PRIVATISATION OF UK GOVERNMENT SCIENCE:

THE CHANGING WORKING LIVES OF SCIENTIFIC CIVIL SERVANTS,

1970-2005

Thesis submitted for the degree of

Doctor of Philosophy

at the University of Leicester

by

Emmeline Gabrielle Beresford Ledgerwood

School of History, Politics and International Relations

University of Leicester

August 2021

Abstract

Privatisation of UK Government Science:
The Changing Working Lives of Scientific Civil Servants, 1970-2005

Emmeline Gabrielle Beresford Ledgerwood

Organisational change in UK government research establishments (GREs) during the late twentieth century profoundly affected the scientific civil servants who worked in them. Civil service reforms in the 1980s and 1990s led to significant upheaval across the civil service with the reconfiguration of career management frameworks, alterations to physical working environments, the introduction of new management practices and an increasingly commercial outlook. This thesis evaluates how the workplace transformations associated with New Public Management and privatisation affected scientific civil servants' career prospects, working practices and professional values.

The research draws on a new collection of oral history interviews with former government scientists who worked at the Royal Aircraft Establishment and the Building Research Establishment during 1970–2005. This original source material is used in conjunction with official papers and archival material to present the first historical study of scientific civil servants' experiences of organisational change during this period. It foregrounds their individual stories to reveal the everyday instances of change that accumulated to engender a process of culture change in the workplace which had a substantial impact on their identities as professional scientists and public servants.

This study shows that organisational change in GREs was driven by the Conservative reform agenda which did not consider scientific research as a government activity that merited special treatment. It provides the first analysis of the distinct working environment of GREs which offered the prospect of a career in scientific research within the security of the civil service frameworks, thereby meeting government's needs for the cultivation of specialist knowledge. It argues that the processes that led to privatisation devalued the status of specialists with these research organisations, suggesting that the

demise of GREs carries long-term implications for government's access to scientific expertise which are only now becoming visible.

Acknowledgements

Table of Contents

List of Tables

List of Illustrations

List of Acronyms

ABRC   Advisory Board of the Research Councils

ACARD   Advisory Council on Applied Research and Development

ACOST   Advisory Council on Science and Technology

ARE   Admiralty Research Establishment

ASO   Assistant Scientific Officer

BGM   Business Group Manager

BL   British Library

BRE   Building Research Establishment

BRS   Building Research Station

CER   Controller R&D Establishments and Research

CDP   Chief of Defence Procurement

CSA   Chief Scientific Adviser

CSD   Civil Service Department

CSO   Chief Scientific Officer

DCSO   Deputy Chief Scientific Officer

DERA   Defence Evaluation and Research Agency

DES   Department of Education and Science

DOE   Department of the Environment

DOI   Department of Industry

DRA   Defence Research Agency

Dstl   Defence Science and Technology Laboratory

DSIR   Department of Scientific and Industrial Research

DTI   Department of Trade and Industry

EU   European Union

EW   Experimental Worker

FPRL   Forest Products Research Laboratory (later Princes Risborough Laboratory)

FRS   Fellow of the Royal Society

GRE   Government Research Establishment

HMSO	Her Majesty's Stationery Office
HNC	Higher National Certificate
HND	Higher National Diploma
HR	Human Resources
HSO	Higher Scientific Officer
IMP	Individual Merit Promotion
IPCS	Institution of Professional Civil Servants
MAFF	Ministry of Agriculture, Fisheries and Food
MOD	Ministry of Defence
MPO	Management and Personnel Office
NAO	National Audit Office
NATO	North Atlantic Treaty Organisation
NLS	National Life Stories
NPM	New Public Management
NPL	National Physical Laboratory
OECD	Organisation for Economic Co-operation and Development
OHBS	Oral History of British Science
OR	Operational Requirements
OSA	Official Secrets Act
PE	Procurement Executive
PSO	Principal Scientific Officer
QQ	QinetiQ
R&D	Research and Development
RAE	Royal Aircraft Establishment
RAF	Royal Air Force
RARDE	Royal Armament Research and Development Establishment
RSRE	Royal Signals and Radar Establishment
SO	Scientific Officer
SPSO	Senior Principal Scientific Officer
SSO	Senior Scientific Officer

STS Science and Technology Studies

TNA The National Archives

UGC University Grants Committee

1. Introduction

Scientific civil servants who worked in UK government research establishments (GREs) and their successor organisations during 1970-2005 experienced transformative changes in the workplace. As governments reviewed and reorganised the funding of state-sponsored scientific research during this period, so the scientists employed in GREs were subject to phases of organisational change that demanded an increasingly commercial outlook and, in some cases, the transfer of their workplaces from the public to the private sector.[1]

GREs were directly attached to government departments and operated within the frameworks of the civil service. As such they were directly affected by the policies of civil service reform initiated by the Conservative Governments of the 1970s, 1980s and 1990s and sustained by the Labour Governments which succeeded them. In the defence GREs, the implementation of these policies coincided with reduced spending on defence research and development (R&D) as the Cold War came to an end in the late 1980s. Consequently, government scientists employed in GREs during this period experienced significant upheaval in their working lives, yet their story is one that has received little attention from historians of science and is barely mentioned in official histories of privatisation and of the civil service.[2]

This thesis is the first historical study to examine in detail how these organisational changes affected the working lives of scientists in GREs. It draws on a series of original oral history interviews with former UK government scientists to explore the management and conduct of government research, government scientists' professional identities and

---

[1] Throughout this thesis I use the term 'scientific research' to refer to the spectrum of research and development (R&D) activities that went on in GREs. 'Farnborough' is used by interviewees to refer to the Royal Aircraft Establishment and its successor organisations based on the same site. Similarly, 'Malvern' for the Royal Radar and Signals Establishment and 'Fort Halstead' for the Royal Armament Research and Development Establishment.

[2] David Parker, *The Official History of Privatisation, Vol. 1: The Formative Years 1970–1987* (London, 2009); David Parker, *The Official History of Privatisation, Vol. 2: Popular Capitalism, 1987–97* (London, 2012); Rodney Lowe, *The Official History of the British Civil Service: Reforming the Civil Service, Volume I: The Fulton Years, 1966–81* (London: Routledge, 2011); Rodney Lowe and Hugh Pemberton, *The Official History of the British Civil Service: Reforming the Civil Service, Volume II: The Thatcher and Major Revolutions, 1982–97* (London: Routledge 2020).

the state's access to scientific expertise. The study focuses on scientists who worked at two GREs: the Royal Aircraft Establishment (RAE) in Farnborough, which during this period was primarily concerned with defence research and attached to the Ministry of Defence (MOD), and the Building Research Establishment (BRE) in Watford, a civil research organisation attached to the then Department of the Environment (DOE).[3] Scientists' personal accounts of change, recorded in the life story interviews, are intertwined with evidence from written sources such as official government publications, parliamentary committee reports, in-house publications from the GREs and archived oral history interviews with British scientists.[4]

By foregrounding the experiences of individuals who are largely absent from the official written record, this thesis offers new perspectives of the British state's changing attitudes to the funding and organisation of scientific research during 1970–2005, adding to historiographies of the civil service and the changing organisation of UK government science. The experiences of scientists within these GREs serve as an example of the many state employees who had no control over their transfer into the private sector, contributing to an understanding of broader processes of cultural change that took place across British society during the late twentieth century. In addition, by seeking to understand how organisational change affected the workplace culture within GREs, the thesis adds to the literature on the sociology of science. Finally, at a time when the Covid-19 pandemic has highlighted the relationships between government Ministers and scientists, this study raises questions about the long-term effects of civil service reform on the cultivation of scientific expertise within the civil service and government access to expertise.

1.1 A review of the relevant literature

Understanding the context of these organisational changes in UK GREs and their impact on government scientists has involved consulting a range of secondary literature drawn from the fields of political history, public administration, the history of science and science and technology studies (STS). I have narrowed the focus of the following literature review to studies that inform the three main themes of my research: the

---

[3] See section 1.4.2 for details of how these establishments were selected as case studies for the research project.
[4] See section 1.3 for details of these sources.

organisation of government-funded science and scientists in Britain, the development of Conservative policies related to civil service reform and science, and the working culture of government scientists.

1.1.1 Government research establishments and the scientific civil service

The diagrams below illustrate the complexity of the networks of government-funded civil and defence research establishments that existed in the UK during the period of this study.

1.1 *Locations of defence research establishments, c. 1980.*
Ministry of Defence, *Defence Science 1983* (London: HMSO, 1982).

Familiarisation with the development of these networks is complicated by the lack of a comprehensive historical overview that covers the evolution of GREs during the twentieth century or of the organisation of the thousands of scientists who worked in them. Reference to official publications has proved to be an important component in building up an understanding of how GREs were organised and managed. Government efforts to understand and plan for the effective management of R&D can be traced through an extensive range of official literature such as Government command papers

and enacted legislation along with reports of parliamentary select committees, advisory committees and think-tanks.[5]
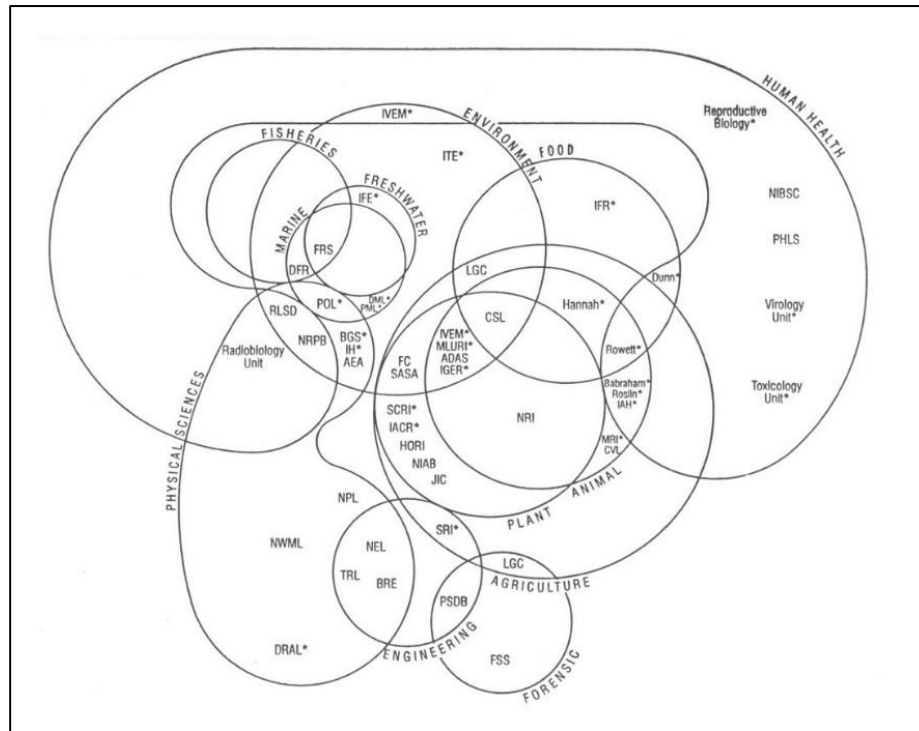
1.2 *Overlapping activities of public sector civil research laboratories, c 1994.*
Cabinet Office, *Multi-Departmental Scrutiny of Public Sector Research Establishments*,
(London: HMSO, 1994), p. 107.

In the secondary literature, analysis of where departmental research establishments and scientific civil servants fit into the landscape of government-funded research is found in discussions of relations between the British state and science, what might be understood by the term 'science policy'. Salomon explains the term 'science policy' as 'the idea of a deliberate integration of scientific and technological activities into the fabric of political,

---

[5] The following constitutes a selection of the extensive range of official papers relevant to this topic: Office of the Minister for Science, *Report of the Committee on the Management and Control of Research and Development* (London: HMSO, 1961); Sir Burke Trend, *Committee of Enquiry into the Organisation of Civil Science,* Cmnd 2171 (London: HMSO, 1963); The Science and Technology Act 1965; Science and Technology Committee, *Defence Research*, 27 March 1969, HC 213 1968–69; Civil Service Department, *Government Organisation for Defence Procurement and Civil Aerospace,* Cmnd 4641 (London: HMSO, 1971); Lord Privy Seal, *Framework for Government Research and Development,* Cmnd 5046 (London: HMSO, 1972); Civil Service Department, *Review of the Scientific Civil Service,* Cmnd 8032 (London: HMSO, 1980); Science and Technology Committee, *Science and Government*, 12 November 1981, HL 20–I & 20–II 1981–82; Cabinet Office, *Annual Review of Government Funded R&D* (1983–1993); Advisory Council on Science and Technology, *Defence R & D: A National Resource* (London: HMSO, 1989); Cabinet Office, *Multi-departmental Scrutiny of Public Sector Research Establishments* (London: HMSO, 1994); Advisory Board for the Research Councils, *A Strategy for the Science Base* (London: HMSO, 1987).

military, economic and social decisions. Policy for and through science.'[6] He relates the emergence of the term in the 1960s as a reflection of the post-war growth in government responsibility for science, partly driven by the critical role played by scientific and technological advances in maintaining a balance of power between hostile nations during the Cold War.[7] More recently Leggett and Sleigh have responded to Irwin's suggestion to use the term 'scientific governance' to reflect changing boundaries between the public, private and voluntary sectors and the emergence of a broader range of societal actors who influence science.[8] While they call for a broader approach in the historiography of twentieth-century British science to connect those involved in science to those affected by it, in this thesis I have chosen to use the term 'science policy' to reflect its focus on aspects of 'the structures and institutions that shaped science'.[9]

Poole and Andrews drew on primary sources published between 1900 and 1970 to illustrate 'the profound changes in the relations between science and government during the twentieth century'.[10] *The Government of Science in Britain* charts the development of the UK government's involvement in R&D activities up to 1970, highlighting the central debates within Whitehall and among the scientific community over the nature of R&D undertaken in GREs, the civil service's ability to recruit qualified scientists and engineers, the career management of scientific civil servants and the role of scientists in the civil service.[11] This collection of extracts shows the background to the debates over science policy which characterised the 1980s and 1990s, as does Gummett's work *Scientists in Whitehall*, a key survey of the government of science in Britain during the twentieth century up to the late 1970s.[12] Gummett outlines the machinery of government arrangements through which state support for scientific research was expended, the

---

[6] Jean-Jacques Salomon, 'Science Policy Studies and the Development of Science Policy', in Derek de Solla Price and Ina Rösing (eds), *Science, Technology and Society: A Cross-Disciplinary Perspective* (London: SAGE Publications, 1977), pp. 43–70.

[7] Ibid., p. 46.

[8] Don Leggett and Charlotte Sleigh, 'Scientific governance: an introduction', in Don Leggett and Charlotte Sleigh (eds), *Scientific Governance in Britain, 1914–79* (Manchester: Manchester University Press, 2016), pp. 1–24; Alan Irwin, 'STS Perspectives on Scientific Governance', in E. Hackett et al. (eds), *The Handbook of Science and Technology Studies* (Boston: MIT Press, 2008), pp. 583–607.

[9] Leggett and Sleigh, 'Introduction', p. 4.

[10] J. B. Poole and K. Andrews (eds), *The Government of Science in Britain* (London: Weidenfeld and Nicolson, 1972), p. 1. See also Hilary Rose and Steven Rose, *Science and Society* (London: Allen Lane, 1969).

[11] In this thesis I use the term 'Whitehall' to refer both to the location of government offices in London and the central policy-making departments of the civil service.

[12] Philip Gummett, *Scientists in Whitehall* (Manchester: Manchester University Press, 1980).

channels through which policymakers in central government could access specialist expertise and the development of the scientific civil service as a specialist stream within the wider civil service.

An illumination of the relationships between government and science outlined by Gummett comes with Kogan and Henkel's 1983 examination of the interactions between research managers and civil servants in the Department of Health and Social Security in the 1970s.[13] *Government and Research* focuses on the implementation of the 1971 Rothschild customer-contractor principle, providing an indication of the issues which would be associated with further commercialisation, including the difficulty for research commissioners in Whitehall to act as intelligent customers. However the study's focus is very much on the systems through which research managers and civil servants negotiated rather than the experiences of the scientists carrying out the research.

