

Research Transplanted and Privatised: Post Office/British Telecom R&D in the Digital and Information Era

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“Research is the door to tomorrow” was the rallying cry engraved above the entrance to the Post Office Research Station, Dollis Hill, home of Colossus, popularly known as the world’s first programmable, electronic, digital computer. In 1975, Dollis Hill was left vacant, substituted for the new Post Office Research Centre in Martlesham, Suffolk, and less than a decade later, in one of the most portentous acts of the Thatcher government, Post Office Telecommunications was renamed British Telecommunications and privatised. Martlesham was no longer a government laboratory, but a private research and development establishment.

The purpose of this dissertation would be to investigate the patterns of research and development at Martlesham in relation to four contexts – local, national, international, and “future-mindedness”. The national context would be explored by relating Martlesham R&D to the shift of telecommunications from public sector to private; the local through investigating the relationship between the research station and the village of Martlesham Heath built around it; the international through comparison with the break-up of AT&T’s monopoly, as well as AT&T’s own patterns of R&D; and finally, the impact of “future-mindedness” in the Post Office’s Long Range Planning Division on Martlesham.

This study would be of value and interest because little has been written about the history of telecommunications R&D in post-war Britain. This dissertation would address that deficit and also relate this history to the politics of telecommunications on local, national, and international scales. A greater understanding of the relationship between telecommunications R&D and these political contexts would help explain the political power of telecommunications.

The Post Office experienced dramatic organisational changes from the 1960s to the 1980s, moving Britain's telecommunications infrastructure from the public sector to the private sector. This transformation begs investigation into the relations of politics, industry, technology, and science. The first substantial shift in structure was the "hiving off" of the General Post Office (GPO) from the Civil Service in 1969, when it was made a nationalised corporation. The second shift was in 1981, when Post Office Telecommunications was renamed British Telecom (BT) and separated from the Post Office entirely. This was quickly followed by the most dramatic change of all: the privatisation of BT, and the final step in the transformation of British telecommunications from a department of state to a private corporation. However, despite BT's political and technological prominence, there have been few histories of this change. The most recent is Campbell-Smith's history of the Post Office and Royal Mail, which necessarily focusses more on the Posts side of the GPO, and departs from the Telecommunications aspect entirely after the separation in 1981.¹ The most scholarly work comes from Pitt, who writes a comprehensive history of telecommunications

¹ Duncan Campbell-Smith, *Masters of the Post: The Authorized History of the Royal Mail* (London: Penguin, 2012).

in the Post Office, but addresses more the organisational and political aspects of this function, rather than the technological or scientific; moreover, Pitt's work was published in 1980, before privatisation, and so leaves that story untold.² Harper's account of the liberalisation of British telecommunications is much more useful in this regard, focussing on the recent history of liberalisation in the telecommunications sector, but is somewhat limited owing to its nature as a personal account of the author's career in the Post Office and BT. Furthermore, like Pitt, Harper focusses more on economics and politics, with scanty references to R&D.³ A final history which is unfortunately only of limited use is Bealey's history of the Post Office Engineering Union from 1870-1970; however, it still proves useful in establishing the nature of management-staff relations at the time of the corporatisation of the Post Office.⁴ Whilst histories of the GPO/BT are lacking, there is still a rich body of literature which contextualises research into the organisational and technological histories of the GPO and BT. Hughes in particular provides an exemplary history of the large scale change of technological infrastructures against their cultural and organisational context.⁵ Likewise, Chandler also proves useful in drawing attention to the relationships between organisational and technological change.⁶ Hounshell notes the similarities between Hughes' and Chandler's approaches, but also provides a useful warning of how scholarship has since distanced itself from Hughesian-Chandlerian histories.⁷ Indeed, Hounshell himself provides a fine example of

² Douglas C. Pitt, *The Telecommunications Function in the British Post Office: A Case Study of Bureaucratic Adaptation* (Farnborough, England: Ashgate Publishing Limited, 1980).

³ J. M. Harper, *Monopoly and Competition in British Telecommunications: The Past, the Present and the Future* (London, U.K.; Washington, D.C.: Cengage Learning EMEA, 1997).

⁴ Frank Bealey, *Post Office Engineering Union: History of the Post Office Engineers, 1870-1970* (London, U.K.: Bachman & Turner, 1976).

⁵ Thomas P. Hughes, *Networks of Power: Electrification in Western Society, 1880-1930* (Baltimore: Johns Hopkins University Press, 1983).

