreciation of the careful and exhaustive research made in this Department and of the important contributions to the elucidation of complicated and difficult problems.
>
> A letter of thanks has also been received from the Ministry of Munitions in connection with our assistance at Imber Court [the Acoustical Research Laboratory]. (BTA: POST 30/4304A).

During all of these research activities during the War, with the huge increase of work due to the need to support the armed services, including project requests from the military, research teams had to be accommodated in various Post Office owned sites (mostly telephone exchanges) around the London area. When this background is taken into account, Slingo's repeated requests to the Treasury to pursue the Dollis Hill scheme throughout the War is therefore easy to understand.

4.4 Armistice and aftermath

The First World War came to end with the armistice agreement, which came into effect on 11th November 1918. As Murray explains in his 1927 book, the primary focus of the Post Office during the war was "to provide adequate and efficient communications to meet military and national requirements" first and foremost (Murray, 1927, p.200). Maintaining its regular civilian services came in second place. The Engineering Department's contribution to this primary objective was clear and Slingo's report demonstrates the significant amount of work that was done during the period both in operational and research terms. The report even includes an appendix of new apparatus designed during the war for departmental purposes, including telephone kiosks for street call offices and a "clickless" ringing and speaking key (BTA: POST 30/4304A, Appendix Z).[48] These developments are in addition to all of the military-focused work that was done by the Engineering Department during the War. Despite this apparent success, it was also a tough war for the Department—997 men of the engineering staff that had been relieved of their work for war service were killed, and 2,500 were wounded.

The research done by the Engineering Department was secretive, extensive, and recognised by the authorities. Unusually, Slingo was knighted in 1915 whilst still in office—the first Engineer-in-Chief for which this happened (Anon, 1915). At the end of the war he was made Chevalier de l'Ordre de Leopold "in recognition of constant and generous help given to Belgium" (Anon, 1919a). One of his Assistant Engineers-in-Chief, William Noble, was similarly honoured.

By July 1917 Post Office engineering researchers occupied rooms in the King Edward's Building on St. Martin's le Grand, Newgate Street Buildings, the Toll Exchange on Fetter Street, Barnet Exchange, the submarine cable depot in Woolwich, and the Holloway instrument factory, as well as the original experiment room at GPO West (BTA: POST 121/345/5). It could be argued that given that the Post Office engineers were able to work across so many other government institutions that a dedicated research site was unnecessary. However, Slingo clearly felt that such a site was important as a way of improving the Research Section's output, and

[48] This "clickless" key was designed to stop there being a 'click' noise in the telephone receiver when a connection was made. This could perhaps have been a development so as to avoid a listener realising their telephone conversations were being overheard.

perhaps as a way of increasing its status amongst other similar institutions. The Dollis Hill project remained part of Slingo's ambition to centralise and expand his research department that had continued throughout the war. One month before Armistice, Stenning the architect, who had been originally commissioned to negotiate with the solicitors of the owners of the Dollis Hill site, wrote to the Office of Works indicating that the offer was still open, although the Post Office did not have first refusal (BTA: POST 121/345/4). Nothing was done at that stage and nor is any evidence that the proposal was re-submitted to the Treasury that year during 1918. It seems quite likely that with the end of the War, the Treasury was preoccupied with more immediate issues and so no further consideration was given to the Dollis Hill plan. As I will show in the next chapter, William Noble—Slingo's successor as Engineer-in-Chief—was more successful with his representations to the Treasury. Whilst the idea of Dollis Hill owes much to Slingo, credit for realising the project goes elsewhere. Slingo retired on 31st May 1919 as a celebrated leader of the Engineering Department. His wartime report was submitted in June that year, perhaps as a way of securing his legacy, particularly as the Dollis Hill plan had not come to fruition.

After the war, it became clear that Britain remained far behind the United States and France in terms of its wireless capabilities. For instance, by mid-1923 Britain only had two wireless stations that were started before the war whilst the United States had 21 and France had 12. In terms of power, Britain had 700 kilowatts whilst the United States had 3,400 and France 3,150 (Headrick, 1991, p.184). As a result, the issue of wireless became increasingly important and a possible factor in the eventual interest in a project like Dollis Hill. From the Treasury's viewpoint however, the Dollis Hill plan was an unnecessary expense: the Engineering Department had showed itself able to take on a broad range of research work and deliver practical results without a centralised research facility. For Slingo, this was evidence that actually supported the case for Dollis Hill: if the Research Section had managed to do well with limited space and resources, his argument was that it could do even better with its own dedicated site. Once Dollis Hill was established, this became the accepted viewpoint: as was said in 1946 by the then Assistant Postmaster General in the House of Commons,

> As far at the Post Office is concerned, research began, in a rather haphazard way, as far back as 1904. It was not until after the end of the First World War that there was any real basis for it in a permanent establishment. Only then, in 1921, was Dollis Hill started (Hansard HC Deb., 3 May 1946).

4.5 Conclusion

In this chapter I have argued that the shelving of the Dollis Hill plan was inevitable given the beginning of the First World War. Even though efforts were made to capitalise quickly on the Treasury's approval of the project in principle, this was not successful. The resignation of Hobhouse as Postmaster General and the appointment of Murray as Secretary of the Post Office meant that the project had lost its most influential cheerleader and the level of internal inertia and ambivalence towards the project grew.

These setbacks did not deter Slingo from pressing the case for a separate research facility; but his persistence did not result in anything tangible, and eventually Slingo could see that nothing was going to happen during wartime. The difficulty was that whilst Slingo argued that more space and resources would assist the research of the Engineering Department, the research requests from the armed services were being satisfied and the results of the research were put to good use. In my view, the Treasury was justified in believing that funding the Dollis Hill project was an unnecessary expense during otherwise particularly straightened times. The Post Office did what they were asked to do excellently and there was no need for a centralised research station during the War.

Accordingly, these various obstacles meant that the project was inevitably going to be put on hold. Even so, the First World War was not without its opportunities for the Engineering Department. It played a vital role in providing the armed services with telecommunications equipment as well as undertaking a great deal of useful research to assist with the war effort. The operational role of the Post Office went far beyond the provision of postal services and included a great deal of work relating to submarine cables as well as building and maintaining the wartime communications infrastructure.

The research work also took the Engineering Department into areas that may seem odd for a telecommunications service, such as the testing of magneto ignition engines and developing submarine hunting technology. However, it seems clear that the Department was highly valued by the armed services for the research it could perform and the technology it could develop or improve. This explains why the armed services kept commissioning the Department on such a relatively broad range of research topics. The hypersensitive transmitter and the hot-wire microphones are particular examples of the Department taking pre-existing technology and then modifying it for the purposes of warfare. Both examples made a significant contribution to how the war was fought in the trenches by providing information about the enemy that would otherwise not have been available. However, the hypersensitive transmitter was a secretive project, whilst the hot-wire microphone eventually had a much higher profile.

The recognition of the hot-wire microphone may be the first example of the Engineering Department had of a public relations success through its research work, to the extent that there was a Royal visit to GPO West in 1918 and interest was shown in how the microphones were manufactured. By contrast, the hypersensitive transmitter was an example of a research project being conducted in less than ideal circumstances on the roof of the King Edward Building and then later at the New Barnet Telephone Exchange. The overall impression of the research done by the Engineering Department was that it raised the esteem and reputation of the Post Office generally and showed how research could lead to tangible, practical benefits. Evelyn Murray, in his book on the Post Office, was complimentary about the role of the Engineering Department during the war and said,

> Like most other Government departments, the Post Office had thrust upon it a miscellaneous collection of war duties, many of which were quite foreign to its ordinary functions. Some of the best talent in the engineering department was engaged on the design of trench telephones and other electrical equipment for use in the field (Murray, 1927, p.214).

The aftermath of the First World War showed how far behind Britain was with its wireless technology, and during peacetime the public became increasingly dissatisfied with the telephone service provided by the Post Office. The Post Office was short staffed after the war and criticism of its service grew louder with time. However, the experiences of the War would help provide a solution to this problem, through the use of research and a concerted public relations campaign that worked in tandem together.

Chapter 5.
Relocating Research 1921-1933.

> The necessities of the war called incessantly for closer attention to research work, and the products of the military years are now being utilised in the arts of peace (Cruickshank, 1920, p.77).

5.1 Introduction

There were two iterations of the Dollis Hill research station: the later site of permanent buildings, some of which still survive today, and the original temporary laboratory huts.

Along with securing the funds for relocating the Post Office's Research Section to Dollis Hill, William Noble was instrumental in shaping its physical beginnings as a research site. He was the instigator behind the 'Hutment' scheme: using prefabricated wooden ex-Army huts as the working laboratory, administration, workshop and storage buildings whilst the permanent laboratory buildings were built alongside. I argue that this is an example of Noble showing himself to be an able tactician—he understood the importance of getting Dollis Hill up and running quickly because once research was being done on site it would be difficult to move the Research Section elsewhere.

For the first engineers employed at the new Research Station, this collection of wooden sheds was the original Dollis Hill and as such, they are a significant episode of the station's history. Their quick assembly meant that in December 1920, only five months after the Post Office took possession of the land, research engineers began to work on site. By 3rd October 1921, all of the work undertaken by the Research Section of the Engineering Department had transferred to the new premises. Over the next decade as the permanent buildings grew, the hutments were gradually vacated and disassembled as researchers and their researches transferred to the new workspaces next-door. There are, therefore, two versions of the Research Station at Dollis Hill: its initial, temporary form and its later, permanent site.

By the 1937 "At Home" Open Day all of the huts had been dismantled. However, even though today the hutment complex is invisible in comparison to the remaining buildings of the second version of Dollis Hill, it is not a separate history. In a wider sense, the Dollis Hill hutments make an interesting case study for the historical geography of science and technology—a field that can be accused of being skewed by a natural focus on permanent buildings, as they are more likely to still be in place.[49] I further argue that the hutment scheme can be seen as more successful than even the permanent buildings, which were vacated in 1958.

5.2 Negotiations pursued: the Noble tactic

William Slingo's attempts at asking the Treasury for funding towards his centralised research station plan had become less and less frequent as the War progressed, until finally in 1918 he stopped trying completely.[50] It seems as though Slingo took the end of hostilities as time to handover his role, as six months after Armistice it was announced in the *Post Office Circular* that William Noble, Assistant Engineer-in-Chief and a close colleague of Slingo, would be taking up the position of Engineer-in-Chief upon Slingo's retirement at the end of May 1919 (Post Office, 1919, p.160). A little over a month into his promotion, however, Noble wrote to the Post Office Secretary to ask to reinitiate the Dollis Hill proposal. Less than a year later, the Treasury granted his request. This section shows how Noble, despite a relatively short tenure as Engineer-in-Chief, managed to persuade the Treasury to fund Slingo's plans and in turn lead the Research Section to become more tactical in their efforts to improve their situation.

Noble had had a remarkably similar career to Slingo, first being employed within the Post Office as a telegraph messenger boy and gradually rising through the ranks of the Engineering Department. Noble was involved in both telephony and telegraphy, first being responsible for the "Telephoning of London" project and then heading the Telegraph Section, whereby through supervising "exhaustive experiments and many practical tests" he was responsible for the Post Office adopting various telegraphic systems (Anon, 1912a).[51] After a series of promotions, in 1912 he became an Assistant Engineer-in-Chief—the same year that Slingo became Engineer-in-Chief. The two men worked well together. In the *Post Office Electrical Engineer's Journal* article announcing Noble's promotion, another Assistant Engineer-in-Chief, A. J. Stubbs, commented upon the relationship between the two: "both before and during the war, Sir William Slingo had a stout supporter" (Anon, 1919b, p.68). Noble would have been well aware of Slingo's Dollis Hill proposal as there is evidence he helped Slingo in

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[49] See Galison and Thompson (1999) and Agar and Smith (1998) for an introduction to the field, however neither example includes a study of temporary spaces.

[50] This was discussed in the previous chapter. In 1917 the Secretary wrote to Slingo asking whether he would like to resume the Dollis Hill plan. Slingo said no.

[51] The 'Telephoning of London' project was the Post Office installing their own telephone cables throughout the Metropolitan District at the beginning of the 20th century

pushing it: on a letter to the Secretary dated 13th September 1918 and signed by Slingo, it is clear from the handwriting that Noble actually wrote it (BTA: POST 121/345/6).

According to the *POEEJ*, Noble was "well known to a large section of Londoners as a progressive engineer, and as an individual who keeps abreast of modern developments in relation to commercial needs" (Anon, 1919b, p.65). It is this commercial-mindedness of Noble which is important to highlight, especially in comparison to Slingo. As I have demonstrated in the previous chapter, Slingo's letters to the Treasury are idealistic, urging the Treasury to release funds towards a centralised research station because research conditions were less than ideal. He stressed how the Post Office researchers were struggling to carry out important wartime work in limited laboratory space but did not explain how improved conditions would benefit anyone other than the Post Office researchers. Although it is unknown what was discussed internally at the Treasury in response to Slingo's requests, it is clear from the rejection letter from 1917 that Treasury officials could not see any evidence of potential gain to the public service through funding the Dollis Hill plans (BTA: POST 121/345/5). In order to persuade the Treasury, the Post Office needed to demonstrate how better research facilities would benefit the country—something which might have seemed so obvious to Slingo that he did not feel the need to justify or explain it.

In contrast, Noble's approach was far more commercially astute. A little over a month after his appointment as Engineer-in-Chief, on 10th July 1919 Noble wrote a nine-page letter to the Post Office Secretary, Evelyn Murray, explaining why the Dollis Hill plans ought to be reinitiated (BTA: POST 121/345/6). To introduce the situation, he used examples from the press to show how public confidence in the Post Office's service was waning precisely because it failed to invest in science and technology. His letter began,

> I beg leave to draw the Secretary's attention to the importance from the public point of view of expediting Treasury Authority for the proposals … on the subject of provision for Telegraph and Telephone research. In this connection I submit two leading articles published in the Daily Telegraph of the 14th and 25th ultimo which, although dealing principally with the London Telephone Service, strongly criticises the Post Office for its want of initiative in the Scientific side of its Telegraphic and Telephone business. … The statements can with advantage be discussed in so far as to reflect public opinion. In the article of the 14th ultimo it is said: we are behind in the science, but we are still worse behind in the service itself.

Adding insult to injury, Noble then repeated a statement from the Chief Engineer of the American Telephone Company saying that "no Government telephone administration in the world has a scientific staff equipment anything approaching ours" (BTA: POST 121/345/6). Here, Noble was playing upon notions of Imperialist pride in order to further twist the knife.

The Daily Telegraph was a wise choice of newspaper for Noble to use. At this time, *The Daily Telegraph* was a liberal leaning newspaper that prided itself in publishing the latest news in science and technology, as evidenced by its name. One of its first editors is recorded to have stated that "we should report all striking events in science, so told that the intelligent public can understand what has happened and can see its bearing on our daily life and our future. The same principle should apply to all other events—to fashion, to new inventions, to new methods of conducting business" (Lawson Burnham, 1955, p.6). In choosing such a publication, Noble was using a source that the government would have found credible. At the time of his letter the Liberals were in government under David Lloyd George, having been in power throughout the First World War and since 1905. Noble was therefore demonstrating how legitimate his concerns were as his sources could not be dismissed as mere oppositional bias.

In writing this letter, not only was Noble renewing Slingo's initiative but he also demonstrated a fresh enthusiasm in a number of ways. His letter came complete with all of the newspaper articles that he referenced, carefully cut out and pasted onto paper, and key sentences underlined. He also pointed out that he was aware (also through public press statements) that the Department of Scientific and Industrial Research (DSIR)[52] had announced that they were able to award £2,000,000 of grant money over a five-year period. In addition, Noble included yet more newspaper evidence that the Board of Agriculture had just received a similar amount from the Treasury.[53] In this way he was both highlighting to the Treasury that there was clearly money to spend on projects relating to research and was also pre-empting any potential financial grounds for their refusal.

Noble had two further arguments. First, he outlined some improvements to the telegraph and telephone systems that had recently been made by Post Office researchers. For example, they had developed a new system for using telephone trunk lines to send telegraph messages without disturbing the telephone signals (BTA: POST 121/345/6). His belief that the telegraph system could yet be improved is in complete contrast with Walkely's opinion that further original research on telegraphy by Post Office engineers was not required. Secondly, he was concerned that the profits from innovation would go to private companies rather than benefit the

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[52] This was a government strategy and funding agency established in 1916 on the recommendation of the McCormick Committee, initially to fund scientific education but later to promote co-operative research in industry. See Chapter 2, as well as Magnello (2001, p.57) and Arapostathis and Gooday (2013b, p.208).

[53] Dominic Berry (2014) looks at the origins of the National Institute of Agricultural Research, to which Noble's newspaper cutting refers.

state. In this context, he pre-empted a possible argument that the recently expanded National Physical Laboratory should be the location for such research by arguing that if Post Office staff were transferred there, their intellectual capital might leak into the private sector,

> disclosure of the Post Office programme of research to an outside body would mean the surrender of ideas which could be made the subject of matter of patents by outsiders and might prejudice the rights of the Post Office later on in subsequent inventions (BTA: POST 121/346/6).[54]

This was a legitimate concern. As Arapostathis and Gooday have explained, the Post Office had previously been caught out by patenting. In the early days of wireless technology, Marconi had cultivated a patronage with the Engineer-in-Chief William Preece, enabling him to demonstrate his invention in front of public audiences and army and navy officials in London with long-distance trials. Since the Post Office held a monopoly over the terrestrial telegraph and telephone services, Marconi had viewed it purely as a potential customer. His savvy patenting of his wireless telegraphy in 1897—before demonstrating it to the Post Office—meant that Marconi had the upper hand in negotiations (Arapostathis and Gooday, 2013a, pp.156-8).

Noble's letter worked. His financial evidence and argument that investing in research would be of benefit to the economy, and his tactical method of using respectable press sources reporting on public shame in the Post Office's service was a new approach from the Engineering Department. Although the views from the Treasury's internal administration are unknown, the fairly long response time of a month suggests that there might have been serious discussions about Noble's letter. The Treasury responded granting permission for the Postmaster General to purchase the site, and the Government's identity as a buyer could also be revealed to the landowners (BTA: POST 121/345/7). After a year of drafting and revising contracts, the Post Office took possession of the Dollis Hill site on 12th July 1920 (BTA: POST 121/345/7). That same year, Noble received a knighthood for his services to the nation.

After achieving permission from the Treasury to purchase the site, and overseeing the transfer of all of the Research Sections activities to the new Research Station by October 1921, William Noble resigned from the position of Engineer-in-Chief of the Post Office less than a year later. He had spent exactly three years in the role from 1st June 1919 to 1st June 1922. This was the shortest length of time an Engineer-in-Chief had stayed in the position before retirement

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[54] This attitude of Post Office ownership caused a problem for Pollock later on in his career. After realizing that the Post Office later used his wartime work on hot-wire microphones for profit during peacetime, Pollock launched a complaint to the War Office for his contributions to be recognised and rewarded. He received £500 in 1935 (BTA: POST 33/4780).

or resignation, and significantly shorter than the roughly six and half year average from the job's 1870 creation to 1939 (see Appendix 1). It is possible that Noble had had enough of the frustrations of working in the public sector and having to argue with civil servants without science or engineering backgrounds for research funding, as his subsequent career took a much more corporate direction. After his Post Office retirement he joined the board of directors of the (privately owned) General Electric Company to advise them on their telephone systems. He later served on the Executive Council of the Association of Chambers of Commerce, and was President of the Coventry Chamber of Commerce for three years (Anon, 1943, p.397).

However, his dealings with Post Office administration did not cease upon his leaving. Less than two months into his new position at the General Electric Company, Noble joined—and became a key player in—the negotiations to form the British Broadcasting Company, eventually becoming chairman of the Manufacturers' Committee.[55] This was quite likely because of his previous Post Office experience, as it was the Post Office who needed to grant the new Company's broadcasting license. In fact, Evelyn Murray, still Post Office Secretary in 1922, wrote to Noble soon after he joined the proto-BBC to express his interest and amusement upon hearing of Noble's new position. Perhaps as an unkind reference to the length of time it took for the Dollis Hill scheme to be approved, Murray wrote that he hoped Noble would do all he could to get the Committee's affairs submitted to the Post Office as "the Postmaster-General is rather perturbed at the length of time during which this has been dragging on" (Briggs, 1961, p.117). Interestingly, Noble's obituary in *Nature* written by Thomas Purves (his successor as Engineer-in-Chief) does not mention anything of his career beyond the Post Office after his retirement on 1st June 1922. Along with Murray's letter, this could be an indication that Noble's jump from public service into the corporate world was seen as an act of betrayal by his Post Office colleagues.[56] However, without Noble's takeover of the Dollis Hill negotiations and his

[55] This was a group of representatives from the 'Big Six': the Marconi Company, Metropolitan-Vickers, the Western Electric Company, the Radio Communication Company, the General Electric Company and the British Thomson-Houston Company. They became the centre of all crucial negotiations in the formation of the BBC, first meeting in May 1922 at the Institute of Electrical Engineers.

[56] There is a comparison to be made here with Major O'Meara who resigned from his post as Engineer-in-Chief and proceeded to criticise how the Post Office operated. It appears that colleagues from the Engineering Department would celebrate former colleagues that were popular 'Post Office men', such as William Slingo and Harry Kempe, but would overlook colleagues that did not fit this ideal, such as Noble and O'Meara. This applied even if a person made a significant contribution to the Engineering Department.

tactical approach at gaining Treasury approval and sealing the deal, the Research Station might not have existed when it did.

5.3 The 'Hutment' scheme

The Treasury gave the authority for the purchase of the Dollis Hill site on the 5th February 1920—coincidentally, 50 years to the day since the inland telegraph network transferred to the State. The amount granted also included a budget for a 'Hutment' scheme: a plan to erect temporary buildings on the purchased site for the Research Section to use before and during the construction of the permanent buildings. These temporary buildings were leftovers from use during the First World War and managed by the Army's Surplus Disposal Board. As I have mentioned in the previous chapter, it was Slingo who first suggested using "portable huts" for the Department's outdoor experimental work in asking the Treasury for permission to purchase the site in a letter dated 2nd July 1917 (BTA: POST 121/345/5). However it is not certain who first came up with the idea for the whole of the research station to be built using temporary accommodation. In explaining their reasons for choosing Dollis Hill as a suitable site, both Pollock and Slingo argued that it would be appropriately free from noise and vibration for accurate research work. Working within what were effectively wooden sheds next door to a building site as the permanent buildings were constructed would certainly not have fitted this brief. Therefore I think that it is arguable that this was yet another tactic of William Noble, who recognised that in order to make sure that the building of the Research Station would go ahead as planned, the Post Office researchers should move themselves in as soon as possible.

After securing Treasury approval for the purchase of the site, Noble outlined his reasons for the 'Hutment' scheme in a letter written to Murray, the Post Office Secretary, on 19th December 1919 (BTA: POST 121/347/3/5-9). According to Noble, the scheme had four advantages. First, as it was cheaper than building a permanent site it lessened the immediate financial pressure on the country that was at that time recovering from the vast economic strain of the First World War. This also meant that having accommodation already in situ, there would not be as great a rush to start the proper construction as quickly—the letter estimated a two-year postponement at least. Secondly, Noble predicted that building costs would eventually become significantly reduced once the cost of labour and the supply of materials normalised back to pre-War conditions. Noble's third reason was again financial. Perhaps a result of lessons learnt during the War, by setting up a temporary but functioning station on site the Post Office engineers could decide on what needed ordering and installing based on results of their own research rather than predictions. In theory, this would lessen any potentially unnecessary expenditure. As previously discussed, Noble was well aware of the inadequacies of the British telephone system compared to other countries, in particular, the United States. Before writing his letter, Noble had just returned from a "visit of investigation" to the United States from October to November 1919, along with three other Post Office engineers, visiting various companies and looking in particular at the introduction of machine switching technologies (BTA: TCB 371/34). As a result of their findings, the British Post Office Engineering Department concentrated on improving and installing automatic exchanges throughout the country during the 1920s. The existing accommodation in central London at the beginning of the decade did not have the facilities or space for experiments on these new telephone programmes. Noble's hutment scheme, therefore, would not only provide space for new experiments, but also be an experiment itself to see what was the ideal equipment for this research. Fourthly and lastly, Noble felt that the Post Office Engineering Department could not leave their research work too late as alternative telephone manufacturing companies were "only too eager to exploit their own patents" (BTA: POST 121/347/6). The Post Office bought in much of its equipment from private manufacturing companies. If these companies held the monopoly on certain patents, they would be able to set their own prices and the Post Office would have no choice but to pay for what they asked.