Gummett draws the important distinction between research establishments attached to government departments—GREs—and those that operated within the research council system. Published accounts of how research institutes such as GREs were organised and managed in the period of this study are limited.[14] There are some narrative accounts of the GREs chosen as case studies that tend to focus on the content of early research programmes and senior personnel, but these do not extend into the period under study here.[15]

Gummett's survey ends before the Conservatives came to power in 1979 and deals mainly with mechanisms to support civil research.[16] Wilkie's 1991 overview *British Science and Politics since 1945* also focuses on civil research, yet he makes no reference to where GREs or defence research activities fitted into the changing science policy landscape, nor to the effects of the Conservative civil service reform programme on government

---

[13] Maurice Kogan and Mary Henkel, *Government and Research: The Rothschild Experiment in a Government Department* (London: Heinemann Educational, 1983).

[14] John Cockcroft (ed.), *The Organization of Research Establishments* (Cambridge: Cambridge University Press, 1965).

[15] For example, F. M. Lea, *Science and Building. A History of the Building Research Station* (London, 1971); Graham Rood, 'The Royal Aircraft Establishment, Farnborough', *Journal of Aeronautical History,* 10 (2020), pp. 53–113.

[16] Gummett, *Scientists in Whitehall*.

scientists.[17] This is in contrast to studies that have focused on earlier phases of government defence research, such as Balmer's analysis of government policy concerning biological warfare during 1930-1965 or Leggett's examination of technical expertise in the Royal Navy during the nineteenth century.[18] There are various explanations for this scholarly focus on civil research after 1979, with Agar noting that it 'is in fact largely an artefact created by what was publicly visible,' while MacKenzie and Spinardi have put it down a lack of systematic collection of data.[19] However Broadbent's 1988 survey offers insight into the changing interactions between military and government over the post-war organisation of defence. In this he offers a coherent account of scientists' place in the complex process of arms procurement, both within the research establishments and Whitehall, as well as in advisory roles in the services.[20]

Edgerton, as part of his work challenging declinist accounts of twentieth-century Britain, has set out to recalibrate how scholars think about government spending on defence R&D and its contribution to the British economy.[21] In *Warfare State* he demonstrates how state commitment to supporting innovative research was critical to Britain's military capability during the Second World War.[22] His work complements that of other scholars which show that a complex web of connections was forged between the military, academia and industry on both sides of the Atlantic in creating a state of readiness for war.[23] Interactions between these sectors drive innovations forward, conceptualised by Etkowitz and

---

[17] Tom Wilkie, *British Science and Politics since 1945* (Cambridge, Mass: Basil Blackwell, 1991).

[18] Brian Balmer, *Britain and Biological Warfare: Expert Advice and Science Policy, 1930–1965* (Basingstoke: Palgrave, 2001); Don Leggett, *Shaping the Royal Navy: Technology, Authority and Naval Architecture, c.1830–1906* (Manchester: Manchester University Press, 2015).

[19] Jon Agar, *Science Policy Under Thatcher* (London: UCL Press, 2019), p. 27; Donald MacKenzie and Graham Spinardi, 'The Technological Impact of a Defence Research Establishment', in R. Coopey, Matthew Uttley and Graham Spinardi (eds), *Defence Science and Technology: Adjusting to Change* (Reading: Harwood Academic, 1993), pp. 85–124; David Edgerton, *Science, Technology, and the British Industrial 'Decline', 1870–1970* (Cambridge: Cambridge University Press, 1996).

[20] Ewen Broadbent, *The Military and Government: From Macmillan to Heseltine* (Basingstoke: Macmillan, 1988).

[21] David Edgerton, 'The Prophet Militant and Industrial: The Peculiarities of Correlli Barnett', *Twentieth Century British History*, 2, no. 3 (1991), pp. 360–79.

[22] David Edgerton, *Warfare State: Britain, 1920–1970* (Cambridge: Cambridge University Press, 2006). For an example of a case study, see Hermione Giffard, 'Engine of Innovation: The Royal Aircraft Establishment, State Design and the Coming of the Gas Turbine Aero-Engine in Britain', *Contemporary British History*, 34, no. 2 (2020), pp. 165–78.

[23] See Stuart W. Leslie, *The Cold War and American Science: The Military-Industrial-Academic Complex at MIT and Stanford* (New York: Columbia University Press, 1993); Patrick J. McGrath, *Scientists, Business, and the State, 1890–1960* (Chapel Hill, NC: University of North Carolina Press, 2002); Katherine C. Epstein, *Torpedo: Inventing the Military-Industrial Complex in the United States and Great Britain* (Cambridge, Mass.: Harvard University Press, 2014).

Leydesdorff as a 'triple helix' model.[24] The GREs can be considered as a key component in this model, itself an element of the systems of science that Agar argues have evolved to solve the problems of 'working worlds'.[25]

The defence research establishments' position in the national R&D landscape is explored in Bud and Gummett's 1999 edited collection *Cold War, Hot Science*.[26] Published during this period of disruptive organisational change, the articles review the defence research establishments' post-war record for technical developments and their transfer into practical applications. GREs' R&D activities as an integral element in national innovation systems and processes of technology transfer is discussed by James.[27] His observation that 'changes within an organisation have implications for the nature of the relationships that it has with other actors in the system' indicated the potential for organisational change to disrupt these innovation systems. James' study built on MacKenzie and Spinardi's analysis of the 'effect of these establishments on the general development of technology'.[28] This thesis picks up on MacKenzie and Spinardi's observation that 'long-standing ties, often involving years of personal contact, joint work, and trust do exist between RSRE and many British firms'.[29] There is very little written about the nature and extent of government scientists' working relationships with their peers in other institutional settings, so the interviews allow us to find out more about how social processes across institutional boundaries contributed to the transfer of tacit knowledge that supported innovation systems.[30]

---

[24] H. Etzkowitz and L. Leydesdorff, 'The Dynamics of Innovation: from National Systems and 'Mode 2' to a Triple Helix of University-Industry-Government Relations', *Research Policy*, 29, no. 2 (2000), pp.109–123; For the USA, see M. Crow and B. Bozeman, *Limited by Design: R&D Laboratories in the US National Innovation System* (New York: Columbia University Press, 1998). A key exploration of these types of relationships is in Michael Sanderson, *The Universities and British Industry, 1850–1970* (London: Routledge and Kegan Paul, 1972). The innovation studies literature can be accessed through references in Tim Flink and David Kaldewey, 'The Language of Science Policy in the Twenty-First Century: What Comes after Basic and Applied Research?' in David Kaldewey and Désirée Schauz (eds), *Basic and Applied Research*: *The Language of Science Policy in the Twentieth Century* (New York: Berghahn Books, 2018), pp. 251–84.

[25] Jon Agar, *Science in the Twentieth Century and Beyond* (Cambridge: Polity, 2012), pp. 3–6.

[26] Robert Bud and Philip Gummett (eds), *Cold War, Hot Science: Applied Research in Britain's Defence Laboratories, 1945–1990* (Amsterdam: Harwood Academic, 1999).

[27] Andrew D. James, 'Organisational Change and Innovation System Dynamics: The Reform of the UK Government Defence Research Establishments', *The Journal of Technology Transfer*, 34, no. 5 (2009), pp. 505–23.

[28] MacKenzie and Spinardi, 'The Technological Impact'.

[29] Ibid., p. 115.

[30] John Krige (ed.), *How Knowledge Moves: Writing the Transnational History of Science and Technology* (Chicago: The University of Chicago Press, 2019).

The studies mentioned here counter Edgerton's view that 'the military/state sciences and technologies and industries … tend to be left out of the history of twentieth-century science, which focuses on academic particle physics and biology.'[31] However Edgerton's statement has made me reflect not only on state sciences being left out of histories of science, but also on the absence of state sciences and government researchers in histories of the state. I agree with Edgerton's opinion that 'the history of the state's experts needs telling' and that the 'huge literature on the civil service' fails to give 'specialists' or 'professionals' within the service due space.[32] He writes about a 'technocratic critique of modern Britain' whereby technocrats who wanted to see more experts in positions of power—not just 'on tap' but also 'on top'—would claim that the British elite was hostile to science and technology.[33] He argues that this critique fostered a contemporary perception that science and scientific expertise were not valued by the state, a perception that some historians have accepted at face value, thereby assuming that science and scientific expertise were not integral components in the machinery of government.

While a 1956 study by McCrensky analysed the position of scientists in the civil service, scientists are not the focus of the majority of studies in the public administration field. They tend to appear either as occasional entries in a table of civil service numbers or pay grades, or in discussions of the impact of the 1968 Fulton report which recommended the promotion of more specialists into the management tiers of the service.[34] Hennessy's wide-ranging and masterful illumination of the intricacies of *Whitehall* is as good an example of this as any.[35] The more recent publication of two major volumes on the history of the civil service, authored by Lowe and Pemberton, continues this historiographical bias in that specialists are barely mentioned.[36] Instead the history of the Institution of Professional Civil Servants (IPCS), the union to which many government scientists

---

[31] Edgerton, *Warfare State*, p. 13.

[32] Ibid., p. 109. Edgerton cites Kevin Theakston, *The Civil Service since 1945* (Oxford: Blackwell, 1995), pp. 191–2. Similarly, John Garrett, *Managing the Civil Service* (London: Heinemann, 1980), pp. 18–19 and Gavin Drewry and Tony Butcher, *The Civil Service Today*, 2nd edn (Oxford: Basil Blackwell, 1991), pp. 141–143. For a review of the literature on the twentieth-century civil service, see Rodney Lowe, 'Review: Of Mice and Men: Constructing an Administrative History of Twentieth-Century Britain', *Twentieth Century British History*, 16, no. 1 (2005), pp. 103–15.

[33] Edgerton, 'The Prophet Militant', p. 365.

[34] Edward McCrensky, 'Scientists in the British Civil Service', *Science*, 124, no. 3222 (1956), pp. 567–71; Civil Service Commission, *The Report of the Committee on the Civil Service*, Cmnd 3638 (London: HMSO, 1968).

[35] P. Hennessy, *Whitehall* (London: Secker & Warburg, 1989), p. 196 and p. 532.

[36] Lowe, *Official History, Vol. I*; Lowe and Pemberton, *Official History, Vol. II*.

belonged, is a rare example of a study that details the changing working lives of scientific civil servants.[37] Photographs of IPCS members striking during pay disputes of the 1970s show scientists as employees who had already experienced significant change in the workplace before the civil service reform programme introduced by Thatcher.
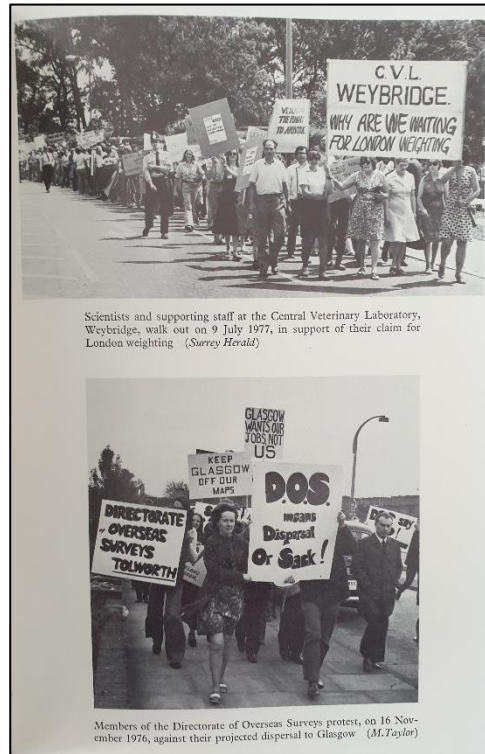
1.3 *Government scientists protesting against workplace change, 1970s.*
Published in Mortimer and Ellis*, A Professional Union.*

The thesis adds the experiences of scientific civil servants to the existing literature on the twentieth-century history of British government. By so doing, it builds on previous works that have examined the position of scientists and experts within the operations of the state. Key texts that have examined this question include MacLeod's edited volume *Government and Expertise* which shows the varied nature of relationships between government and experts during 1860–1919, a theme that is picked up in the more recent collection edited by Leggett and Sleigh which covers the period 1914–79.[38] Agar has also focused on relations between scientists and the British state from various angles during

---

[37] J. E. Mortimer and Valerie Ellis, *A Professional Union: The Evolution of the Institution of Professional Civil Servants* (London: Allen and Unwin, 1980).
[38] Roy MacLeod (ed.), *Government and Expertise: Specialists, Administrators and Professionals, 1860–1919* (Cambridge: Cambridge University Press, 1988); Leggett and Sleigh (eds), *Scientific Governance*.

this period, and recent contributions to the field continue to explore government access to a cadre of experts during the twentieth century.[39]

Some political scientists have focused on the impact of bureaucratic reform on the shared ethos of public service displayed by civil servants.[40] In particular Ferlie et al. considered its effects on professionals in the public sector such as lawyers and teachers.[41] However these studies largely fail to discuss how those public sector reforms specifically affected the values of the professional scientists in GREs. Horrocks and Lean's article is the exception in exploring scientific civil servants' values, showing the influence of the Second World War on the culture of government scientists which blended notions of public service with the ethos of professional scientists.[42] The authors draw on a collection of oral history interviews with British scientists to address the 'absence of attention to government scientists' in the literature, however they found that this set of interviews did not provide a clear picture of the organisational changes of the 1980s, recognising that, 'future interviews will contribute further to our understanding of how governance regimes shaped the experience of scientists who worked for the state.'[43] This thesis is the outcome of those 'future interviews', building on Horrocks and Lean's work in its use of interviewee reflections to explore how government scientists' dual identities as both

---

[39] Jon Agar, *Science and Spectacle: The Work of Jodrell Bank in Post-War British Culture* (Amsterdam: Harwood Academic, 1998); Jon Agar and Brian Balmer, 'British Scientists and the Cold War: The Defence Research Policy Committee and Information Networks, 1947–1963', *Historical Studies in the Physical and Biological Sciences,* 28, no. 2 (1998), pp. 209–52; Jon Agar, *The Government Machine* (Cambridge, Mass: MIT Press, 2003). Recent contributions to this field include: Rachel Boon, ''Research is the Door to Tomorrow': the Post Office Engineering Research Station, Dollis Hill, 1933–1958' (unpublished PhD thesis, University of Manchester, 2020); Sabine Clarke, *Science at the End of Empire* (Manchester: Manchester University Press, 2018); Samuel A. Robinson, *Ocean Science and the British Cold War State* (London: Palgrave Macmillan, 2018); Stuart Butler, *National Prestige and In(ter)dependence: British Space Research Policy 1959-73'* (unpublished PhD thesis, University of Manchester, 2016); Dominic Berry, 'Genetics, Statistics, and Regulation at the National Institute of Agricultural Botany, 1919–1969' (unpublished PhD thesis, University of Leeds, 2014).

[40] Wouter Vandenabeele and Sylvia Horton, 'The Evolution of the British Public Service Ethos', in L. W. Huberts, Jeroen Maesschalck and Carole L. Jurkiewicz (eds), *Ethics and Integrity of Governance: Perspectives Across Frontiers* (Cheltenham: Edward Elgar Publishing, 2008), pp. 7–24; Geoffrey K. Fry, 'The British Career Civil Service under Challenge', *Political Studies*, 34, no. 4 (1986), pp. 533–55; David L. Dillman, 'Enduring Values in the British Civil Service', *Administration & Society,* 39, no. 7 (2007), pp. 883–900. See also Laurie Cohen, Joanne Duberley and Pete Smith, 'Losing the Faith: Public Sector Work and the Erosion of Career Calling', *Work, Employment and Society*, 33, no. 2 (2019), pp. 326–35.

[41] Ewan Ferlie et al., *The New Public Management in Action* (Oxford: Oxford University Press, 1996), pp. 165–94.

[42] Sally Horrocks and Thomas Lean, 'Doing It for Britain: Science and Service in Oral History with Government Scientists', in Leggett and Sleigh (eds), *Scientific Governance*, pp. 161–78.

[43] British Library, *An Oral History of British Science*, C1379; Horrocks and Lean, 'Doing It for Britain', p. 176.

scientists and public servants were affected by civil service reforms of the 1980s and 1990s. It also reveals the nature of scientific civil servants' roles both within the civil service and as producers and sharers of knowledge in the wider spheres of scientific research and innovation beyond the GREs.