⁶ Alfred D. Chandler Jr., *The Visible Hand: Managerial Revolution in American Business*, New Ed edition (Cambridge, Mass.: Harvard University Press, 1977).

⁷ David A. Hounshell, 'Hughesian History of Technology and Chandlerian Business History: Parallels, Departures, and Critics', *History and Technology*, 12 (1995), 205-24.

further approaches to the relationships between science, technology, and organisational change.⁸ Finally, Campbell-Kelly's history of ICL is useful as it concerns a British technological organisation, and is contemporaneous with this dissertation's period of study.⁹ This dissertation aims to build off the historical gap in the history of British telecommunications and the literature looking at the management of highly technical organisations; the key question for this inquiry would be to explore what drove the liberalisation of telecommunications in the UK, starting with the corporatisation of the Post Office in 1969 and culminating with the privatisation of BT in 1984; and further, how this influenced and was influenced by the GPO/BT's role as a technical organisation tasked with managing the nation's telecommunications infrastructure.

The relocation of the research centre to Martlesham is a natural starting point for the history of GPO/BT telecommunications R&D, as the move straddles the pre-/post-corporatisation boundary, and also exposes the tensions inherent to a civil laboratory with stakeholders at government, management, and staff levels. The research centre was relocated from Dollis Hill, North-East London, in a move initially proposed in 1958, announced in 1964, commenced in 1968, and finally completed in 1975. The move involved protracted negotiations between the policies and values of Post Office management, research staff, and the government itself. The main competing interests driving the move were between the research staff, who wished to stay near London, and the government directive of "dispersal", which aimed to reduce unemployment in less affluent regions across the United Kingdom by

⁸ David A. Hounshell and John Kenly Smith Jr, *Science and Corporate Strategy: Du Pont R and D, 1902-1980* (Cambridge, England; New York, N.Y.: Cambridge University Press, 1988).

⁹ Martin Campbell-Kelly, *ICL: A Business and Technical History* (Oxford : New York: Clarendon Press, 1990).

relocating Civil Service offices. Two bodies of literature which help to unpack the historical processes underlying the relocation are the geography of science and critical geography. The geography of science aids understanding with its conceptual focusses on places and movements of science; in particular, those site studies which explore laboratory architecture and the geopolitics of laboratory location prove useful.¹⁰ Studies of the movement of science are more concerned with the circulation of knowledge from local to global, but may still be relevant.¹¹ However, I would argue that the insights of critical geographers such as Doreen Massey and David Harvey are perhaps more useful to understanding the relations of power manifest in the move, and how these relations spatialize the nation-state.¹² The move also begs further inquiry into the influence of telecommunications, as an intrinsic part of the organisation which may have supported one faction's cause over the other, on these power relations. Research into the relocation would thus focus on the reasons and consequences of the move, how the move surfaced relations between state, science, and industry, and if the move affected or was affected by telecommunications infrastructure.

One consequence of the relocation which merits further investigation is the construction, in 1972, of the "new village" of Martlesham Heath around the research centre.

¹⁰ *The Development of the Laboratory: Essays on the Place of Experiments in Industrial Civilization*, ed. by Frank A. J. L. James (Basingstoke, Hampshire: Palgrave Macmillan, 1989); *Making Space for Science: Territorial Themes in the Shaping of Knowledge*, ed. by Crosbie Smith and Jon Agar (New York, N.Y.: Palgrave Macmillan, 1998).

¹¹ Christopher R. Henke and Thomas F. Gieryn, 'Sites of Scientific Practice: The Enduring Importance of Place', in *The Handbook of Science and Technology Studies*, ed. by Edward J. Hackett and others, 3rd edn (Cambridge, Massachusetts; London, England: The MIT Press, 2008).

¹² Doreen Massey, *Spatial Divisions of Labour: Social Structures and the Geography of Production* (London, UK: Macmillan, 1984); Doreen Massey and David Wield, *High-Tech Fantasies: Science Parks in Society, Science and Space* (London ; New York: Routledge, 1991); David Harvey, *The Condition of Postmodernity: An Enquiry into the Origins of Cultural Change* (Oxford England ; Cambridge, Mass., USA: Wiley-Blackwell, 1991); David Harvey, *Limits to Capital*, New and Fully Updated Ed edition (London ; New York: Verso Books, 2007).