The Treasury required persuading to approve the hutment scheme. The Office of Works estimated the cost of the scheme at £26,500, and they ascribed an additional £18,000 to experimental apparatus and engineering plant. This was a significant amount of money considering the country's post-War economic position: in comparison, the original alterations to Bushy House for the National Physical Laboratory totalled £19,000 by 1902. Perhaps having learnt from previous experience in approving the Dollis Hill purchase, Murray wrote back to Noble asking for more detail and justification for the huts before writing to the Treasury himself (BTA: POST 121/347/3/16-18). Assistant Engineer-in-Chief, Thomas F. Purves wrote the reply on 1st January 1920. After clearly stating the economic advantages, Purves went on to point out that compared to the approximately 36,000 square feet of floor space the Post Office was asking for, "the Western Electric Co. actually use over 300,000 super feet of floor space for their telephone and telephone research work" (BTA: POST 121/347/3/20). He promised to send photographs of the Western Electric Company's research building in New York "showing portions of the laboratories allocated solely to automatic Exchange apparatus research" along with a list of a backlog of research work that was waiting to be looked at by the Post Office. Again, as in Noble's first letter to the Treasury discussed in the previous section, a Post Office official used the United States as an unfavourable comparison to persuade the Government to fund research. Murray forwarded both items to the Treasury and one month later, the Treasury gave its authority to purchase the land and allocate fund towards implementing the Hutment scheme. Half of the amount of money ascribed was to be paid out from the State's Telephone

Capital Account, half from money appropriated from Parliament that would usually be put towards building post offices and other municipal buildings (BTA: POST 121/347/3/49).[57]

The actual huts in question did not have to travel very far. In 1916 the Army's Mechanical Warfare Supply Department opened a secret experimental depot for tanks a few hundred yards away from the designated Post Office Dollis Hill site (BBC, 2014).[58] Here, Army researchers experimented on captured enemy tanks and developed new designs and tactics for coping with trench warfare. The nearby Brent Reservoir (known locally as the Welsh Harp because of its shape) provided opportunities for trials with amphibious machines (see Figure 5.1). After the War, the depot's activities ceased and its buildings were no longer required—Tankridge Road, NW2 is one of the few signs left today of it ever being there. The fact that the huts existed almost on site was likely a stroke of good luck as the Dollis hill proposal predates the depot by a couple of years. However, the depot itself could have been the inspiration behind Noble's Hutment scheme. As mentioned in the previous chapter, Sam Pollock investigated alternative locations during the War, which included revisiting Dollis Hill. Once the Hutment scheme was approved, Pollock worked with the architect from the Office of Works in charge of the Dollis Hill project, Andrew R. Myers, to select several of the huts from the depot and secure a lien on them by March 1920, with Myers promising that these huts could be erected in "a matter of a few weeks once the contractors were instructed to start work" (BTA: POST 121/347/3/56-57).[59] Pollock might have been the one who originally reported back to Slingo or Noble of the existence of the depot.

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[57] The Telephone Capital Account dated back to 1892 when the Post Office "undertook the provision of trunk lines" (Ogilvie, 1922, p.106).

[58] The BBC podcast (2014) contains first-hand accounts of the depot workers and descriptions of the often explosive experiments they carried out.

[59] A 'lien' (pronounced *lean*) is a legal term describing an order that allows a party to keep the property of another until a debt has been paid, similar to a mortgage.

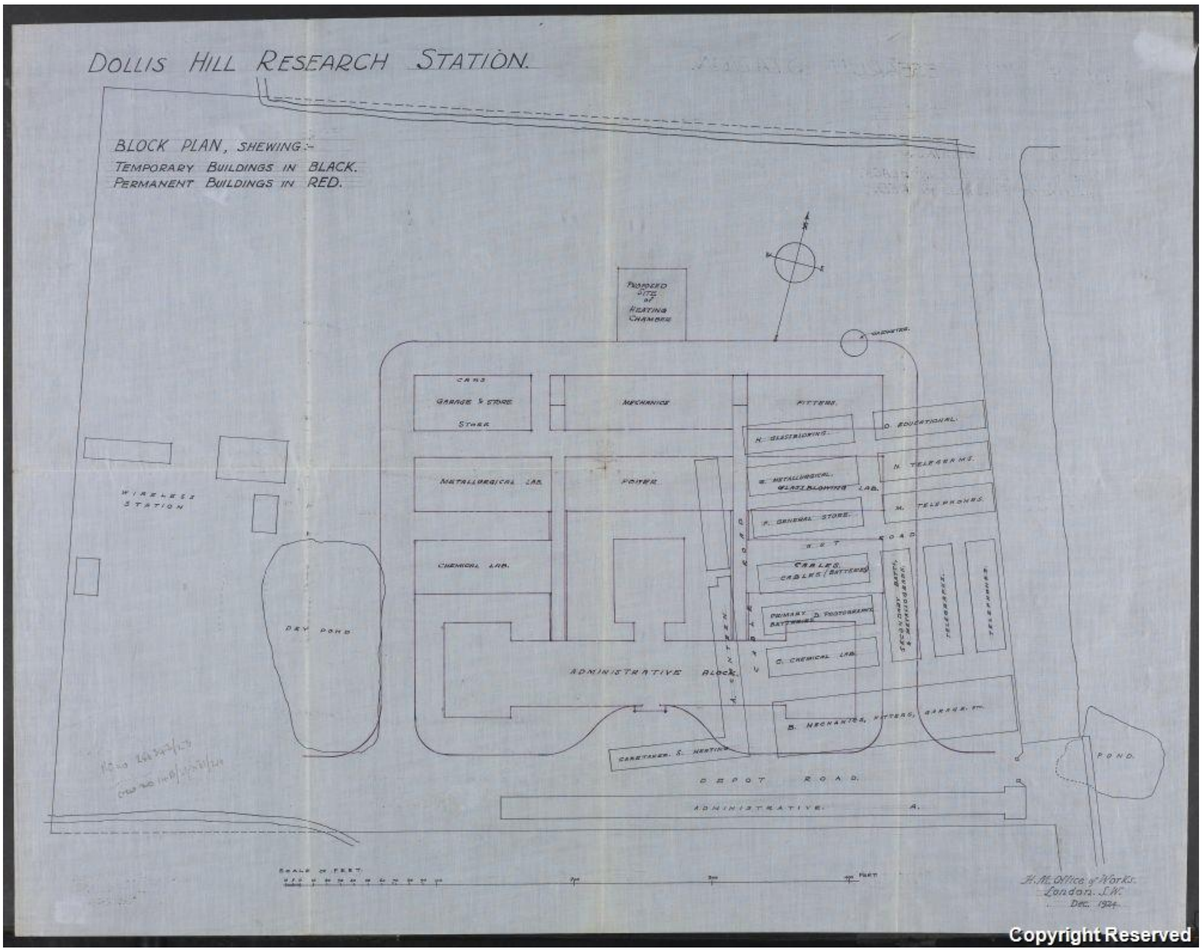
5.1—Flotation experiments with a Mark IX Tank at the Welsh Harp reservoir (© IWM: Q 14626).

Pollock was still the staff engineer in charge of the Research Section at this time. Whether it was he who suggested using the wooden huts from the tank depot is uncertain, however he did visit the Dollis Hill site when drawing up his proposal and later worked in close connection with the architect, Myers, in planning the details of the hutment scheme as well as the placing and order of construction of the huts and permanent buildings (BTA: POST 121/347/3/53.) By installing the huts on the eastern side of the site nearest to the approach road, work could eventually begin on the permanent buildings at the western edge of the site without much disruption to the researchers already there.

The Post Office took possession of the land on 12th July 1920, and only five months later, research engineers began to work on site in their temporary accommodation. Less than a year afterwards, on 3rd October 1921, all of the work undertaken by the Research Section of the Engineering Department had transferred to the new premises. This quick turnaround demonstrates the effectiveness of Noble's hutment scheme and how quickly the Dollis Hill site got up and running.

5.4 Layout of the site

Figure 5.2 is an architect's block plan from December 1924 showing the layout of the huts superimposed on the permanent buildings yet to be built. By then, all of the huts would have been in place and the first permanent building, the garage in the top left-hand corner of the permanent site plan, completed. Most of the temporary station was composed of twelve laboratories, in four groups of three, which were the familiar 80ft by 20ft army huts. These were framed by longer temporary structures (blocks) on the western and southern edges of the site. The Approach Road ran along the eastern edge.



5.2—Architect's block plan of the research site including the placement of the temporary huts, December 1924 (BTA: POST 121/348/1/15).

In 1924 Assistant Staff Engineer Capt. B.S. "Bertie" Cohen wrote and delivered a paper on the layout and workings of the temporary Research Station to The Telegraph & Telephone Society of London, which was subsequently published in the Society's journal (Cohen, 1924). Cohen's talk at the Society was a seemingly straightforward description of the layout of the temporary accommodation as well as a more in-depth account of telephone technology; Cohen's own area of research. He began by describing the Research Section's organisational structure and a brief mention of the staff before leading the audience on a virtual tour around the site, describing the huts and their functions as he came to them. All of the temporary huts were labelled with a letter, for example, the long thin block running parallel along the southern edge of the plot was known as Hut A and was where the administration offices were situated, as well as the drawing office and telephone exchange for the station, a water tower and pumping plant. North of this was Block B, another large hut divided up for garage space, a machine shop, woodworking shop, coil winding shop, workshop mess room, transformer room, motor generator and switchboard room, and high-tension laboratory. Cohen explained that the machine shop was "well equipped with modern lathes, milling and grinding machines for the construction of research apparatus of any description". The Research Station was therefore intended to be self-sufficient in providing and maintaining its own apparatus and even its office furniture and equipment: the woodworking shop contained machines used "for the rapid production of cabinets, boxes and mounting board, &c., for research purposes", whilst the garage was for the maintenance and repair of 'testing vans'. These vans acted as travelling laboratories and contained delicate measuring equipment used for electrical balancing and testing telephone trunk cables. The rest of the huts were labelled sequentially from C to S, although intriguingly there was no Hut I or P, perhaps simply because both letters could be easily misread or misheard. A complete list of the huts and their functions can be found in the Appendix.

Cohen's account of the research site corroborates mostly with another account written by a Post Office engineer who worked in the temporary hutments (BTA: BT1-CEN15/4/3: Anon, 1985). Unfortunately the author is anonymous, although it is clear they worked as a research chemist. There is one significant difference between their account and Cohen's, however: according to Cohen, the hut south of where the temporary storage battery was kept was the photographic hut "with one end assigned to the drawing office for blue printing, and the other fitted as a photographic studio for the photography of apparatus" (Cohen, 1924, p.47). This is likely to be Hut D, however there is a discrepancy here between the block plan and Cohen's paper as the hut is labelled both "primary battery" on its left and "photography" on its right. The anonymous author also identifies the photography hut as Hut D1, and also identifying Hut D2 as containing "various but not publicly known experiments" (BTA: BT1-CEN15/4/3: Anon, 1985, p.2). Hut E, the hut immediately north of Hut D, is labelled "cables / batteries" in the block plan but Cohen admits that it was not yet fully equipped with the submarine cable testing facilities at the time of his paper, and instead was used to house the temporary storage battery that supplied direct current at various voltages to the other laboratory huts. Although they would have worked fairly close by in the chemistry laboratory (Hut C), the anonymous author remembered this hut as "probably the main battery" and nothing to do with cables. It is possible, therefore, to suggest that Hut E was used solely for battery storage—both the primary and temporary batteries. Cohen's blueprinting office, or the primary battery label on the block plan, at the other end of the photography hut might have been a suitably innocuous cover for more covert operations.

5.5 Expansion

In 1920, before the move to Dollis Hill, the staff in the Research Section of the Engineering Department consisted of 45 members of staff, including Pollock as the staff engineer in charge, his two assistants Jimmy Hill and Capt. Cohen, 14 assistant engineers and other various lower grades ranging from chief inspector down to "youth" (BTA: POST 121/347/3/45). According to Murray in his 21st January1920 letter to the Treasury seeking authority for the hutment scheme, the Postmaster General was considering increasing the research staff "by something like a dozen officers in the near future, and further increases will probably be desirable by the time the new accommodation is available" (BTA: POST 121/347/3/45). With hindsight this reads like a calculated understatement in an effort to persuade the Treasury to allocate the money quickly, especially as his following paragraph warns that according to the Office of Works there was a risk the chosen huts would soon be sold off unless the Treasury sanctioned things soon. In reality, according to Lionel Harris, an engineer at Dollis Hill during the hutment period and a future Engineer-in-Chief, the much-needed expansion of the Research Branch in the early 1920s had actually been planned on an ambitious scale (Harris, 1951, p.67). In the space of four years by 1924, the Research Station's personnel amounted to around 190 staff members, including 38 engineers, "a number of chief inspectors and inspectors, and a considerable workshop staff" (Cohen, 1924, p.46). There also were three female members of staff; one telephonist and two typists.[60]

Harris was part of the first wave of university graduate recruits to the Research Section. In 1921 Harris graduated from the City and Guilds Engineering College and learned that "the Post Office, which must expand willy-nilly, was going to hold an open competitive examination for Assistant Engineers with pay and prospects which seemed reasonable" (Harris, 1951, p.64).[61] Interestingly, this marked a change from Slingo's unenthusiastic attitude towards university

[60] According to an account written by Dollis Hill research chemist Joseph Wright, "the chief clerk guarded their chastity closely. Woe betide any young man who dared to hover in the vicinity of that part of Hut A where they worked" (BTA: BT1-CEN15/4/3: Wright, 1975, p.1).

[61] City and Guilds was part of Imperial College in South Kensington, together with the Royal School of Mines and the Royal College of Science.

graduates as Noble was clearly experimenting with recruiting them to the Engineering Department again: whilst Noble himself did not attend university, his soon to be successor as Engineer-in-Chief, Thomas Purves, had (Anon, 1951, p.182). The exam taken by Harris was not unique to the Post Office, however: the Colonial Office who was also recruiting engineers at the time used the same paper.

The next surge of new staff came from within the Post Office's own ranks when in 1923, 39 men joined the staff of the Research Section chosen again by a competitive exam. Known collectively as the "Forty Thieves", according to the anonymous author they were "probably the best known group of engineers at any time in [the Engineering Department's] history" and although they were all recruited from the very lowest grades of the Department, many of them finished their careers high up in the organisation, above many of the university graduates who were subsequently recruited—Tommy Flowers was one of them (BTA: BT1-CEN15/4/3: Anon, 1985, p.5). The reasons behind this particular recruitment drive was due to a lack of sufficiently trained technical staff needed for the Department's plan to replace the heavy overhead cables used for long distance telephony with more lightweight conductors in underground cables and repeater stations. These speech circuits had to be carefully tested and balanced onsite using the equipment in the aforementioned testing vans, in order to reduce the risk of cross talk.

The Post Office continued to steadily recruit staff to Dollis Hill over the next decade (Panton, 1984, p.5). By the Research Station's official opening ceremony in 1933, staff numbered 290; an increase of nearly five and a half times the original number of research staff in 1920. Considering the country's economic struggles of the interwar period, this would seem quite an achievement.[62] This perhaps reflects something of a Keynesian approach to Dollis Hill by investing in employing new staff during an otherwise economically difficult period. A job in the Post Office had attractions such as a relatively generous pension and the potential for a "job for life". As I will show in the next chapter, the growth of Dollis Hill is linked to the growth of the Post Office as a whole. This contrasts with the approach taken by Ramsay MacDonald's government to the wider economy, which sought to deal with the economic turbulence of the Great Depression by restricting government spending—something which is said to have exacerbated the effects of that recession (Robinson, 2011).

5.6 Life in the huts

In this section I present what it was like to work as a research engineer in the huts. Much of the information is from first-hand accounts, such as Harris' autobiography and the anonymous

[62] The economy of this period shall be discussed in more detail in the following chapter.

author's reminiscences, however an unexpectedly useful source came from the Engineering Department's administration records on the successive industrial strikes during the 1910s and 1920s as the result of the First World War on the British economy and rising unemployment levels (BTA: TCB 510). Records of special and preventive measures that were taken in reaction to these circumstances offer a chance to learn more about the workings of the Station and daily life of the staff. Earlier strikes held by coal miners, engineers, rail and transport workers all affected the work of the Post Office Research Station at Dollis Hill and added extra challenges for the engineers at Dollis Hill working in the rudimentary hutment laboratories.

The civil service issued their own regulations regarding working conditions during strike action. The earliest reference to these on file at the BT Archives in relation to the Research Section staff in particular refers to the railway strike of 1919. If staff lived further than "walking distance" from their offices—5 miles away for men; 4 miles for women—then the Department was authorised to pay for "reasonable excess expenditure on public conveyances" or "authorised mileage allowance for use of bicycles, motor cars or motor bicycles". It is not recorded how many Post Office employees requested expenses for their travels in this instance (which would have been before the installation of the hutments at Dollis Hill) however the General Strike of 1926 offers insight into the commutes of some staff to Dollis Hill. The General Strike of 1926 lasted nine days, from 4th to 13th May, and was initiated by the Trades Union Congress on behalf of coal miners facing a reduction in wages and worsening of working conditions. This affected many aspects of British society: along with energy and transport, many newspaper companies were forced to run a reduced service. At Dollis Hill, radio news reports were typed up and issued as bulletins to workers at the Research Station. These reports included last train times for the Metropolitan Railway and the conditions of other railway lines, as well as brief reports of more general subjects of interest including the official denial of rumours such as a reported killing of two police officers, and updates on Captain Amundsen's polar flight. Transport to and from the Research Station for members of staff became an organised operation. A handwritten list of Dollis Hill staff members and their place of address was used to organise groups for carpooling. It shows that staff lived all over London, from Ilford in the east to East Sheen in the west. Some also commuted from as far out as Reading. Ten cars in total were sourced from various members of staff in order to help get people to work (including several Austins and Buicks that were most likely owned by the more senior staff members). The Research Station's testing vans were put to similar use, although sleeping accommodation had been arranged for thirty staff members had the vans been needed elsewhere. One van even made do as a makeshift post van: on the 15th May, 'Van XU 9945' transported 46 bags of mail from Newark to the Lincoln Post Office. It had originally been driven to Lincoln to pick up equipment but had stepped in to assist with the heavy congestion of post still being experienced from the aftereffects of the Strike.

The most difficult element of working in the huts was contending with the weather. The lack of sufficient insulation of the huts meant that conditions inside would often match those outside. Harris worked all of his ten years at Dollis Hill in one of the wooden huts “dabbling with the ‘insides’ of automatic telephone systems and telephone signalling devices” and spending most of his time improving telephone relays (Harris, 1951, p.68). Although his account does not describe in detail what it was like to work in one of them it strongly implies that he did not much appreciate his surroundings where he was “alternatively freezing and frizzling” (Harris, 1951, p.74). Figure 5.3 gives an indication of how cold conditions could get.

5.3—Photograph of Hut D, c. 1925 (BTA: BT1-CEN15/4/3).

During the strikes, civil service regulations also applied to fuel consumption. Heating was cut off completely unless conditions were exceptionally cold, and then only maintained at night. Domestic hot water services were cut off, lamps were removed along corridors, cloakrooms and refreshment rooms, and lower wattage light bulbs were used in order “to ensure than no wastage of current is taking place”. For the Research Station at Dollis Hill, the lack of heating became an issue. Although the General Strike occurred in May, the Engineer-in-Chief Thomas Purves granted permission to allow the hot water boiler serving the administration block and the stoves in each of the laboratory huts to be started on cold mornings “in view of the exposed position of the Research Station and the temporary character of the buildings” on the condition that after one hour's burning time they could not be replenished with fuel (BTA: TCB 510).[63] In the correspondence records of the construction of the Research Station there is evidence that the huts caused problems not just for staff but also for equipment. In a request for another hut for the wireless station on 10th March 1922, the sender stated that "the roofing should be of the best quality as much valuable apparatus will be stored in the hut. Some trouble has been caused by the tendency to leak displayed by the roofs of the existing huts" (BTA: POST 121/347/8/8). However hut conditions resulted in new practices that also benefitted other Post Office operations. In his 1924 paper Cohen reported that although the temporary storage battery housed

[63] Despite these emergency limitations, Sam Pollock felt able to report to Purves in a letter dated during the midst of the Strike that "with certain exceptions when it was necessary to make changes of duty owing to lack of full power supplies, work was carried on without interruption". Staff attendance was good with "practically a full attendance being registered each day" although he names and shames an E.W. Taylor who was the only staff member to join the strike. One officer was even allowed to volunteer fulltime as a Special Constable for six days. As the Strike went on, a special call for volunteers on behalf of the Government went out amongst Research Station staff, for officers "of every grade, men and women alike". On 13th May, Pollock reported that 97 names out of a total of 198 had signed up, which was a good number according to Pollock, as many staff members were "absent on detached duty, and on cable work" and so he was expecting more volunteer applications to come through by post. Out of the 97, Pollock made sure to retain five members of staff whom he considered too important to lose. These five were either working on cable construction or were soon going to represent the Post Office at a conference on international telephony.

There are no more recorded incidences of strike action affecting operations at Dollis Hill for the rest of the decade. However, an intriguing letter suggests that workforce troubles were not over. On 1st January 1931, Capt. Cohen received a request from the Secretary for an estimate of the number of officers from the Equipment Section of Engineer-in-Chief's Office "for whom it would be essential to provide accommodation in the office in a future emergency" although the enquiry also had "no special significance in relation to current events". Quite what this future emergency might have been or what these concerning current events were are not explained, however Cohen's reply indicates what work he felt required protecting. According to Cohen, 20 beds were needed for staff at Dollis Hill, six at Marshalsea Road. 'Marshalsea Road' was a building in southeast London, formerly owned by the NTC and inherited by the Post Office after the merger in 1912. At the time of Cohen's writing, Post Office Engineers lead by F.O. Morrell had spent most of a year there testing loading coils and units for telephone lines that had been submitted by various manufacturers (BTA: TCB 422/5445) in Hut E had been in situ for three years under a roof of galvanised iron, acid fumes had not caused any trace of corrosion. This was because staff had maintained a protective film of pure petroleum on the surface of the battery's (liquid) electrolyte, preventing any acid from evaporating off. This newfound technique was such a success that it was "generally adopted for [all] Post Office batteries" of which the Post Office was then the largest individual use in the country (Cohen, 1924, p.47).

Although Harris was not fond of the variable temperature conditions of working in the huts, there is a definite sense of nostalgia from every other first-hand account from the time towards the hutments. All of the authors have written more about their experiences in the huts that in the permanent buildings, which further shows the significance and lasting impact of this version of the Research Station's history. The anonymous author presented a favourable account of working in the huts, and suggested that the researchers had considerably more freedom to do as they wished—either in behaviour or their researches—than when they moved into the permanent laboratories. Whilst the huts were generally considered by everyone as less than adequate and a fire risk, there were no reported accidents,

> In many ways it was better to work in the Huts than in the modern laboratories that succeeded them. They were not uncomfortable—if visitors closed the doors behind them, they were warm enough in winter with two cookstoves in each hut. They would, of course, not measure up to modern needs in the way of freedom from dust etc; but when necessary we contrived our own special 'clinic' areas for special work. These were the days of massive measuring instruments, capacitors, resistance boxes, and etc; and big brass terminals. You could string up wiring with the minimum of effort, nails in the beams etc. The fire risks may have been horrible but nothing ever occurred. The only time I ever remember an Extinguisher operating was when Ernie Foulger barged into one, on his way to his office one morning and it fell down and covered him with water… (BTA: BT1-CEN15/4/3: Anon, 1985, pp.2-3).

This laid-back attitude towards the research space would have been fostered if not caused by the temporary nature of the laboratories themselves. If they were going to be pulled down in a few years' time, nailing holes into the beams would not matter. According to another anonymous source, this relaxed attitude became a legacy of the period,

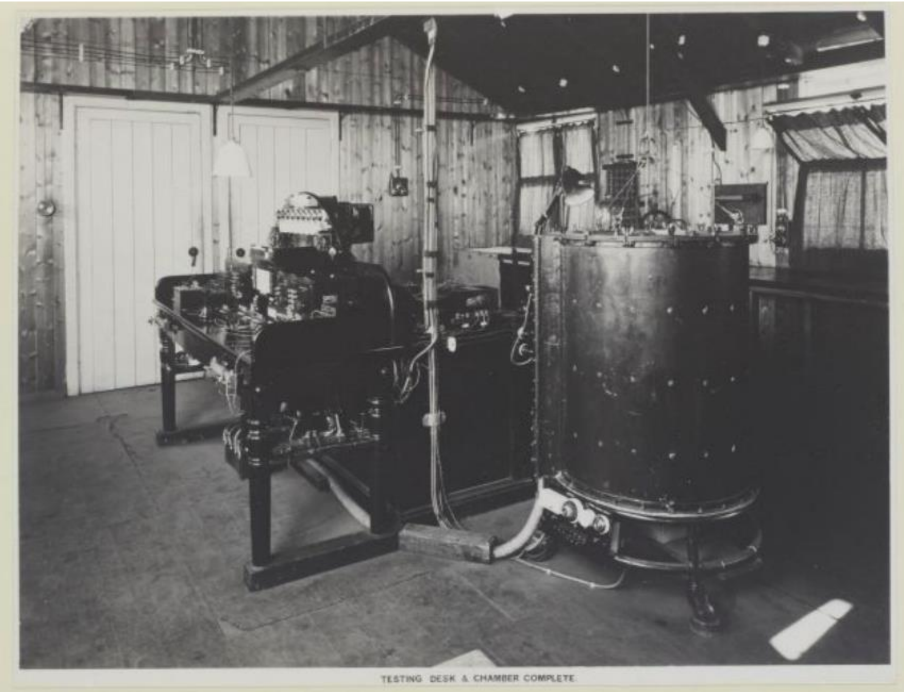
> I never saw the huts but I heard tales about them, and about the sort of behaviour that went on, it was a very informal sort of place in those days with only about twenty or thirty people working there […] in the mid 1920s. But you heard stories about them all having little motor cycles which they used to ride through the huts, follow my leader.

> […] Those people were […] trying to get adjusted to being part of a bigger organisation (BMA: 'Dollis Hill Research Station' information sheet).