This section has indicated the extent to which the literature that deals with the twentieth-century history of British government and science policy refers to GREs and scientific civil servants. It shows that there are three major gaps in this literature. The first is the absence of scientific civil servants in general histories of the civil service. This thesis elucidates the roles, activities and values of scientists in the civil service and their relationships with Whitehall through interviewees' descriptions and reflections on working life. By so doing, the thesis also addresses the second gap, the absence of individual scientists' experiences in the body of work that investigates the administration and management of government-funded research and the technical activities that went on in GREs. Thirdly, the position of GRE scientists within the national landscape of scientific research does not feature to any great extent in studies of twentieth-century UK science policy. By presenting the range of interactions between GRE scientists and their peers in academia and industry, this thesis places scientific civil servants as active participants in national systems of knowledge transfer that stimulated innovation.

1.1.2 Conservative policy-making during the 1980s

The Conservative election victory in 1979 put Margaret Thatcher at the helm of government for 11 years, and her name soon became associated with the ideologies and policies put forward by the Conservative Government of the 1980s.[44] Scholars have devoted much attention to the origins and parameters of 'Thatcherism', what Clarke describes as 'a potent force in the displacement of one set of conventional assumptions about the economic role of the state by another set.'[45] These include detailed analyses of the development and global reach of what are now collectively referred to as neoliberal ideas, although the use of the term neoliberal is contested and sometimes used as a shorthand to refer to loosely defined concepts. For Stedman Jones, neoliberal ideas were

---

[44] Andrew Gamble, 'Privatization, Thatcherism, and the British State', *Journal of Law and Society*, 16, no. 1 (1988), pp. 1–20 (p. 1).
[45] Peter Clarke, 'The Rise and Fall of Thatcherism', *Historical Research*, 72, no. 179 (1999), pp. 301–22 (p. 302).

'not just about superiority of markets but distrust of state authority, intervention and bureaucracy'.[46] Writings by and about individual politicians offer a window into the thought processes of key players who contributed to the development and implementation of these ideas that fall within the scope of 'Thatcherism'.[47] Some of the views expressed are representative of the New Right political movement with its emphasis on reducing the size and power of the state while improving state services and expanding consumer choice.[48]

Plenty of contemporary reviews commented on the changing science policy landscape during the 1980s.[49] A 1989 analysis of how science policy evolved during the Thatcher era came from Hughes and Edgerton who described Thatcherism as representing 'a rejection of the standard argument relating science and technology to social and economic progress.'[50] The authors identify contradictions and inconsistencies displayed in Conservative policy-making towards industry and science during the 1980s. These are discussed in greater detail in Agar's more recent examination of *Science Policy Under Thatcher* which uses recently opened public records to show the developing issues and influential personalities that shaped the evolution of Thatcher's policies towards science.[51] However Agar's study offers limited insight into the impact of civil service reform on government science in GREs, in that the discussion of privatisation of the Radiochemical Centre and various elements of the UK's Atomic Energy Authority do not represent the experience or organisational status of departmental research

---

[46] Daniel Stedman Jones, *Masters of the Universe: Hayek, Friedman, and the Birth of Neoliberal Politics* (Princeton, NJ: Princeton University Press, 2014), p. 14.

[47] Among the many examples are Margaret Thatcher, *The Path to Power* (London: HarperCollins, 1995); Margaret Thatcher *The Downing Street Years* (London: HarperCollins, 1995); John Hoskyns, *Just in Time: Inside the Thatcher Revolution*, (London: Aurum, 2000); Hugo Young, *One of Us* (London: Pan, 2013); Nigel Lawson, *The View from No. 11: Memoirs of a Tory Radical* (London: Corgi, 1993); Charles Moore, *Margaret Thatcher: The Authorized Biography. Vols I, II and III* (London: Allen Lane, 2013, 2015 and 2019); William Waldegrave, *A Different Kind of Weather: A Memoir* (London: Constable, 2015).

[48] For example David Howell, *A New Style of Government: A Conservative View of the Tasks of Administrative, Financial and Parliamentary Reform Facing an Incoming Government* (London: Conservative Political Centre, 1970); Keith Joseph, *Reversing the Trend: A Critical Re-appraisal of Conservative Economic and Social Policies: Seven Speeches* (Chichester: Rose, 1975).

[49] Tam Dalyell, *A Science Policy for Britain* (London: Longman, 1983); Michael Gibbons, Philip Gummett and Bhalchandra Udgaonkar (eds), *Science and Technology Policy in the 1980s and Beyond* (London: Longman, 1984); Martin Ince, *The Politics of British Science* (Brighton: Wheatsheaf, 1986); Paul Cunningham (ed.), *Science and Technology in the United Kingdom*, 2nd edn (London: Cartermill, 1998).

[50] David Edgerton and Kirsty Hughes, 'The Poverty of Science: A Critical Analysis of Scientific and Industrial Policy under Mrs Thatcher', *Public Administration*, 67, no. 4 (1989), pp. 419–33, p. 420.

[51] Agar, *Science Policy under Thatcher*, pp. 62–121.

establishments.[52] Consequently there is a gap in recent scholarship on the impact of Conservative policy-making on science whereby there is no detailed discussion of how civil service reforms affected GREs. This thesis therefore expands our understanding of the breadth of change that was happening across the UK's scientific research community by looking specifically at the translation of neoliberal ideologies regarding the size of the state into policies that affected GREs.

The Conservatives' approach to restructuring the public sector is seen by Clarke and Newman as a convergence of New Right policies with a 'general ideology of managerialism … directed at both private and public sector organisations'.[53] Their study *The Managerial State* fits into a body of work that analyses this bureaucratic reform trend around the world, and public administration scholars have adopted the term 'New Public Management' (NPM) to describe it.[54] NPM encompassed efforts to limit the growth of government, a move towards automation, privatisation of public services, the introduction of performance indicators, devolved budgeting and bonus schemes. In their key comparative study of public management reform, Pollitt and Bouckaert observed that while 'the working lives of millions of public officials have been substantially altered', there remain unexplored aspects of these changes since 'it is usually harder for academics to obtain systematic information about how reforms are being put into practice than about what the reforms are'.[55] In investigating the impact of NPM on government scientists' working lives, this thesis builds on existing studies by showing how bureaucratic reform was put into practice in the GREs and its effect on the group of public servants working within them.

For many public sector bodies, the ultimate stage in the NPM reform programme was privatisation. Young described privatisation at the time as a set of policies which aimed to limit the role of the public sector and increase the role of the private sector, while

---

[52] Ibid., pp. 170–187.

[53] John Clarke and Janet Newman, *The Managerial State: Power, Politics and Ideology in the Remaking of Social Welfare* (London: SAGE Publications, 1997). See also Lorenzo Castellani, *The Rise of Managerial Bureaucracy: Reforming the British Civil Service* (Basingstoke: Palgrave Macmillan, 2018); David Farnham and Sylvia Horton, *Managing the New Public Services*, 2nd edn (Basingstoke: Macmillan, 1996); Laurence E. Lynn, Jr., *Public Management: Old and New* (London: Routledge, 2006).

[54] P. Dunleavy and C. Hood, 'From Old Public Administration to New Public Management', *Public Money & Management*, 14, no. 3 (1994), pp. 9–16.

[55] Christopher Pollitt and Geert Bouckaert, *Public Management Reform: A Comparative Analysis*, 2nd edn (Oxford: Oxford University Press, 2000), p. 1 and p. 111.

improving the performance of the remaining public sector.[56] The words used in early analyses of privatisation in the UK—immense, radical, blueprint, experiment, captivate—indicate the novelty of the programme.[57] Gamble's view was that the Conservatives 'seemed to have stumbled into the policy', while Foreman-Peck and Millward argued that financial considerations were the driving force behind the programme.[58] Clarke's assessment was that it was much more to do with ideological belief than based on economic analysis and comparative assessment of public and private sector performance.[59] The privatisation of GREs appears, if at all, as an afterthought in the outpouring of studies on privatisation. GREs are barely mentioned in Parker's *Official History of Privatisation*, suggesting that by the late 1990s the process had become more routine, less compelling material for historians than the earlier rounds of privatisations of public sector enterprises and utilities in the 1980s.[60]

However, a key study of the roll out of NPM within GREs was undertaken in the late 1990s by a team of scholars comprising Barker, Boden, Cox, Gummett and Nedeva. In the resulting publications, they argue that the desire to commercialise or privatise GREs met with varying success and that the diversity of outcomes suggested 'a process of reform on the hoof, rather than a premeditated application of a standard blueprint.'[61] *Scrutinising Science* provides an essential overview of the stages of civil service reform which introduced new organisational arrangements into GREs, including brief assessments of how BRE and the defence research establishments adapted to change.[62] Potential areas of tension resulting from organisational change were identified in this and

---

[56] Stephen Young, 'The Nature of Privatization in Britain, 1979–1985', *West European Politics*, 9, no. 2 (1986), pp. 235–52 (p. 236).

[57] David Marsh, 'Privatisation under Mrs. Thatcher: A Review of the Literature', *Public Administration*, 69, no. 4 (1991), pp. 459–480 (p. 463); Thomas Clarke, 'The Political Economy of the UK Privatization Programme: A Blueprint for Other Countries?', in Thomas Clarke and Christos Pitelis (eds), *The Political Economy of Privatization* (London: Routledge, 1993), pp. 205–233 (p. 208).

[58] Gamble, 'Privatization, Thatcherism, and the British State', p. 4; J. Foreman-Peck and R. Millward, *Public and Private Ownership of British Industry, 1820–1990* (Oxford: Clarendon Press, 1994), pp. 331–333. See also Lawson, *The View from No. 11,* p. 42.

[59] Clarke, 'The Political Economy', p. 209.

[60] Hennessy, *Whitehall,* pp. 589–627; Parker, *Official History, Vol. 2*, pp. 385–7; Agar, *Science Policy under Thatcher*, pp. 170–187.

[61] Rebecca Boden et al., 'Men in White Coats ... Men in Grey Suits: New Public Management and the Funding of Scientific Research in the UK', *Journal of Auditing, According and Accountability*, 11, no. 3, (1998), pp. 267–91 (p. 268). The main output from the project is Rebecca Boden et al., *Scrutinising Science: The Changing UK Government of Science* (Basingstoke: Palgrave Macmillan, 2004). For the experience in another country see Steve Kenna, 'Globalized New Public Management and Its Impact on Scientific Research Activity in New Zealand', *Asia Pacific Business Review*, 7, no. 1 (2000), pp. 151–70.

[62] Boden et al., *Scrutinising Science*.

other contemporary analyses, such as the impact of reform on GREs' role in the innovation system, shifting relationships between GREs and their customers, changing research priorities, the adoption of management accounting practices and increasing competition.[63]

While these studies did not focus on the impact of change on individual scientists, similar experiences are examined through sociological research on the impact of privatisation on workers in nationalised industries. O'Connell Davidson's analysis of changing employment relations in a privatised water company revealed how new methods of managing the labour force and the drive to cut costs affected specialist craftsmen in the workforce. The division of the company into smaller accountable units exposed areas of work that were less profitable, engendering feelings of insecurity among employees.[64] Craftsmen spoke of losing the freedom they had enjoyed in planning and carrying out their work, while they felt that the quality of their work was not valued once performance was measured in hours recorded on timesheets.[65] Cutting the cost of the labour force saw management initiatives to encourage craftsmen with specific skills to train to become multi-skilled.[66] O'Connell Davidson also showed that workers accepted that the unions were not capable of fighting privatisation.[67] In his study of privatisation in the rail industry, Strangleman evaluated its effects on the existing culture shared by railway staff and the efforts made by management 'to enact change in an existing workplace in the context of established norms, values and patterns of work.'[68] He identified how the break-up of the industry caused a loss in collective knowledge and the curtailment of assumed career prospects, and the emergence of an organisational nostalgia as management sought

---

[63] Andrew D. James, Deborah Cox and John Rigby, 'Testing the Boundaries of Public Private Partnership: The Privatisation of the UK Defence Evaluation and Research Agency', *Science and Public Policy*, 32, no. 2 (2005), pp. 155–161 (p. 157). Roger Courtney, 'Building Research Establishment Past, Present and Future', *Building Research & Information*, 25, no. 5 (1997), pp. 285–91; Anne Beesley, 'Strategic Change in a Government Laboratory: The Case of the Building Research Establishment' (unpublished PhD thesis, University of Manchester, 2000); Angathevar Baskaran and Rebecca Boden, 'Prometheus Bound: Accounting and the Creation of the New Science Paradigm', *International Studies of Management & Organization*, 37, no. 1 (2007), pp. 9–26.
[64] Julia O'Connell Davidson, *Privatization and Employment Relations: The Case of the Water Industry* (London: Mansell Publishing, 1993), pp. 184–5.
[65] Ibid., p. 182.
[66] Ibid., p. 181.
[67] Ibid., p. 186.
[68] Tim Strangleman, *Work Identity at the End of the Line?: Privatisation and Culture Change in the UK Rail Industry* (Basingstoke: Palgrave Macmillan, 2004), p. 135.

to make a break with the past.[69] The pattern of experiences revealed through these two studies provide indications of how privatisation would have affected scientists as a group of specialist workers who together comprised a collective body of knowledge.

There is one study that offers insight into the adjustments that scientists faced with organisational change. Law and Akrich evaluated how scientists applied commercial concepts to scientific activities when a UK experimental facility 'found itself for the first time facing customers who expected the timely delivery of contracted goods and services for which it had paid.'[70] This account of scientists working through change is refreshing in its presentation of the inconsistencies revealed through individuals' behaviour, for example in showing how the experimental scientists' interpretation of value differed to that of the managers. This article stands out due to the lack of such portrayals of UK scientific research environments in the literature, while showcasing the potential for individual experiences to shed light on broader processes of change.

This section has shown that the literature dealing with public sector reforms of the 1980s and 1990s does not include an analysis of their impact on managers or working scientists in GREs. Current work by historians of science is primarily concerned with detailing the processes by which policy was made, while sociological studies which deal with the impact of privatisation on public sector employees have not looked at the experiences of scientific civil servants working in GREs. This thesis therefore fills these gaps in the literature on policy-making under Thatcher by adding a historical analysis of the impact of NPM and privatisation on the working lives of scientists in GREs.

1.1.3 The changing culture of government research

Existing surveys of privatisation in GREs and other public sector research institutes offer little in the way of scientists' personal reflections of change, even when the studies draw on structured interviews with scientists who worked through these changes.[71] Indications

---

[69] Ibid., pp. 154–5.

[70] John Law and Madeleine Akrich, 'On Customers and Costs: A Story from Public Sector Science', in Michael Power (ed.), *Accounting and Science: Natural Inquiry and Commercial Reason* (Cambridge: Cambridge University Press, 1996), pp.195–218 (p. 204).