This village, which placed itself in the legacy of the post-war construction of “new towns” across England, provided housing for both locals and the research scientists and engineers moving to the area. The village was built along traditional English ideals and aesthetics, with a village green and cricket pitch, complete with pitch-side pub and church, at the village’s centre. These ideals extended to the point that residents had to sign covenants agreeing not to put television aerials on their roofs in order to preserve the village aesthetic; instead, Post Office engineers laid down one of the first cable television systems in the UK. Martlesham Heath can thus be placed into a tradition of utopian forward-looking communities, especially in eastern England; Hardy and Armytage both offer scholarly works which speak to this tradition, whilst Grindrod permits context with his popular history of Britain’s new towns.¹³ The “new village” of Martlesham Heath provides a fascinating case study, and research would focus on exploring the relationships between local infrastructure, technological development, and an English tradition in “utopian” purpose-built communities.

The nature of the research which went on at Martlesham and its relationships with state, industry, and infrastructure are the focal point of this dissertation, particularly as no attention has been paid to this research as it moved from public to private. The research centre undertook a number of important R&D projects: the development of satellite base station techniques, digital telecommunications systems, optoelectronics, cable television, the continuing development of submarine cables, videophones, microchip manufacture, and the Prestel Viewdata service. Literature which would aid this historical examination includes

¹³ W. H. G. Armytage, *Heavens Below: Utopian Experiments in England, 1560-1960* (London: Routledge and Kegan Paul, 1961); Dennis Hardy, *Utopian England: Community Experiments, 1900-1945* (London: Routledge, 2000); John Grindrod, *Concretopia: A Journey Around the Rebuilding of Postwar Britain* (Brecon, Wales: Old Street Publishing, 2013).

studies of the relationship between state, science, industry, and technology; laboratory studies; and histories of technological development, innovation, and use. Literature on the state-science-industry relationship exists both in a specific British context and as a broader theoretical approach; I will first explore the former before going on to discuss the latter. A large degree of historical work on the relationship between the British state and science is by this point dated; classic works by the Roses, Vig, Varcoe, and Gummett are decades old.¹⁴ Tom Wilkie's work is more recent – although it was authored closer to the aforementioned than the present day – but is not quite as historically rigorous.¹⁵ More recent work on British science and the state tend towards anti-declinst positions, disabusing the notion that British economic decline was partly caused by an anti-scientific political elite. David Edgerton here is the prime example,¹⁶ but the anti-declinst approach is perhaps a little tired at this point; “post-declinst” histories of British science and politics are the future.¹⁷ Also notably missing are in-depth surveys of the state's approach to technology – the trend in the surveys above is to discuss science first, technology second. Broader theoretical approaches to science and the state focus on the place of science in models of innovation, and variously take approaches which either deconstruct the notion of such models, such as the “linear model” and the “triple

¹⁴ Hilary Rose and Steven Rose, *Science and Society*, New edition edition (Harmondsworth, Middles: Penguin Books Ltd, 1970); Norman J. Vig, *Science and Technology in British Politics*, First Edition edition (Elsevier, 1968); Ian Varcoe, *Organizing for Science in Britain: Case Study*, First Edition edition (London: Oxford University Press, 1974); Philip Gummett, *Scientists in Whitehall* (Manchester Greater Manchester: Manchester University Press, 1980).

¹⁵ Tom Wilkie, *British Science and Politics Since 1945* (Oxford, UK ; Cambridge, Mass: Wiley-Blackwell, 1991).

¹⁶ David Edgerton, ‘Science and Technology in British Business History’, *Business History*, 29 (1987), 84–103; David Edgerton and Sally Horrocks, ‘British Industrial Research and Development before 1945’, *The Economic History Review*, 47 (1994), 213–38; David Edgerton, *Science, Technology and the British Industrial ‘Decline’, 1870-1970* (Cambridge University Press, 1996); David Edgerton, ‘Science in the United Kingdom: A Study in the Nationalization of Science’, in *Science in the Twentieth Century*, ed. by John Krige and Dominique Pestre (Amsterdam: Routledge, 1997), pp. 759–76.