The last sentence of the above quote indicates that it was also the rapid expansion of staff numbers—who would have been young university graduates or junior technicians—that added to the initial informality of the Research Station. This is even more evidenced in an entertaining account written by Joseph Wright, who began at Dollis Hill in 1924 as a 'Youth-in-Training' aged just less than sixteen years old. For 15 shillings a week, Youths-in-Training worked a 48-hour week of five and a half days, with two weeks of unpaid holiday. Formalised training did not exist at this time: instead, boys were expected to attend evening classes three nights a week, working on homework for the other two. Wright worked in the chemistry laboratory, where the first hour of his day was spent polishing benches and dusting the equipment. He explains that "Youths-in-Training were always fetching and carrying for someone, although a certain skill was soon acquired in dodging the column and keeping out of sight. Most of the rest of [my] time in the chemical laboratory was spent washing the dirty vessels and bottles". This sometimes involved liberal use of various concentrated acids if a piece of glassware was stained particularly badly, which "usually produced results, although not necessarily as expected" (BTA: BT1-CEN15/4/3: Wright, 1975, p.1). Practical joking was rife; "sometimes harmless and sometimes downright dangerous". Wright reported that,

> The advent of snow was always a hazardous time, for it was necessary to run the gauntlet of a murderous snowball attack to get into the premises. […] People got trapped in the toilets by jammed doors. In one of the huts nearly every electric light bulb had been shot out by a mysterious marksman with a pistol. Some cod-liver oil and malt, provided by a fond parent for their son to take after meals[,] was laced with mercury. Fortunately someone had the wisdom to warn the young man not to take it, otherwise the consequences might have been very serious (BTA: BT1-CEN15/4/3: Wright, 1975, p.2).

5.4—Photograph of the interior of one of the huts showing a rack of uniselectors and relays (image courtesy of Peter Belcher).[64]



5.5—Interior of one of the huts showing equipment for life-testing of transmitters, 1924 (BTA: TCB 422/3437).[65]

[64] Peter Belcher OBE BSc(Eng) FIET FCIHT is a retired a Post Office engineer, whose father O. G. T. Belcher worked as an engineer during the hutment stage of Dollis Hill from 1922 until his retirement in 1963. O. G. T. Belcher was supervised by Harris in adjusting and testing electromechanical switches, which explains the equipment shown in the photograph.

[65] The transmitters would have been placed in the cylindrical pressure tank and exposed to electrically generated speech sounds and a "jarring" effect produced by an electric horn located at the base of the tank. 96 transmitters would be tested at the same time.

The numbers of investigations increased significantly in the first five years of the Station's existence (see Figure 5.6). According to Wright, "in those early days much of the work at Dollis Hill was testing rather than research; testing samples from batches of telephone transmitters and receivers, life tests on valves and batteries, testing paints and other commodities used by the Post Office" (BTA: BT1-CEN15/4/3: Wright, 1975, p.4). Wright wrote his account in 1975 and so this is another example of the later distinction between "research", "development" and "testing". The life-testing and evaluating which Wright refers to was mostly of equipment already available on the market from private firms, such as coin-operated telephones (BTA: TCB 422/4182) and telephone transmitters (TCB 422/3437; see Figure 5.5). Thus the Post Office used research to decide between which commercially produced alternatives to purchase—the National Physical Laboratory (NPL) performed a similar function (Magnello, 2000, p.5). During this period, research engineers did produce improvements on the design and construction of thermionic valves and amplifiers (BTA: TCB 422/3707; TCB 226/88), as well as develop automatic trunk signalling (BTA: TCB 422/4431) and improve upon their ability to detect cable faults (TCB 422/5721). The most well-known example of Dollis Hill innovation, however, was still related to the testing of equipment: W. West's artificial ear. Having successfully measured the acoustical range of the human ear in 1926, West designed a machine that was able to measure the performance of telephone receivers against a "human" standard (BTA: TCB 422/4946).[66]

[66] Coreen McGuire (2016) has written about Wright's artificial ear in relation to the production of amplified telephones for deaf and hard-of-hearing subscribers..

5.6—Chart showing total investigation carried out by Research Section, 1921-1925.[67]

Unsurprisingly, there are no physical reminders of the 'Hutment' scheme left. As the permanent buildings were gradually erected one-by-one, the research teams moved into their new purpose-built accommodation. It is unknown as to where the disassembled huts went, if they were repurposed elsewhere or destroyed.

It is apparent from the contemporary sources that the culture of the hutments was relatively relaxed and informal. Perhaps the best way of describing the experience was that it was simply a fun place to work. Harris notes that the energies of the young workforce were diverted into civil service trophy competitions, in sports such as hockey and swimming. He said that, "we ran a hockey team at Dollis Hill. It was composed entirely of engineering scientists and played the least scientific game imaginable" (Harris, 1951, p.70). The pond was a particular source of entertainment—figure 5.7 shows staff members ice skating in winter, whilst Harris recounts a story regarding fish in the pond that were introduced during construction work. Harris says,

[67] Data taken from BTA: POST 121/347/14.

> Micky Hebden, who acted as foreman of the original digging, collected a few sixpences and bought six gold-fish and six tench, and although several of these were seen to have died a few days later the remainder survived and multiplied to such an extent that a few years later I was able to count several hundred first-class fish (Harris, 1951, pp.71-72).

The transfer to the permanent buildings may well have tempered this somewhat. In May 1931, the Training School building was the first to be occupied and provided a more formalised training of engineers. It seems that nearby Gladstone Park became a venue for recreation, rather than the Dollis Hill site itself. For instance, the Park offered an outdoor swimming pool. In 1935, 70 students from the Training School signed a petition to Willesden Council protesting against being forbidden to wear trunks or "to turn down their bathing costumes" when sunbathing at the Gladstone Park pool (Anon, 1935a, p.10).

5.7—Dollis Hill engineers ice-skating on the frozen pond c.1931 (Image courtesy of Peter Belcher).

5.7 Announcing Dollis Hill

In this section I shall show how the Research Station at Dollis Hill was announced to public newspapers only a few years after the temporary site had been built, before the completion of any permanent buildings. Whilst Cohen became the spokesperson for the Research Station amongst engineering circles, it was Pollock who welcomed news reporters to the site itself. Security was still a concern for Pollock, however, and to the site was by invitation only.

Cohen's aforementioned 1924 paper is a clear example of Post Office promotion, and so a straightforward demonstration of the Research Station not being kept a secret, even with only the temporary hutments to show for it. (Cohen, 1924). However, although the *POEEJ* had ambitions for a readership beyond professional engineering circles, Cohen's paper is aimed at those with an engineering interest. Cohen has been mentioned in the previous chapter as the engineer in charge of the secret hypersensitive transmitter experiments during the First World War. However, most of his work during the war centred on aircraft communications, for which he received a commission in the Royal Navy Air Service earning his 'Captain' title.[68] In 1924 he was an Assistant Staff Engineer in the Research Branch and second to Sam Pollock, a position he held since he transferred from the NTC in 1912, and so he would have been suitably qualified to talk as an expert on Post Office research ('A. S. A.', 1943).[69] The Telegraph & Telephone

[68] According to an anonymous account of the history of the Dollis Hill Research Station, "for some reason, which [the author] could never fathom, the I.E.E. would never use his military title though I never knew them baulk at Capt. Stiles who was in the same outfit" (BTA: BT1-CEN15/4/3: Anon, 1985, p.4). Whilst there is no explicit evidence, it is easy to assume that Cohen was Jewish: along with his fairly common Jewish surname, Cohen was educated at Highbury New Park Grammar School. Sometimes referred to colloquially as Highbury "Jew" Park, this was within an area of London that had a large Jewish population by the end of the nineteenth century (Englander, 2010, p.22). Although he was a member and prominent speaker at IEE events, perhaps the IEE were guilty of some anti-Semitic discrimination. In Britain, the early twentieth-century and interwar period saw an increase in expressions of anti-Semitism largely in relation to national politics and the influence of leading Jewish politicians—a well-known example of this, and involving state telecommunications, being the first Marconi Scandal of 1912. See Frances Donaldson (1962).

[69] It is reasonable to assume that Cohen was skilled at presenting: he delivered many papers including a Faraday Lecture to the Institution of Electrical Engineers and was awarded their "Fahie Premium" three times for papers read on telegraphy and telephony. He was nominated by staff to represent the Post Office at international relations committees and conducted

Society of London was one of a number of societies run by the Post Office and funded by grants from the Treasury, with the journal published "in the interests of the telegraph and telephone service, under the patronage of the Postmaster-general" (BTA: POST 30/4541B). Although a Post Office publication, the reach of the journal's readership would have been beyond just Post Office circles; therefore Cohen's paper constituted an advertisement of the Post Office's new premises to the wider telecommunications community.

Whilst Cohen spoke to academic and specialist audiences, the existence of the temporary Research Station was also promoted to the general public through newspaper articles. Three clippings dating from 1923 and 1924 have been preserved amongst the box of papers relating to the history of the research station in the BT Archives, suggesting that whoever kept hold of the articles at the time was pleased with the reporting and probably had a hand in their creation, especially since one article has pinned to it a calling card from an editor of the publication (BTA: BT1-CEN15/4/3). All three articles are from London papers, *The Evening Standard*, *The Daily Telegraph* and *The Morning Post* and their authors mention being contacted by a representative of the Post Office—two out of three describe a personal tour of the premises lead by Sam Pollock. They are all positive in their outlook and write of promising future developments and economic success, stressing the importance of such a facility for the benefit of the nation. It is possible, therefore, that Pollock was behind this publicity, perhaps having learnt from Noble's example of using the press to their gain.

The earliest article was published in June 1923 and titled, 'G.P.O. Research Work. Some Striking Results'. In a couple of sentences that read like soundbites, it explained why fairly little had previously been written about the output of the Post Office's Research Department,

> the influx of problems is so great that there is always a waiting list, and it is a difficult matter to find sufficient time for original research. The staff, therefore, are far too busy to be able to adopt the usual method of making such work known by reading papers before scientific societies (Anon, 1923).

Cohen's paper published the following year might have been written to rectify this attitude. After a section on the quest for perfection of underground cables, the article includes a section alluding

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meetings across Europe as Chairman of the 4th Commission of the Comité Consultatif International des Communications Téléphoniques à Grande Distance (CCIF) (BTA: POST 30/3072A). However, according to an interview with Tommy Flowers who worked under Cohen when he was Head of the Research Department, as Cohen was due to retire around 1930, "he was rather anxious to be in on anything that might bring him some credit" suggesting his motivations were also personal (IWM: Hart, 1998).

to the Research Department's work during the War, without giving details on the nature of it, but implying that it was an integral part of the Allies' winning.

The Daily Telegraph produced a more in-depth report in 1924 (Anon, 1924a). In a complete turnaround from the damning articles that Noble had employed to justify the Treasury's expense on a new research station a few years earlier, this time the same newspaper (after "the privilege of a personal inspection") declared itself to be full favour of a government department that claimed to contribute to an annual saving to the economy exceeding £300,000. The report stated that "there is certainly no lack of initiative or enterprise by reason of the fact that public ownership is involved". This figure is repeated in *The Evening Standard* article, provocatively titled 'Science Secrets of the G.P.O' (Anon, 1924b). All three articles mention the station's hutment accommodation with the promise of permanent buildings soon to be built.

These eventual permanent buildings are depicted on a Christmas card from 1930 (Figure 5.8). Cohen would have been promoted to the Head of the Research Section by this time, after the sudden resignation of Pollock earlier that year. The completeness of the image is false: by the end of 1930 only the western three laboratories and the central research block would have been finished and so many of the hutments would have still been in use (Panton, 1984, p.3). The image of the hutments, therefore, is erased from view.

5.8—Christmas card showing an idealised sketch of the Research Station, 1930 (BMA: 1993.9.45).

In contrast to this promotion of Dollis Hill and the activities of its engineers, in July 1926 the activities of the Research Station at Dollis Hill and its Chemical Laboratory in particular were called into question by the local Harlesden Customs Officer. Early that month, Pollock received a letter requesting him to apply for an exemption of licence duty for the use of a still. Seemingly mistaking the request, and after seeking advice from a scientist at the Government Laboratory, Pollock replied refusing to fill out any such form, declaring “it is not the practice for laboratories and particularly government laboratories engaged in chemical research to apply for license to use stills” (BTA: POST 121/347/13). The matter eventually reached the Postmaster General. Pollock’s concern, after the misunderstanding was made clear, was the threat of annual visits from the local officer in order to check whether the stills were still in use and not disposed of improperly. Pollock wrote to the Secretary explaining that the stills were used specifically for distilling water for batteries and the chemical laboratory. Seemingly trying to play Customs House at their own game, he firmly stated that “there is objection to giving any person outside the Post Office the right to visit this Research Station without a permit being obtained on account of the fact that more or less confidential work is carried on more particularly in time of war”.[70] Suggesting he ought to involve the Solicitor’s opinion on the matter, Pollock then wrote that he was “assured by a responsible officer in the Government Chemical Laboratory, where probably hundreds of stills containing condenser worms are in use for the distillation of spirits, that no license is held, no exemption applied for, and the laboratory is not subject to visits from officers of the Customs and Excise”. After a more carefully worded letter from Murray to Customs House, the matter was officially dropped.

5.8 Constructing Dollis Hill

In this section I show that the difficulties in gaining Treasury funding for construction of the permanent buildings continued throughout the 1920s, despite the plans already having been approved. I also explain the architecture before discussing the wider area of Dollis Hill in north-west London.

In a letter dated 10th April 1924, Pollock described the huts as “very congested as the result of normal increase of work” (BTA: POST 121/348/11/6). By the end of 1926, only five years into the hutment scheme, a letter to the Treasury drafted in December remarked that,

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[70] Brent Museum and Archives have an Engineering Department pass in their collections dating from 1916 (BMA: 1993.9.17a-b).

> the huts are not weather-proof, and the damp conditions increase the grave risk of leakage of high frequency currents. This risk, added to those caused by cramped space, low height, and bulky apparatus in use, renders the huts dangerous to the staff. There is little doubt that is the huts were used for similar purposes by private enterprise they would be condemned under the Factory Acts (BTA: POST 121/347/14).[71]

Reminiscent of the way that the Dollis Hill proposal was introduced following a visit from the Postmaster General, Joseph Wright recalls how in order to initiate construction of the permanent laboratory buildings—the first being the chemistry laboratory—extra staff from other disciplines positioned themselves within the chemistry hut "in front of imposing arrays of equipment about which they knew very little" in order to convince the Postmaster General of their desperate need for better facilities (BTA: BT1-CEN15/4/3: Wright, 1975, pp.2-3).

Eventually, construction of the permanent buildings began in 1923 but progress was slow compared to the increasing work of the Post Office engineers. In order to cope with the increasingly disruptive activities, the Engineer-in-Chief, Thomas Purves, initiated a new circuit laboratory in central London in order to divert some "experimental testing" for automatic telephone exchanges away from the Research Station (POST 121/347). Even though Slingo had stressed the need for a Research Station free from vibration or electrical interference, Figure 5.9 shows just how close daytime construction occurred to the temporary hutments.

[71] The letter includes financial details of the ratio of funds from the Telephone (80%) and Telegraph (20%) Capital Accounts that were to cover the £37,000 for the main building, that was deferred to the year 1927-28 estimates. This might have been a hopeful prediction that telephone revenue would increase towards the end of the 1920s.

5.9—Construction of the permanent buildings, c.1931-32 (BTA: TCB 361/ARC 376).

5.8.1 Architecture

The architecture of Dollis Hill is a good example of the Neo-Georgian style. This was a style that was a particular feature of public buildings built by the Office of Works between the interwar years of 1914 and 1939. The hallmark of Neo-Georgian architecture is a relatively simple, straightforward design that has accents that refer back to the colonial style, such as subtle columns or stonework detailing. An important underlying principle has been described as 'good manners', in other words self-effacing buildings that do not call attention to themselves (Holder and McKellar, 2016, p.2). The emphasis is on order and careful simplicity that includes details sparingly; contemporary critics summed up this style as "boxes with lids" (Holder and McKellar, 2016, p.124). This distinguishes the style from the Georgian style which might include details such as elaborate mouldings and artistic wrought-iron work, albeit within a template of carefully structured facades. This distinction also matches the difference in proprietors of properties in both styles. A Georgian town house would likely have been the residence of a wealthy aristocrat, whereas a Neo-Georgian house might have been in the suburbs and lived in by the middle-classes. This reflects the changed circumstances of the times: the Georgian style was prevalent during the period of 1714 to 1830, a period of relative prosperity and expansion of the British Empire. By contrast, during the later interwar years the period was marked by economic recession and political turmoil. This is said to have shifted popular opinion towards more culturally conservative values (Holder and McKellar, 2016, x).

The architect of Dollis Hill was Andrew R. Myers from the Office of Works. During the interwar period the Office of Works was responsible for building hundreds of public buildings all over the country that included social housing, government buildings, barracks, law courts and museums. For instance, in 1929 the Office of Works was involved in constructing 400 new buildings during that year. Each of these buildings were designed in what became the ubiquitous style of the Office of Works. The contemporary architecture critic, P. Morton Shand described,

> There is now a definite Office of Works style, well sustained, competent, refined, traditional, commendably English, predominately Neo-Georgian, and wholly unadventurous (Holder and McKellar, 2016, p.122).

The Office of Works was engaged extensively by the Post Office in building post offices, which reflected the Post Office's more extensive services around the country. The design of large telephone exchange buildings was said to stretch the principle of 'good manners' to its limit because of the height required by such buildings (Holder and McKellar, 2016, p.129).[72]

The General Research Block of the Dollis Hill Research Station bears many hallmarks of the Office of Works approach to the Neo-Georgian style (see Figure 5.10). The building has a simple design with two symmetrical wings with undecorated windows, apart from two that bookend the façade. There are two columns in the centre that lead to an arch and is topped by a small pediment. Whilst there is some decoration, it is restrained, carefully located and 'well mannered'. This style of building was hardly unique—other examples of a similar profile include the Cambridge University Library, the Parkinson Building in Leeds and the Royal Air Force College in Cranwell, Lincolnshire. Each of these were also designed during the interwar period and display the same low, elongated profile with a pediment in the middle.

[72] A.R. Myers also designed the Faraday Building on Queen Victoria Street in central London, which was built to house the London telephone exchange in 1933. It controversially ended up blocking the view of St. Paul's Cathedral from the river Thames, and so inspired legislation to regulate the heights of new buildings that had the potential to obscure views of St. Paul's from certain vantagepoints.

5.10—The ‘General Research Block’ as viewed from Gladstone Park, taken just prior to the official opening on 23rd October 1933 (BTA: TCE 361/ARC 337).

Of course, that description only deals with the profile view of the building. There was much more behind, which can be seen from the plan of the site (see Figure 4.10). There were four laboratory blocks perpendicular to the façade as well as a central service building at the heart of the site, none of which can be seen from the front. From an architectural perspective, it was common for the Office of Works to design post office buildings with “windows all aligned within a symmetrical Classical grid, and the more operational parts of the building hidden to the rear” (Holder and McKellar, 2016, p.127). However it would have suited the Research Section to have the majority of the laboratory space with complete privacy from the public. This was aided by the orientation of the main building which meant that the access point to the station was from the side, along Brook Road which is to the east of the main door: you enter from the side of the site rather than from in front. Sophie Forgan makes this point in relation to institutional laboratories of scientific societies that “laboratories were not private spaces, but regarded with intense personal possessiveness… [they] were tucked well away from the public eye” (Forgan, 1986, p.110). Perhaps the most private place at Dollis Hill was the basement of the service block where there was a specially built acoustic laboratory. Within this room was an inner chamber, built from bricks then “lined with celotex and about two foot thickness of Gamgee tissue, a species of cotton wool” (Cohen, 1931, p.10).

Forgan’s work on the architecture of scientific societies provides a useful framework for understanding how the Engineering Department might have viewed their new accommodation. She makes the point that the credibility of a scientific society was reinforced by its buildings and premises and the space that they occupied, and that the buildings reflect the hierarchical structure of the institution. However, Forgan argues that more modern scientific buildings had,

> connotations of utility, accessibility and morality… Science was making explicit claims [through its architecture] to be a useful and practical subject (Forgan, 1986, p.111-12).

Seen in this light, the architecture of Dollis Hill can be seen as a statement that goes beyond the standardised pattern of Neo-Georgian buildings produced by the Office of Works. Instead, the form of the building served a particular purpose for the Engineering Department beyond just increased laboratory space. For instance, the credibility of the Research Section was cemented through the building of Dollis Hill: it had gone from being a small group of people to a larger institution that deserved to be taken seriously and move up the internal Engineering Department hierarchy. The building of Dollis Hill recognised that. The building itself sought to justify its existence through its weathervane and portico, the latter of which included the phrases "Research is the Door to Tomorrow" and "To Strive, To Seek, To Find".[73] Both of these speak of an institution that had proved itself by having its own purpose-built building but also had grander ambitions. For example, by 1934, the number of people working at Dollis Hill either employed or training had grown to over 600 (Cohen, 1934, p.137). The very fabric of the building also alluded to the importance and global reach of the telecommunications networks it was built to maintain and improve: the use of "Empire timbres", including Gurjun wood for flooring was a reported feature of the building in an architectural article in *The Times* (Anon, 1933b).

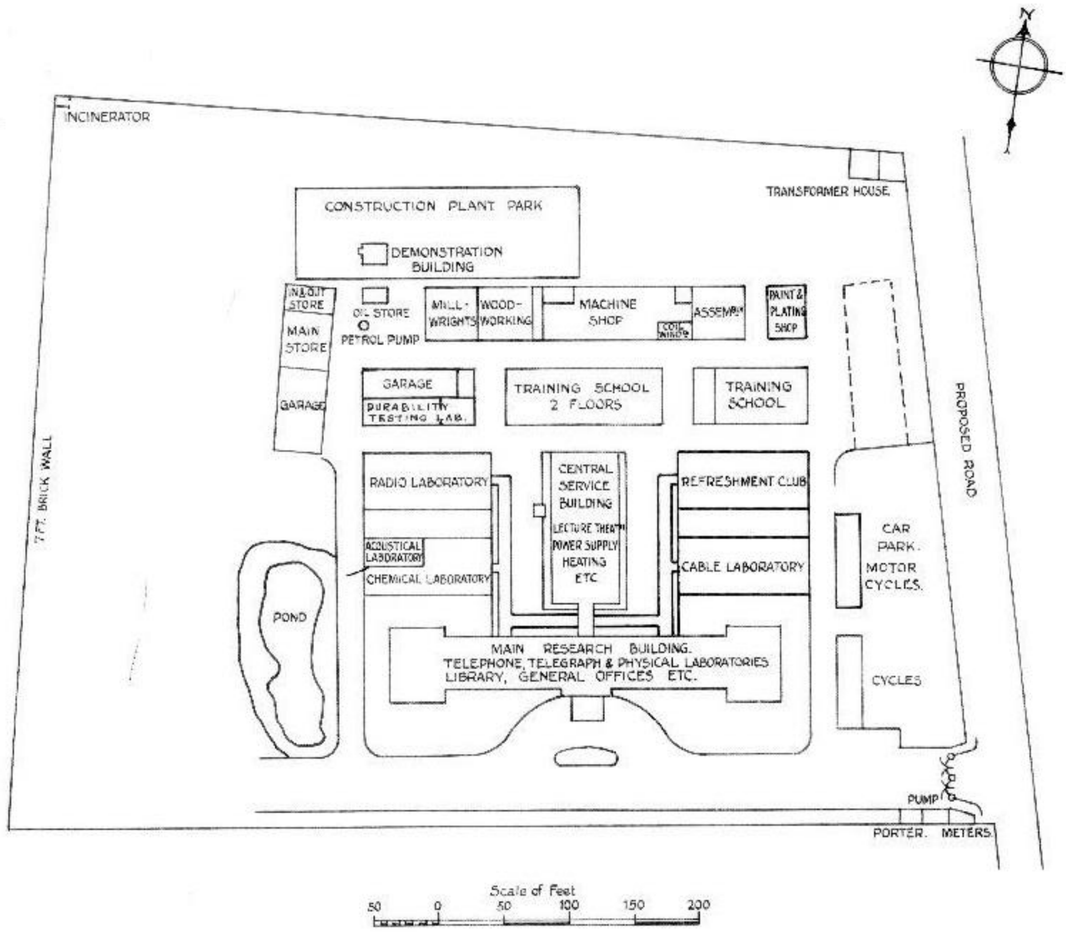
Within Dollis Hill there was also an internal hierarchy at work. For instance, it is notable that the telephone and telegraph laboratories were separated between two floors (see Appendix, Figure 3). This could have been a personal preference of Pollock: because of his telegraph engineering background, he was known to have disdained the telephone (BTA: BT1-CEN15/4/3, Anon, 1985, p.4).[74] As such, the building of Dollis Hill provided an opportunity for assertions of status both externally; between the Engineering Department and the wider world, and internally; within the Department itself.

The Post Office would have wanted the Research Section to be viewed in increasingly accessible terms and to prove their utility. The existence of demonstration rooms on the Second

[73] 'To Strive, To Seek, To Find' is a line taken from the dramatic monologue poem, *Ulysses*, by Alfred Tennyson, which is about pushing forwards beyond the limits of human thinking. The full last sentence reads; "To strive, to seek, to find, and not to yield". In an newspaper article from 1939 the reporter explains that this was taken by some members of staff at Dollis Hill to refer to the difficulties visitors would have in finding the place (Nickolls, 1939).

[74] According to the author, Pollock and his Assistant Staff Engineer, Jimmy Hill, often spoke to each other in Morse code in protest.

Floor (see Appendix, Figure 3) as well as the opening ceremony of Dollis Hill, plus the extensive public relations campaign about the research work being done demonstrates this: the next chapter explores these later points in more detail. However, as that chapter will explain (and noted above), there was also a desire to keep what was *really* happening at Dollis Hill private. As such, there was an inherent tension in the Research Section moving in to occupy their new accommodation—whilst the profile and accessibility of the Section increased the necessity of maintaining privacy also increased.