[71] A. J. Webster, 'Privatisation of Public Sector Research: The Case of a Plant Breeding Institute', *Science and Public Policy*, 16, no. 4 (1989), pp. 224–32; R. C. Whelan, 'Management of Scientific Institutions NPL 1995–98: The Transition from Agency to Government-Owned Contractor Operated (GOCO)', *R&D Management*, 30, no. 4 (2000), pp. 313–22.

of how they might have felt come from Smith's evaluation of employees' reactions to outsourcing at National Savings Bank.[72] In this he observes that,

> The extant literature documenting the changes introduced in the Civil Service during the 1980s and 1990s … typically takes for granted that the service has one coherent and homogenous organisational culture. … Such notions are inadequate in explaining the complexities of organisational cultures and subcultures. Thus, there is a noticeable gap in the existing literature on civil service culture change, where the experiences of those on the shop floor are largely absent.[73]

In coming to an appreciation of how culture change unfolded on the GRE 'shop floor' I have turned to the STS literature which considers the culture and changing environments of scientific knowledge production.[74]

An early and long-lasting influential theory about the behaviours and values that govern the way scientists work was published in 1942 by sociologist Robert Merton.[75] Merton's theories have stimulated numerous studies designed to evaluate whether scientists' behaviours at work correspond to his norms. These have taken a variety of approaches in considering scientists as 'specialists who are enculturated into a body of practices and skills.'[76] An ethnographic approach is exemplified in Latour and Woolgar's exploration of how the social dynamics of laboratory staff, including non-scientists, directed the construction of scientific facts.[77] This is demonstrated through their analysis of the progression of science through theoretical and experimental work and the circulation of findings through the act of writing. They observed how this work was carried out through interactions with equipment and colleagues, all of which was influenced by the physical

---

[72] Andrew John Smith, 'The Process of Change in a Public-Private Partnership: Work and Culture. A Case Study of Durham National Savings and Investments' (unpublished PhD thesis, Durham University, 2006).
[73] Ibid., p. 54.
[74] For example: Alan Irwin and Brian Wynne, *Misunderstanding Science?: The Public Reconstruction of Science and Technology* (Cambridge: University Press, 1996); Sheila Jasanoff et al. (eds), *Handbook of Science and Technology Studies* (Thousand Oaks: SAGE Publications, 2001); John Pickstone, *Ways of Knowing* (Manchester: Manchester University Press, 2000); David Wootton, *The Invention of Science* (London: Allen Lane, 2016). For a discussion of evolving approaches to STS, see Dominique Pestre, 'Thirty Years of Science Studies: Knowledge, Society and the Political', *History and Technology*, 20, no. 4 (2004), pp. 351–69.
[75] Robert K. Merton, *The Sociology of Science: Theoretical and Empirical Investigations* (London: University of Chicago Press, 1973), pp. 267–78.
[76] Trevor Pinch, 'The Culture of Scientists and Disciplinary Rhetoric', *European Journal of Education*, 25, no. 3 (1990), pp. 295–304. A good insight into how sociologists developed approaches to studying science is in Barry Barnes and David Edge (eds), *Science in Context* (Milton Keynes: Open University Press, 1982).
[77] Bruno Latour and Steve Woolgar, *Laboratory Life: The Construction of Scientific Facts*, 2nd edn (Princeton, NJ: Princeton University Press, 1986). See also Karin Knorr-Cetina, 'Laboratory Studies: The Cultural Approach to the Study of Science' in Jasanoff et al. (eds), *Handbook of Science and Technology Studies*, pp. 140–66. Another example of this approach is in Sharon Traweek, *Beamtimes and Lifetimes: The World of High Energy Physicists* (Cambridge, Mass: Harvard University Press, 1992).

environment and access to funding. *Laboratory Life* signalled the cultural turn taken by STS scholars, but for sociological studies such as this, an industrial or academic laboratory has proven to be more accessible than a GRE occupied on sensitive research for the state, leaving laboratory life in GREs mostly unexamined. This thesis therefore fills that gap by providing a study of the working culture in GREs. I have taken inspiration from the findings of Latour and Woolgar's study in my use of the oral history methodology to stimulate and record interviewee reflections about their relationships with colleagues, the equipment they used and the dissemination of their research findings. In doing so I am also bearing in mind Gooday's call for historians to see laboratories as 'interstitial entities, drawing their value and meaning from the people and institutions with which they were juxtaposed, opposed, and integrally networked' to show how GREs and their scientists fitted into the broader scientific community.[78]

Mukerji adopted a similar approach to Latour and Woolgar in her study of state-funded oceanographers in the USA during a period of change.[79] While the system for distributing state funds for scientific research in the USA differed to the Vote system by which GREs were funded, Mukerji's work is particularly useful in demonstrating the types of behaviours and interactions that can influence how scientists and public administrators interact with each other. In her exploration of the conflicting needs of scientists to secure funding while seeking autonomy in their work, she states: 'The government may limit the subjects scientists study and their methods for research and analysis, but they do not control the ways scientists use their research materials to address the world of science.'[80] This observation pointed to the kinds of expectations that professional scientists working within the parameters of public service would hold.

Clarke and Newman reach a similar conclusion about the expectations of professionals employed in the British civil service who believed that 'professionalism lays claim to an

---

[78] Graeme Gooday, 'Placing or Replacing the Laboratory in the History of Science?', *Isis,* 99, no. 4 (2008), pp. 783–95.

[79] Chandra Mukerji, *A Fragile Power: Scientists and the State* (Princeton, NJ: Princeton University Press, 1989).

[80] Mukerji, *A Fragile Power*, p. 192. Clarke reaches a similar conclusion in Clarke, *Science at the End of Empire,* p. 59. A well-known, early argument for allowing government-funded scientists such autonomy is made in V. Bush, *Science, the Endless Frontier. A Report to the President by Vannevar Bush* (Washington: Office of Scientific Research and Development, 1945).

irreducible autonomy'.[81] I have followed Morrell's guidance in considering professionalisation in science as a process involving 'the pursuit of various forms of power, including success in persuading the public to pay well for services rendered', driven by 'the desire for higher status and autonomous control of condition of work'.[82] Building on these ideas, this thesis explores interviewees' changing perceptions of freedom in their work as a factor that contributed to changing professional identities, revealing for the first time the values associated with working as a scientific civil servant in a GRE.

Another group of studies relevant to an appraisal of the culture of knowledge production in a GRE are those that consider science conducted beyond academia. According to Shapin this is when science becomes invisible to sections of the academic community:

> So far as the great majority of historians, sociologists, and philosophers are concerned, science stops being science—and places itself largely outside their domain of interest— precisely when it becomes embedded in the modern institutions of government, production, and, to a lesser extent, war. [83]

Other scholars agree, with Edgerton noting that 'our knowledge of scientists pursuing careers in industry and in government is very limited', while more recently Lucier has commented that commercial science 'simply did not fit within the dominant narratives being constructed by historians of science or historians of technology'.[84] Shapin has set out to address this gap in his study of industrial scientists in the USA. He shows that industrial science in the USA could offer scientists opportunities to maintain their academic interests and credentials, thereby demonstrating that the values held by scientists and managers in industry were more similar to those of their peers in universities than earlier studies have tended to portray.[85] In this Shapin picks up on Cardwell's caution 50 years earlier against reading too much into the idea of a clash of

---

[81] Clarke and Newman, *The Managerial State*, p. 6.

[82] J. B. Morrell, 'Professionalisation', in R. C. Olby (ed.), *Companion to the History of Modern Science* (London: Routledge, 1990), pp. 980–989.

[83] Steven Shapin, 'Invisible Science', *The Hedgehog Review*, 18, no. 3 (2016), pp. 34–46 (p. 42).

[84] David Edgerton, 'Time, Money, and History', *Isis*, 103, no. 2 (2012), pp. 316–27 (p. 326); Paul Lucier, 'Commercial Science', in B. Lightman (ed.), *A Companion to the History of Science* (Chichester: John Wiley and Sons, 2016), pp. 268–281 (p. 273).

[85] Steven Shapin, *The Scientific Life: A Moral History of a Late Modern Vocation* (Chicago: University of Chicago Press, 2008). Examples of earlier studies include W. Kornhauser, *Scientists in Industry* (Berkeley: University of California Press, 1963); Steven Box and Stephen Cotgrove, 'Scientific Identity, Occupational Selection, and Role Strain', *The British Journal of Sociology*, 17, no. 1 (1966), pp. 20–28.

interests between industrial managers and scientists.[86] However there is no corresponding evaluation of how the values held by scientific civil servants operating in GREs aligned with the values that are typically assigned to scientists in academia. Consequently this thesis builds on existing studies of scientists' professional values in different institutional settings by adding the GRE dimension into the picture.

Shapin also set out to,

> retrieve from the frontlines of present-day technoscientific knowledge-making something of what it feels like to those trying to make a career, to make knowledge, and to make sense of the increasingly uncertain institutional worlds they inhabit.[87]

That uncertainty stems partly from what historians of science and STS scholars have described as an 'epochal break' in the shifting contours of knowledge production which took place around 1980.[88] A well-known argument for this juncture is in Gibbons et al.'s *The New Production of Knowledge*.[89] Gibbons et al. proposed that a new mode of knowledge production was emerging alongside the established 'complex of ideas, methods, values, norms … that determine what shall count as significant problems, who shall be allowed to practise science and what constitutes good science'.[90] While *The New Production of Knowledge* has been criticised for its simplistic demarcation between two modes of knowledge production, it is indicative of how significant these changes were perceived to be by contemporary commentators, described elsewhere as 'a real and urgent sense that the scientific enterprise is in transition'.[91] Williams' call for scientists to 'come to see achievement and standing in the commercial value of R&D as well as (and not instead of) in its contribution to knowledge' indicates the perceived challenge in 1988 that commercialisation posed to the existing norms of scientific activity in the 1980s.[92] More recently Lave et al. have pointed out that 'neoliberal concepts have been used to justify major innovations in the structure and organization of science,' such as the

---

[86] D. S. L. Cardwell, *Organisation of Science in England* (London: Heinemann Educational Publishers, 1959), p. 236.
[87] Shapin, *The Scientific Life*, p. 17.
[88] Cyrus C. M. Mody, 'The Professional Scientist' in Lightman (ed.), *A Companion to the History of Science*, pp. 164–177 (p. 172).
[89] Michael Gibbons et al., *The New Production of Knowledge: the Dynamics of Science and Research in Contemporary Societies* (London: SAGE Publications, 1994). See also Partha Dasgupta and Paul A. David, 'Towards a New Economics of Science', *Research Policy*, 23, no. 4 (1994), pp. 487–521.
[90] Gibbons et al. *The New Production of Knowledge*, p. 3.
[91] Michael Gibbons and Björn Wittrock, *Science as a Commodity: Threats to the Open Community of Scholars* (Harlow: Longman, 1985), p. xiii.
[92] Roger Williams, 'UK Science and Technology: Policy, Controversy and Advice', *The Political Quarterly,* 59, no. 2 (1988), pp. 132–44 (p. 143).

promotion of entrepreneurialism among university academics and university efforts to commercialise their research.[93]

Studies conducted by social scientists in the fields of organisational and management studies made extensive use of interviews to gather insights into scientists' attitudes to the increasing focus on accountability and meeting customer requirements.[94] However these studies were examining ongoing processes rather than conducted from a historical standpoint. They also looked at scientists working in different settings to GREs, for example those working in an industrial R&D laboratory, a research council institute or a research organisation in another country.[95] As yet there is no such evaluation of how scientists in GREs felt as they adjusted to the 'epochal break' in knowledge production that disrupted the established patterns of their working lives. This thesis therefore serves as a case study into the impact of commercialisation on the conduct of science and its effects on scientists' professional values, illuminating theories about the changing production of knowledge.

This section shows that neither historians of science nor sociologists of science have studied the professional values embodied in British scientific civil servants and how they created an institutional culture in the GREs, nor have they nor investigated how bureaucratic reforms engendered processes of culture change. This thesis therefore adds the experiences of GRE scientists to the literatures that deal with the cultures of scientific knowledge production and the culture of public service.

---

[93] Rebecca Lave, Philip Mirowski and Samuel Randalls, 'Introduction: STS and Neoliberal Science', *Social Studies of Science,* 40, no. 5 (2010), pp. 659–75 (p. 664). See also Philip Mirowski, *Science-Mart: Privatizing American Science* (Cambridge, Mass.: Harvard University Press, 2011).

[94] Laurie Cohen, Joanne Duberley and John McAuley, 'The Purpose and Process of Science: Contrasting Understandings in UK Research Establishments', *R&D Management*, 29, no. 3 (1999), pp. 233–46; Mary Mallon, Joanne Duberley and Laurie Cohen. 'Careers in Public Sector Science: Orientations and Implications', *R&D Management*, 35, no. 4 (2005), pp. 395–407.

[95] Keith Randle, 'The White-Coated Worker: Professional Autonomy in a Period of Change', *Work, Employment and Society*, 10, no. 4 (1996), pp. 737–53. Barbara Simpson, 'After the Reforms: How Have Public Science Research Organisations Changed?', *R&D Management*, 34, no. 3 (2004), pp. 253–66; Bruce Small and Mary Mallon, 'Science, Society, Ethics, and Trust: Scientists' Reflections on the Commercialization and Democratization of Science', *International Studies of Management & Organization*, 37, no. 1 (2007), pp. 103–24; Tim Turpin and Adrian Deville, 'Occupational Roles and Expectations of Research Scientists and Research Managers in Scientific Research Institutions', *R&D Management*, 25, no. 2 (1995), pp. 141–57. Laurie Cohen, John McAuley and Joanne Duberley, 'Continuity in Discontinuity: Changing Discourses of Science in a Market Economy', *Science, Technology, & Human Values*, 26, no. 2 (2001), pp. 145–66.

Together, the three sections in this literature review show that historians of science, political scientists and STS scholars have so far shown minimal interest in studying government scientists' working lives, nor how these scientists experienced the profound changes in their working environments during the 1980s and 1990s. These gaps in the historical literature on government science are in part due to the choices made by historians of science over the sources they consult. Producing more rounded analyses of the intersecting worlds of British government and British science means thinking about the relationship between the sources we interrogate and the questions we can ask of them. If scholars focus on one set of sources as the basis for their research, and those sources are themselves limited, there is then a limit to the questions that can be asked, the topics that can be explored or the people that can be studied, thereby limiting the interpretations of change. While the people that populated and drove the working worlds of government science might appear as names in the written records of government, many dimensions of their working lives are unarticulated. Edgerton has commented that,

> even within government there were very different kinds of scientists ranging from the most intellectual of the scientific advisers to narrow professional bench scientists. The difficulty for the historian is that only some of the former became public or scientific intellectuals, while the latter are largely silent.[96]

By using oral history in the writing of this thesis, I show that those scientists do not have to remain silent. These new oral history interviews with former government scientists offer reflections and feelings about the impact of political decisions in the workplace that are not the stuff of official written records. Their accounts shed new light on the established narratives of civil service reform and science policy during the 1980s and 1990s, opening up new questions for consideration. Individuals' stories about the changing practices in the workplace and relationships with their employer point to the long-term effects of reform that are only now becoming evident. By examining processes of change in GREs that are revealed in the interviews this thesis shows that we are only beginning to investigate and understand the consequences of organisational change in GREs on the position of scientific expertise in Whitehall today. This study is therefore significant in using oral history to ask different questions of different sources, thereby providing alternative perspectives and novel insights into the shifting relationships between government and science towards the end of the twentieth century.

---

[96] Edgerton, *Warfare State*, p. 195.

1.2 Research questions

This interdisciplinary literature review has indicated where existing studies in the fields of public administration, history of science and STS have overlooked the impact of organisational change in GREs on the scientists who worked in them. From this review I developed the hypothesis that civil service reform and organisational change would have fundamentally altered the management and conduct of science in GREs, thereby affecting the prevailing values of scientific civil servants. This thesis therefore asks: 'In what ways did government policies that led to transformative change in the civil service during the 1980s and 1990s affect the scientists who worked in GREs?'

To investigate this, my inquiry concentrated on these subsidiary questions:

- What drove the different stages of civil service reform that led to the privatisation of GREs?
- What did it mean to work as a scientific civil servant in a GRE?
- What new processes and practices were introduced into GREs as a consequence of civil service reform?
- How did organisational change affect scientists' careers, working relationships and the conduct of scientific research in GREs?
- Have these changes had broader implications for national systems of knowledge transfer and the state's access to scientific expertise?

By answering these questions, the thesis addresses the limitations in the literature identified in the preceding review. It fills gaps in the public administration literature in its examination of the role of scientific civil servants within the wider civil service, and in evaluating how public sector reform policies affected the working lives of scientific civil servants. It incorporates the personal perspectives of government scientists into the historiography on government-funded research and science policy. It offers an original portrait of the workplace culture in GREs, adding a new perspective to sociological studies of scientists at work. It builds on contemporary studies of organisational change in GREs in providing a new, historical analysis.

Answering these questions enables us to understand the changing values of the institution of science associated with the trend towards the commercialisation of science.

Additionally, as Covid-19 focuses attention on the use of scientific advice in government, this research reveals how general decisions regarding the civil service, leading to the transfer of GREs and scientific civil servants into the private sector have had specific, long-term consequences on the state's access to scientific expertise. By seeking to understand how organisational change effected culture change in the workplace, it also expands our understanding of broader processes that have characterised British society in the late twentieth century.

1.3 The sources used

The research foregrounds scientists' experiences of organisational change by drawing on a series of 23 original oral history interviews conducted during 2018–19. Oral history offers the opportunity to capture the personal reflections of those whose experiences are not well documented in the official record, the media or through autobiographical writings. This new collection of life story interviews with former government scientists and some senior civil servants, the creation of which is discussed in section 1.4 below, is one of three main sources on which the thesis is based.