¹⁷ See the following for a good appraisal of the move beyond decline: Jim Tomlinson, ‘After Decline?’, *Contemporary British History*, 23 (2009), 395–406.

helix”, or explore how these models have been deployed historically.¹⁸ Edgerton again exemplifies the former, whilst Hounshell also reappears as an example of the latter.¹⁹ Laboratory studies will help unpick the internal dynamics of the research centre at Martlesham, as well as the research centre’s relationship with the wider world. Knorr-Cetina provides a useful introduction to laboratory studies, whilst Latour and Woolgar provide the seminal text on the laboratory as site of knowledge creation.²⁰ Latour’s later work, whilst rightly criticised for its militaristic tone, also helps to understand the laboratory’s relations with the wider world and how the laboratory can be leveraged to effect social change.²¹ Finally, historical approaches to technological development and use will help understand the patterns of infrastructure and product development at Martlesham. Here, the classic texts are MacKenzie and Wajcman’s social shaping of technology and Bijker, Hughes, and Pinch’s social construction of technology (SCOT);²² however, Hughes’ works on large technological systems are worth considering in their own right as his technological systems take more of a blended approach to the social and the technical (to the point where sociotechnical, or

¹⁸ *Science-Industry Nexus: History, Policy, Implications*, ed. by Karl Grandin, Nina Wormbs, and Sven Widmalm (Sagamore Beach, MA: Science History Publications, 2004).

¹⁹ David Edgerton, “‘The Linear Model’ Did Not Exist: Reflections on the History and Historiography of Science and Research in Industry in the Twentieth Century”, in *Science-Industry Nexus: History, Policy, Implications*, ed. by Karl Grandin, Nina Wormbs, and Sven Widmalm (Sagamore Beach, MA: Science History Publications, 2004), pp. 31–57; David A. Hounshell, ‘Industrial Research: Commentary’, in *Science-Industry Nexus: History, Policy, Implications*, ed. by Karl Grandin, Nina Wormbs, and Sven Widmalm (Sagamore Beach, MA: Science History Publications, 2004), pp. 59–65.

²⁰ Karin Knorr-Cetina, ‘Laboratory Studies: The Cultural Approach to the Study of Science’, in *Handbook of Science and Technology Studies*, ed. by Sheila Jasanoff and others (California: Sage, 1995), pp. 140–66; Bruno Latour and Steve Woolgar, *Laboratory Life: The Social Construction of Scientific Facts* (Beverly Hills; London: Sage Publications, 1979).

²¹ Bruno Latour, ‘Give Me a Laboratory and I Will Raise the World’, in *Science Observed*, ed. by Karin Knorr-Cetina and Michael Mulkay (Beverly Hills, California: Sage, 1983), pp. 141–69; Bruno Latour, *Science in Action: How to Follow Scientists and Engineers Through Society* (Harvard University Press, 1987).

²² Donald MacKenzie and Judy Wajcman, *The Social Shaping of Technology: How the Refrigerator Got Its Hum* (Milton Keynes ; Philadelphia: Open University Press, 1985); *The Social Construction of Technological Systems: New Directions in the Sociology and History of Technology*, ed. by Wiebe E. Bijker, Thomas P. Hughes, and Trevor Pinch (Cambridge, Massachusetts; London, England: The MIT Press, 1987).

techno-social, systems might be a better term).²³ This mutually constitutive approach, alongside the move from innovation to use, is more indicative of the current consensus in the historiography of technology, and is exemplified well in Oudshoorn and Pinch's more recent collected volume on users and technology.²⁴ By exploring the unstudied history of Martlesham and deploying the various approaches discussed above, this dissertation would seek to uncover what research was undertaken, how the research scientists and engineers constructed their knowledge, and to what ends this knowledge was deployed, both on a micro-social scale in the research centre, and on a macro-social scale in the research centre's relationship with state and industry. This macro-social relationship would also be studied in reverse, aiming to explore how the workings of the research station were affected by the corporatisation and privatisation of the GPO/BT. The final focus in this R&D history would be the role of the research centre in technological change, both in terms of infrastructure and products.

The Long Range Planning Division of the Post Office is another useful point of inquiry for studying the influences on R&D and infrastructure in British telecommunications. Shortly before corporatisation, Post Office Telecommunications set up the Long Range Planning Division, using technological forecasting to guide scientific research and the development of telecommunications infrastructure. Recent scholarship highlights the impact that envisioned

²³ Hughes, *Networks of Power*; Thomas P. Hughes, 'The Evolution of Large Technological Systems', in *The Social Construction of Technological Systems: New Directions in the Sociology and History of Technology*, ed. by Wiebe E. Bijker, Thomas P. Hughes, and Trevor Pinch, 1987, pp. 51–82; Thomas P. Hughes, 'Technological Momentum', in *Does Technology Drive History? The Dilemma of Technological Determinism*, ed. by Merritt Roe Smith and Leo Marx (Cambridge, Massachusetts: The MIT Press, 1994), pp. 101–13.