5.11—Key plan of the Research Station, created 1933 (BTA: TCE 361/ARC 339).

5.8.2 The crystal laboratory and interdisciplinary research

Although the term did not exist in British academia until the 1960s, through the crystal laboratory Post Office engineers were already applying the interdisciplinary ideas of Materials Science to their researches throughout the 1920s and 1930s, aided by the layout of the Dollis

Hill laboratories (Cahn, 2001, v).[75] During this period, chemistry was a broad discipline that included electrochemistry which would now be considered closer to physical chemistry. Figure 5.11 shows the idealised plan of the Research Station as planned in 1933. By then, most of the buildings would have been built, bar the refreshment club and cable laboratory on the eastern side of the site. Pollock worked alongside the Office of Works architect to draw up the plans to the Research Station.

Having headed the Research Section for roughly a decade before plans were finalised, Pollock would have been well experienced in the work of the Post Office engineers and how buildings would be able to accommodate them. This is in complete contrast to the facilities of the NPL, which as Lee Macdonald has shown, grew out of an existing institution—that of Kew Observatory—and became a laboratory in order to become financially viable (Macdonald, 2018, pp.189-202). The architecture and location of a scientific site has an influence on the workings of the people within it (Forgan, 1986), as such I argue that the freedom to design a research station from scratch enabled Post Office researchers to develop interdisciplinary investigations which impacted Post Office products, with a specific example of the Dollis Hill crystal laboratory.

Quartz crystals had been used to detect radio signals from the late nineteenth century. In 1929, an engineer at Bell Laboratories, W. P. Mason, in the United States published a paper on a new design for coaxial cables which incorporated quartz crystal wave filters (Mason, 1934).[76] It was a compact and extremely efficient design which would become the basis of all other crystal filter designs generated for the next 20 years. After the publication of Mason's findings, the Consultative Committee for International Telephony and Telegraphy decided on an international standard of coaxial cable. The Post Office, therefore, needed to start building their own crystal filter coaxial cables to conform. This fell to the Radio Branch of the Engineering Department, who were also stationed at Dollis Hill, and headed by Captain Booth. The problem faced by his team was not the technology, but rather the materials: since these coaxial cables were potentially going to become part of its infrastructure, Britain required a large supply of precisely milled quartz.

[75] Cahn was the first professor to teach and organise Materials Science and Engineering (MSE) research in Britain.

[76] Two crystals with mirror image lattices of each other, placed at either end of a cable, would act as sieves both separating out then re-merging speech frequencies. This meant that more information could be packed within a bandwidth without any interference between the frequency bands.

The Radio Branch engineers collaborated with Research Branch engineers from other disciplines to develop equipment for the production of specifically milled quartz crystals, establishing their own specifications. Although the laboratories were purpose built, specific to various scientific disciplines, the positioning of the laboratories at Dollis Hill leant itself to an interdisciplinary project such as this. The engineers involved were physicists, chemists, and metallurgists who worked under the jurisdiction of Booth and the radio scientists. As shown in Figure 5.11, the chemistry and radio laboratories were adjacent to each other, whilst Appendix Figure 3 shows how the physics, metallography and material and special measurement group offices and laboratories were all situated on the ground floor of the west wing of the general research building. Initially the crystal laboratory at Dollis Hill was divided into two sections: the ‘production’ team responsible for building mounted plates; and the ‘development’ team, exploring new processes and types of plates and bars, and its set-up was seen as essential in order to enable a smooth production line. However, due to heavy demands on the production end of the process, it was later relocated to three adjacent rooms, and the different stages in the crystal production were completed in consecutive rooms starting with cutting, then leading to more accurate adjustments and testing, then the final room where they were embedded with the drive circuit development (BTA: TCB 226/449, p.83).

As a result of the work of the crystal laboratory researchers, the Post Office maintained absolute control over the development of quartz crystals, from the raw material to finished project. This was an unusual activity for the Post Office research engineers who, as I have shown, were more often engaged with testing and calibrating equipment for private firms and investigating faults in the communication network (BTA: TCB 226/223 to 226/1043; TCB 422/5858 to 442/11080).

The impact of this small team of Post Office engineers was felt across the British Empire, private manufacturers and other state departments. Between 1930 and 1939 the Post Office Radio Department published a number of reports in which they tested quartz crystals from across the world. Countries included: Uganda, Kenya, Burma, British Guiana, New South Wales, Tanganyika Territory, Tasmania, Canada and India. They also developed equipment for the production of quartz and tested other companies’ equipment, e.g. the Diamond Development Company and Automatic Telephone and Electric Company. They established specifications of the material, experimented with different applications of quartz in receivers, oscillators and resonators, and supplied crystals to the War Office, Ministry of Aviation, Greenwich Observatory and the BBC (TNA: AVIA 23/672). Engineers also assessed the capacity for quartz crystals to be used as a frequency standard. The knowledge gained by the Post Office Engineers was directed back to industry as the crystal laboratory shared the details of their methods, designs of the cutting machines and production process with manufacturers who were also interested in producing coaxial cable equipment (Booth and Sayers, 1939, p.93).

The laboratory also established the best manufacturing methods and set the standards for quartz crystal production. As such, it framed the development of communication systems that used these components once their production was scaled up and relocated to private firms. The quartz crystal resonator was a key part of the London-Birmingham coaxial cable which was installed in 1936 for carrier telephony. Standard Telephone and Cables (ST&C) were appointed to manufacture the cable and the company applied the knowledge and standards for the quartz crystal set by the Post Office Engineering Department. The service was expanded from Birmingham to Manchester, followed by Leeds and Newcastle (POST 76, 1937). Thus the growing coaxial network in Britain was an opportunity for the Post Office to increase its control over the physical telecommunications infrastructure.

5.8.3 'Metro-Land' and the growth of suburbia

On 23rd October 1933, the Post Office Research Station was declared officially open by the then Prime Minister Ramsay MacDonald in a filmed and broadcast ceremony (G.P.O's Research Station, 1933). Despite functioning as a centralised research station for the Research Branch of the Post Office's Engineering Department for a decade, its presence and activities were now fully publicly celebrated. This did not signal the end of building works, however. Several of the permanent laboratories had yet to be started and many of the temporary ex-Army huts were still in full use.

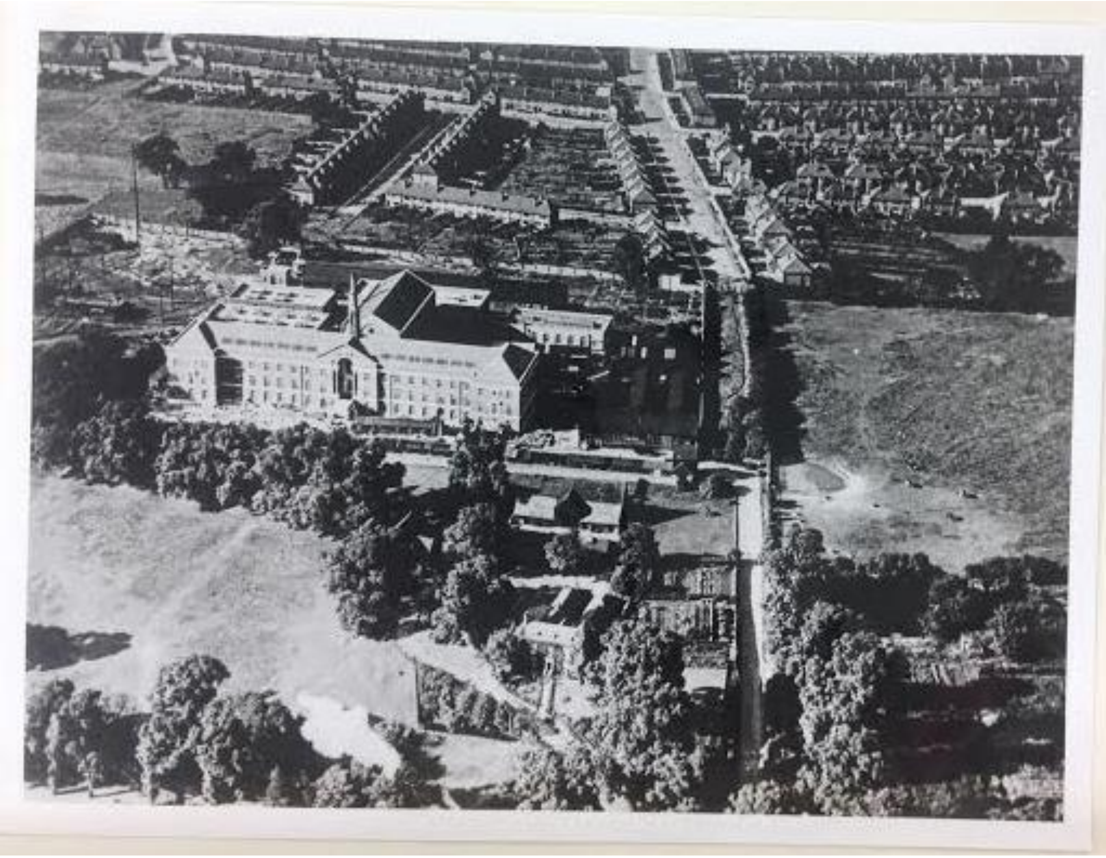
Meanwhile, suburban London continued to expand. Unfortunately for the Post Office Research Branch, the Metropolitan Railway had built housing developments along its line, through a legal clause that enabled it to retain surplus land. Marketing it as Metro-Land, a swathe of mostly middle-class settlers moved to desirable 'residences' that was still an easy commute away from central London. Between 1921 and 1939, 800,000 people were added to the census total of west and north-west London (White, 2008, p.29). What was once a golf course and farmland surrounding the Dollis Hill Research Station became streets of semi-detached commuter belt housing (see Figure 5.12). Jacob Ward has provided a stark visual comparison of the growth of suburbia around the Research Station's site from 1914 to 1936 (Ward, 2016, p.77). There is a note in the Engineering Department's monthly progress bulletin from July 1930 that indicates how early the development of the local area began to impinge on the site of the Research Station,

> The rapid development of the northern slope of the hill for housing property has rendered imperative the erection of a wall, especially on the west side, along which the

> Borough council has reserved a broad strip for recreation purposes (Post Office Engineering Department, 1930).

When the Research Section of the Post Office Engineering Department moved most of its activities to the Dollis Hill site, staff from the experimental branch of the Radio Section came too. During the 1920s and early 1930s, Dollis Hill radio researchers were mostly working on field-strength measuring apparatus, frequency measurement and control, and receiver designs; activities that did not require an extensive amount of space or facilities (Anon, 1956, p.238). As a result, they were assigned the narrow width of land along the west side of the Research Station plot, the onsite lake acting as a natural divide between the departmental sections. By 1935, however, the Dollis Hill accommodation for radio experiment was already insufficient. Improvements in coaxial cable designs and in shortwave systems promised potentially more efficient telecommunication infrastructure and the amount of radio research increased faster than planned. In July 1937, the Postmaster General wrote to the Treasury to ask whether the planned extension of the Dollis Hill radio site could be further extended as "in consequence of the continued expansion of the work of the Radio Branch, the accommodation to be provided under the building scheme [already] sanctioned … [would] be insufficient" (TNA: WORK 12/110/1/59).

Now that it was hemmed in by outer London suburban housing, Dollis Hill was already outgrowing itself. Although the Treasury agreed to the further extension, building work was slow. A steel shortage later that year caused further delays: concerned letters from the Chief Architect, Postmaster General and contractors hint at the frustration of the Dollis Hill engineers not being able to carry out their "urgent experimental work" (TNA: WORK 12/110/1/103). As a solution, some of the Radio Section moved out to the old Wembley Exhibition site nearby. Twenty years later, this makeshift accommodation was still in use (Anon, 1956, p.238).



5.12—Aerial photograph of Research Station at Dollis Hill, c.1933/34 (PMA: POST 76/47).[77]

Ward (2016) has shown that researchers were feeling crowded in the 1950s and the decision was made to relocate in 1958, only 25 years since the 1933 launch. By 1934, Cohen reports that over 600 people were employed or in training at the Research Station (Cohen, 1934, p.137). The temporary hutments were meant to be used for only five years, yet some were still in use over 10 years later (Figure 5.12). As such, the permanent buildings could ultimately have been a failure, erected too late to make use of the space before suburbia surrounded it, and not built big enough to accommodate the growing numbers of staff. This suggests that the heyday of Dollis Hill was really the time spent in the temporary huts. Although the huts were not ideal, the staff who worked there had high morale and the huts enabled Post Office research output to rapidly increase.

[77] This is likely to have been taken around the time of the station's official opening ceremony in 1933, as an Ordnance Survey map of the area for 1935-36 shows two cul-de-sacs of terraced housing replacing the field in the bottom left-hand corner. Some of the remaining temporary huts can be seen still in situ in the centre of the image.

5.9 Conclusion

In this chapter I have described the move of the Engineering Department to its new accommodation at the Dollis Hill site. I have argued that a significant part of the story of Dollis Hill relates to the period of time that the hutment scheme operated, which lasted over 10 years.

The hutment scheme was the idea of William Noble, the Engineer-in-Chief between 1919 and 1922. I have argued that Noble was more astute and tactical than Slingo, who could be unduly idealistic to persuade the Treasury. Instead it was Noble who was able to eventually persuade the Treasury to purchase the Dollis Hill site and then, shortly afterwards, occupy it with ex-army huts. This approach was much more effective than Slingo's. For instance, Slingo had talked up all the advantages of a dedicated, centralised research for the Engineering Department's Research Section but had failed to make the case on a broader basis. By contrast, Noble made his pitch in terms of the poor reputation of the Post Office's service and, in particular the lack of innovation there had been. He also applied pressure by referring to the money being made available for similar projects by the Treasury and argued that without better research facilities the private sector might benefit, potentially increasing costs in the long term if the Government wanted to make use of any developments made by that sector.

Once the Engineering Department acquired the Dollis Hill site in the middle of 1920 it was only five months later that research work commenced in the huts. The hutment scheme was funded as part of the initial award from the Treasury, so it seems clear that the acquisition of the site and the plan to use huts went together. Again, the Treasury must have been persuaded by Noble's economic arguments such as that the hutment scheme would be cheaper at a time of financial pressure and that eventually the cost of building would reduce. This is further evidence of Noble's skill at advocacy and his ability to get things done. In my view, Noble had clearly realised that if anything was going to come of the Dollis Hill project, the Research Section needed to get on-site as soon as possible; once the Section was in-situ and developing new, useful technology it would be much harder for the Treasury not to fund the construction of the permanent buildings.

The huts themselves were arranged on the site and included everything that was necessary for research purposes. This allowed the Research Section to grow, and it virtually quadrupled in size from 45 members of staff in 1920 to 190 in 1924. Primary sources that describe life in the huts indicate that, apart from weather-related discomfort, the working atmosphere was fun and jovial. More importantly, the amount of work the Research Section was able to do increased considerably, such as the testing of W. West's artificial ear.

In the early stages of Dollis Hill, the Research Section engaged in some modest promotion of the site and the work being done there. This amounted to papers in the *POEEJ* and lectures to an audience that was primarily made up of academic and specialist audiences, although there was some interest shown by newspapers too. In my view, this was an effort made by Pollock and Cohen to increase the profile of Dollis Hill and build support for it both within specialist audiences and the public. However, this promotional work was relatively low-key compared to the intensity of such work when Dollis Hill was officially opened in 1933. This is explained in the next chapter.

Construction of the permanent buildings began in 1923. However, it was slow work: the completion of all of the permanent buildings took until at least 1935. The architectural style of Dollis Hill was in the Neo-Georgian style, which is consistent with virtually every other building constructed by the Office of Works during the interwar period. This reflected the culturally conservative attitudes of the time but was criticised by architects as being unadventurous. Even so, the architecture allowed for the Research Section to maintain the privacy of its laboratories whilst also conveying a sense of accessibility now that the location of the research being undertaken could be seen. This was built into the site with rooms dedicated for demonstrations. Perhaps more significantly, I argue that the existence and design of Dollis Hill allowed the Research Section to assert its status as an important centre for the development of new technology.

Research work that was done at Dollis Hill included work that would have been unlikely to happen anywhere else. For instance, the development of quartz crystals demonstrated the value of having people skilled in a number of different disciplines working in the same place. This was aided by the layout of the laboratories and set the standard for the production of quartz crystals in the future.

Whilst the construction of the permanent buildings at Dollis Hill was slow, the development of the surrounding area was quick. Marketed as the desirable ‘Metro-Land’, the surrounding local population of Neasden increased rapidly during the 1930s. This prevented the Dollis Hill site from expanding far enough and even by 1935 space in the laboratories was already considered insufficient. I suggest that, in some ways, the permanent buildings were a failure because they were found to be too small much quicker than expected. As permanent buildings they did not have the flexibility of the hutment scheme, so changes to the site could not be made easily. Furthermore, it seems clear that the location of Dollis Hill was not as isolated as Slingo and Pollock originally hoped: perhaps by being too well connected to central London the surrounding area was able to develop and gentrify rapidly and thereby hemmed in the Research Station. In hindsight, the extended period of time spent in the huts may have been when there was the greatest opportunity to develop the site. As a result, even though delaying the building of the permanent buildings was an argument used by Noble to progress the project, this may have ultimately curtailed the useful life of Dollis Hill.

Chapter 6.

Dollis Hill goes public 1933-1938.

> Officially it is known as the Post Office Research Station. Actually it is a palace of gadgets in which the telephone and telegraph, and everything appertaining thereto, are investigated, dissected, analysed, tested, and their innermost mysteries laid bare on the laboratory table (Anon, 1933a).

6.1 Introduction

The year 1933 fell within a turbulent period of time in the United Kingdom. At the national level, the country was still trying to cope with the effects of the Great Depression. The second 'National Government' that had been in power for two years was led by Ramsay MacDonald who had formed this coalition in order to address the acute economic issues that the country faced. At the level of the Post Office, the organisation was also facing a difficult set of circumstances. The service it provided was widely criticised and there was an ever-present threat of privatisation. At a time of fiscal austerity following the Great Depression, the Post Office needed to justify the subsidy of its activities at public expense.

In this chapter I introduce Postmaster General Sir Kingsley Wood who coordinated a high profile opening ceremony for the Research Station in October 1933. Wood was instrumental in rebranding the Post Office during the 1930s, and through his hiring of Stephen Tallents as Public Relations Officer he was able to promote a forward-looking and design-focused service. I argue that Wood and Tallents used Dollis Hill and its research engineers as advertising tools for their mission and a starting point for their rebranding campaign through film, publicity posters and a high profile opening ceremony—even though it had already been in operation for over a decade. This opening ceremony was an event that represented an opportunity for both the Post Office as well as the government: as guest of honour, Prime Minister Ramsay MacDonald used the ceremony as a platform to advocate his socialist ideals of a science-focussed society, and an opportunity to be seen (through the use of film) to be in charge during his challenging leadership. However, it is clear that the opportunity for MacDonald and his government was limited in scope and represented a single 'good news day' for an otherwise embattled administration. By contrast, for the Post Office, the opportunity presented by Dollis Hill would form part of a longer term strategy to improve the institution's public image as a whole, as well as also producing research that would go on to improve the service it provided. This episode illustrates Leggett and Sleigh's distinction between the governance *of* science and governance *by* science by providing an example of scientific research being used as a means of exerting influence over events: a Prime Minister representing himself as being in charge (governance), but the administration of Dollis Hill actually calling the shots.

I conclude by arguing that the utility of Dollis Hill for the Post Office was primarily in public relations terms and allowed the Post Office to demonstrate that it was improving its service to its customers through its publicly presented research projects. In other words, the Post Office administration used Dollis Hill and its research engineers to sell itself. To support this, I give some examples of the public relations work to which the research work carried out at Dollis Hill contributed, such as newspaper articles, the creation of educational demonstration sets and featuring in a film of the GPO Film Unit. By contrast, other technical but no less significant work was done at Dollis Hill, but this work was either not publicised by the Post Office, or was not enough of a story for newspaper reports. I suggest that whilst Dollis Hill became well known during the 1930s, much of the actual substance of its work did not. This chapter seeks to address that imbalance.

6.2 Sir Kingsley Wood and the public relations machine

Sir Kingsley Wood was a Conservative member of MacDonald's Cabinet and was Postmaster General throughout the National Government of 1931 to 1935. He is credited with turning around the fortunes of the Post Office, and as part of this, the opening of Dollis Hill represented a significant opportunity for Wood to improve the Post Office's public image. Campbell-Smith describes Wood as "the most influential politician at the Post Office since Henry Fawcett in the 1880s" (Campbell-Smith, 2011, p.293). In this section I will describe where the Post Office's public image had reached by 1933 and I will explain how Wood intended to change those fortunes. I argue that the Post Office had much to gain from the opening of Dollis Hill in terms of public relations. In that way, both the Government and MacDonald and the Post Office and Wood stood to benefit from the opening of Dollis Hill. However, the benefits for the Post Office were much more profound than for the Government: this is understandable given that for the Post Office, opening the Dollis Hill Research Station was part of an effort to rebrand the service it provided, whereas for government it provided only a brief good news day.

A decade on from William Noble's collection of damning newspaper articles regarding the state of the service provided by the Post Office, the public and political condemnation of the British Post Office services, namely the telephone system, had not diminished. In fact, publicised criticism had even come from high up within the Post Office's own administration: in 1928 the

Assistant Postmaster General and Conservative MP, Roundell Cecil Palmer, gave a speech to his constituency in which he suggested the privatisation of the Post Office because “there is great difficulty in a State-run department in finding the right man to control a great business organisation” (Campbell-Smith, 2011, p.282). Palmer’s speech fuelled complaints from business lobbying groups, led by the Telephone Development Association, who were concerned that the Treasury’s frugality was stifling the growth and development of an important new industry. It seemed Slingo’s wartime funding frustrations were still ongoing.

A year after Palmer’s speech and in reaction to its mounting bad press, the Post Office set up its own Publicity Department in 1929. This was on the initiation of Alexander G. Highet, a former commercial publicist who went on to have a distinguished career as a civil servant of official publicity. Unfortunately for the Post Office, Highet was a staunch traditionalist. Although he was in charge of a completely new department that could be taken in any engaging new direction, he took a very straightforward approach to public promotion: Highet organised the Post Office’s publicity along the lines of the commercial advertising of the time and promoted its specific services in turn (Swann, 1989, p.49). Highet’s tendency to stick with the status quo would become his legacy. While achieving a notable wartime career in Air Raid Precautions and the Ministry of Information, he annoyed others in the industry with his “bureaucratic penny-pinching” and would later be described by a colleague as “a pompous Scot … whose total creative problems had been bounded by whether to paint the Post Office at Nether Wallop white or pink!” (Welch, 2013, p.48). As a result, Highet’s initial efforts went without much immediate effect.

Campbell-Smith explains how actions leading to the Post Office’s reorganisation began in 1929, despite it being an already nationalised industry under a supportive Labour government, which even included six Labour MPs who had been sponsored by postal unions (Campbell-Smith, 2011, p.282). The Government wanted to investigate the civil service as a whole, and so in October of that year it appointed a Royal Commission to look into its structure and organisation. Named after the judge leading proceedings, the Tomlin Commission uncovered huge pay discrepancies between the Post Office’s lowest paid employees (in particular, its lowest paid women) and the salaries of its officials. Women were also discovered to be totally excluded from being employed at certain administrative ranks, as well as in all engineering and technical roles. Helen Glew has investigated the segregation of men and women working in the Post Office in the first half of the twentieth century. She explains how the Secretary, Evelyn Murray, under questioning during the Tomlin Commission, revealed an underlying fear of the growing proportion of female staff—accelerated by the First World War—which was common amongst male civil servants.[78] It was this fear that had reinforced the Post Office's segregation policies over the years (Glew, 2016).

The Tomlin Commission published its report in July 1931 and left Post Office reform looking like the inevitable option. Four weeks after the report's publication, MacDonald resigned as Prime Minister and subsequently returned to power as leader of the National Government, relinquishing much of his control over domestic policies to Stanley Baldwin and Neville Chamberlain. It was Chamberlain, as Chancellor of the Exchequer, who then appointed his previous parliamentary secretary throughout his 1924-29 government to the role of Postmaster General, Sir Kingsley Wood, following the general election of November 1931 (Peden, 2011).

On his appointment, Wood found himself in a difficult situation whereby the public and parliamentarians were impatient for reform of the Post Office, but its officials remained impervious to any such criticism. Wood, however, eventually came up with an elegant solution that he hoped would satisfy all parties; a change in working practices that stopped short of a full reorganisation of the Post Office. This would avoid any risk of splitting up the three functions of post, telegraphs and telephones, but would also provide an opportunity to review how those functions were delivered. Wood's strategy was to appoint a committee to approve these changes or, rather, a committee that would just so happen to recommend the changes that Wood had decided upon. The Committee was led by Lord Bridgeman and Wood briefed the Committee about what he considered to be "certain relevant preliminary observations" in which he ruled out splitting up the Post Office or privatising any of its functions (Campbell-Smith, 2011, p.296). The Committee's task was to investigate the accusations of technological incompetence that had continued since Highet's employment. It was to investigate whether the Post Office should, in fact, be run more as a business rather than an ordinary government department.