The second is a wide range of official papers which have provided the sequence and detail of policy decisions. These include government White Papers, government responses to parliamentary committee reports and reports published by government advisory committees. However this set of sources primarily represents the attitudes of people in positions of power, written at the time in formal language with no capacity to include the personal reflections of those affected by policy decisions. An important exception is in the evidence sessions included in parliamentary select committee reports, valuable for articulating contemporary attitudes to policy formulation from a range of stakeholders. These can offer a rare record of the opinions of GRE scientists, managers and union representatives who gave evidence to the committees.[97]

The third main source for this thesis is a range of internal publications from the case study organisations which have been preserved through the efforts of company and voluntary

---

[97] Select committee reports are an untapped source for future research projects on twentieth-century British science, combining both written submissions and transcripts of oral evidence sessions on science policy issues.

archivists at BRE and the Farnborough Air Sciences Trust (FAST). In-house newspapers, internal memoranda and company strategy documents offer a rich source of detail on how organisational reform was implemented and communicated to staff, while staff reactions can be gauged through opinions expressed in letters published in the internal publications. During the project access to organisational material depended on the resources and capability within the archivist teams. In the case of BRE, I was able to consult digitised and original copies of newsletters until archiving activities at BRE were suspended when institutional support was withdrawn. In the case of RAE's successor organisations, the material available at FAST is from the pre-privatisation era. Repeated attempts to identify and make contact with a company archivist to consult post-privatisation records held by the privatised company QinetiQ have been unsuccessful.

These two situations highlighted problems that can arise in researching organisations that move out of public ownership, confirming de Chadaverian's observation that when institutions are transferred from public to private ownership it can have a substantial impact on the availability of archival sources.[98] Private entities may choose not to provide resources for archiving, nor are they obliged to make their internal records publicly available. This account from interviewee Chris Scivyer articulates another limitation about the BRE records that are available in the public domain:

> Some of the papers were actually taken to Kew, the National Archives. Things were taken at that point, but I don't think they took the right things. […] Those things they should have taken are still in the cabinet at BRE, anything with names in had to go … I don't think they had time to know what they were looking for. Suddenly [for] the whole organisation which had been there since 1926, somebody was given the task of sifting through what they ought to keep and what went as part of the privatisation. […] It would have been someone from the DOE who came along I think, they were tasked with doing that in a matter of days or couple of weeks. It seemed very rushed to me.[99] 🎧▶

I have consulted some of those records in the National Archives created by departments such as the Cabinet Office, MOD and DOE. These discuss issues such as scientists' role in the civil service, the efficiency scrutinies of the 1980s and proposals for the privatisation of research establishments, however these provide only one side of the story, that of the employer, the civil service. I have also taken into consideration the process of

---

[98] Soraya de Chadarevian, 'The Future Historian: Reflections on the Archives of Contemporary Sciences', *Studies in History and Philosophy of Biological and Biomedical Sciences*, 55 (2016), pp. 54–60 (p. 55).
[99] Chris Scivyer, interviewed by Emmeline Ledgerwood, Frogmore, 2018, BL C1802/10, Track 4 [00:55:20–00:58:36]. 🎧▶ indicates the audio clip is available through a link in Appendix 4.

selection described by Scivyer since it is noticeable how few records are listed on the archives' catalogue for one of the RAE's successor organisations.[100] For an organisation that employed thousands of people this raises questions about the management of public records during transfer of ownership.

The issues associated with the available written records for this project—government classifications, commercial confidentiality or the closure of archives during a pandemic—have reinforced the value of choosing oral history as a methodology. It has allowed for the collecting of an alternative strand of information about the post-privatisation organisations when documentary material is out of reach, and for creating sources that will be archived for the benefit of future researchers. The vibrancy, range and nuance of the material in the oral history interviews became even more valuable during 2020–21 when Covid-19 curtailed opportunities for further archival research, with cancellation of planned research trips to the Modern Records Centre and the National Archives. At the National Archives I had intended to spend time looking at minutes of cabinet committee meetings for insight into ministerial discussions regarding the rationale for privatising GREs, while at the Modern Records Centre I would have consulted material relevant to union reactions to proposed organisational changes in GREs. Consequently I have been unable to fully explore the arguments made by policymakers for privatisation of GREs, nor the arguments made by the unions against it. However this has allowed more space in the thesis to examine and appreciate the content of the interviews.

1.4 Using oral history

As indicated in the previous sections, using oral history as a primary methodology in this project allows for the lived experiences of scientists to be added to the existing literature. The fieldwork focused on conducting life story interviews with former government scientists to explore their experiences of working through organisational change, but also to understand their motivations and influences for embarking on a scientific career in the civil service and the everyday nature of working life in the GREs. Additionally, the use

---

[100] The National Archives (TNA), *DEFE 75/1–55, Defence Evaluation and Research Agency (DERA) and its immediate predecessors: Reports and Files 1991-2001*, <http://discovery.nationalarchives.gov.uk/details/r/C16166> [accessed 1 April 2021]; Ministry of Defence and the National Archives, *MOD Records Appraisal Report 2020*.

of oral history in this project expands the range of primary resources available to other researchers in the future. The interviews are being deposited in the British Library collections and will made accessible in accordance with interviewees' permissions, complementing and building on the existing, separate collection *An Oral History of British Science*.[101]

1.4.1 The nature of oral history

In his assessment of the value of oral history to the history of science, Weiner wrote:

> Used with other sources, oral history can help to penetrate the mystique of science as a neutral, value-free enterprise solely concerned with the disinterested search for truth about the natural world through the application of rational methodology.[102]

Doel has pointed out that oral history interviews offer valuable insights into 'hierarchical relationships between individuals in complex bureaucratic organizations, and the traditionally invisible members of scientific communities: women, minorities, engineers, and technicians.'[103] This has been demonstrated in Hartley and Tansey's use of interviews to explore the work of laboratory technicians.[104] Horrocks and Lean commented that using oral sources allowed them to explore 'the motivations that led people to become government scientists, how they understood the goals and direction of their own work and the meanings they ascribed to it.'[105] More recently Merchant has encouraged historians of science to see the 'empirical value' in interviews that can offer background context and detail of changes which are absent from written accounts.[106] These assessments indicate the potential of oral history to provide supplementary details that may be missing from written records, while offering access to subjective understandings of change that reveal what mattered to scientists and the people they worked for. However it remains the case that many historians of science do not embrace oral history as a methodology in their work. While some make use of interviews as a fact-finding

---

[101] British Library, *An Oral History of British Science*, C1379.

[102] Charles Weiner, 'Oral History of Science: A Mushrooming Cloud?', *The Journal of American History,* 75, no. 2 (1988), pp. 548–59 (p. 549).

[103] Ronald E. Doel, 'Oral History of American Science: A Forty-Year Review', *History of Science*, 41, no. 4 (2003), pp. 349–378.

[104] J. M. Hartley and E. M. Tansey, 'White Coats and No Trousers: Narrating the Experiences of Women Technicians in Medical Laboratories, 1930–90', *Notes and Records of the Royal Society*, 69, no. 1 (2015), pp. 25–36.

[105] Horrocks and Lean, 'Doing It for Britain', p. 162.

[106] Paul Merchant, 'What Oral Historians and Historians of Science Can Learn from Each Other', *British Journal for the History of Science*, 52, no. 4 (2019), pp. 673–88 (p. 687), referring to Alistair Thomson, 'Making the Most of Memories: the Empirical and Subjective Value of Oral History', *Transactions of the Royal Historical Society*, 9 (1999), pp. 291–301.

approach, they do not necessarily explore the ability of oral history to explore questions that are unanswerable by written sources, whether available or not.

Portelli has described oral history as being distinguished by 'the combination of the narrative form on one hand, and the search for a connection between biography and history, between individual experience and the transformation of society, on the other.'[107] As Bornat states, the heart of oral history methodology lies in 'a focus on the recording and interpretation … of the life experience of individuals'.[108] In the telling of their life stories, there is a recognised tendency among interviewees to practise 'composure', what Summerfield sees as the striving for 'personal equanimity' in composing a coherent and meaningful narrative.[109] Summerfield's analysis is representative of the evolution in the methodology from one which first sought to uncover facts to one that seeks out the personal experiences with all their contradictions and nuances.[110] Indeed, rather than challenging interviewees with documentary evidence as Hoddeson was prepared to do when 'memories and documents come into conflict,' oral historians acknowledge this conflict but focus on what oral history interviews offer that documents do not.[111] Perhaps oral history's recognisable qualities that oral historians celebrate—subjectivity and the ambiguities of shared memories narrated in the vernacular forms—are perceived as problematic or not particularly interesting by scholars who focus on the political or technical aspects of science.

Yet the institution we call science exists through the ideas and activities of the people engaged in it. As Perks commented about the value of using oral history in business history, 'interviews have proved particularly effective at documenting the minutiae of repetitive daily routine and everyday practice, those that have often disappeared and

---

[107] Alessandro Portelli, 'Oral History as Genre', in P. Thompson and M. Chamberlain (eds), *Narrative and Genre* (London: Routledge, 1998), pp. 23–45.

[108] Joanna Bornat, 'Oral History', in Clive Seale et al. (eds), *Qualitative Research Practice* (London: SAGE Publications, 2004), pp. 34–47 (p. 35).

[109] Penny Summerfield, 'Culture and Composure: Creating Narratives of the Gendered Self in Oral History Interviews', *Cultural and Social History*, 1, no. 1 (2004), pp. 65–93, p. 65 and p. 68.

[110] Alistair Thomson, 'Four Paradigm Transformations in Oral History', *Oral History Review*, 34, no. 1 (2007), pp. 49–71.

[111] Lillian Hoddeson, 'The Conflicts of Memories and Documents: Dilemmas and Pragmatics of Oral History', in Ronald E. Doel and Thomas Söderqvist (eds), *The Historiography of Contemporary Science, Technology and Medicine: Writing Recent Science* (Abingdon: Routledge, 2006), pp. 187–200 (p. 187).

might not otherwise be recorded.'[112] In this project interviewees' various descriptions of the workplace, everyday activities, professional relationships along with their reflections on change have allowed me to piece together the ordinariness of a working life in science and the values that informed scientific civil servants' identities and the culture of their working environment. Anecdotes of working relationships have revealed the position of scientists as nodes in a web of connections through which tacit knowledge passed, an integral element to the process of national innovation.

However the interviews aimed to capture not only the everyday nature of working life in a GRE but also the impact of policy changes on the scientists at work. Oral history has been recognised for its capacity to probe the 'political', the effects of which have been described as 'creeping, subliminal and unseen in the individual experience'.[113] I have borne in mind Thompson's warning that the pressures of economic and structural change can be hidden by a tendency for oral sources to encourage the illusion of an everyday past.[114] As Weiner noted, using oral history 'can help shed light on the ideological, institutional, financial, and political contexts that make scientists' work possible and influence its content, methods, and direction,' thus providing 'insight on the origins and functions of personal and communal perceptions of the role of scientists and their relation to society.'[115] As such, interviewee reflections on how they felt as individuals about their work and recollections of their interactions with Whitehall reveal how changing values in government affected broader relationships between government and science, and the position GRE scientists occupied in the wider scientific community.

This section has discussed aspects of oral history which are relevant to its use as a methodology in this project. The following section discusses the practicalities of creating the oral history sources.

---

[112] Rob Perks, '"Corporations Are People Too!": Business and Corporate Oral History in Britain', *Oral History*, 38, no. 1 (2010), pp. 36–54 (p. 40).
[113] Editorial, 'Oral History', *History Workshop Journal*, 8 (1979), pp. i–iii (p. ii).
[114] Paul Thompson, *The Voice of the Past*: *Oral History*, 2nd edn (Oxford: Oxford University Press, 1988), p. 298.
[115] Weiner, 'Oral History of Science', p. 549.

1.4.2 Creating the oral history sources

The first stage of designing the fieldwork phase of the project was to select two case study organisations that fulfilled the criteria of being GREs that were ultimately fully privatised. A 1980 review of the scientific civil service showed that roughly 5.5 per cent of the nation's scientists were employed by the civil service in 1979.[116] Approximately 18,000 qualified scientists were employed in the scientific civil service in GREs on civil and defence research, of which approximately 6,200 worked in the 12 defence GREs which the MOD was operating in 1980.[117]

The Royal Aircraft Establishment (RAE) at Farnborough was not only the largest of the defence GREs but was described by the MOD as 'the largest research and development establishment in Europe'.[118] RAE's origins lay in the Balloon Factory that carried out development work on military balloons, kites and airships at Farnborough in the very early twentieth century.[119] The factory was renamed the Royal Aircraft Establishment after the First World War to reflect the Government's focus on research rather than design, however it became standard practice for aircraft firms to draw on RAE's expertise in aerodynamics and aeronautical design.[120] The director of RAE in the early 1960s described it as a 'central reservoir of scientific and technological knowledge and skill on which all British producers and users of aircraft and missiles are able to call when they need.'[121] RAE was also renowned for its specialised, often unique, experimental facilities.

RAE scientists were engaged in the whole spectrum of aerospace activities, some of which were highly classified for security purposes. An MOD publicity brochure produced during the mid-1980s highlights the breadth of RAE's activities in aerodynamics research, the advancement of aircraft and missile systems such as flight control, information display and the man/machine interface, and its work on developing highly-accurate instrumentation for its testing programmes. Other major areas of work covered

---

[116] Civil Service Department, *Review of the Scientific Civil Service*, p. 109.
[117] Ibid., p. 88 and p. 130.
[118] Ministry of Defence, *Defence Science 1983*, p. 37.
[119] Percy B. Walker, *Early Aviation at Farnborough: The History of the Royal Aircraft Establishment, Vol. I* (London: Macdonald & Co., 1971); Ministry of Defence, *Royal Aircraft Establishment* (London: HMSO, c. 1984), pp. 42–44.
[120] Giffard, 'Engine of Innovation', p. 167; Ministry of Defence, *Royal Aircraft Establishment* (London: HMSO, c. 1984),
[121] M. J. Lighthill, 'The Royal Aircraft Establishment', in Cockcroft (ed.), *The Organization of Research Establishments*, pp. 28–54.

research into materials and structures, radio and navigation and weapons systems.[122] In the 1950s RAE was a key contributor to the developing guided weapons industry, and during the 1960s and 1970s was regarded as 'the foremost British laboratory working on the technological side of space research'.[123]

It was this organisation that was amalgamated with the other defence GREs in 1991 to create the Defence Research Agency (DRA) which later became the Defence Evaluation and Research Agency (DERA) in 1995. When DERA was split in 2001, approximately 75 per cent of its staff transferred into the private sector with the formation of QinetiQ. The remainder continued working as civil servants for the newly created Defence Science and Technology Laboratory (Dstl).[124] I selected RAE as my first case study organisation as it employed a significant number of scientific civil servants who had contrasting experiences of privatisation depending on whether they went on to work in QinetiQ or Dstl.

1.4 *Aerial view of the Royal Aircraft Establishment, 1985*.
© Ministry of Defence. Personal collection of Shirley Jenkins.