²⁴ Nellie Oudshoorn and Trevor Pinch, *How Users Matter: The Co-Construction of Users and Technology* (Cambridge, Massachusetts: The MIT Press, 2005).

futures can have on science and technology. McCray's work encapsulates this well, exploring bold – even “fringe” – futures, whilst recent work by Messeri and Vertesi shows in detail how stabilising documents and community rhetoric can be deployed to reinforce futures, and thus, by extension, the community which deploys such evidence in the first place.²⁵ However, it is Flichy's work on the Internet which may prove most directly relevant, as Flichy demonstrates how such envisioning has applied to telecommunications research and development.²⁶ Historical futures are clearly gaining more attention, and this research would locate the Long Range Planning Division within such scholarship. However, where that scholarship focusses mostly on the futures of grand projects which win hearts and minds, and are often international in their flavour, research into the Long Range Planning Division would look at the rhetorical power of the future with regards to one organisation's infrastructure, innovation, and research, and how this makes and is made by the British state.

The final point of inquiry proposed for this dissertation is comparison with the American example, which may be revealing given that AT&T was broken up shortly before BT was privatised. There was a clear political influence from America on the British Conservative right-wing in the decade preceding these events, with Margaret Thatcher's party leadership victory in 1975 evidence of this. There was also an American influence evident within the Post Office itself, with the Long Range Planning Division looking to AT&T's management, infrastructure and innovative products, such as the AT&T Picturephone, to guide their own

²⁵ W. Patrick McCray, *The Visioneers: How a Group of Elite Scientists Pursued Space Colonies, Nanotechnologies, and a Limitless Future* (Princeton: Princeton University Press, 2012); Lisa Messeri and Janet Vertesi, 'The Greatest Missions Never Flown: Anticipatory Discourse and the "Projectory" in Technological Communities', *Technology and Culture*, 56 (2015), 54–85.

²⁶ Patrice Flichy, *Internet Imaginaire* (Cambridge, Mass.: MIT Press, 2008).

forecasting. This suggests that comparison with America may reveal more about infrastructure, R&D, and future-mindedness than study of the British case alone. A range of literature comparing the relationship between politics, technology, and science both in the USA and the UK will help lay the foundations of this inquiry. Chandler's *Scale and Scope* is especially useful as it not only deals with the American case, outlining shifting forms of management and industry, but relates this to the British (and German) example also.²⁷ Mazzucato's work on innovation and the state looks at much more recent examples to contrast the role of the state in the USA and the UK in fostering technological innovation, particularly drawing attention to public versus private sector investment.²⁸ Mirowski takes a similar, but more historical, approach to Mazzucato, looking at the privatisation of science, and, unlike Mazzucato and Chandler, focusses solely on the American example.²⁹ Drawing on this literature will help better frame this dissertation's comparison of the relationships between technology, infrastructure, science, and politics in the USA and the UK, and the influences the USA and UK had on one another in these areas.

My methodology for exploring these avenues of research would be to conduct a detailed investigation of telecommunications R&D and related functions at the Post Office and BT, drawing on a range of documentary, material, and oral sources. My main documentary sources would be: the National Archives, including Treasury, Home Office, and Department of Trade and Industry (and predecessors) documents; BT Archives; and the British

²⁷ Alfred D. Chandler Jr., *Scale and Scope: Dynamics of Industrial Capitalism* (Cambridge, Mass: Harvard University Press, 1990).

²⁸ Mariana Mazzucato, *The Entrepreneurial State: Debunking Public vs. Private Sector Myths* (London ; New York: Anthem Press, 2013).

²⁹ Philip Mirowski, *Science-Mart: Privatizing American Science* (Cambridge, Mass: Harvard University Press, 2011).

Postal Museum and Archive (provisional bibliography attached). Oral histories would be conducted with both staff from Martlesham and residents from Martlesham Heath, as well as potentially those who worked in the Long Range Planning Division. Science Museum collections would be used to explore the material histories of telecommunications R&D, as well as locating any “transatlantic objects” which may cast light onto the Anglo-American telecommunications relationship. I also hope to take part in the AHRC Smithsonian Fellowship program, in which I would make use of Smithsonian documentary and material resources to further explore transatlantic influences in telecommunications R&D, infrastructure, and planning. With these resources, this dissertation would aim to determine the nature and role of R&D at Martlesham, particularly in relation to the GPO/BT’s shifting political and organisational function. This would be considered through direct historical inquiry into the GPO/BT’s shift from public to private, and into the R&D which took place at Martlesham throughout the 1970s and 1980s. Alongside this national context, the local relationships of Martlesham would be explored by studying the reasons and consequences of relocation to Martlesham, and the growth of the new village of Martlesham Heath around the research centre. Finally, this dissertation would study the inspirations and influences on the GPO/BT’s organisation, infrastructure, and R&D from the Long Range Planning Division and AT&T in the USA. I would hope to explain from these research topics the patterns of invention, innovation, and infrastructure and product development and use in British telecommunications in the 1970s and 1980s, and contextualise this within the shifting organisational structure of the GPO/BT as it moved from public to private.