In the end, the report of the Bridgeman Committee concurred with Wood's starting position; that there was excessive centralisation of authority in the Post Office and that a Board would be created to replace the role of Secretary. As I discussed in Chapter 3, this was precisely what Engineer-in-Chief, Major O'Meara had been frustrated by before his resignation in 1912. Wood's Board would delegate the implementation of policy to the local level and would end the split of finance, administration and engineering functions that were then only coordinated high up the Post Office's management structure. The Post Office would also gain some limited financial independence from the Treasury: as I have demonstrated in previous chapters, the Post Office needed to apply to the Treasury to release funds from accounts that its services paid into, such as the Telephone Capital Account. The Treasury's authority over the Post Office as a

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[78] See Appendix Figure 2 for a chart on the number of women employed in engineering grades during the First World War.

revenue department gave the organisation limited room to manoeuvre because of constant questioning by Parliament. This, in turn, was the real source of the Post Office's tendency to over-centralise.

Wood fought hard to implement the proposals which faced staunch opposition from Evelyn Murray: as I mentioned in the previous chapter, Murray's preferred outcome was eternal inertia, an approach which he felt had worked so well in the past, however this time his own role was being called into question. There were further committees, reports and discussions with Murray attempting to undermine the Bridgeman recommendations. As a compromise, Wood decided to promote Murray in order to remove him, and so found him a promotion as Chairman of the Board of Customs and Excise, thus avoiding having to spend more time dealing with Murray's intractable objections. After Murray's departure, Wood was able to implement some of the Bridgeman recommendations and he established a new relationship with the Treasury, where a fixed annual contribution of Post Office profits would be handed to the exchequer (instead of everything) and any surplus profit could retained by the Post Office to be put back into its service (Peden, 2011). As Campbell-Smith says, Wood's objective was, "to rebuild the credibility of the Post Office—and to restore, if he could, some of the popular affection for it that had seeped away since the end of the war" (Campbell-Smith, 2011, p.302).

As Scott Anthony points out, there is no complete biography of Kingsley Wood and so his motivations against splitting or part-privatising the Post Office have yet to be fully explored (Anthony, 2011, p.120). Alan Clinton suggests that Wood was acting in order to please Chamberlain, Chancellor of the Exchequer, who had warned him of the huge difficulty in splitting the Post Office into separate companies for post, telephones and telegraph networks (Clinton, 1984, p.289). Campbell-Smith suggests that Wood thought it simply did not make sense to split up services such as telegraphs and telephone that in rural areas were delivered at a single desk by the same counter staff (Campbell-Smith, 2011, p.295).

Under Wood's tenure, the Post Office launched high-profile campaigns such as the 'Empire Air Mail Scheme' that meant all international first class mail would be delivered by aeroplane. In order to attract the next generation of telephone consumers, the Post Office, supported by Wood launched a series of public exhibitions including the Young People's Telephone Exhibition held at the Imperial Institute (see Figure 6.2).[79] The Research Section at Dollis Hill provided equipment for these exhibitions, which included working demonstration models of automatic telephone sets (BTA: [uncatalogued], 1932, Bulletin No.6). The Post Office also opened its own museum in a corner building on the Strand in central London. Admission was free, and it had a corner dedicated to Post Office research (BTA: TCB 417/E 8755).

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[79] This exhibition was repeated at least once more in 1936 (Anon, 1936).

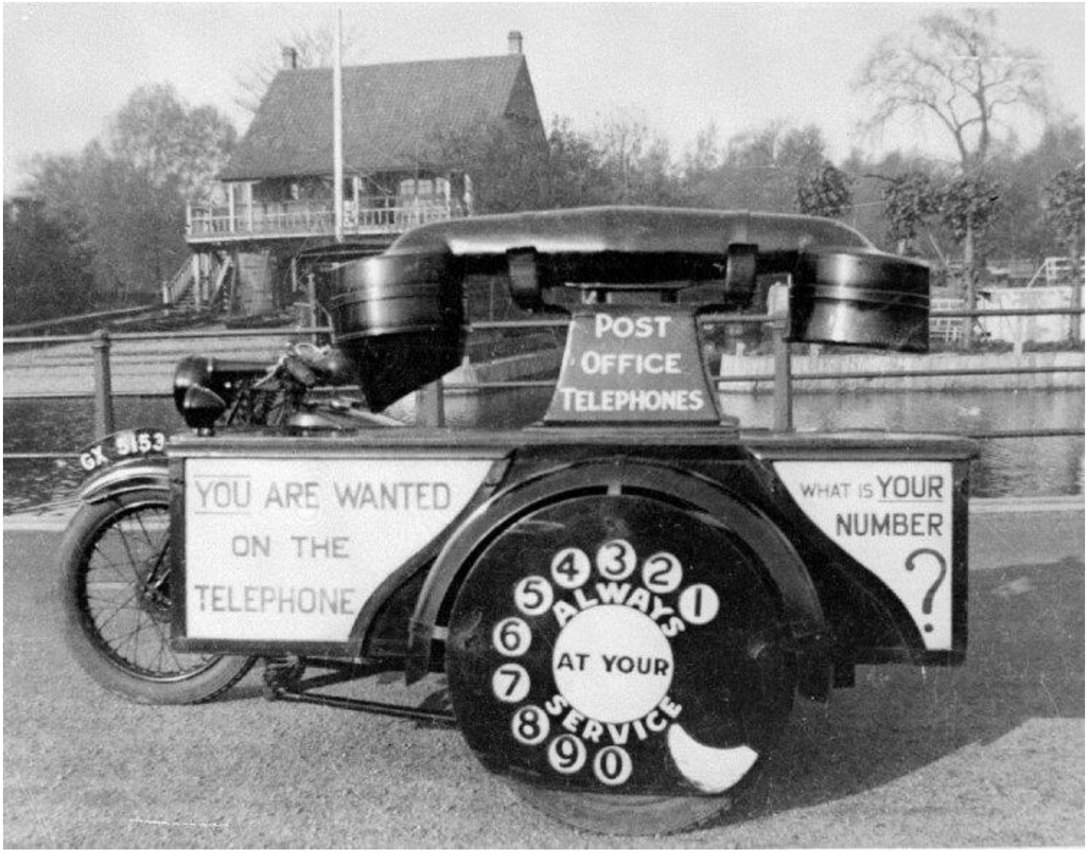
6.2—Postmaster General Sir H. Kingsley Wood (seated) at the Young People's Telephone Exhibition, 1932 (BTA: TCB 417/E 7725).

An important part of Wood's efforts to improve the reputation of the Post Office was his relaunching of the Publicity Department in September 1933 with Stephen Tallents in the role of Public Relations Officer. Tallents had a strong reputation for his public relations work and was knighted for the "missionary zeal" his showed in the promotion of the Empire Marketing Board (EMB) (Campbell-Smith, 2011, p.306). Tallents spearheaded numerous initiatives with a view to softening the Post Office's otherwise rather bureaucratic image. This included launching the *Post Office Magazine* which had a wide circulation, as well as other publications that were addressed to a variety of audiences, such as children and academics. Figure 6.3 shows an example of the sort of publicity with which the Post Office began to engage. I explain below how the GPO Film Unit, which was made up of members of the EMB Film Unit, previously overseen by Tallents, used the research activities of Dollis Hill engineers as its first topic to promote.

Overall, Wood's efforts to change how the Post Office operated and was perceived was a success. Profits began to grow from virtually nothing in 1929-30 to £2.1 million in 1934-35. The press began to report on the improvements being made. *The Times* said in 1934 that the Post Office had achieved,

> the orderly development of a great State department on bold and progressive lines to meet the needs to our time…the reason is not far to seek in the considerable transformation of its outlook and methods (Campbell-Smith, 2011, p.310).

The Observer was similarly complimentary and said in 1938 that "the praise of the Post Office is nowadays in everybody's mouth; its efficiency, its enterprise, its alertness and responsiveness, its courtesy and humanity" (Campbell-Smith, 2011, pp.310-11). It was in this context that Dollis Hill was officially opened.



6.3—Promotional motorcycle c.1934 (BTA: TCE 361/ARC 1187).

6.3 The Official Opening Ceremony of Dollis Hill, 23rd October 1933

At 4.30pm in the afternoon on 23rd October 1933, the Prime Minister Ramsay MacDonald arrived at the Dollis Hill Research Station, where he was met by Wood. Both men were dressed smartly, carrying sticks and top hats. The station was already busy with Post Office staff, reporters and film crews. According to *The Times*, there were invited guests from the science and engineering professions and representatives from telephone and telegraph research departments from all over the world in attendance (Anon, 1933c, p.11). Cars and busses continued to pull into the driveway and a crowd of people queued near the gates to catch a glimpse of the distinguished visitors. A large Union Jack had been raised above the main entrance. Before heading in to the lecture hall, MacDonald was escorted by Wood to greet a line of men stood to attention in military dress. He walked along the line slowly, nodding to and greeting the men, even pausing to lift up a medal of one man for a closer inspection (Ramsay MacDonald […], 1933).

The army-like display of a line of soldiers was not unique to this event. Throughout the late 1920s and 30s, opening ceremonies of scientific institutions involved similar line-ups and marches. For example, Prime Minister Stanley Baldwin was greeted by a line of soldiers at the opening of Birmingham University's new biological building in 1927; in 1929 the Duke of York was introduced to a line of retired servicemen when he opened the new electric power station at Hams Hall, Yorkshire; and the Prince of Wales inspected a long line of soldiers at the 1930 opening of new physics and chemistry laboratories at the University of Cardiff (Prime Minister Opens New […], 1927; Great New Electric […], 1929; The Prince of Wales in Wales, 1930). The image of a parade of soldiers outside a place of science added symbolism of a higher purpose to proceedings. A hangover from the First World War, soldiers standing to attention associated the scientific and technological research happening within the research station at Dollis Hill with discipline and useful application.[80]

The research station had been open for at least an hour beforehand: staff (wearing "distinguishing badges") directed people around the station to see the 78 pre-prepared exhibits on display, including an artificial ear, silence rooms and a "Robot Operator"—a machine that would play recorded voice messages such as "line engaged" instead of the usual electronic tone (BTA: BT1-CEN15/4/3, 1971 reprint). The telephone; how it worked, its components and the materials that made them, was the main subject of demonstrations. On show was equipment for the analysis of metals and other materials, staff offered demonstrations of the latest in telephone repeaters and echo suppressors, sample articulation efficiency tests were run and the Training School's automatic exchange was an exhibit in itself. The aforementioned correspondent from the Aberdeen Journal was particularly taken with a demonstration of a machine to test the durability of telephone receivers. This carousel-shaped machine would repeatedly lift and drop receivers onto a metal plate to see how many thousands of bangs they could withstand. The machine was nicknamed "Galloping Gus", which the reporter considered "an unexpectedly

[80] See Arapostathis and Gooday (2013b) for a discussion on how "applied science" emerged during the First World War within the fields of physics and electrical engineering.

human touch on the part of the Post Office"—an astute observation considering the Post Office's drive towards mechanisation and automation (Anon, 1933a, p.4). Another reporter, from London's *Daily Herald*, announced that the latest way to telephone was shown to be via loud-speaker (Anon, 1933d, p.3).

In contrast to what was on display, the speeches from the opening ceremony—in particular those from Wood and MacDonald—focussed on wireless communication. The ceremony began with an introduction by Wood, who made reference to the global nature of scientific research and the "cooperation and spirit of mutual help" between Dollis Hill and organisations from across that world, likely in recognition of his international audience (G.P.O's Research Station, 1933). He announced that the Post Office's engineers and researchers already had a global and high reputation. As an example of this, he mentioned a recent tribute from the Italian inventor Guglielmo Marconi towards Post Office engineers, and who had also remarked upon how Britain was the first country to build short-wave beam stations for wireless telephonic communications throughout the Empire.[81] Next, Capt. B.S. Cohen, Head of the Research Station and the only representative from within Dollis Hill to speak, gave a short account of the work that was currently being done at the research station and read out a congratulatory telegram from the International Consultative Committee on Telephony. MacDonald's speech however, like Wood's, involved Marconi and wireless telegraphy. He recounted befriending William Preece decades earlier, who introduced him to Marconi and his early demonstrations of wireless technology,

> Did they ever think 20, 30 or 40 years ago that things that were toys, ideas that were speculations, pretty striking experiments done within the walls of the Royal Institution—wireless sounds sent up from a cellar to a lecture-room, and so on—would in 1933 become great parts of the foundations of our industry, applied so that they affected the whole of our lives so intimately and so powerfully that a new kind of life was being introduced to mankind on account of them? Had they had the vision of today, would they not all have felt proud that the men at work on these experiments, students and assistant experimenters, whose names were to be recorded for ever in the annals of the progress of science, were British? (Anon, 1933c, p.11).

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[81] This was probably in reference to a speech Marconi made as guest of honour at a luncheon at the Royal Empire Society in May 1933 (Anon, 1933e, p.14). This comment was perhaps less flattering to the Post Office than Wood was suggesting, as the entrepreneur Marconi had a vested interest in Britain adopting his company's technology. For an in-depth discussion on how the Post Office contributed towards the early development and adoption of wireless technology, see Elizabeth Bruton (2012).

MacDonald continued to provide reassurance in his speech that it was “no silly or vain form of patriotism” to be proud of the successes of the British engineer, which demonstrates a concern that the opening ceremony, or even the very existence of a state-funded research station, might have been seen as unnecessary by the British public (G.P.O’s Research Station, 1933). It could even have been more of a personal comment towards MacDonald’s own presence as Prime Minister at a celebratory event: in introducing MacDonald to the floor, Wood had suggested that it was not certain MacDonald would have been able to attend given “the difficult time through which he is passing in leading the nation at the moment” (Ramsay MacDonald Opens […], 1933). In 1933 MacDonald was leading the National Government; a coalition of the three major political parties stemming from an unpopular decision made by MacDonald in 1929, then Prime Minister of a Labour government, towards cuts in unemployment benefit. As I have mentioned previously, the 1920s and 30s were a difficult time for the British economy coupled with record levels of unemployment. According to Roy Hattersley, unemployment was the defining memory of interwar Britain and National Hunger Marches became a regular feature of the 1930s (Hattersley, 2007, p.174).[82] MacDonald was therefore seen to be betraying his party’s traditions by cutting unemployment benefits—effectively harming the people his party sought to serve—and the Labour Party split in two. Recent scholarship, however, paints a more sympathetic picture of MacDonald. David Marquand argues that MacDonald put the country before his party, and saw the perils of huge unemployment and inflation of Weimar Germany as a warning and so succumbed to orthodoxy over the new Keynesian economics (Marquand, 1977).

Despite these difficulties, MacDonald was the ideal figure to open Dollis Hill. A unique aspect of MacDonald as Prime Minister is that he had a scientific background and initial hopes of a scientific career—the first British Prime Minister to do so (Marquand, 1977, p.22). Throughout his political career he sought to raise the profile of scientific research to the extent that he was characterised as a “Master Chemist” in a satirical cartoon regarding his attempts to form a coalition government in 1931 (Figure 6.1).

The stressing of the supposed Britishness of wireless technology in both Wood and MacDonald’s speeches is striking, especially in comparison to the telephone-heavy display of investigations that were exhibited by the Dollis Hill researchers. However, both Wood and MacDonald were politicians and would have been conscious of their audience beyond the Dollis Hill lecture hall. As the camera crews present in the bottom left-hand corner of Figure 6.4 show, the ceremony itself was recorded on film to eventually be shown in cinematic newsreels, and many of the newspaper reports quote MacDonald’s words verbatim.

[82] The most famous of these marches was the ‘Jarrow March’ of 1936.

6.1—Ramsay MacDonald as 'The Master Chemist' © National Portrait Gallery (Partridge, 1931).[83]

Publications such as the *Falkirk Herald* and the *Yorkshire Post* picked up on the nationalist rhetoric, with headlines such as "Prime Minister Praises British Scientists" and "Premier opens New Research Station. British Triumphs" (Anon, 1933e, p.6; Anon, 1933f, p.5).

[83] This cartoon appeared in *Punch* magazine with the caption: "Professor MacDonald: "Now if only these rather antagonistic elements will blend as I hope, we'll have a real national elixir"" (Lee, 2005, p.372).

In contrast, Cohen's speech about the work being done at Dollis Hill hardly gets a mention in the press. As I have previously noted, the British Post Office felt that it was playing catch-up with other countries both in terms of telephone technology and subscriber numbers, especially with the United States. Emphasising the British achievements in wireless technology, despite not being the focus of the research station's actual work, played to the nationalist zeitgeist of the time. Even the absent Italian inventor Marconi could be considered part of British story, since his mother's Irish connection was used as his way in to British business circles (Hong, 2010, p.18). To a public audience perhaps more familiar with the radio than the telephone, linking Dollis Hill with the supposed triumphant British history of wireless telegraphy would have helped to justify the ceremonial launch of a 'new' state-funded research station.

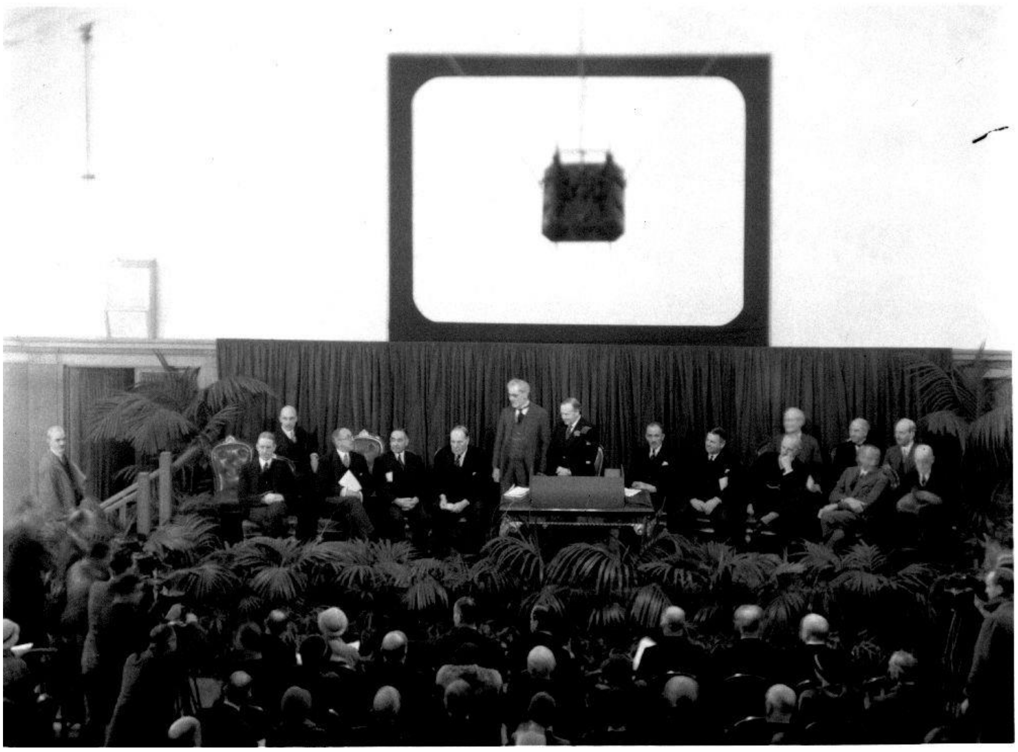
A curious thing about the opening of Dollis Hill is its timing: in October 1933, the building works for the rest of the site had not been completed. As the previous chapter has demonstrated, the construction of the permanent buildings continued well into the 1930s with some buildings still yet to be finished, let alone occupied, by 1933. The "new wonder house of experiment & invention" as so described by the British Pathé newsreel of the opening ceremony, was so new that it was still surrounded by construction works.

The opening of Dollis Hill was a high profile event for the Government and Post Office. It served MacDonald well to praise British engineers and scientists at time when the wider political situation was difficult and complicated. The opening also served Wood well as an example of how the 'new' Post Office might go about presenting itself to the wider public. It is notable that Tallents had been in post as Public Relations Officer for a month before the opening ceremony—it is reasonable to assume that he would have played a role in inviting in the press, although it is unlikely that Tallents would have been responsible for arranging the date of the ceremony.

I have not been able to find any evidence that indicates why Dollis Hill was opened when it had not been completed. Perhaps Wood felt that the opening ceremony was a good opportunity to demonstrate the virtues of the Post Office's more public-facing attitude, which was part of his campaign to rebrand the Post Office that had begun in 1932. Perhaps Cohen, as head of the Research Section, felt that it was time to show the Treasury and others in government that the public money had been put to good use even though the project had not been completed: it demonstrated that even an incomplete but dedicated research site was better than the previous accommodation, and Cohen would have been able to argue that this would only get better as the site nearer completion. Of these two possible explanations, I think it is simpler to conclude that Wood would have wanted to see Dollis Hill open as part of his campaign to enliven the Post Office. He would have had the authority to declare that Dollis Hill was finished, even though it would not be fully completed until 1935, and the contacts to secure MacDonald's attendance, who was the perfect state ambassador for its promotion. This is in addition to Tallents' skill in delivering the overall public relations message that emphasised the improvements in the Post Office's service that Dollis Hill would provide.

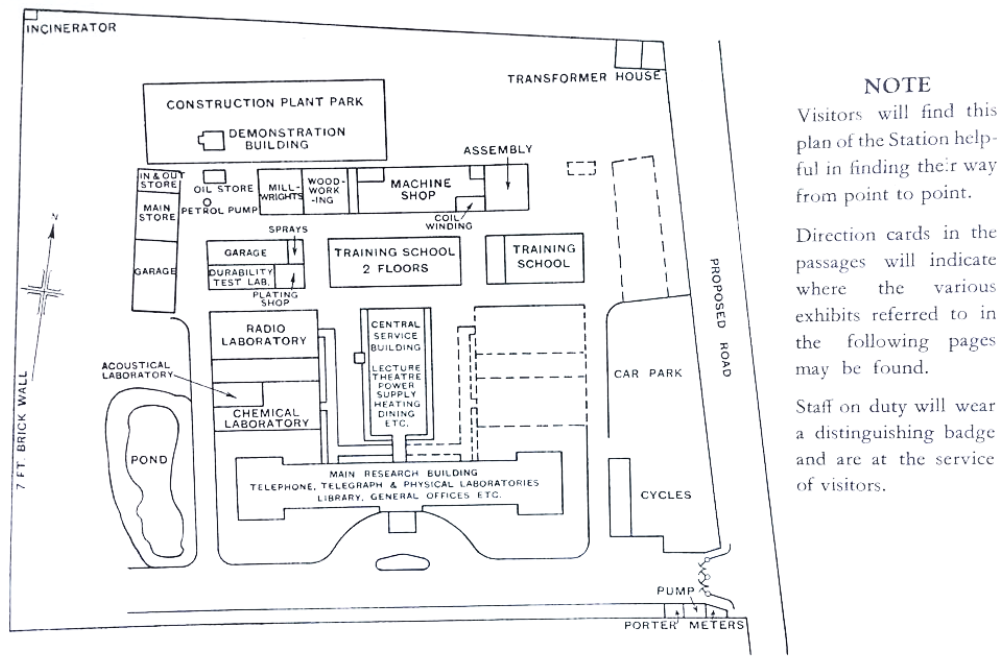
There is some force in the argument that Cohen might have wanted to get Dollis Hill officially opened even if that was somewhat premature. The background to Dollis Hill shows us that Slingo had originally been impatient to make progress with the project but was stymied by the First World War, and Noble had shown a similar sense of urgency through his use of hutments to secure the site and get the Research Section's foot in the door at Dollis Hill. It is possible to conclude that the official opening of Dollis Hill would have suited Cohen as it would have proved to the Treasury that the whole project was a good use of money.

The further reason for preferring the argument that Wood was the reason behind the early opening ceremony was what followed: a concerted public relations campaign which emphasised the practical solutions that Dollis Hill was providing. In the next section, I show how Dollis Hill fitted into the overall public relations strategy that Wood and Tallents developed together.



6.4—View of the opening ceremony speeches from the lecture hall, Dollis Hill (BTA: TCE 361/ARC 341).[84]

[84] Prime Minister Ramsay MacDonald is standing centre-left, Sir Kingsley Wood is standing centre-right. Capt. B.S. Cohen, head of the Research Station, is seated fourth from the left. Lt. Col. A.G. Lee, Engineer-in-Chief, is seated to the right of Wood.



6.5—Plan of the Research Station site from the opening ceremony programme (BTA: BT1-CEN15/4/3, 1972 reprint).

6.4 Good, bad and no news: Dollis Hill research in and out of the press

In this section, I set Dollis Hill in the context of the Post Office's public relations efforts. In doing so, I provide examples of the activities done by the Research Section at Dollis Hill that the Post Office used to promote itself and why, by studying contemporary newspaper articles as well as film. As Jeff Hughes has shown with his study of James Crowther, a self-styled science correspondent, scientific journalism became a profession in itself in the interwar period. As such, newspaper articles of this period provide an opportunity to gain an insight of what the Post Office wanted to promote of itself, as well as what a general reader would find interesting (Hughes, 2007). I also provide examples of activities undertaken by Dollis Hill engineers that were not used for promotion, such as sensitive military trials and more mundane operations. I argue that Dollis Hill had an important role to play in the Post Office's wider public relations work that was spearheaded by Wood and Tallents. The Post Office administration were selective in its publicity of certain projects in order to give the impression of openness, but ultimately this allowed them to ensure that other projects could remain out of the public eye.

During his opening ceremony speech, Prime Minister Ramsay MacDonald did more than just thank Sir Kingsley Wood for his presence. He suggested that the Research Station's very existence was also down to his effort,

> There is one thing I should like to do, however, before I sit down now, and that is that you record a very hearty vote of thanks and vote of appreciation to the Postmaster General, not only for being here this afternoon, but because he is very largely… his own action is very largely the reason why he is here: the production of this building (Ramsay MacDonald Opens […], 1933).

The point is reflected by Campbell-Smith who states that Dollis Hill was "greatly expanded by Kingsley Wood in 1933" (Campbell-Smith, 2011, p.343). However, as I have previously discussed, plans for the construction of the research station were already in place by the time of Wood's appointment as Postmaster General on 25th August 1931. It is clear that by 1933, Dollis Hill was being used for public relations purposes, not just for the Post Office, but for Wood himself.