---

[122] Ministry of Defence, *Royal Aircraft Establishment*.
[123] H. Massey and M. O. Robbins, *History of British Space Science* (Cambridge: Cambridge University Press, 1986), pp. 12–13 and p. 127.
[124] TNA, *DEFE 75/1–55*.
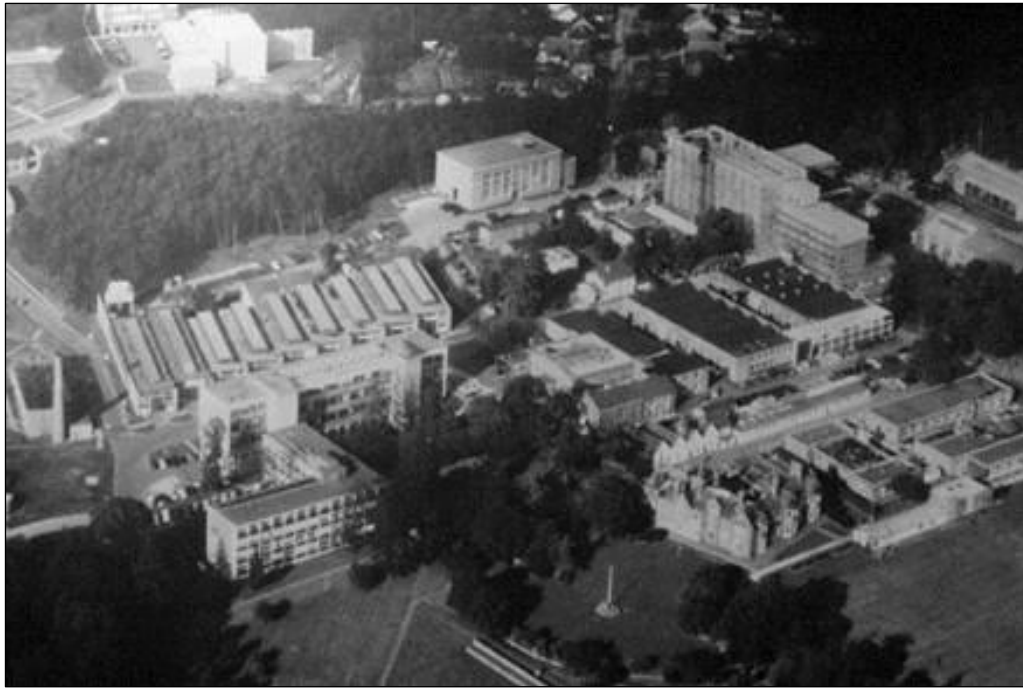
1.5 *The Building Research Establishment, Watford, c. 1980.*
© BRE.

To widen the range of experiences among interviewees I looked for a GRE engaged on civil research for the second case study. These varied in size, with numbers of scientific civil servants working in them ranging from 10 to around 500 in 1980.[125] Of the GREs for civil research that were privatised, I selected the Building Research Establishment (BRE) in Watford as it was one the larger GREs in this group, employing about 500 qualified scientists in 1980.[126] Its size offered the potential to identify patterns of change and in recruiting potential interviewees. BRE was formed in 1972 by amalgamating the Building Research Station (BRS), the Fire Research Station (FRS) and the Forest Products Research Laboratory (FPRL). It became an executive agency in 1990 and was fully privatised through a management buy-out process in 1997.[127]

The BRS had been set up in 1921 as it was recognised that the building industry in the UK was poorly equipped to meet the demands of reconstruction following the First World War.[128] Scientific researchers were initially occupied on assessing the performance of building materials, but their research activities gradually expanded into geotechnics

---

[125] Civil Service Department, *Review of the Scientific Civil Service*, pp. 129–134.
[126] Ibid., p. 131.
[127] BRE Group, *Our History* <https://www.bregroup.com/about-us/our-history/> [accessed 29 May 2021].
[128] Courtney, 'Building Research Establishment Past, Present and Future', p. 285.

(previously known as soil mechanics), structural and civil engineering, and the physics of buildings such as heating, acoustics, ventilation and lighting.[129] FRS, originally set in 1935, investigated the resistance of building materials to fire and the factors that influenced the spread of fire in buildings while FPRL was occupied with understanding wood preservation and timber mechanics.[130] After the Second World War the use of large-scale trials expanded along with new research into plumbing and drainage as well as the operational and economic aspects of building.[131] In the 1970s and 1980s BRE undertook major programmes into the assessment and rehabilitation of high-rise blocks and energy efficiency in buildings.[132] Alongside their work for their customers in government BRE researchers could be working in collaboration with industrial partners or on investigations commissioned by private firms known as 'repayment work'. They were expected to respond to technical enquiries from the public, to disseminate the results of their research to the construction industry and to advise committees responsible for developing British Standards specifications for building materials and industry codes of practice.[133]

Practical considerations also came into the selection of these organisations as case studies in that I speculated that a good proportion of potential interviewees would still live within reach of their former workplaces. I lived in Surrey at the time of the research project and wanted to restrict my travel for fieldwork to the south-east while acknowledging that this decision would exclude the voices of interviewees located further afield. I drafted project participant documentation in line with guidance published by the Oral History Society which was then submitted for approval to my university ethics committee (see Appendix 3).[134] Consideration of the ethics involved in this fieldwork included the commitment on my part to use the recorded material in accordance with interviewee wishes and to take responsibility for discussing with them any potential sensitivity issues concerning data protection or the Official Secrets Act that might arise from the recordings.[135]

---

[129] Lea, *Science and Building*, pp. 60–69.
[130] Ibid., p. 59.
[131] Ibid., p. 126.
[132] Courtney, 'Building Research Establishment Past, Present and Future', p. 287.
[133] Ibid., pp. 74–87.
[134] Oral History Society, *Is Your Oral History Legal and Ethical?* <https://www.ohs.org.uk/legal-and-ethical-advice/> [accessed 1 June 2021]. Practical guidance on preparing and conducting oral history interviews is in Anna Bryson and Seán McConville, *The Routledge Guide to Interviewing: Oral History, Social Enquiry and Investigation* (London: Routledge, 2014).
[135] Oral History Society, *Dealing with GDPR* <https://www.ohs.org.uk/gdpr-2/> [accessed 1 June 2021].

I identified potential interviewees by noting names of scientists mentioned in company literature, archival documents and *Who's Who*, networking at events held by relevant organisations and asking for recommendations from the archival teams at FAST and BRE. Once I began recruiting participants, they in turn suggested the names of other potential interviewees in a snowball effect. Lummis raises the question of the degree to which an interview, or group of interviews, might be representative of a wider social group, arguing that interviews should not be seen as typical.[136] The difference in nature and size between these two case study organisations meant that they could not be studied in a comparative way. As Shapin has commented in his work on different institutional settings,

> the texture of quotidian life in entrepreneurial science, like that obtaining in more traditional academic research, is also too heterogeneous to summarize concisely or to be captured by any one coherent narrative.[137]

With a target of interviewing 20 former government scientists, I followed Thompson's advice for strategic sampling to record a range of experiences rather than a representative sample, acknowledging Latour's observation that 'depending on which scientist is followed, completely different pictures of technoscience will appear.'[138]

With this in mind I created an initial 'wish list' of interviewees that cut through the organisational strata of the GREs and across the civil service to include people who had worked as managers, policymakers, administrators, research scientists and lab technicians plus an accountant and a librarian. I also hoped my interviewee cohort would reflect the gender ratio and ethnic mix of staff in the GREs. To some extent the final selection of 17 men and six women (including three interviewees who were not former government scientists) depended on pragmatic decisions which balanced availability and location of participants against my project timeframe.

The GRE scientists I met had studied natural sciences (Roger Courtney, Alan Gray), physics (Vic Crisp, Susan James, Sarah Herbert, Shirley Jenkins), physics with electronics (Paul Cannon), chemistry (Carol Atkinson, Wendy Wyatt), materials science

---

[136] Trevor Lummis, 'Structure and Validity in Oral Evidence', in Rob Perks and Alistair Thomson (eds), *The Oral History Reader*, 1st edn (London: Routledge, 1998), pp. 273–83 (p. 278).

[137] Shapin, *The Scientific Life*, p. 251.

[138] Thompson, *Voice of the Past*, p. 130. Bruno Latour, *Science in Action: How to Follow Scientists and Engineers through Society* (Cambridge, Mass: Harvard University Press, 1987), p. 155.

(David Dunford, Chris Peel, Steve Rooks), mechanical sciences (John Chisholm), applied science (Phil Catling), engineering (Martin Wyatt, Chris Scivyer, Mike Westby, Robyn Thorogood) and botany and zoology (Anthony Bravery).

Table 1.1 *List of project interviewees and places of work in the civil service.*

Interviewee	Born	Case study organisation
C1802/01 Roger Courtney	1946	BRE/Whitehall/BRE
C1802/02 Dr David Dunford	1959	RAE/DRA/DERA/QQ
C1802/03 Dr Vic Crisp	1943	BRE*
C1802/04 Dr Martin Wyatt	1950	BRE*
C1802/05 Pam Turner	1949	RAE/DRA/DERA/QQ
C1802/06 Carol Atkinson	1959	BRE*
C1802/07 Dr Chris Peel	1946	RAE/DRA/DERA/QQ
C1802/08 Susan James	1960	RAE/DRA/DERA/QQ
C1802/09 Phil Catling	1955	RAE/DRA/DERA/QQ
C1802/10 Chris Scivyer	1957	BRE
C1802/11 Dr Steve Rooks	1966	DRA/DERA/Dstl
C1802/12 Alan Gray	1949	RSRE/DRA/DERA/Dstl
C1802/13 Dr Sarah Herbert	1946	RAE/DRA/DERA/Whitehall
C1802/14 Sir Andrew Cahn	1951	Whitehall
C1802/15 Mike Westby	1967	RAE/DRA/DERA/Dstl
C1802/16 Wendy Westby	1968	RAE/DRA/DERA/QQ
C1802/17 Shirley Jenkins	1935	RAE/DRA/DERA/Dstl
C1802/18 Dr Anthony Bravery	1941	FPRL/BRE
C1802/19 Dr Paul Cannon	1953	RAE/DRA/DERA/QQ*
C1802/20 Ian Linsdell	1956	Whitehall/RARDE/DRA/DERA/QQ
C1802/21 Dr Robyn Thorogood	1941	BRE/Whitehall*
C1802/22 Lord Peter Levene	1941	Whitehall*
C1802/23 Sir John Chisholm	1946	DRA/DERA/QQ*
BRE	Building Research Establishment (1921–1997) and BRE Group (1997–present)	
DRA	Defence Research Agency (1991–1995)	
DERA	Defence Evaluation and Research Agency (1995–2001)	
Dstl	Defence Science and Technology Laboratory (2001–present)	
FPRL	Forest Products Research Laboratory (1923–1972)	
QQ	QinetiQ (2001–present)	
RAE	Royal Aircraft Establishment (1918–1991)	
RARDE	Royal Armament Research and Development Establishment (1955–1991)[139]	
RSRE	Royal Signals and Radar Establishment (1976–1991)[140]	
Whitehall	Government department offices located in Whitehall, London.	
* Denotes interviewees with experience of working in industry.More detailed information is given in Appendix 4.		

Some had filled senior leadership roles (Roger Courtney, Martin Wyatt and John Chisholm) and many progressed into substantial management roles (David Dunford, Vic

---

[139] RARDE's origins lie in the Research and Design Departments set up at Woolwich in the early twentieth century.

[140] RSRE's origins lie in various research establishments set up during the early twentieth century that were subsequently amalgamated in the late 1970s.

Crisp, Phil Catling, Carol Atkinson, Steve Rooks, Sarah Herbert, Anthony Bravery, Ian Linsdell). Chris Peel and Paul Cannon rose to become high-ranking technical experts, while Susan James, Mike Westby and Shirley Jenkins also became technical leaders in their research areas. Sarah Herbert and Robyn Thorogood moved into roles in central government where they were responsible for allocating research funding. A few had experience of working in industry before joining the civil service, notably Martin Wyatt and Carol Atkinson, and Alan Gray had worked in a GRE as a military liaison officer. (Please refer to Appendix 4 to become more familiar with the people I interviewed.).

The first interview session took place on 6 February 2018, and the final session was on 27 November 2019. I was extremely fortunate that I completed the interviewing phase of the project before the introduction of restrictions in March 2020 to control the Covid-19 pandemic. I interviewed 23 participants, which involved 68 separate interview sessions, producing a total of 149 hours and 33 minutes of recorded material.

For each interview I compiled a content summary as stipulated by the terms of the studentship (see Appendix 6). While I did not set out to focus on women's careers, the interviews with six women have proved to be a rich resource in revealing the experiences of women working in this male-dominated environment.[141] However I was unable to recruit any participants whose background was not white or British, reflecting the lack of ethnic diversity in the working environment during the late twentieth century. Regarding their reasons for agreeing to participate, interviewees were motivated by a number of factors, including feelings of being flattered to have the chance to put their version of their life story on the record for National Life Stories, taking the opportunity to air their opinions about the consequences of organisational change, and a willingness to help with the research. [142]

In her discussion of microhistory, Lepore comments: 'Finding out and writing about people, living or dead, is tricky work. It is necessary to balance intimacy with distance

---

[141] Emmeline Ledgerwood, *Experiences of Women in STEM: Working in the Scientific Civil Service*, 10 February 2021, <https://www.bl.uk/womens-rights/articles/women-in-stem> [accessed 1 April 2021].
[142] For example Roger Courtney, interviewed by Emmeline Ledgerwood, Watford, 2018, BL C1802/01, Track 2 [01:04:08]; Paul Cannon, interviewed by Emmeline Ledgerwood, Colwall, 2019, BL C1802/19, Track 7 [01:13:47]; Steve Rooks, interviewed by Emmeline Ledgerwood, Meonstoke, 2018–19, BL C1802/11, Track 7 [01:29:47].

while at the same time being inquisitive to the point of invasiveness.'[143] This becomes even more tricky when interviews take place in participants' homes and the interviewer is not in a position of control over the encounter. The blurred roles of being both interviewer and guest creates a tension in managing the interview process while showing courtesy to one's host. I felt the success of the interview demanded good manners and the need to be respected or even liked.[144] With my interviewees, the preliminary, off the record stage of a session was very much part of the process of building trust, a social interaction with the interviewee in which we usually made chit-chat about my journey and the local area over a cup of tea or coffee before moving on to questions about the project and switching on the recorder.[145]

National Life Stories (NLS), one of the partners in this PhD studentship, advocates and adopts the life story approach, collecting autobiographical accounts through in-depth extended interviews that start with family background and childhood, and move on to education, work and leisure and the community.[146] In her meditations on the telling of coherent life stories, Linde has observed that 'life stories express our sense of self: who we are and how we got that way … for some people, although certainly not for everyone, a job or profession constitutes a major component of their understanding of their lives.'[147] However oral historians are aware that the task of telling a life story, with the demands of making sense of that life and giving it meaning, can mean that narrators will decide which version to share.[148] Often the interviewees in this project behaved in a similar way to those interviewed by Lean about privatisation in the electricity supply industry: 'few tell anything like a straightforward story, confusing dates, motives, the order of events and presenting inconsistent interpretations.'[149]

---

[143] Jill Lepore, 'Historians Who Love Too Much: Reflections on Microhistory and Biography', *The Journal of American History*, 88, no. 1 (2001), pp. 129–44 (p. 129).
[144] Valerie Yow, '"Do I Like Them Too Much?": Effects of the Oral History Interview on the Interviewer and Vice-Versa', *The Oral History Review*, 24, no. 1 (1997), pp. 55–79.
[145] Anna Sheftel and Stacey Zembrzycki (eds), *Oral History off the Record: Toward an Ethnography of Practice* (New York: Palgrave Macmillan, 2013).
[146] Sally Horrocks, 'The Use of the Life Story in An Oral History of British Science', *NLS Review and Accounts 2015/2016* (London: British Library, 2016), p. 16.
[147] C. Linde, *Life Stories: the Creation of Coherence* (New York: Oxford University Press, 1993), pp. 3–4.
[148] Lynn Abrams, *Oral History Theory*, 2nd edn (London: Routledge, 2016), p. 59.
[149] Thomas Lean, 'The Life Electric: Oral History and Composure in the Electricity Supply Industry', *Oral History*, 46, no. 1 (2018), pp. 55–66 (p. 64).

The collaborative nature of my studentship between NLS and the University of Leicester meant there were conflicting goals for the interviews. As the sole researcher on this project I was aware of the need to manage my resources to ensure the interviews answered the PhD research questions as well as forming a new collection for archival deposit. For this reason I followed an adapted life story approach by focusing on those aspects of interviewees' lives that were relevant to the research questions. The interviews therefore deal with early life and education to inform interviewees' routes into government science and then focus on their working lives. I did not explore interviewees' intimate relationships in adulthood, social worlds beyond the work environment or details of retirement. This prompted interviewee Chris Peel to reflect on being 'pulled slightly in different directions in the interview which may be because you're doing it for two reasons, for your PhD and the BL.'[150]

The schedule of questions that I prepared was informed by that used for *An Oral History of British Science* and my own preliminary reading of the secondary literature.[151] (See Appendix 5.) The questions aimed to encourage accounts of early life, growing up, and education as well as reflections on working life, providing insights into what motivated interviewees to become scientists in GREs, why they chose to pursue a career in the civil service, how their professional knowledge-sharing networks operated and details of their everyday working practices that are rarely described on paper. I was also interested in exploring how the communication and implementation of national policies translated into culture change in the workplace and whether this period of upheaval provoked stronger union activity or political activism in interviewees. I was conscious that most interviewees would have signed the Official Secrets Act which would prohibit them from talking in detail about some aspects of their work, for example when Phil Catling admitted 'that's pretty vague, [but] I can't go much deeper than that.'[152]

---

[150] Chris Peel, interviewed by Emmeline Ledgerwood, Fleet, 2018, BL C1802/07, Track 7 [01:04:00].