To summarise, the key themes explored in this dissertation would be:

- The history of the liberalisation of British telecommunications, considering the political, organisational, and technological aspects of this liberalisation.
- The reasons and consequences of the research centre's move to Martlesham, focussing on how the move may have affected relations between state, science, and industry.
- The new village of Martlesham Heath as unique insight into the local context of technological development and its interface with "traditional" English utopian communities.
- The R&D undertaken at Martlesham, including patterns of technological development and the relationships of R&D with the broader political context of British telecommunications.
- The Long Range Planning Division and the impact of "future-mindedness" on infrastructure, innovation, and research.
- The American example of AT&T, comparing the political influence on science, technology and infrastructure on both sides of the Atlantic.

Proposed chapter plan:

1. Introduction and Literature Review
2. A History of Telecommunications and the Post Office, 1960-85
3. The Move from Dollis Hill to Martlesham Heath, 1958-75
4. The New Village of Martlesham Heath, 1972-85
5. R&D at Martlesham Heath, 1968-85
6. Long Range Planning at Telecommunications HQ, 1967-81

7. Research, Planning, and Politics: Comparison with the USA

8. Conclusion

Bibliography

Primary Sources

The National Archives

Treasury records, e.g.

T 319/712, *Select Committee on the Nationalised Industries: examination on the Post Office 1966*

T 370/1416, *Post Office: review of telecommunications strategy, 1976-79*

T 386/71, *Post Office Review Committee (Carter Committee), 1976*

T 386/72, *Post Office Review Committee (Carter Committee), 1976*

Home Office records, e.g.

HO 245/866, *Technical Group visit to Post Office Research Department at Dollis Hill and Alperton 25 Mar 1975*

HO 255/996, *Proposed satellite earth station at Post Office Research Station, Martlesham (Suffolk): risk of interference from proposed Ministry of Defence tropospheric scatter terminal at Martlesham*

Department of Trade and Industry (and predecessors) records, e.g.

BT 229/62, *Post Office Bill 1967: copy of and comments on the draft*

BT 229/67, *Possible future Post Office Bill: based on the premise that the Post Office will be split*

BT 363/1, *Reorganisation of the Post Office: early departmental consideration*

BT 363/20, *Establishment of the Ministry of Posts and Telecommunications*

BT Archives

Engineering records, e.g.

TCB 135/24, *The Engineer-in-Chief's Annual Report 1964-65*

TCB 135/25, *The Engineer-in-Chief's Annual Report 1965-66*

TCB 135/26, *Engineering Department Annual Report 1966-67*

Research records, e.g.

TCB 555/8, *Research reports subject index 1968-81*

TCC 323/975, *Research and development, 1981-83*

TCC 323/1220, *Research and development, 1982*

Long Range Planning Division records, e.g.

TCC 90/1, *LRIB 1: Long Range Economic Forecasts: The economic consequences of energy scarcity*

TCC 90/2, *LRIB 2: Long Range Social Forecasts: working from home*

TCC 90/3, *LRIB 3: Interaction between Telecommunications and Face-to-face Contact: The energy factor*

TCC 90/4, *LRIB 4: Residential telecommunications applications: the growth of cable TV*

The British Postal Museum and Archives

Post Office Parliamentary Papers, e.g.

POST 71/451, *Reorganisation of the Post Office (1967)*

POST 71/452, *Report of the Post Review Committee (Jul 1977)*

POST 71/453, *Appendix to the report of the Post Review Committee (1977)*

POST 71/454, *White paper entitled: 'The Post Office' (1978)*

Organisational Structures and Staff Lists (1966-1991), e.g.