This explains a piece in *The Times* from 13th October 1933, where an announcement from Wood is reported, which was originally made in the *News-Letter*, the National Labour Fortnightly. This was the political journal of the Labour MPs who had followed Ramsay MacDonald into the National Government with the Conservatives and Liberals. Wood announced the opening of the Dollis Hill Research Station and *The Times* remarked that "the work already accomplished has made the laboratory the most famous in the world" and that,

> The Post Office during the coming year is to increase and intensify its policy of bringing its numerous services prominently before the public and of educating both old and young in their use (Anon, 1933h, p.11).

This sort of coverage had a precedent. As early as August 1932 an article that appeared in both the *Lancashire Evening Post* and *Edinburgh Evening News* mentions,

> [the] Dollis Hill centre, where much of the Post Office research work will be carried out. The superstructure is already in being, and the building awaits only interior fittings. Not only will it possess vast laboratories, equipped particularly for wireless and telephone research work, but even its own cinematograph theatre (Anon, 1932, p.4).

However, it is striking how the commentary around the opening of Dollis Hill put Wood at the centre and credited him with the existence of the new site. As this thesis has explained, this is an important inaccuracy, which suggests that Dollis Hill could be used for more than one public relations purpose.

This could well have been down to the influence of Tallents who had been working as Public Relations Officer for the Post Office for about a month before the opening of Dollis Hill.[85] It could have been his suggestion to give some of the focus of the public relations work to Wood's role. If that was the case, this would have been a clever move by Tallents to impress his employer. Tallents was clearly keen to show the benefits of a proper approach to public relations not just within the Post Office but within the wider civil service. He said,

> Official publicity seems to me to be regarded in some government circles much as scientific research was regarded when I entered the Civil Service. I hope that the younger generation of civil servants will live to see it as well appreciated as scientific research has today come to be (Tallents, 1935, p.5).

According to Swann, the purpose of all this emphasis on public relations was not concerned with expanding sales, but more with informing the public of what services it provided and what were available, and to generally improve its public image (Swann, 1989, p.53).[86] What follows are some examples of this.

6.4.1 Dollis Hill research activities that were publicised

In this section I show how in particular, the work of the life-testing laboratory at Dollis Hill was used to promote the durability of Post Office products and advertise them as worthy investments. These researches appeared in films created by the newly-formed GPO Film Unit, public exhibitions and newspaper articles. I speculate that one such machine, 'Galloping Gus', was even designed by Dollis Hill engineers for the sole purpose of using "research" to sell the Post Office's telephone service.

As I have shown in previous chapter, the Research Station at Dollis Hill had already been featured in newspaper articles during the 1920s and so its presence was not kept a secret

[85] Tallents had already been brought in to Post Office's Publicity Committee by Clement Attlee when he was Postmaster General in 1931, but Wood subsequently appointed him as Post Office's first ever Controller of Public Relations.

[86] It became interested in using films when the Telephone Publicity Advisory Committee arranged for the EMB Film Unit to produce a series of films publicising the new automatic telephone system.

from the press. However, there is a clear increase of newspaper reports about the station and the output of its engineers from the early 1930s onwards. Even before the official opening ceremony of October 1933, there is an example of a reporter being invited on site to be shown the laboratories and various equipment. In an article from the *Daily Herald*, titled 'H.V. Morton discovers the C.I.D. of the G.P.O.' the Dollis Hill engineers are presented as detectives solving cases of defective microphones, and "shifty" automatic exchanges (Morton, 1933, p.8). Reporters wrote of developments in telephone technology before they were finalised, so it is reasonable to assume that this information came from Dollis Hill itself—possibly Cohen—as a way of drumming up or maintaining a level of public interest it its endeavours. One example of this is the 'loudspeaker telephone'. What we would nowadays call a "hands-free kit", this invention would enable a user "to sit at his desk and talk with a friend in the United States or Australia without even raising his voice" (Anon, 1934, p.9). A common theme in these articles is the researchers' quest for perfection; "in the unlikely neighbourhood of Dollis Hill […] engineers and inventors dream of, and work for, the perfect exchange, the perfect stamp, the perfect cable, and perfect wireless transmission to the ends of the earth" (Morton, 1933, p.8). The "perfect telephone" is a feature of an article in *The Manchester Guardian* from 1935 (Callisthenes, 1935, p.10). According to the author, this telephone already existed at Dollis Hill but was "not yet obtainable in the ordinary world of commerce" and it was the aim of the Research Station to bring it closer to the consumer market. Articles such as this one were glowingly positive in tone, which was not unique to stories about the Post Office technologies. As Bowler writes, the language of public science and industry articles was used to create a sense of awe and wonder, particularly, but not exclusively, in articles written for younger readers (Bowler, 2009, p.55).

Not all of the reported research activities was about the telephone or telephone-related. In an 1937 article in *The Times*, the sub-heading and first example of Post Office innovation described a lacquer that Post Office research chemists had applied over the glue on the back of stamps, that would "come off pleasantly when licked" so as to affix the stamp to the envelope but meant that they would not stick together in an automatic stamp vending machine (Anon, 1937a, p.21; PMA: POST 76/50). Although described as a novelty for the reader, the incentive behind this this lacquer was of obvious economic value if it prevented waste. The article ended with a report on the financial gains that research investigations had made to the Post Office over the past year of £800,000. Similarly, an article from the *Yorkshire Evening Post* excitingly described the artificial fogs created to test the weathering of difference metal alloys used in cables. Researchers had created two "brews" of fog; industrial and marine (Anon, 1933i, p.6). Another theme was wireless interference and the Research Station's silence room facilities. Dollis Hill was amusingly described in an earlier article by *The Manchester Guardian* as "a sort of university for the study of noises in the wrong place" where experts "make their own special noises … and take extraordinary precautions to exclude it" (Our London Staff, 1932, p.10). Not all reports were accurate with their information: in 1935 the *Nottingham Evening Post* reported on the supposed discovery made by Dollis Hill researchers of spraying a room with molten zinc in order to prevent "waves coming from medical electrical apparatus which would otherwise cause interference" (Anon, 1935b, p.5).[87] The reporter was repeating what they had learnt from a Post Office official at a public exhibition.

Many of the newspaper articles mentioned—particularly the ones focussing on telephone-related studies, and involving a personal visit to the Research Station—end their reports with an economic justification for the research they reported on, listing large sums of money that the work of the Post Office researchers had saved the country. These figures are likely to have been given to the reporters directly by Post Office, and so can be taken as further evidence of Wood's tactical methods of improving the Post Office's image. *The Manchester Guardian* states that "four successful bits of research brought about an annual saving of £190,000" (Callisthenes, 1935, p.10). The *Daily Herald*'s reporter ended his report stating that:

> I left Dollis Hill with the feeling that the Post Office is lucky in its enthusiasm and I also felt slightly less depressed by the thought that possibly a little of one's income tax trickles into this endeavour, which at least does something to show for it (Morton, 1933, p.8).

The activities of the research engineers were also promoted through visual means. In 1935, the Post Office published 'The Post Office in Pictures' to celebrate the tercentenary of the public mail service.[88] This was a picture book of 295 illustrations, with a foreword by the Postmaster General claiming that for three hundred years the Post Office had "constantly sought to improve its services and to keep them abreast of scientific developments". The Research Station was featured, along with the Speaking Clock.[89]

However, perhaps the most famous example of Post Office promotion was the GPO Film Unit. This was an integral part of Wood's efforts to rebrand the Post Office and was set up

[87] The molten zinc spray is unlikely to be true as I have not found a corresponding Post Office research report, and zinc melts at over 400 degrees Celsius.

[88] 1635 is taken as the year when Thomas Witherings was appointed by King Charles I to organise a service run by the state to convey private letters

[89] The Speaking Clock, where telephone subscribers could dial 'TIM' to learn the time, was a hugely popular service that became an important source of income for the Post Office. It was designed and constructed at Dollis Hill by a team lead by E.A Speight. Rachel Boon discusses the impact of the Speaking Clock in her thesis (2020).

by Tallents with the help of John Grierson, and other members of the Empire Marketing Board (EMB) Film Unit. The GPO Film Unit operated like a freelance agency that purchased avant-garde footage, and was given a great deal of freedom by Wood who used his considerable influence to manage the Treasury's concerns on how much money it spent (Anthony, 2008, p.6).[90] Between 1933 and 1939, the GPO Film Unit produced more than 30 films, including films not strictly related to the Post Office—such as on coal mining and the fishing industry—and so has become an important source for historians looking at the British interwar documentary film movement (Swann, 1989, p.49). Its films, however, all demonstrate a noticeable concern to represent the latest technologies, industries and mass communications within normal public life (Boon, 2008, p.39).

It is no coincidence that the very first film produced by the GPO Film Unit featured the Research Station at Dollis Hill; *The Coming of the Dial* in 1933. At just under 14 minutes long, this film was a detailed and painstakingly slow introduction to the working of an automatic telephone exchange, which celebrated the process of modernisation and involved testing equipment and processes filmed at the Research Station itself. The film opens with a futuristic abstract sequence of a kinetic light display sculpture.[91] A voiceover explains how the researchers at Dollis Hill are on a par with industrial scientists from other important disciplines,

> Research; the creative power behind the modern world, building the future in the laboratory. The industrial chemist, determining a carbon percentage for a safety steel; the physicist, analysing coloured light-rays for signal lenses; the plant-breeder, pollinating selected grasses for mountain pastures: these men are applying the laws of science to everyday problems, and research into the behaviour of electromagnets has revolutionised the telephone system and introduced the dial. In the laboratories of Dollis Hill, they are testing specimen telephones for the dial system (The Coming of the Dial, 1933).

The Coming of the Dial was advertising the Post Office's move towards automation. Women telephone operators barely feature in the film as they have been replaced by "ordered banks of automatic apparatus"; depicted quite literally, as a row of stationary sitting operators fade away into an image of a dial. A newspaper article from around the same time enthusiastically describes

[90] In exchange, the GPO Film Unit reportedly became a source of employment for the children of Wood's lovers. It is telling that Tallents joined the BBC soon after Wood left the Post Office in 1935.

[91] This was created by the Hungarian artist László Moholy-Nagy, who was a professor of the Bauhaus school of design and advocated the use of technology in the arts.

small rural automatic exchanges "housed in brick-built huts, [that] can be left entirely unattended except for periodical inspections by an engineer" as examples of progress (Anon, 1933a, p.4). However the Post Office also anthropomorphised its technologies in order to make them appealing to consumers, for example, the Speaking Clock service was referred to as 'TIM' in advertisements (BTA: TCE 361/ARC).

The life-testing of equipment was the Post Office's most obvious use of research for the promotion of its products. It was not a feature unique to Dollis Hill, as the United States' Bell Telephone Laboratories also conducted durability tests on its equipment (Gertner, 2012, pp.48-49). One such test was given the quirky name of "woodpecker machine" and was featured in an edition of *Popular Science Monthly* in 1937 (Anon, 1937b, p.117). American historians consider this work of Bell Labs as the start of modern quality control in the 1920s, however it is arguable that this type of testing originated alongside, or even before, at Dollis Hill: the life-testing laboratory (and garage) was the first permanent building to be completed in 1924 and similar testing of equipment had been performed in the hutments beforehand (Blanton Godfrey, 1986).[92] Alternatively, certain durability tests of Bell Labs could have been the inspiration behind similar tests at Dollis Hill. In 1927, an article on accelerated laboratory tests described a large freestanding "dropping machine" to test the durability of telephone receivers (Montchyk, 1927, p.156). A 1932 newsreel about the life-testing work of engineers at Dollis Hill called 'Treating 'em Rough!', features a remarkably similar machine named 'Galloping Gus' ('Treating 'Em Rough', 1932).[93] It is a much neater and smaller design than the Bell Labs' dropping machine: instead of a long row of mechanisms, a carousel of levers would lift and drop telephone receivers repeated in turn so as to "represent the ill treatment that telephones sometimes get at the end of an unsatisfactory call". However, I suspect that this particular machine was purely built for show rather than actual testing. It is on a much smaller scale compared to other Dollis Hill life-testing apparatus (see Figure 5.5 in the previous chapter) and it was portable enough to be easily featured in public exhibitions (see Figure 6.6). Its quirky name, used in newspaper advertisements, suggests a marketing strategy so as to become a recognisable element of Post Office research (BTA: TCB 699/1/28).

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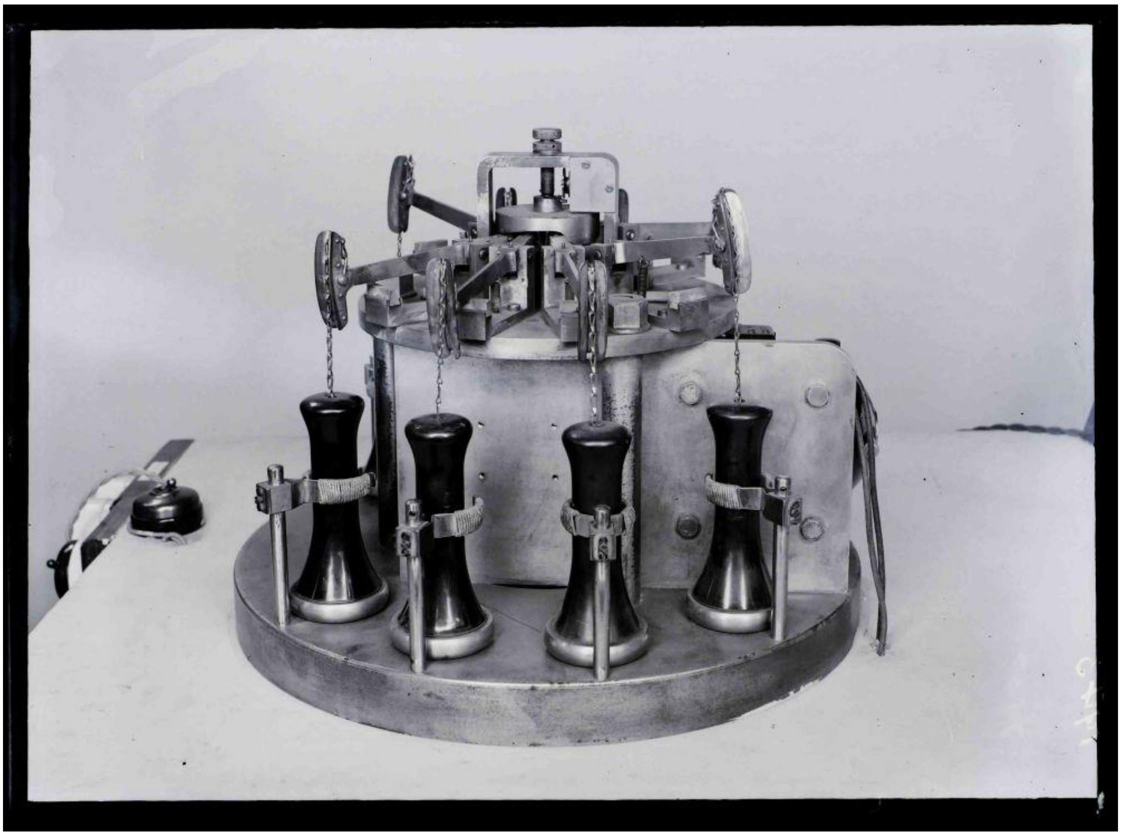
[92] I have described telephone receiver tests in the previous chapter.

[93] This film features other durability investigations such as measuring the amount of stress that telegraph poles can withstand before snapping, and the number of times a lightbulb can be hit before it breaks. The similarities of the camera angles of the human voice testing scenes suggest that the film might well have been the initial inspiration for Tallents and his team to create *The Coming of the Dial*.



6.6—‘Galloping Gus’ on display at the Ideal Home Exhibition, Olympia, 1932 (BTA: TCB 417/E 7943).

Along with the results of its research, Dollis Hill engineers manufactured equipment for the sole purpose of advertising—as in the as case of ‘Galloping Gus’—as well as educating the next generation of telephone subscribers. In his *Green Paper* on Post Office Publicity, Tallents ends his report with a section on telephone demonstration sets (Tallents, 1935, p.21). After negotiations with the Education Departments of the UK, Dollis Hill engineers were commissioned to design and produce telephones to give to schools that could be used to instruct children on how to use the telephone, and how the telephone works. Tallents suggests that the demand for this came from the school themselves, although it was clearly in the Post Office’s best interests to target a potential new pool of subscribers. An example of one half of a school telephone set, built at Dollis Hill, is on permanent display at the Science Museum’s ‘Information Age’ gallery. This campaign went hand in hand with Wood’s series of public exhibitions, some aimed particularly at children (see Figure 6.7).

6.7—School Telephone, c.1930 (SMG: 2004-106).[94]

To summarise, the research and testing activities of the life-testing laboratory at Dollis Hill were widely publicised through newsreels, the GPO Film Unit's *The Coming of the Dial*, and in newspaper articles. By advertising the sturdiness of their equipment, the Post Office were presenting their telephone as something worthy of investment. Reporters were invited on site to Dollis Hill both before and after the official opening ceremony and given information on

[94] These were supplied in sets of two so that two users could call each other. This is currently on permanent display in the Science Museum's *Information Age* gallery. Notice the mirror behind the dial so that the user can view the inner workings of the mechanism.

potential new developments in telephone technologies as well as facts and figures on the economic value of state funded research, further legitimising its presence and work. The Research Station also manufactured demonstration equipment, such as 'Galloping Gus' and school telephone sets, to appeal to the next generation of telephone subscribers.

6.4.2 Dollis Hill activities that were not publicised

In this section I show how there were many activities of the Research Station at Dollis Hill that were not written about in the national press. Some projects, despite their importance to British telecommunications development, were not reported on even though they were not considered confidential. An example of this would be the crystal laboratory which milled quartz crystals for coaxial cables, which I have already described in detail in the previous chapter. Other projects were much more secret, such as potential surveillance technologies and investigations stimulated by the threat of another international war. Researchers at Dollis Hill also involved themselves in creative one-off research projects in order to improve the Post Office's reputation when it was called into question after the Holborn Explosion of 1928.

On 26th May 1937 the Research Station hosted an Open Day on site to showcase its many research ventures, and possibly to mark the five years since its official launch. Guests included "government officials, Post Office advisory experts, members of the Radio Research Board, and a number of Dominion telephone officials" as well as reporters (Anon, 1937c, p.7). At was similar to the official opening ceremony in that on display were 275 different projects and equipment, ranging from samples of asbestos to television set (BMA: [uncatalogued] 1937 programme). However, many of these exhibits went unreported to the wider public, as reporters favoured "lickable" stamp lacquer, lightning machines and an instrument "which enables you to "see" your own speech" in their articles (Anon, 1937d, p.8; Anon, 1937c, p.7). This is not surprising: as Hughes states, "novelty was naturally important for news—but it was always tempered by this need for accessibility by the readership" (Hughes, 2007, p.15). He explains this by describe a tension between a science journalist, James Crowther, working for the *Manchester Guardian* in the 1920s and 30s, who wanted to report on big physics topics such as quantum mechanics, and Crowther's editors who knew that in order to sell their newspapers, articles needed to be simple to follow and to relate to the reader's own life. In a similar way many important activities and research work undertaken at Dollis Hill were not picked up on by the press. An example of this is the work of the crystal laboratory—which I have described in the previous chapter—that became an integral operation for updating the Post Office's coaxial cable networks. The machines used to analyse and mill these quartz crystals were on display at the Open Day of 1937, but their absence from newspaper reports suggests they were considered too technical and disconnected from normal life for the average newspaper reader. Of course, the Dollis Hill researchers performed many other such investigations that would not have caught the public eye, for example, they tested equipment on behalf of other companies such as Siemens, General Electric and the Ericsson Telephone Company. Along with expected experiments and tests related to telephone and telegraph equipment, more unusual examples include "spectrographic examination and colour matching tests" on various types of lampshades as well as designing apparatus to test the manual dexterity, memory, and "attention to visual signals" of prospective telephone operators (BTA: [uncatalogued], 1930, Bulletin No.7).[95]

Another example—although not as new an operation—is the hot wire microphone, which Dollis Hill engineers had continued to manufacture on behalf of the War Office throughout and after the First World War until November 1932 (BTA: POST 33/4780).[96] This activity is supporting evidence of Edgerton's 'Warfare State' thesis: that Britain continued to develop and increase its military research and industry even though the country was no longer officially at war (Edgerton, 2006). In fact, this production became problematic as in 1935 Sam Pollock, who had resigned from the Post Office as Head of Research in 1930, launched a campaign for some financial recognition for his work on the hot wire microphone. In a letter to the Secretary of the War Office dated 26th March 1935 Pollock explained that whilst he had no desire to make a claim for his work during the war, "the position is radically changed when it is proposed to use my invention in time of peace" (BTA: POST 33/4780).[97] As I have shown in Chapter 4, the redesign and production of hot wire microphones during the First World War was celebrated by the Post Office and was not kept secret. As the transfer of the production of the microphones occurred before the opening ceremony, it is not known whether the Post Office researchers would have featured a hot wire microphone in their exhibits had production continued—it was not a featured exhibit in either programmes for the opening ceremony or the

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[95] The telephone operator testing equipment was for a request from the National Institute of Industrial Psychology.

[96] In a letter dated 29th April 1935 it is reported that the manufacture was transferred to the Biggins Hill Air Defense Experimental Establishment in 1933.

[97] Pollock had resigned from his position of Head of the Research Section in 1930 for unknown reasons, and so had relinquished his right to a civil service pension. His letter states that he was aware that Captain Tucker, the original inventor of the hot wire microphone who had sought help from the Post Office to make it viable for trench warfare, had received an award for £7,000. A.G. Lee, the Post Office Engineer-in-Chief at the time, supported Pollock's claim and stressed that without Pollock's input Tucker's design would have been useless. He also mentioned that that design of the microphones had not changed since Pollock's wartime developments. Pollock was offered £500 by the War Office, which he accepted.

1937 Open Day. Another example of this is a 1934 War Office report of a trial of "Special Service Respirators" (gas masks) on site at Dollis Hill (TNA: WO 189/4300). This was the first year of Britain's re-armament period and so it is evidence to suggest the importance that the War Office placed on the maintenance of the country's communications by protecting its service staff. The Dollis Hill staff involved in the trial were required to wear the respirators for one hour whilst performing a variety of tasks, such as running cables, climbing telegraph poles, laboratory bench activities such as wiring uniselectors, and general deskwork. Unfortunately for the staff, this trial "was done at the very peak of the hot weather of June/July 1933 under most abnormal conditions". Results were not ideal, with many of the testers complaining of poor vision from condensation and breathing in charcoal. The presence of the one "girl operator" involved in the trial confirmed that the standard respirator size did not fit all. As the trial occurred before the official opening ceremony, and gas masks were not part of the exhibit, this is more evidence to suggest that the Post Office were keeping their military links quiet.

Another intriguing example of the secrecy of Post Office research is the possibility of its involvement in interwar surveillance operations. According to Keith Jeffery, a branch of the secret service called Section X was set up in the 1930s to tap the telephone lines of London embassies with help from at least one telephone specialist from the Post Office (Jeffery, 2010, p.317). A wealth of political, economic and military intelligence was gathered from listened in conversations to, from and within embassies of Germany, Spain, Italy, Japan and the USSR. The technology to tap telephones was available and developed by Dollis Hill engineers: there is a report from 1936 for modifications made to a tapping telephone used for telephone exchange maintenance (BTA: TCB 422/8229). These research reports would have been available to and shared with any interested government body and so it is possible that this is a further interwar example of Post Office researchers being consulted for assistance with secret military and intelligence projects.

In direct contrast to these covert examples of Post Office research is the involvement of Dollis Hill researchers in the aftermath of the Holborn gas explosion of 1928. On the morning of 20th December 1928 an explosion ripped along half a mile of High Holborn, central London. Reports describe manhole covers shooting into the air, windows smashing and lampposts falling down as the road beneath them rippled and caved in (see Figure 6.8) (Moller, 1929, p.47). The explosion was triggered by a Post Office maintenance engineer, Percy Thrower, who was working down one of the manholes. Before he could connect his "blowing-out" apparatus to clear any gas, an explosion occurred. He was thrown into the road, suffering serious burns, and sadly died in hospital 10 days later. Preliminary investigations after the incident concluded that gas had accumulated along a stretch of an abandoned pneumatic railway tube that was owned by the Post Office. As a result of the damage and loss of life, the Post Office was sued for negligence. An inquiry was called by the Home Secretary and several expert witnesses were consulted to investigate the cause of the explosion and who ultimately was responsible. Of these, three were members of the Post Office Research Department based at Dollis Hill: two research chemists, John Glover, C.E. (Thomas) Richards, and an Assistant Staff Engineer, William Gordon Radley.[98] These engineers performed experiments and investigations in order to attempt to prove that the fault did not lie with the Post Office. Both Glover and Richards collected samples from the disaster site and carried out their own analyses at Dollis Hill: Richards was concerned with the chemical composition of the gas in the tunnel, Glover investigated the moisture content of the soil in the tunnel. Radley's experiments were to do with gas flow: in a large open building at Dollis Hill, Radley mounted a 3 feet length of cast-iron gas pipe (4 inches in diameter) that had been completely cut into two pieces, on a wooden stand. Both ends of the pipe with the "circumferential gap" were sealed, with one fitted with a manometer and the other a rubber hose connected to a gas supply. He, along with his superior Sam Pollock, then took pressure readings before and after switching on a flow of gas and in order to calculate the rate at which it leaked from the pipe (BTA: [uncatalogued], printed minutes).