[151] A template of 'model questions' for a life story interview is included as an appendix in Thompson, *Voice of the Past*, pp. 296–306.

[152] Phil Catling, interviewed by Emmeline Ledgerwood, Farnborough, 2018, BL C1802/09, Track 1 [00:16:14].

Tooth Murphy notes that the oral history interview is 'an encounter taking place between two unique individuals at a unique moment in time.'[153] Interviewers and interviewees are recognised as co-creators of the resulting recording, what Frisch conceptualises as 'shared authority'.[154] Abrams' key text on oral history theory states:

> In the context of oral history intersubjectivity refers to the relationship between the interviewee and the interviewer or, in other words, the interpersonal dynamics of the interview situation and the process by which the participants co-operate to create a shared narrative.[155]

However prepared or experienced a researcher may be, the outcome is determined by the interviewee's engagement with the process and the developing relationship between the two participants, what Bornat describes as 'the complexities of intentions and emotions on both sides of the microphone'.[156] As Thomson observes:

> Interviewees may start by performing fixed or rehearsed stories, but in the process of remembering, and with the careful encouragement and gentle probing of the interviewer, more complex and unexpected memories may emerge. [157]

Within this fluid interaction between interviewer and interviewee, the researcher has an invigorating capacity to seek clarification and further detail that is does not accompany consultation of written sources. In listening back to the recordings I have often been aware of the sound of that intersubjectivity, my pencil scratching as I scribbled notes and follow-up questions in response to what the interviewee was saying.[158]

The inter-subjectivity of oral history interviewing demands a level of self-awareness on the part of researchers in the way they approach and conduct the interview and how they reflect on the interview process. Oral history interviewing and interpretation is a dynamic, subjective process in which the sharing of memories and emotions is shaped by a particular social and cultural context. This incorporates the idea of a 'cultural circuit' whereby personal memories of events and public representations of events inform each other.[159] Instances of this emerge from the interviews in references to TV sitcoms or in the use of expressions or opinions that echo the cultural commentary of the 1980s.

---

[153] Amy Tooth Murphy, 'Listening In, Listening Out: Intersubjectivity and the Impact of Insider and Outsider Status in Oral History Interviews', *Oral History*, 48, no. 1 (2020), pp. 35–55 (p. 35).

[154] Michael H. Frisch, *A Shared Authority: Essays on the Craft and Meaning of Oral and Public History* (Albany, NY: State University of New York Press, 1990).

[155] Abrams, *Oral History Theory*, p. 54.

[156] Bornat, 'Oral History', p. 36.

[157] Alistair Thomson, 'Memory and Remembering in Oral History', in Donald A. Ritchie (ed.), *The Oxford Handbook of Oral History* (New York: Oxford University Press, 2011), pp. 77–95 (p. 88).

[158] For example, Courtney, Track 9 [00:11:06].

[159] Alistair Thomson, *Anzac Memories: Living with the Legend* (Oxford: Oxford University Press, 1994).

As an experienced oral history interviewer I was confident in using this methodology, but from the beginning of the project I was mindful that I had no familiarity with the working worlds of science. The particularly esoteric nature of scientists' work conducted in distinctive work environments can lead non-scientists to attribute a special, separate status to members of the scientific community, a status that scientists themselves will cultivate. I have found two analyses particularly helpful in understanding this behaviour. The first is Turner's description of public scientists who consciously attempt 'to persuade the public or influential sectors thereof that science both supports and nurtures broadly accepted social, political, and religious goals and values, and that it is therefore worthy of receiving public attention, encouragement, and financing'.[160] The second is Gieryn's study that added to Turner's work by showing that scientists' descriptions of science— as truthful, useful, objective or rational—while they may be ideological, portray a separate working world that they feel deserves special treatment.[161] Consequently scientists and their work are often studied through a lens that construes science as a separate activity that merits special distinction, rather than a set of workers doing their jobs.

Since the project's main focus was on the impact of organisational change, the interview process did not seek to construct detailed descriptions of individual projects or theories that interviewees had worked on, but I was still interested in recording the essence of their scientific careers. While I researched each interviewee's specific area of work in preparation for the interview, I experienced a measure of self-doubt in questioning professional scientists about their areas of expertise. This meant that I sometimes subconsciously moved onto a different subject when I felt out of my depth rather than display the ineptness which Freund admits as threatening 'our identities as skilled interviewers and people who want to be liked by others.'[162]

---

[160] Frank Turner, 'Public Science in Britain, 1880–1919', *Isis*, 71, no. 4 (1980), pp. 589–608 (p. 599).
[161] Thomas F. Gieryn, 'Boundary-Work and the Demarcation of Science from Non-Science: Strains and Interests in Professional Ideologies of Scientists', *American Sociological Review*, 48, no. 6 (1983), pp. 781–95 (p. 792). See also J. Mulkay, 'Norms and Ideology in Science', *Social Science Information*, 15 (1970), pp. 637-56.
[162] Alexander Freund, 'Toward an Ethics of Silence? Negotiating Off-the-Record Events and Identity in Oral History', in Rob Perks and Alistair Thomson (eds), *Oral History Reader*, 3rd edn (London: Routledge, 2016), pp. 273–286 (p. 254).

However throughout the project I found reassurance in Kunda's reflection on his own study of engineers: 'the specifics of high-tech engineering never really attracted me and they still do not.'[163] My focus was on investigating the experiences of scientists, not the science on which they worked, and I asked very different questions to someone who would be more interested in understanding the technical content of scientists' working lives. As an outsider I was able to ask for explanations of their work that might have been assumed if I had a scientific background. As Portelli commented about his own experience as an interviewer, 'it was what I didn't know that encouraged people to talk to me.'[164] I came with the authority associated with being an interviewer with NLS, the UK's leading oral history charity, and a representative of a distinguished national institution, the British Library. As Tooth Murphy acknowledged, 'the university paperwork and recording equipment I brought with me were welcomed as trappings that granted legitimacy to our encounter.'[165] I did not feel that being a female researcher investigating a working world that was dominated by men particularly affected the interview dynamics with the male interviewees. I looked and sounded familiar to participants, as I shared with the majority of them a socio-economic background that included university level education, home ownership in the south of England and white British ethnicity.

Conducting the interview is seen by Abrams as only one of four forms in which an oral history interview takes shape, the other three being the recording, the transcript and the interpretation.[166] Once the interview sessions were completed, I then moved on to dealing with the interview in its other forms.

1.4.3 Analysis and use of the audio material

Abrams describes the interview as 'an event of communication which demands that we find ways of comprehending not just *what* is said, but also *how* it is said, *why* it is said and *what* it means.'[167] The process of analysis began while I listened to the recordings in

---

[163] Gideon Kunda, *Engineering Culture: Control and Commitment in a High-Tech Corporation* (Philadelphia: Temple University Press, 2006), p. 240.
[164] Alessandro Portelli, *They Say in Harlan County: An Oral History* (New York: Oxford University Press, 2011), p. 7.
[165] Tooth Murphy, 'Listening In, Listening Out', p. 41.
[166] Abrams, *Oral History Theory*, p. 9.
[167] Ibid., p. 59.

order to compile written content summaries (see Appendix 6); the studentship did not provide the funds or time needed to produce full transcripts. Content summaries aim to capture the essence of interview by including the key words and topics that are covered in the recording, yet inevitably this removes what Stewart describes as 'the power and emotional engagement that the voice brings.'[168] Many valuable aspects of the audio material recede when converted into text, flattening out the meaning which Frisch sees as 'carried and expressed in context and setting, in gesture, in tone, in body language, in pauses, in performed skills and movements.'[169] Some of the extracts included in this thesis are available as audio clips which enable the reader to appreciate the nuances and texture that comes with the sound of interviewees' voices, offering a direct, emotive connection between the listener and the speaker. The selected clips are indicated by the symbols ∩ ▶ and can be accessed through the links provided in Appendix 4.

As I listened back to the interviews I transcribed passages that were relevant to my research questions. My approach was to be led by the ideas and themes that emerged from the the recorded material , bearing in mind my research questions and my hypotheses about scientists' experiences of change.[170] These became noticeable through the accumulative use of certain words across the collection, for example 'freedom', 'professional' and 'individual'. Having identified these themes, I then revisited the recordings in a more strategic way. I loaded the completed summaries into Nvivo software which enabled me to conduct keyword searches to locate additional relevant sections. However it must be accepted that without the right keywords in the summaries, useful material goes undetected unless the interview is played out in full.

While beyond the scope of this particular project, the collection offers fertile ground for detailed analysis of the narrative devices and language patterns that interviewees displayed in telling their life stories.[171] Some of the vocabulary and idioms used by interviewees reflect the influences that permeated their working world, giving us a sense

---

[168] Mary Stewart, 'Exploring Family Reactions to Life Story Recordings', *Oral History* 41, no. 1 (2013), pp. 51–62.
[169] Michael H. Frisch, 'Three Dimensions and More: Oral History Beyond the Paradoxes of Method', in S. N. Hesse-Biber and P. Leavy (eds), *Handbook of Emergent Methods* (New York: Guilford Press, 2008), pp. 221–238 (p. 223).
[170] Graham R. Gibbs, *Analyzing Qualitative Data* (London: SAGE Publications, 2018).
[171] Linde, *Life Stories*, p. 13; Abrams, *Oral History Theory*, pp. 106–129.

of the everyday back and forth of the workplace.[172] When Chris Peel uses the term 'admin wallah' it invokes echoes of the civil service's colonial history.[173] Mike Westby's choice of 'scuttlebutt' as a naval term for gossip or rumour indicates the association of GRE scientists with members of the armed services.[174] Steve Rooks' use of the word 'mandraulic' implies a world inhabited by humans and machines, while the engineering focus of Paul Cannon's work comes through in his use of the word 'breadboarded'.[175] Google Ngram shows that Vic Crisp's use of 'flimflammery' was at its height in 1968, while Tony Bravery's description of 'keyboarding' indicates the transition from typewriters to computers.[176]

This thesis makes extensive use of transcribed passages to demonstrate the emergent themes and the subtle nuances between the different narratives. Shopes has written about the practical considerations involved in presenting oral history evidence in academic written work.[177] Brown and Valk comment that 'editing for publication imposes still more levels of interpretation and decision making upon oral historians'.[178] Some projects can present researchers with dilemmas in how to represent the spoken language without accentuating differences in interviewees' educational or economic status, however in this case my interviewees' spoken language, with some very light editing, was easily transferrable into text.[179] At times I have used a combination of excerpts from more than one interview together if they are concerned with the same theme. In analysing and interpreting the audio material I have endeavoured to represent interviewees' accounts fairly yet objectively. I have felt a responsibility to respect the relationships of trust that were established during the interviews whereby interviewees shared personal details of their life stories, sometimes expressing or exhibiting emotions. Certain aspects of the

---

[172] For a discussion of the potential of combining linguistics research with oral history, see Katja Roller, 'Towards the "Oral" in Oral History: Using Historical Narratives in Linguistics', *Oral History*, 43, no. 1 (2015), pp. 73–84.
[173] Peel, Track 2 [00:19:50].
[174] Mike Westby, interviewed by Emmeline Ledgerwood, Hedge End, 2019, BL C1802/15, Track 2 [00:45:06].
[175] Rooks, Track 1 [01:11:19]; Cannon, Track 3 [00:26:26].
[176] Vic Crisp, interviewed by Emmeline Ledgerwood, London, 2018, BL C1802/03, Track 6 [00:17:30]; Anthony Bravery, interviewed by Emmeline Ledgerwood, Longwick, 2019, BL C1802/18, Track 5 [00:27:45].
[177] Linda Shopes, 'Editing Oral History for Publication', in Perks and Thomson (eds), *The Oral History Reader*, 3rd edn, pp. 490–509.
[178] L. Brown and A. Valk, *Living with Jim Crow: African American Women and Memories of the Segregated South* (New York: Palgrave Macmillan, 2010), p. 11.
[179] Frisch, *A Shared Authority*, pp. 81–146 (p. 86).

interviews have not been relevant to this thesis which is concerned with the interviewees' professional working lives.

In these sections I have discussed various aspects of oral history methodology that informed its use in this project. The multiplicity of interviewee experiences, some of which fall into a pattern, some of which do not, conveyed through their life stories and specific use of language, allows us to begin to understand the changing frameworks of their working lives while providing a case study of the broader processes of social change in Britain during the 1980s and 1990s.

1.5 The structure of the thesis

The thesis chapters broadly follow a chronological sequence while also moving through a consideration of the process of change at different levels. First, the thesis outlines the decisions made at the very top level in government that led to organisational change and privatisations in GREs. It then discusses the efforts across the civil service to implement reform involving the introduction of new structures and management practices within the research organisations. Finally it examines the adjustments that individuals at the bottom of this hierarchy experienced in their working lives. The chapters also cover the matrix of connections that formed the framework of scientists' working lives: how the organisational structure determined their roles and career prospects, how they interacted with the physical environments, equipment and materials of the workplace, their dealings with management processes and their relations with colleagues and peers in the wider scientific community.

Chapter 2 provides an overview of the British state's evolving attitudes to the organisation of government-funded scientific research during the 1960s and 1970s. It draws out which government reviews and policies of the 1980s and 1990s affected GREs, arguing that these establishments were not regarded as a special case but were subject to the same programme of reform as many other parts of the civil service.

Chapter 3 moves to focus on the scientists who worked in GREs and were subject to the processes of change described in Chapter 2. It explores the educational backgrounds, motivations and influences that led project participants to become scientists. It then discusses interviewees' reasons for applying to join the scientific civil service during the

1960s, 1970s and 1980s, and the prospects for advancement as a scientific civil servant, showing that the provision of opportunities for further education was part of the attraction of a scientific career in a GRE.

Chapter 4 draws on interviewee accounts to portray working life in a GRE as scientists remembered it before the onset of the organisational changes of the 1980s and 1990s. This includes explanations of how scientific research was organised and funded in a GRE compared to that conducted in a university or industrial laboratory. Chapter 5 uses these descriptions of working life to identify the values, behaviours and expectations associated with working as a scientist in a GRE which, I argue, contributed to an institutional culture that defined the GREs.

The final two chapters, Chapters 6 and 7, explore individual experiences of civil service reforms and their impact on the the institutional culture. Chapter 6 focuses on what the experiences of scientists tell us about the implementation of different management practices and increasing customer focus. Chapter 7 evaluates the ensuing effects on how scientists were able to address their work, showing that the demands of meeting contractual obligations limited resources that had previously allowed for the cultivation of deep expertise within GREs. It argues that the process of adjusting to commercialisation posed particular challenges for scientists within the civil service as they felt their professional values became less relevant.

Together the chapters show that organisational change in GREs was one element in a much wider programme of reform across the civil service yet it had a specific impact on the identities of scientific civil servants who embodied both the values of professional science and public service. They show how the everyday working culture in GREs was subtly different to that of a university department or an industrial R&D laboratory, and that the commercialisation and privatisation of GREs diminished the standing those specialists felt they held within the civil service organisations. The findings presented throughout these chapters illuminate Paul Cannon's assessment of the consequences of this process of change: 'We lost a type of job for a type of person in this country'.[180]

---

[180] Cannon, Track 4, [00:37:40].

This thesis demonstrates how evaluations of individual experiences allow us to contemplate the broader impact of change. In exploring how organisational change and commercialisation affected scientists' working lives, this thesis shows that the changing values within these case study GREs profoundly affected the cultivation of deep scientific expertise. It raises questions about the long-term impact of public sector reforms of the 1980s and 1990s on the state's capacity to operate as an intelligent customer in commissioning research and the cultivation of expertise relevant to government's needs.