POST 72/986, *Organisational charts for Post Office Board and Chief Executive Posts (c. 1981)*

POST 72/941, *Organisation charts for the Post Office Corporation (30 Nov 1969-31 Aug 1970)*

POST 72/1109, *The Post Office and Post Office Headquarters: Organisation charts (1977-1980)*

Secondary Works

GPO and BT

Bealey, Frank, *Post Office Engineering Union: History of the Post Office Engineers, 1870-1970* (London, U.K.: Bachman & Turner, 1976)

Campbell-Smith, Duncan, *Masters of the Post: The Authorized History of the Royal Mail* (London: Penguin, 2012)

Pitt, Douglas C., *The Telecommunications Function in the British Post Office: A Case Study of Bureaucratic Adaptation* (Farnborough, England: Ashgate Publishing Limited, 1980)

Organisations, Science, and Technology

Campbell-Kelly, Martin, *ICL: A Business and Technical History* (Oxford : New York: Clarendon Press, 1990)

Chandler Jr., Alfred D., *The Visible Hand: Managerial Revolution in American Business*, New Ed edition (Cambridge, Mass.: Harvard University Press, 1977)

Harper, J. M., *Monopoly and Competition in British Telecommunications: The Past, the Present and the Future* (London, U.K.; Washington, D.C.: Cengage Learning EMEA, 1997)

Hounshell, David A., 'Hughesian History of Technology and Chandlerian Business History: Parallels, Departures, and Critics', *History and Technology*, 12 (1995), 205–24

Hounshell, David A., and John Kenly Smith Jr, *Science and Corporate Strategy: Du Pont R and D, 1902-1980* (Cambridge, England; New York, N.Y.: Cambridge University Press, 1988)

Hughes, Thomas P., *Networks of Power: Electrification in Western Society, 1880-1930* (Baltimore: Johns Hopkins University Press, 1983)

Geography

Armytage, W. H. G., *Heavens Below: Utopian Experiments in England, 1560-1960* (London: Routledge and Kegan Paul, 1961)

Hardy, Dennis, *Utopian England: Community Experiments, 1900-1945* (London: Routledge, 2000)

- Massey, Doreen, *Spatial Divisions of Labour: Social Structures and the Geography of Production* (London, UK: Macmillan, 1984)
- Harvey, David, *Limits to Capital*, New and Fully Updated Ed edition (London ; New York: Verso Books, 2007)
- , *The Condition of Postmodernity: An Enquiry into the Origins of Cultural Change* (Oxford England ; Cambridge, Mass., USA: Wiley-Blackwell, 1991)
- Henke, Christopher R., and Thomas F. Gieryn, 'Sites of Scientific Practice: The Enduring Importance of Place', in *The Handbook of Science and Technology Studies*, ed. by Edward J. Hackett, Olga Amsterdamska, Michael Lynch, and Judy Wajcman, 3rd edn (Cambridge, Massachusetts; London, England: The MIT Press, 2008)
- Massey, Doreen, and David Wield, *High-Tech Fantasies: Science Parks in Society, Science and Space* (London ; New York: Routledge, 1991)
- Smith, Crosbie, and Jon Agar, eds., *Making Space for Science: Territorial Themes in the Shaping of Knowledge* (New York, N.Y.: Palgrave Macmillan, 1998)

Science and Technology in Britain

- Edgerton, David, 'Science and Technology in British Business History', *Business History*, 29 (1987), 84–103
- , *Science, Technology and the British Industrial 'Decline', 1870-1970* (Cambridge University Press, 1996)
- , 'Science in the United Kingdom: A Study in the Nationalization of Science', in *Science in the Twentieth Century*, ed. by John Krige and Dominique Pestre (Amsterdam: Routledge, 1997), pp. 759–76
- Edgerton, David, and Sally Horrocks, 'British Industrial Research and Development before 1945', *The Economic History Review*, 47 (1994), 213–38
- Gummett, Philip, *Scientists in Whitehall* (Manchester Greater Manchester: Manchester University Press, 1980)
- Rose, Hilary, and Steven Rose, *Science and Society*, New edition edition (Harmondsworth, Middles: Penguin Books Ltd, 1970)
- Tomlinson, Jim, 'After Decline?', *Contemporary British History*, 23 (2009), 395–406
- Varcoe, Ian, *Organizing for Science in Britain: Case Study*, First Edition edition (London: Oxford University Press, 1974)

Vig, Norman J., *Science and Technology in British Politics*, First Edition edition (Elsevier, 1968)

Wilkie, Tom, *British Science and Politics Since 1945* (Oxford, UK ; Cambridge, Mass: Wiley-Blackwell, 1991)