6.8—Aftermath of the Holborn Gas Explosion, 1929 (BTA: TCB 417/E 5886).

[98] Radley will be a familiar name in Rachel Boon's thesis on the later years of Dollis Hill (2020). He was a lead developer of the transatlantic submarine cable project and Post Office hearing aids, and was a colleague and supporter of Tommy Flower and the Colossus project.

Despite the efforts of the researchers, the result of the inquiry was that the fault lay with the Post Office for not properly ventilating their tunnel. The gas had originated from a pipe owned by the Gas & Coke Company which was still actively maintaining it, and gas leaks would have happened as a matter of course. However, by allowing the gas to accumulate for so long, the Post Office through their negligence had created an accident waiting to happen. As a result of the verdict, the Post Office ended up having to pay approximately £100,000 to cover legal, construction and compensation fees (Hansard HC Deb, 8 March 1937).

This incident is a clear example of bad publicity for the Post Office. Newspapers reported on Holborn Gas Explosion and the resulting inquiry all over the country: Sheffield (Anon, 1930, p.10); Edinburgh (Anon, 1929a, p.7); Nottingham (Anon, 1929b, p.5); and Londonderry (Anon, 1928, p.6). According to the *Leeds Mercury* writing several months after the incident in April 1929 anyone visiting Holborn "[could not] but sympathise with the resolve of the Holborn traders to lodge claims against the General Post Office … for loss of business due to the explosions" (Anon, 1929c, p.4). The research investigations of the Dollis Hill engineers went unreported. However, following the explosion Dollis Hill researchers spent time evaluating and designing inflammable gas alarms and detectors that could be connected to automatic fans to ventilate underground tunnels (BTA: BT1-CEN15/4/3: Anon, 1985, p.5). Radley and Richards developed portable detectors for Post Office workmen to wear (BTA: TCB 422/7666). The Holborn Gas Explosion is therefore an example of how the Post Office used creative and original research to better its reputation, but in response to bad publicity rather than hoping to inspire good publicity—and also doing so quietly.

6.5 Conclusion

In this chapter I have shown how Dollis Hill fitted into the developing culture of the Post Office that was undergoing to an extensive overhaul in its public image courtesy of Kingsley Wood and Stephen Tallents. With the reputation of the Post Office in the doldrums after the First World War, Wood sought to turn the Post Office into a twentieth century organisation that moved away from its reputation for bureaucratic and bad service and towards and approach that focused on providing its customers with improved products and levels of service.

To achieve this, Wood sought to change how the Post Office operated. This included trying to decentralise the services provided and seeking a measure of financial independence from the Treasury. In addition to these substantive changes, Wood also sought to change how the Post Office was perceived by the public. For this, he engaged Stephen Tallents who had a considerable amount of success in softening the image of the Post Office and made the services provided appear more attractive to potential customers.

The Research Section of the Engineering Department presented an opportunity to form part of this effort to improve the public image of the Post Office. The opening of Dollis Hill was one of the first times that the new Post Office approach to public relations could be applied. This came to replace the more informal and lower-key way that Cohen and Pollock had been promoting the research work that had been taking place in the huts at Dollis Hill.

The opening ceremony was a much publicised occasion, not least because of the attendance of Ramsay MacDonald. I have argued that in looking for someone to open Dollis Hill, MacDonald was an excellent choice. This was not just because he was Prime Minister – in addition it was well known that he was a keen supporter of science and technology. This informed a position he repeated numerous times over his career – that science can be the basis for improvements in the live standards of everyone. I describe this position of MacDonald's as 'scientific socialism'.

The publicity of the opening ceremony came from the television cameras that were there to record the event, plus a verbatim version of MacDonald's speech. This was just the start of the new form of Post Office public relations that continued from 1932 until the Second World War. In this chapter I have given a range of examples that demonstrate the breadth of the research work that was, and wasn't, publicised.

The focus of the Post Office publicity machine was anything that contributed to the consumer's experience of products and services provided by the Post Office. I cite the 'Galloping Gus' device as an example of something that is produced purely for advertising purposes in order to demonstrate the robustness and durability of Post Office telephone receivers. As part of this, the research engineer became part of the Post Office brand as "wizards" and "detectives". A rather more advanced way of publicising the work of Dollis Hill was through film and *The Coming of the Dial* is a good example of this. One of the first films produced for the Post Office by the Film Unit lead by Tallents it is at times abstract and futuristic introduction to an automatic telephone exchange.

Another important aspect of the publicity techniques was to emphasise how developments made at Dollis Hill would ultimately save money—this seemed calculated to justify the expense of the research being done at Dollis Hill. By contrast, there was a great deal of work undertaken at Dollis Hill that was not publicised. Some of this was work that was unlikely to interest the public, such as the work of the crystal laboratory. It seems that this work was considered too far removed from everyday life to be actively publicised. Additionally, sensitive or secret work was kept confidential: examples of this are testing gas masks and interwar surveillance work.

This shows that whilst Dollis Hill was an important source of public relations material, it was also a place that undertook much more work than was ever publicised. However, the Post Office seemed largely concerned with using Dollis Hill for its wider aims of improving its image. As part of this it was important that the Research Section was able to produce improvements and developments in the products and services that the Post Office offered. However, it was also important that Post Office could capitalise on this research as much as possible. The emphasis on quoting the savings brought about by Dollis Hill research indicates that there was a need to justify the research work that did not seem to have a direct bearing on everyday life. In that way, the public relations work would have supported the existence of Dollis Hill and allow it to prove its worth publicly.

As part of this publicity effort it is worth noting that the Post Office was keen to emphasise a 'pure' approach to research—in other words an approach to research that amounted to a scientist discovering a new technology from scratch. This is at odds with much of the testing and development work that went on at Dollis Hill. For instance, Galloping Gus and *The Coming of the Dial* are examples of 'applied' research that were presented using the image of 'pure' research. This supports Sabine Clarke's analysis of 'fundamental' science having an important rhetorical quality during this period, and that by using this idea the work of Dollis Hill could claim greater cachet than it might otherwise (Clarke, 2010, pp.301-10). Yasuko Suga makes a similar point where she notes that,

> The general image promoted by the GPO after 1937 depicted a fantasy world of 'dream-come-true', realisable by modern communications—a positive image of a future society built upon GPO services (Suga, 2011, p.24).

This chapter has sought to demonstrate that this 'general image' in fact began rather earlier than 1937 and that the positive image of a future society owes something to the publicity of Dollis Hill from 1932 onwards.

Chapter 7.
Conclusion.

> One of the most vital functions of [the Engineering] department is research. In the improvement and elaboration of communication services it is not content with the discoveries of outside scientists and foreign administrations. At Dollis Hill, in the north-west of London, it has its own research station and here Post Office engineers live constantly and excitingly on the very edge of knowledge (Crutchley, 1938, p.181).

The above quotation, taken from his book on the GPO, shows that by 1938 Crutchley saw the Post Office's Engineering Station at Dollis Hill as an established, celebrated, and crucially a *visible* symbol of British progress. Crutchley names, locates and describes the research station, and presents its engineers just as the Lord Tennyson quotation on the portico of the permanent building evokes: striving towards, seeking and (presumably) finding the future of the country's communications technology. In this thesis I have provided the first academic account of the early history of Dollis Hill, explaining why and how the British Post Office established its own centralised research facility. In doing so, I have traced the history of the Post Office's Engineering Department and its burgeoning research culture. I have shown that research was conducted by Post Office engineers much earlier than previously thought and that this culture developed into a separate Research Section within the department, which grew upon the nationalisation of the country's telephone network and the merger with the NTC.

As I showed in Chapter 3, saddled with unsuitable accommodation the question of a separate, dedicated research site began to emerge. The Head of Post Office Research, Sam Pollock, identified a suitably isolated plot of land in Dollis Hill, northwest London. An historic underlying mistrust between the Treasury and Post Office administration delayed funding decisions to the extent that Engineer-in-Chief William Slingo was forced to put his plans on hold whilst the First World War played out, notwithstanding his repeated appeals. Meanwhile, Post Office engineering researchers assisted with the war effort with important large-scale manufacturing projects such as the hot-wire microphone, and more clandestine investigations such as hypersensitive transmitters, whilst making do in a number of makeshift laboratories spread out across the capital. When the War ended and despite the country's economic troubles, Engineer-in-Chief William Noble successfully argued for funding to purchase the original plot of land at Dollis Hill and to quickly build accommodation for the Research Section. The whole section moved into temporary hutment laboratories in 1921, and work began on the permanent buildings a few years later.

The engineers who wrote of their time working in the hutments remember an informal and light-hearted atmosphere; the temporary nature of the buildings themselves fostered creativity and adaptability in research which would have been a natural progression from working in the makeshift laboratories before the move. Once the staff moved into the permanent building a more formalised training regime was established. During his 1930s rebranding of the Post Office to the 'GPO', Postmaster General Sir Kingsley Wood used the Research Station at Dollis Hill as a marketing tool to encourage new telephone subscribers to its service. Although it had already been operating for over a decade, in 1933 Wood orchestrated an opening ceremony with Prime Minister Ramsay MacDonald. While certain projects were openly celebrated and exhibited in the press and station open days, Dollis Hill researchers were still involved in more covert operations. The imposing architecture of the permanent buildings, and the select release of 'safe' knowledge meant that engineers could securely run classified government projects behind the grandiose façade of a public building.

This narrative formed the basis of the establishment and early years of the Post Office Research Station at Dollis Hill and allows me to address the two principal questions posed by this thesis:

1. What was the Post Office trying to achieve by building and promoting Dollis Hill?
2. What or who were the influences behind its establishment and what were their motivations?

7.1 Building and promoting Dollis Hill

As I outlined in Chapter 1, the Post Office Engineering Research Station at Dollis Hill hardly appears in literature of the history of state-supported science and technology. In fact, there has been absolutely no scholarly attempt to give a full historical account of Dollis Hill's origins and pre-Second World War activities. As such it is impossible to conclude what the British Post Office was trying to achieve through establishing Dollis Hill by debating the secondary literature. My literature review in Chapter 2, therefore, sets out the context for Dollis Hill and identifies the historical lacunae in which it sits. Historians such as Alter and Gummett who have focused on similar British institutions such as the National Physical Laboratory, show how often it was in reaction to what Germany was doing that sparked a British initiative to match its international rival. Apart from Crutchley's aforementioned work, British Post Office historians have either missed out Dollis Hill entirely from their narratives or only mention in in reference to the Second World War and the building of the Colossus machine. This is similar for histories of the profession of telecommunications engineering. Where Dollis Hill does feature is in histories of the GPO Film Unit and the public promotion of science during the interwar period. By viewing this publicity campaign of state research through the lens of the history of secrecy, I conclude that by promoting select features and activities of the Research Station as a distraction technique, the Post Office administration enabled the engineers to continue with more secretive government projects.

The British Post Office's aims in building Dollis Hill changed over time. Initially, the pressing concern was obtaining adequate accommodation for the Research Section of the Engineering Department to enable it to conduct better and more efficient research. A running theme throughout this thesis has been a lack of space, beginning with the cramped basement experimenting room of the Central Telegraph Building and even continuing when all of the research work had moved to Dollis Hill. The Engineering Department of the Post Office was a place of significant growth following the enactment of the 1868 Telegraph Act as the Post Office took over the inland telegraph network. An experiment book dating back to 12 June 1878 shows how a research culture began to emerge amongst Post Office engineers a decade later, and that research itself was already a function of the Department—a fact very few historians seem to have noticed. At that stage, research appears to have been a relatively minor concern for the Department and it is probably that experiments took place wherever there was space in Post Office-owned buildings, such as GPO West. At an undetermined point, this work was allocated a dedicated room in GPO West: this has previously been stated as occurring in 1904, although I suggest that this could have been earlier based on the reports submitted by the Engineer-in-Chief to the Postmaster General. It is clear that there had been a basement workshop since 1902 and that around 1910 there was a move to a different room within GPO West. However, this central London location was not ideal for research purposes as it was cramped and suffered from vibrations from passing traffic. This led to some elaborate workarounds by the researchers, such as suspending certain sensitive instruments from the ceiling. Engineer-in-Chief Major O'Meara's installation of a working Strowger automatic exchange for testing purposes only made working conditions more cramped. The turning point on this issue was the 1912 merger with the National Telephone Company (NTC) which significantly expanded the size of the Research Section. This saw an influx of staff into the Engineering Department and meant that research had to be conducted at two sites across London. As I showed in Chapter 3, this appears to have been the principal driving force behind the idea to have a separate, dedicated research site. This was certainly Engineer-in-Chief William Slingo's main argument when drafting his proposal for the Treasury. As such, the initial reason behind the idea of Dollis Hill was to address the lack of adequate space, but this rationale was not fully accepted for funding prior to the First World War.

Chapter 4 shows how Post Office engineering researchers made a significant contribution to the war effort, which was wide and varied. This was externally recognised by such senior figures as Earl Haig and the monarchy. One factor behind the push to establish a central research station, therefore, was an effort to capitalise on the high regard that the armed forces had for the Post Office Engineer Department. Chapter 5 shows how after the First World War, the Dollis Hill project is taken up by Engineer-in-Chief William Noble. His arguments in favour of the project differ to Slingo's: rather than focussing on the need for more room to conduct experiments more effectively, Noble emphasised the poor reputation of the service provided by the Post Office. He also refers to the prospect of money being lost if private companies are able to take advantage of intellectual capital before the Post Office. It is particularly interesting that Noble's arguments were pitched in terms of the reputation of the Post Office—this is the first indication that a new purpose of the Dollis Hill project might be developing in addition to the practical ambition for more space. Noble's arguments have much in common with the public relations approach adopted by Kingsley Wood and Stephen Tallents for the opening of Dollis Hill in 1933. This was the other main aim of building Dollis Hill which developed over time: to improve the reputation of the Post Office by improving the service it provided through research, as well as embarking on a public relations campaign to demonstrate that all of the research work being done was to improve its service.

Initially any public relations work was relatively informal and low profile. As Assistant Staff Engineer in charge of the Research Section, Capt. Cohen undertook speaking engagements amongst specialist audiences at engineering societies and Sam Pollock as the Head of the Research Section welcomed journalists onto the site whilst the first temporary hutment buildings were still the base for the Research Section. I have found at least three articles that covered

Dollis Hill during this period, all of which mention a promising future for the site. In my view, this was almost certainly an effort by Pollock to apply pressure on the Treasury for funds to progress the construction of the buildings. Such a public statement about the future of the site would have applied pressure on the Government to complete the Dollis Hill project. A further example of this is the Christmas card from 1930 showing Dollis Hill in a completed state when at that stage most of the buildings had not been completed (see Figure 5.8). Someone in receipt of the card who then visited the site might have been surprised to find the card's illustration wholly inaccurate. The likely response from the Research Section would have been: this is what Dollis Hill *will* become. Again, this can be explained as an effort to force the hand of the Treasury to complete the project.

A notable objective that the construction of Dollis Hill highlights is that the Research Section was hoping to avoid interference with their research. This included interference from electrical sources and vibrations, which formed part of Slingo's practical arguments in favour of the project. However, it also included external interference from both Post Office officials and the public. By moving to outside central London, Post Office officials were no longer able to keep such a close eye on the research work being done by the Engineering Department. Similarly, the design of the buildings suggests that whilst the presence and authority of Research Section would be acknowledged, it would be able to maintain a significant amount of privacy. The laboratories were effectively hidden behind the main building, thus negotiating the tension of the increased profile of the Research Section and the requirement for privacy for the sensitive military research that would be undertaken at Dollis Hill. As I argued in Chapter 5, the architecture of the Dollis Hill buildings effectively serves a public relations purpose that shows through its architectural style and prominent hilltop location a strong, assertive Research Section that is able to demonstrate its utility to the public. However, it also served to keep the public at arm's length: the impression of accessibility is given through designated areas designed specifically for the public presentation of work, whilst accessibility is only granted on the terms of the Research Section. An equally important feature of the connected design of the building encouraged cross-department collaboration, as I demonstrated through the example of quartz crystal production.

The emphasis on public relations is more clearly prevalent in Chapter 6, which begins with the official opening of Dollis Hill in 1933. This was an impressive event of which the highlight was Ramsay MacDonald's attendance. As well as being Prime Minister, MacDonald was known for his interest in science and had often argued that science had the ability to improve the living standards of the whole country (I described this as MacDonald's 'scientific socialism'). It was a coup for the Post Office to have someone so high-profile and so well suited to officially open Dollis Hill. From the perspective of the Post Office, the opening of Dollis Hill fell into an overall public relations campaign that was undertaken to turn around its faltering image. Kingsley Wood was a Postmaster General who wanted to change how the Post Office approached its services and, in doing so, sought to decentralise aspects of the Post Office and sought some limited financial independence from the Treasury. However, Wood's principal contribution in this context was having the foresight to appoint Stephen Tallents as the Post Office's first Public Relations Officer. Tallents wielded considerable influence in the Post Office and brought about changes not only in how the Post Office's services were presented but also in how they were run. This was all in a bid to soften the image of the Post Office and convey the impression that the Post Office provided useful and reliable services—in particular, its telephone service—that were attractive to new subscribers.

As I showed in Chapter 6, there was also a great deal of publicity around the Research Section's life-testing work. This would have been easy work to market because it was relatively easy to understand and also proved that the products being developed by the Research Section were durable and high quality. A good example of this is the 'Galloping Gus' device which I argue might have been produced purely for public relations purposes. Much of the public relations work followed in this vein of presenting easily digestible aspects of the research work done at Dollis Hill, that conveyed that the Post Office was making great strides in improving the life of the nation. An example of this is how many newspaper reports would often refer to the amount of public money saved as a result of an innovation achieved at Dollis Hill. In public relations terms, any scientific research that is saving money, as well as making technological improvements, is easy to justify. By contrast, there was plenty of work done at Dollis Hill that the Post Office's public relations machine did not advertise. A reason for this might be that some of the research that was done would not have caught the imagination: samples of asbestos, as were displayed at the open day in 1937, were unlikely to pique the public's interest. Similarly, I argued that developments such as the milling of quartz crystals would have seemed disconnected from the everyday even though they had an essential application in improving the efficiency of coaxial cables. Another reason for not promoting the work of Dollis Hill was that the Research Section was also involved in sensitive or secretive projects, such as the hot-wire microphone, gas mask testing and interwar surveillance.

I showed that the building of Dollis Hill can thus be seen to have served two purposes. The first was practical: to provide the Research Section of the Engineering Department with enough space in a location that was free of vibrations and interference. This was the starting point for the Dollis Hill project. However, after the First World War, it became clear to the Post Office that the Dollis Hill project provided a significant opportunity to contribute to its plan to revitalise the image of the services that it provided. There is a link between these two purposes: the increased space in a suitable location allowed for research to be conducted more smoothly and would have supported faster, better research work. Much of this work would have directly contributed to the improvement of the services provided, which thereby enhanced the reputation of the Post Office. As such, the more efficient research carried out at Dollis Hill was a source of further public relations opportunities beyond the simple focus on the construction of the buildings.

My first question was: What was the Post Office trying to achieve by building and promoting Dollis Hill? In conclusion, the primary objective of Dollis Hill was to ensure the revitalisation of the fortunes of the Post Office through the means of research. Dollis Hill enabled more and better work to be done by the Research Section, but this was for the overall purpose of improving the standing and service of the Post Office. In the 1930s, Postmaster General Kingsley Wood saw Dollis Hill as an opportunity to launch his rebranding of the Post Office to a more modern service. Of course, not all of the research work being done was suitable for public consumption—some of it was either too boring for sensational news stories, or too secret. Whilst better research outcomes were a motivation behind the Dollis Hill scheme, this work was always aimed at improving the service provided by the Post Office. As I will show in the next section, it was Noble who was the first to articulate the point that research had a role to play in reviving the fortunes of the Post Office, and the eventual success of Dollis Hill in improving the Post Office's public image is testament to that insight.

7.2 The influences behind the establishment of Dollis Hill

The discoveries I have made in researching for this thesis fits the broader themes of the existing historiography. Looking back to Chapter 2, Alter identifies Germany and the United States as the major competitors to the UK in scientific research and industry. This is seen in Major O'Meara's research trip to North America for inspiration in running a successful state-owned telecommunications network (Chapter 3) and Assistant Engineer-in-Chief Thomas Purves' use of the square footage of the American Western Electric Company building's research facilities as a persuasion technique in securing Treasury approval for the hutment scheme (Chapter 5). Similarly, Slingo encouraged Postmaster General Charles Hobhouse to visit Germany's wireless telegraphy institutions as an example of what could also be done in Britain (Chapter 3). Edgerton shows how warfare readiness enhances state science and technology provision: this military theme to Post Office research is seen from Chapter 4 onwards with Post Office engineering researchers' key contributions to the war effort, the ongoing military and espionage projects that ran through relative peacetime (Section 6.5.2), and the army-like parade of Dollis Hill engineers at the official opening ceremony (Chapter 6). Dollis Hill's conservative yet imposing neo-classical architecture (Section 5.8.1) is a further example of Joyce's analysis of state control through "connectivity" by quietly inhabiting the public realm through background infrastructure and symbols.

At this point I return to the major character of the thesis and conclude how the establishment and shaping of Dollis Hill depended on who was in charge. Overall, this thesis has traced the roots of Dollis Hill in terms of a succession of Engineers-in-Chief who contributed in various ways to the development of the Research Section and, in turn, the need for a dedicated research site. However, it is important to take into account relevant factors, such as the effects of the First World War, and institutional constraints such as attitudes at the Treasury. Chapter 3 described how **William Preece** systematised the entries within the experiment book and as such he can be credited with contributing to the formalising of a research culture. At this stage, research does not seem to have been a particularly intense activity given that the experiment book took 13 years to fill (assuming the engineers recorded all of their experiments in it). In addition, the reports from the Engineer-in-Chief to the Postmaster General showed a steady increase in the amount of research work being undertaken, until in 1908 it seemed appropriate to create a separate Research Section. This was done whilst **Major O'Meara** was Engineer-in-Chief. The influence of O'Meara on the research work of the Engineering Department has not been previously recognised but I have shown that he played a key role in attempting to improve the administration of the Department and sought to change methods of working. However, this was met with the inertia that was typical of the old Victorian era *laissez faire* practices of the civil service. O'Meara was responsible for encouraging the Institution of Post Office Engineers, and the associated journal the *Post Office Electrical Engineers' Journal*, which had the effect of crystallising the importance of research as part of the Post Office's engineering work and lead to its official standing within external engineering societies. He also undertook a great deal of comparative work on the approaches taken in other countries and from a trip to North America he brought back a Strowger automatic exchange. The presence of this large piece of equipment crowded an already tight research space and, in its own way, contributed to the need for more appropriate accommodation. I argued that O'Meara has been overlooked in the literature because he resigned his position in protest of what he considered to be the inertia and general mismanagement of the Post Office at that time.

The immediate consequence of the merger with the National Telephone Company (NTC) in 1912 was that there was not enough space to accommodate the Research Section and so research was split across two buildings, neither of which were ideal for researching and testing highly sensitive equipment. **William Slingo** was a well-liked and influential Engineer-in-Chief—this was shown through his contribution to the Committee on Wireless Telegraphy Research, where he clearly had a good relationship with the chair, **Charles Hobhouse**. Slingo suggested that Hobhouse visit Germany to see how wireless telegraph was approached there, which Hobhouse did. I also suggest that by doing this Slingo may have been influential in persuading Hobhouse that if a new research institution was needed for wireless telegraphy research it should be part of the Post Office. By contrast, the Committee suggested an entirely separate research institution. When Hobhouse became Postmaster General in 1914, there was an opportunity to press the case for a dedicated research site. Slingo's initial proposal was accepted in principle by the Treasury, which seems surprisingly straightforward given the Treasury's typically parsimonious attitude, even though they questioned the project's overall cost.

Chapter 4 shows how the outbreak of the First World War foiled these plans. The Treasury were no longer interested in funding a new capital expenditure project for the Engineering Department, despite Slingo's repeated attempts to persuade them otherwise. The performance of the Department during the First World War was exemplary and it completed numerous research commissions for the armed services. Slingo's repeated representations regarding the Dollis Hill project were undermined by this performance because the Treasury saw no need to fund new research facilities when the Department was performing so well, particularly in unusual wartime conditions. As a final show of evidence of the importance of his Department, Slingo recorded all of the Department's wartime activities in a report that demonstrated the broad subject matter of the projects undertaken. In my view, the impact of the First World War on the Dollis Hill project was more complex than simply providing a temporary obstacle during the war. The Research Section had clearly proved itself able to use research to provide innovative solutions to wartime problems, demonstrating to both inside and outside the government that investment in Post Office research was worthwhile. As an institution its stature and reputation had grown. The opportunity to press the case for the project again fell to Slingo's successor, **William Noble**. An important part of the arrangement with the Treasury that was agreed with Noble was the implementation of Noble's hutment scheme. This had the advantage of speed and relatively low upfront costs. However, the consequence of the hutment scheme was a significant delay in the construction of the permanent buildings, which took another 14 years to complete. By that time, the suburban housing area of Dollis Hill had grown rapidly and soon the benefits of the location—space and lack of interference and vibrations—were lost. Indeed, complaints about a lack of space were noted as early as 1930. As such, the First World War had a significant but multifaceted influence on how Dollis Hill was established. Whilst it stalled the project in the short term, its influence extends to how Dollis Hill was ultimately realised which in turn had implications for the life of the site. I argue that the war lead to the proposal of the hutment scheme which resulted in the permanent buildings being constructed too late and missed any opportunity to expand because of the development of the local area. Accordingly, the First World War was perhaps the most determinative event in the life cycle of the Dollis Hill project.

Ultimately, however, it was Noble's commercially-minded influence in managing to persuade the Treasury to fund the project that secured the establishment of Dollis Hill. Unlike Slingo, he knew exactly how to pitch his arguments and they were ultimately successful. As I show in Chapter 5, Noble realised that the Post Office's reputation after the First World War had waned and was able to exploit his knowledge of other funding that had been made available. Together with the hutment scheme, Noble made it much easier for the Treasury to fully accept the Dollis Hill proposal. Therefore, a focus on Slingo explains where the inspiration for Dollis Hill came from, whilst a focus on Noble explains how that inspiration was converted into a reality.

Outside of Post Office administration, the **Treasury** was the major institution that had the most profound influence on the establishment of Dollis Hill. As a revenue department, the Post Office was entirely under the financial yolk of the Treasury and it was only Postmaster General Kingsley Wood's agitation in the 1930s that allowed the Post Office to gain some modest financial independence. As a result the Post Office was dependent on the Treasury to look favourably on any proposals to spend public money. This relationship stemmed from the scandal arising from the misappropriation of funds as part of takeover of the telegraph network in the 1870s (see Chapter 3). Slingo's proposals for Dollis Hill were naive because they did not take into account the Treasury's focus on providing funds only when a convincing business case had been made out. By contrast, Noble's proposals fully took into account the Treasury's perspective and was framed by reference to the hutment scheme, which was designed to keep costs down in the long-run. However, as I explain at the end of this conclusion, the hutment scheme may have ultimately been the death knell for Dollis Hill in the long term.

Chapter 6 identifies Postmaster General **Kingsley Wood** as the major operator in the 1930s rebranding of the Post Office and how he used Dollis Hill as part of his advertising strategy. Despite Dollis Hill having operated for 11 years previously, Wood coordinated a high-profile opening ceremony with the aim of showcasing the GPO as a technologically advanced, reliable service to which consumers should be able to confidentially subscribe. Wood hired Stephen Tallents—now recognised as the father of public relations—who made use of Dollis Hill in his first film for the GPO Film Unit (*The Coming of the Dial*). The opening of Dollis Hill in October 1933 happened only a month after Tallents' appointment. Though it was probably planned before, in my view it is highly likely that he would have had a hand in how the opening ceremony was presented to the press and the public. The use of television cameras and the verbatim reports of Prime Minister Ramsay MacDonald's speech show that there was a great deal of interest in the opening of Dollis Hill which would have been strongly encouraged by Tallents. Getting the sitting Prime Minister to attend the opening ceremony was particularly befitting given MacDonald's vision for a country based on scientific socialism: whilst MacDonald used the opportunity as a demonstration of his authority in a time of governmental instability, it was really Post Office officials who were, in fact, pulling the strings.

The question of what the Post Office was trying to achieve by building and promoting Dollis Hill has more than one answer, depending on which individuals within the Post Office are considered. On the one hand, successive Engineers-in-Chief wanted to improve the physical conditions under which research was done. Their concerns were practical, and a research station like Dollis Hill provided a solution. On the other hand, those higher up the Post Office administration hierarchy saw the value in a research station as a way of promoting the institution to a wider audience. Between these two factors, my thesis has shown that it was ultimately the practical concerns of the Engineering Department that was the principal driver behind the establishment of Dollis Hill. The promotional value of Dollis Hill was seized upon after it had been established. However, I argue that the responsibility for the establishment of Dollis Hill must ultimately be reserved for Slingo and Noble. Dollis Hill was Slingo's idea, and Dollis Hill was implemented by Noble. Of the two, Noble had a more significant influence on the establishment of Dollis Hill because of how he was able to get the project approved and operational. By contrast, it is reasonable to assume that anyone in Slingo's position would have wanted to have adequate accommodation for an important part of their department. Noble's achievements in relation to Dollis Hill shows his qualities as a tactical operator, and he demonstrated this again when he left to work in the private sector and contributed to the establishment of the BBC.

Noble was a relatively overlooked figure regarding his role in relation to Dollis Hill. This is remarkable given the large contribution he made as the shortest serving Engineer-in-Chief. I argued that this could be because of his short tenure and the fact that his move into the private sector may have meant that the Engineering Department felt he was not really a 'Post Office man' despite starting his career there. Another reason could be that his other achievements overshadowed what he did as Engineer-in-Chief. His role in relation to Dollis Hill was closely related to the situation that followed the First World War: Noble understood that the Treasury was unlikely to fund the project in full but was able to persuade the Treasury to fund the hutment scheme. The underlying theme of the establishment of Dollis Hill was that the hutment scheme both enabled and stymied the success of the project. Without the hutment scheme, Dollis Hill might never have happened. It was evidence of Noble's tactical ability that he was able to suggest a viable alternative to a full-blown construction project. However, the unintended consequence of the hutment scheme was that the construction project took so long to be completed that the principal advantages of the site were lost. There was no additional agreement with the Treasury regarding a plan of construction that would have resulted in a more structured timetable for the development of the site. Instead, Noble's hutment scheme was left standing twice as long as anticipated (for 10 years rather than the recommended five) whilst Post Office engineers such as Joseph Wright resorted to staging overcrowded laboratories in order impress on Post Office authorities the urgent need for the construction of permanent buildings to happen soon.

My second question was: What or who were the influences behind Dollis Hill's establishment and what were their motivations? In conclusion, the establishment of Dollis Hill owes much to the influence of Noble and his ability to obtain an agreement from the Treasury to progress the project. Of course, Noble was operating in a context that owed a great deal to the First World War as well as the efforts of Slingo's Engineering Department during that period. Whilst Slingo is the originator of the idea, his principal contribution to the establishment of Dollis Hill was through his demonstration that his Department would make good use of a dedicated research site. It is clear that Noble's influence cuts both ways: whilst the hutment scheme contributed to the establishment of Dollis Hill, the scheme—and the lack of an agreed plan of construction—also played a significant role in undermining the site. Either way, it is clear that Noble's contribution to the Dollis Hill project was immense.

7.3 The life and death of Dollis Hill

As I argued above, Dollis Hill was established primarily to revive the fortunes of the Post Office through research. This was achieved by providing better services and products to an expanding number of paying customers. However, this does not explain why Dollis Hill has until now been an overlooked institution within the history of British industrial research.

There are several factors which have contributed to the disappearance of Dollis Hill. First, telecommunications is often an overlooked subject when discussing the role of the state in scientific activities. This may be because telecommunications in some key countries, such as the United States, was not under state control—indeed, in the UK it is now once again privately owned and operated. The engineers at Dollis Hill were trained in such a niche range of subjects that their work does not neatly fit alongside the histories of broader disciplines such as civil or aeronautical engineering. This thesis therefore showcases an important contingency for historians to consider in regard to past forms of state-supported science and technology.

Secondly, whilst Dollis Hill was not kept secret at the time of its establishment—indeed it was widely celebrated by the 1930s GPO—its role in the Second World War was much more secret than the research undertaken by the Engineering Department during the First World War. The role of Dollis Hill engineers in the Colossus project has never matched the legend of the codebreakers at Bletchley Park. Although the Second World War is beyond the scope of this thesis, the activities of Dollis Hill during that period fall into Edgerton's explanatory thesis of a warfare state, in that war work was done alongside civilian work. Rachel Boon's thesis—the second in this project—describes how the publicity of the Research Station ceased with the outbreak of the Second World War (Boon, 2020).

Thirdly, the people that were instrumental in establishing Dollis Hill were not high profile and their contributions have tended to be overlooked. Previous accounts of the research work of the Post Office tend to focus on the role of William Preece, whose profile was raised through his dealings with Marconi and his own self-promotion. Whilst Preece can be credited with laying the foundations for the Engineering Department's research culture, it was lower profile characters like O'Meara, Slingo and Noble that developed the Research Section which culminated in the establishment of Dollis Hill. But the role of each of these characters has never previously been highlighted. For instance, O'Meara's early resignation in response to an obstinate administration is likely to be a reason why he has not previously been considered a significant actor and why his contributions are unknown. Slingo positively writes himself out of the Dollis Hill narrative by crediting Hobhouse with the idea to establish a dedicated research site, whilst Noble only spent three years at GPO before moving on to higher profile roles, such as with the BBC.

Finally, whilst Slingo and Noble's ambition for Dollis Hill was that it would provide a permanent site for the Engineering Department's research work, circumstances changed more quickly than were anticipated. The location, which had been chosen for its relative isolation, had become rapidly surrounded by suburbia. The eventual privatisation of telecommunications, and the formation of British Telecom, resulted in the establishment of a new research station in the much more rural setting of Martlesham Heath, which is a village outside Ipswich towards the Suffolk coast. Jacob Ward's thesis describes why this site was chosen as the new research centre. With these changes, it is perhaps understandable that the old research station at Dollis Hill would be overlooked in favour a new research station that BT had developed itself (Ward, 2016).

As I have sought to argue in this thesis, the life and death of Dollis Hill is linked to the implementation of the hutment scheme after the First World War. Whilst this scheme was responsible for getting the Research Section of the Engineering Department on site and conducting research in a centralised location, the rapid development and gentrification of the Dollis Hill area quickly limited room for expansion. By the time the permanent buildings were erected, the site was already hemmed in by newly built houses. Today, the building that housed the research station is a gated community. Whilst a trained eye might be able to discern the building's original purpose, the casual observer is likely to miss the low-key plaque that commemorates the research station. Accordingly, there have been many factors that have encouraged previous accounts of the Post Office to overlook Dollis Hill. It is to be hoped that this thesis begins to redress that imbalance.

7.1—Gladstone Park summer entertainment with Dollis Hill Research Station in the background, 1947 (BMA: 2487).

7.4 Opportunities for further research

In writing this thesis further potential avenues of research have emerged that would deepen an understanding of Dollis Hill and its place in the history of state science and technology. These include:

1. *An investigation into the relationship between Dollis Hill and the National Physical Laboratory.* These institutions conducted overlapping activities at the same time, such as testing and calibration. However, the boundaries between the activities and purposes of these two institutions have not yet been fully explored. Similarly, it is not clear from the evidence I have uncovered in this thesis how these institutions interacted with each other, and the extent to which such interactions were collaborative or competitive.

2. *An investigation into the international presence of Dollis Hill*. It is clear from much of the material uncovered as part of this thesis that Dollis Hill was recognised internationally, in France and Germany especially. For instance, there are uncatalogued papers housed at the BT Archives on international conferences to which Dollis Hill representatives attended. However, the international status of Dollis Hill has not been fully explored. For instance, it is not yet clear whether Dollis Hill was known internationally only for its public-facing work or whether the results of its military projects were shared with foreign allies.

3. *An investigation into the relationship between Dollis Hill and private industry*. The relationship between Dollis Hill and the private telecommunications industry has not been explored.[99] The Post Office had established relationships with private firms that provided it with a range of services and materials. However, as a government department the Post Office had a dominant role in the telecommunications sector and it is not clear the extent to which this impacted the nature of the research carried out at Dollis Hill, and whether there was any response from the private sector as a result.

4. *An investigation into the role of Dollis Hill engineers and the establishment of the British Broadcasting Corporation (BBC)*. In 1927, the BBC became a state broadcaster and engineers from Dollis Hill assisted with the first live broadcast in the same year. The collaboration between engineers at Dollis Hill and the BBC have not been fully investigated. In 2022 the BBC will celebrate its centenary which may spark renewed interest in the history behind its formation.

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[99] For a discussion on the relationship between the Post Office and private postal technology firms in the 1960s and 70s, see Sutton (2012).

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Appendix

[1] Positions of authority, 1908-1938.

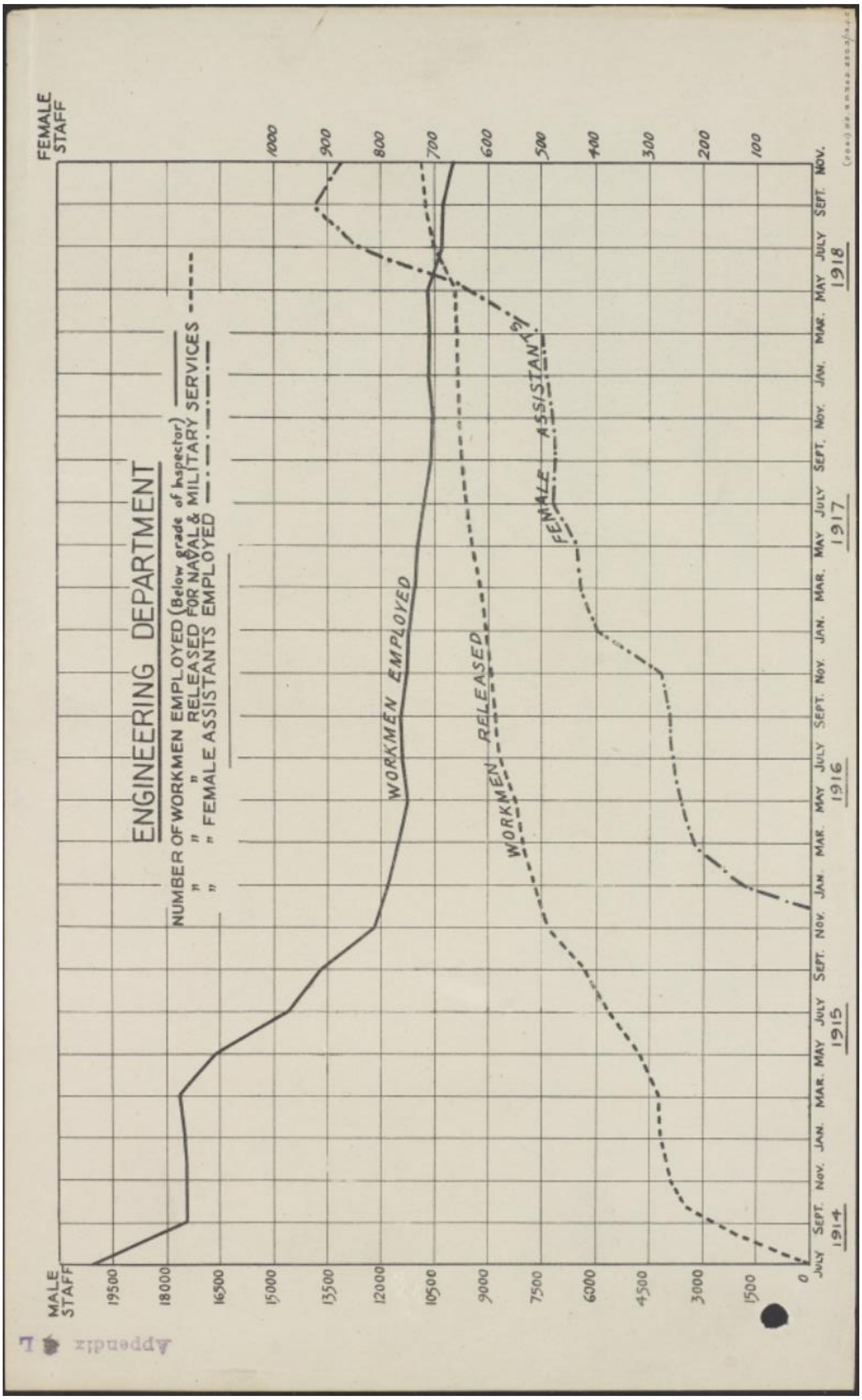
	Head of Research Branch	Engineer-in-Chief	Secretary	Postmaster General	Prime Minister
1908	Harry Kempe, 'Electrician' (retires 31 Dec 1912)	Walter O'Meara (16 Apr 1907)	H. Babington-Smith (1 Oct 1913)	Sydney Boxton (11 Dec 1905)	Herbert Asquith [Lib] (7 Apr)
1909					
1910			Matthew Nathan (17 Jan)	Herbert Samuel (19 Feb)	
1911					
1912		William Slingo (1 Mar)			
1913	Samuel Pollock[100]		Alexander King (1 Oct)		
1914			G. Evelyn Murray (24 Aug)	Charles Hobhouse (10 Feb)	
1915				Herbert Samuel (28 May)	
1916				J. A. Pease (21 Jan) Albert Illingworth (13 Dec)	David Lloyd George [Lib] (7 Dec)
1917					
1918					
1919		William Noble (1 Jun)			
1920					
1921				Frederick Kellaway (4 Apr)	
1922		Thomas Purves (1 Jun)		Neville Chamberlain (2 Nov)	Andrew Bonar Law [Con] (23 Oct)
1923				W. Joynson-Hicks (12 Mar) Laming Worthington-Evans (29 May)	Stanley Baldwin [Con] (23 May)

[100] It is uncertain exactly when Sam Pollock was promoted to being the Staff Engineer in charge of the Research Branch, however it is likely that it was upon the retirement of Harry Kempe as the Engineering Department's last 'Electrician' on 31st December 1912. The earliest record of Pollock referred to as Head of the Research Section is dated 1914.

1924				William Lowson Mitchell-Thomson (13 Nov)	J. Ramsay MacDonald [Lab] (22 Jan) Stanley Baldwin [Con] (4 Nov)
1925					
1926					
1927					
1928					
1929				H. B. Lees-Smith (10 Jun)	J. Ramsay MacDonald [Lab] (5 Jun)
1930	Bertram S. Cohen				
1931				Clement Atlee (4 Mar) W. G. A. Ormsby-Gore (4 Sep) H. Kingsley Wood (12 Nov)	J. Ramsay MacDonald [National Coalition] (24 Aug)
1932		A G Lee (1 Dec)			
1933					
1934			Donald Banks[101] (14 Aug)		
1935				G. C. Tryon (7 Jun)	Stanley Baldwin [Con] (7 Jun)
1936			Thomas Gardiner (9 Aug)		
1937					Neville Chamberlain [Con] (28 May)
1938					

[101] In 1934 the position of Secretary was renamed Director General.

[2] First World War employment chart



App Fig 1—Chart showing the numbers of male and female staff of the Engineering Department employed during the First World War (BTA: POST 30/4304A, Appendix L).

[3] List of the temporary hutment buildings

Information is taken from the anonymous account of Dollis Hill and the 1924 paper by Capt. Cohen (BTA: BT1-CEN15/4/3: Anon, 1985; Cohen, 1924).

App Fig 2—Block plan showing temporary hutments, circa 1923 (PMA: POST 76/47).

Block A – Administration

Block B – Mechanics' workshops

Hut C – Chemistry. This was where the anonymous author worked. According to Cohen, this was equipped "chiefly for such work as the analysis of materials used in the construction of primary and secondary batteries, of which the Post Office is the largest individual user in the country". The prevention of cable sheathing and conductor corrosion was another on-going chemical investigation. Hut C also had a metallographic laboratory that contained a 'Leitz' metallograph for microphotography and a 'clean spectrograph' (spectroscope) that was used to detect minute traces of various elements.

Hut D – Photography (D1) and either a blueprinting drawing office according to Cohen, or "various but not publicly known experiments" according to the anonymous author (D2).

Hut E – Designated as a submarine cable testing laboratory. However when Cohen presented his paper this was not yet fully equipped and instead was used to house the temporary storage battery, which supplied direct current at various voltages to other laboratories for use in experiments. The anonymous author remembered this hut as “probably the main battery”.

Hut F – General storage hut for apparatus and materials.

Hut G – Designated as a metallurgical furnace. It was not yet equipped in 1924.

Hut H – Glass-blowing shop and valve exhaustion laboratory. Here was where valves, an important element of interwar telecommunications, were made and tested. Equipment in the valve exhaustion laboratory included ‘Gaede’ and ‘Langmuir’ pumps for creating high-level vacuums.

Hut J – Battery experiments (J1) and Physics (J2). Cohen does not mention the physics laboratory however, this could have been a later addition to the site.

Hut K – Telegraphy. Here investigations included experiments with ‘composited circuits’ (systems that could be used simultaneously for telephony and telegraphy) and the development of electric tube amplifiers.

Hut L – telephone exchange experiments.

Hut M – telephone transmission laboratory.

Hut N – telephone transmission laboratory, local line work and telephone instruments.

Hut O – Education, including a library and lecture room.

Block Q – Sundry machines. These included a liquid air plant and dry ice making facilities. The liquid air plant came from the British Oxygen Company and produced about a litre of liquid air per hour. Liquid air was mostly used for producing vacuums for research into thermionic valves. It also contained a series of compressors which supplied compressed air to the onsite glassblowing shop and metallurgical furnaces. Other machines supplied alternating current at telephonic speech and telephone bell-ringing frequencies for measurement work.

Block R – Staff canteen and kitchen.

Block S – Caretaker’s premises and heating plant for the offices.

[4] Plans of the general research building

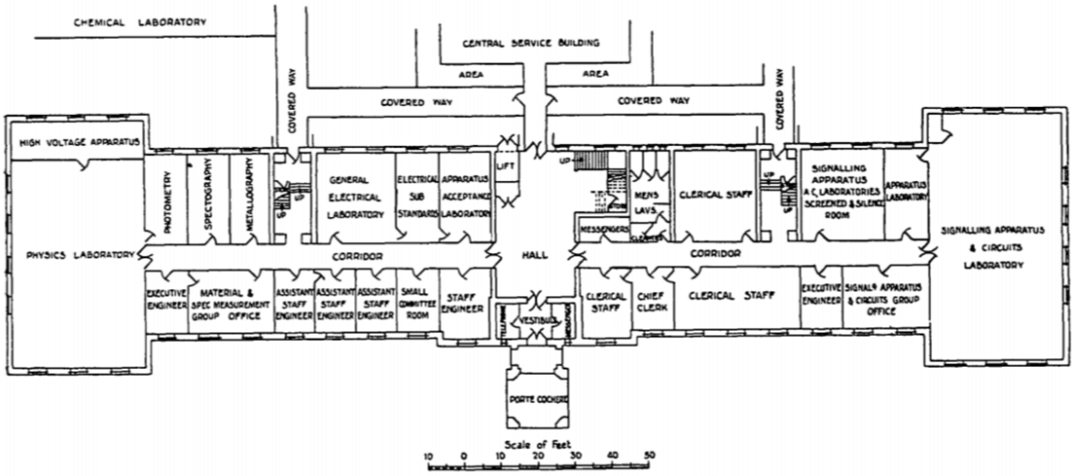


FIG. 3.—General research building: ground floor.

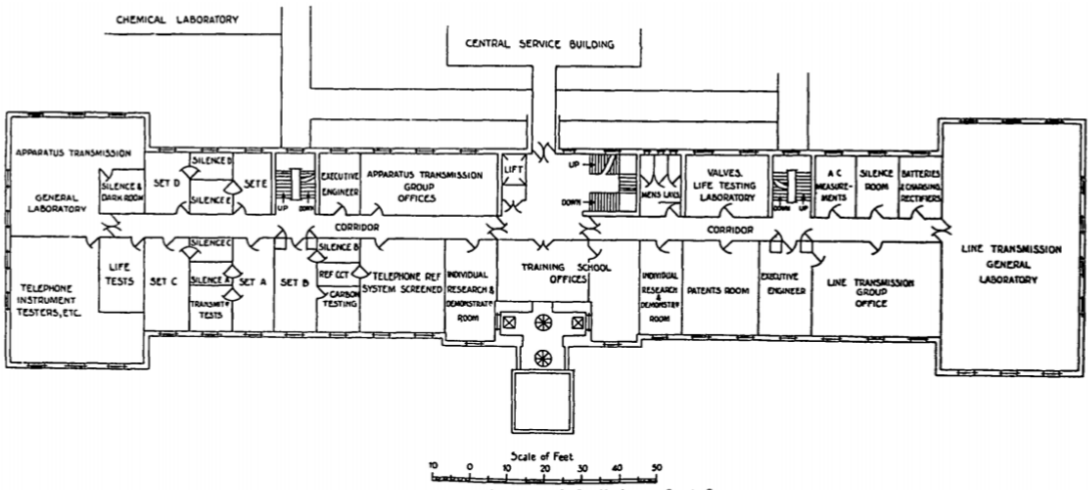


FIG. 4.—General research building: first floor.

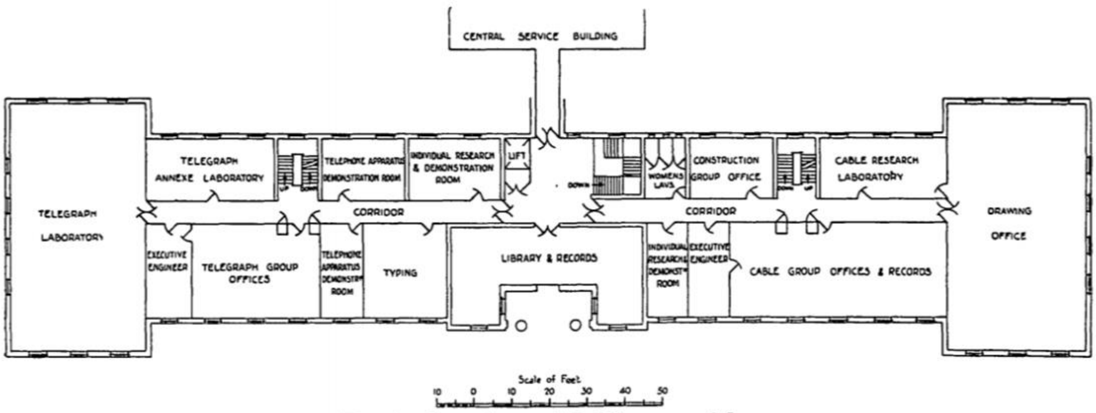


FIG. 5.—General research building: second floor.

App Fig 3—Plans of the general research building (Cohen, 1934, p.135).