Science, Industry, and the State

Edgerton, David, “‘The Linear Model’ Did Not Exist: Reflections on the History and Historiography of Science and Research in Industry in the Twentieth Century’, in *Science-Industry Nexus: History, Policy, Implications*, ed. by Karl Grandin, Nina Wormbs, and Sven Widmalm (Sagamore Beach, MA: Science History Publications, 2004), pp. 31–57

Grandin, Karl, Nina Wormbs, and Sven Widmalm, eds., *Science-Industry Nexus: History, Policy, Implications* (Sagamore Beach, MA: Science History Publications, 2004)

Hounshell, David A., ‘Industrial Research: Commentary’, in *Science-Industry Nexus: History, Policy, Implications*, ed. by Karl Grandin, Nina Wormbs, and Sven Widmalm (Sagamore Beach, MA: Science History Publications, 2004), pp. 59–65

Laboratory Studies

Knorr-Cetina, Karin, ‘Laboratory Studies: The Cultural Approach to the Study of Science’, in *Handbook of Science and Technology Studies*, ed. by Sheila Jasanoff, Gerald E. Markle, James C. Petersen, and Trevor Pinch (California: Sage, 1995), pp. 140–66

Latour, Bruno, ‘Give Me a Laboratory and I Will Raise the World’, in *Science Observed*, ed. by Karin Knorr-Cetina and Michael Mulkay (Beverly Hills, California: Sage, 1983), pp. 141–69

———, *Science in Action: How to Follow Scientists and Engineers Through Society* (Harvard University Press, 1987)

Latour, Bruno, and Steve Woolgar, *Laboratory Life: The Social Construction of Scientific Facts* (Beverly Hills; London: Sage Publications, 1979)

James, Frank A. J. L., ed., *The Development of the Laboratory: Essays on the Place of Experiments in Industrial Civilization* (Basingstoke, Hampshire: Palgrave Macmillan, 1989)

Historiography of Technology

Bijker, Wiebe E., Thomas P. Hughes, and Trevor Pinch, eds., *The Social Construction of Technological Systems: New Directions in the Sociology and History of Technology* (Cambridge, Massachusetts; London, England: The MIT Press, 1987)

Hughes, Thomas P., *Networks of Power: Electrification in Western Society, 1880-1930* (Baltimore: Johns Hopkins University Press, 1983)

———, 'Technological Momentum', in *Does Technology Drive History? The Dilemma of Technological Determinism*, ed. by Merritt Roe Smith and Leo Marx (Cambridge, Massachusetts: The MIT Press, 1994), pp. 101–13

———, 'The Evolution of Large Technological Systems', in *The Social Construction of Technological Systems: New Directions in the Sociology and History of Technology*, ed. by Wiebe E. Bijker, Thomas P. Hughes, and Trevor Pinch, 1987, pp. 51–82

MacKenzie, Donald, and Judy Wajcman, *The Social Shaping of Technology: How the Refrigerator Got Its Hum* (Milton Keynes ; Philadelphia: Open University Press, 1985)

Oudshoorn, Nellie, and Trevor Pinch, *How Users Matter: The Co-Construction of Users and Technology* (Cambridge, Massachusetts: The MIT Press, 2005)

Historical Futures

Flichy, Patrice, *Internet Imaginaire* (Cambridge, Mass.: MIT Press, 2008)

McCray, W. Patrick, *The Visioneers: How a Group of Elite Scientists Pursued Space Colonies, Nanotechnologies, and a Limitless Future* (Princeton: Princeton University Press, 2012)

Messeri, Lisa, and Janet Vertesi, 'The Greatest Missions Never Flown: Anticipatory Discourse and the "Projectory" in Technological Communities', *Technology and Culture*, 56 (2015), 54–85

Science, Technology, and Industry in the USA

Chandler Jr., Alfred D., *Scale and Scope: Dynamics of Industrial Capitalism* (Cambridge, Mass: Harvard University Press, 1990)

———, *The Visible Hand: Managerial Revolution in American Business*, New Ed edition (Cambridge, Mass.: Harvard University Press, 1977)

Hounshell, David A., and John Kenly Smith Jr, *Science and Corporate Strategy: Du Pont R and D, 1902-1980* (Cambridge, England; New York, N.Y.: Cambridge University Press, 1988)

Mazzucato, Mariana, *The Entrepreneurial State: Debunking Public vs. Private Sector Myths* (London ; New York: Anthem Press, 2013)

Mirowski, Philip, *Science-Mart: Privatizing American Science* (Cambridge, Mass: Harvard University Press, 2011)