2. The journey from state to private: mapping organisational change in GREs

Evolving government attitudes to the structures within which government scientists operated and the scientific research programmes on which they worked resulted in a wide-ranging agenda for organisational change within GREs during the 1980s and 1990s. These attitudes were influenced by broader considerations about the role of the state in providing public services and the role of scientific research in driving economic growth and development.[1] This chapter focuses on the changes to the overarching structures and foundations on which departmental government science had been built since the Second World War. It takes a chronological approach by setting out the key decisions and strategies that drove the process of organisational change which directly affected the scientists who worked in GREs during the 1980s and 1990s. It shows that the execution of these changes was predominantly the consequence of a commitment launched by the Conservative governments of the 1980s to reform the civil service. These changes permanently disrupted the environments in which scientific civil servants worked, affecting the physical spaces, the practice of science, organisational culture and professional relationships.

Depending on which government was in power and their policy focus, organisational changes occurred at different levels of the frameworks around which government science was organised. Top level machinery of government changes saw the creation and demise of various government departments, especially during 1960–1971, which meant that responsibility for some GREs passed from one government department to another. These were followed by programmes of rationalisation at establishment level that led to amalgamations and closures. Finally, changes to the operating frameworks within the establishments saw the internal structures rearranged to accommodate commercial operations.

Influential figures from the world of business emerge as steering the processes of change that affected government scientists, in particular by promoting the application in the civil service of management processes drawn from the commercial world. Change can also be

---

[1] Mariana Mazzucato, *The Entrepreneurial State: Debunking Public vs. Private Sector Myths*, 2nd edn (London: Anthem Press, 2013), p. 2.

visualised as a process by which the strength of the relationship between the research establishments and the centre of government gradually diminished. Initial changes moved GREs around but kept them close to departments, then they were pushed out to become arm's length bodies, and finally they were propelled beyond the sphere of government to operate in the private sector. It is the two latter processes that characterise 1970–2005, the period covered by this research project (see Appendix 2).

In this chapter I outline developments from the 1970s to the early 2000s that changed the ownership arrangements, operating structures and systems which determined how the research establishments functioned. I first cover the efforts in the 1960s and 1970s to encourage GREs to operate on more commercial grounds, initially by outlining an ideal relationship between them as contractors and their customers, the parent departments. I then look at the Conservative commitment of the early 1980s to improve efficiency across the whole civil service through the hiving off of public services and the introduction of new management practices to increase accountability. As these measures were perceived to fail in achieving the desired changes, subsequent more radical steps were taken that saw the introduction of new and varied organisational forms in the 1990s with the eventual transfer of many civil service activities into the private sector. These sections show that the stimulus for organisational change in GREs shifted from a goal to improve the management of government-funded R&D to the much broader objective of improving efficiency across the whole civil service.

2.1 The landscape of government science in the 1960s and 1970s

From the 1960s government scientific research programmes, both defence and civil, were subject to an ongoing process of evaluation. The benefits gained during the Second World War through state support for scientific research meant that funding levels continued to grow throughout the 1950s. However in 1957 a Defence White Paper brought a halt to some of the expansive programmes, signalling the emergence of a more critical examination of how the British state funded and managed scientific research in both the military and civil arenas.[2]

---

[2] Ministry of Defence, *Defence: Outline of Future Policy*, Cmnd 124 (London: HMSO, 1957).

Decisions over how government money was spent on R&D were not made centrally, but by separate departments on policies relating mainly to defence, industry, the environment, agriculture and transport.[3] Government expenditure on scientific research programmes was disbursed in a number of ways. By far the largest proportion went on defence research and was distributed through the Ministry of Defence (MOD) budget (or through the budgets of the departments that preceded the MOD). This was allocated to the MOD's departmental research establishments—defence GREs—in which defence research was conducted.[4]
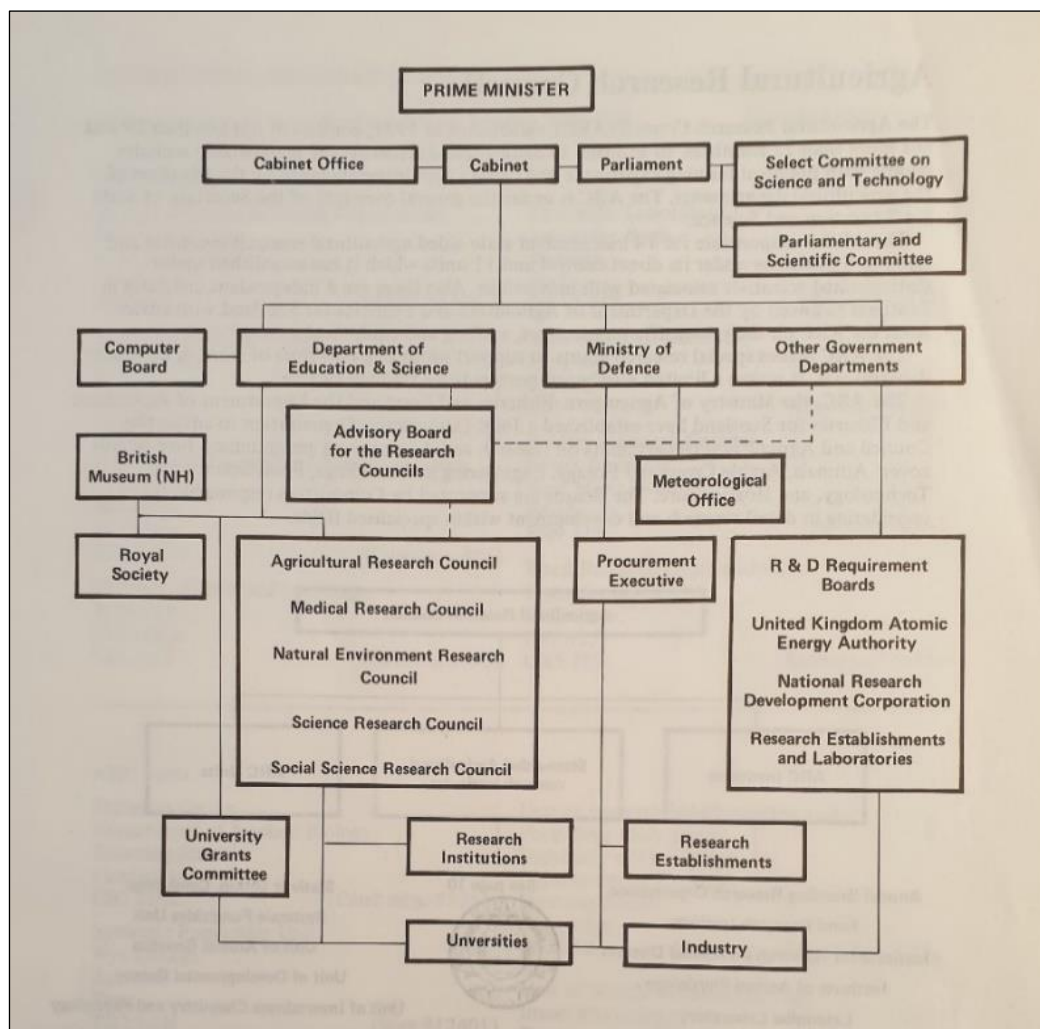
2.1 *The relationships between government and arenas of scientific research, c. 1976.* British Council, *Government Organisation of Science and Technology in Britain*, p. 7.

[3] Lord Privy Seal, *Review of the 'Framework for Government Research and Development' (Cmnd. 5046),* Cmnd 7499 (London: HMSO, 1979), p. 1.
[4] Robert Bud and Philip Gummett, 'Introduction: Don't You Know there's a War on?', in Bud and Gummett (eds), *Cold War, Hot Science*, pp. 1–28 (pp. 3–4).

There was a more complicated pattern of funding for civil research, with two channels in operation during the period of this study. One channel functioned in the same way as that for defence research; the government's civil GREs were allocated a proportion of their parent department's budget to conduct research in support of the parent department's policies and responsibilities. The second was through the Science Budget from the Department of Education and Science (DES). This was disbursed through the research councils which were responsible for assigning the money to academic research projects undertaken in research council institutes or in the universities.[5] At the same time scientific research conducted in universities received support through grants from the University Grants Committee (UGC) which covered equipment purchases and recurrent expenditure. State-funded R&D also took place within the in-house laboratories of nationalised industries.

Consequently government-sponsored science and technology activities in the UK during the 1960s and 1970s took place within a network of research settings described as one of 'bewildering complexity'.[6] This quotation from Sarah Herbert gives a sense of the complexity:

> Initially there were a whole series of research establishments across the country. [Farnborough] was the research establishment for aerospace and some weapons capability … the one at Holton Heath was all related to sea vessels … Rosyth was all to do with submarines, Fort Halstead was all to do with various weapons and guns and things like that, Christchurch was all to do with tanks.[7]

Government-owned research organisations were often in a stage of flux with periods of expansion and rationalisation or transfer between government departments. A 1982 review counted more than 70 R&D establishments which varied in size and function, from agricultural field stations or niche testing facilities with staff numbers lower than 100 to the huge defence research operations that employed thousands.[8] (See Appendix 1.) At that time about 35,000 staff worked in those establishments, of whom approximately 18,000 belonged to the scientific classes of the scientific civil service.[9]

---

[5] Education, Science and Arts Committee, *The Future of the Science Budget*, 9 July 1985, HC 46 1984–5, p. 116.
[6] Philip Gummett et al., 'The Changing Central Government of Science and Technology', in R. A. W. Rhodes (ed.), *Transforming British Government, Volume 2: Changing Roles and Relationships* (Basingstoke: Macmillan, 2000), pp. 237–88 (p. 241).
[7] Herbert, Track 8 [01:07:33–01:09:02].
[8] Cabinet Office, *Review of Support Services in Research and Development and Allied Scientific Establishments* (London: Management and Personnel Office, 1982).
[9] Ibid.; Civil Service Department, *Review of the Scientific Civil Service*, p. 88.

The scientific civil service was one of a number of vertical specialist streams that operated in parallel with the main bulk of the wider civil service, the administrative stream. These streams were divided horizontally into different grades, with civil servants climbing up the ladder of their stream until they reached the open structure level. Above that lay the very top tier of civil servants who were in charge of running government departments. A post-war rationalisation of the scientific civil service resulted in three categories of government scientist: scientific officer, experimental officer and scientific assistant.[10] Experimental officers assisted the scientific officers, while the scientific assistants were employed in the preparation of materials and apparatus, undertaking observations and running calculations. The higher grades of scientific officers were responsible for the direction and administration of the scientific work.

These arrangements were subject to review during the 1960s.[11] A 1965 review of the scientific civil service identified a need to improve scientists' managerial capabilities, along with issues such as maximising the recruitment of good quality science graduates and creating opportunities for increased mobility for scientists through interchange between GREs and universities or industry.[12] The 1968 report of the Fulton Committee's inquiry into the civil service led to a unified grading system that aimed to bring coherence across the administrative and specialist classes.[13] For the scientific officers the grades began with assistant scientific officer (ASO), rising to scientific officer (SO), higher scientific officer (HSO), principal scientific officer (PSO) and senior principal scientific officer (SPSO). Above that lay deputy chief scientific officer (DCSO), chief scientific officer (CSO) before reaching Under Secretary in the open structure level.[14]

Scientists in the GREs worked across a spectrum of technical activities, as this statement in the 1965 review indicated:

> One of its most striking features is the great variety of the work, which ranges from basic research on the one hand to prototype manufacture on the other. Basic research is an essential element of this total effort. It contributes to the formulation of national scientific policy; it makes possible the establishment of reference standards, and provides basic

---

[10] HM Treasury, *The Scientific Civil Service. Reorganisation and Recruitment during the Reconstruction Period*, Cmd 6679 (London: HMSO, 1945).

[11] Office of the Minister for Science, *Management and Control of R&D*; Trend, *Organisation of Civil Science*.

[12] HM Treasury, *Report of a Committee appointed to review the Organisation of the Scientific Civil Service* (London: HMSO, 1965), pp. 12–17.

[13] Civil Service Commission, *The Report of the Committee on the Civil Service*.

[14] Civil Service Department, *Review of the Scientific Civil Service*, p. 42.

knowledge required in the public sector as well as for the solution of problems in industry. Moreover, in the defence field security considerations make it necessary for certain basic research to be done within rather than outside the Government service. Nevertheless, the emphasis … is heavily on applied research and development projects.[15]
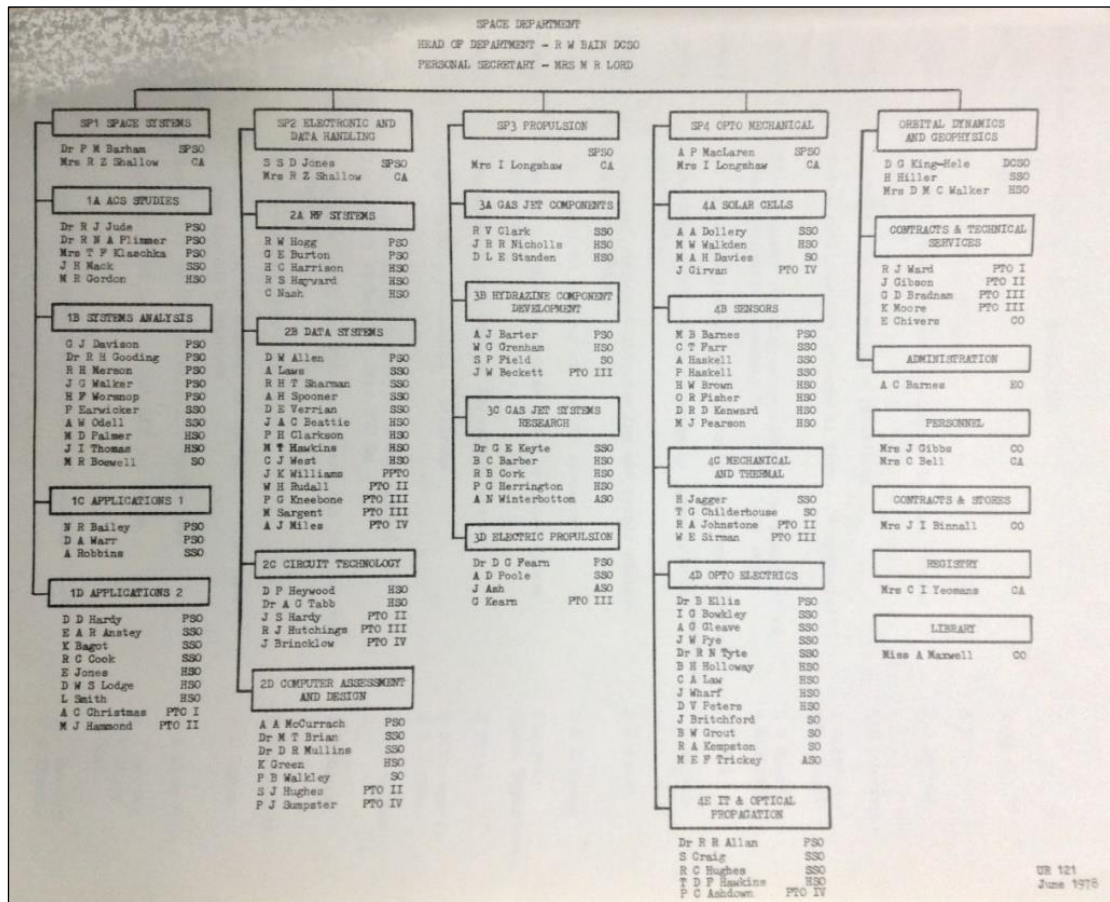
2.2 *Organisation of scientific officers in an RAE Department, June 1978.*
TNA, *DEFE 72/213*, 'RAE Space Department R&D Development Review, 1978'.

This thesis is not specifically concerned with the scientific content of the research programmes on which these scientists worked, nor with assigning labels to the work which they did.[16] Whatever activities GRE scientists were occupied with, programmes

---

[15] HM Treasury, *Organisation of the Scientific Civil Service*, p. 8.

[16] In 1962, OECD member countries adopted the *Frascati Manual* for measuring research and scientific activities. The three components of research are defined as: fundamental (sometimes called pure or basic) primarily for the advancement of scientific knowledge without a specific practical application in view; applied, primarily for the advancement of scientific knowledge but this time with a specific practical aim; and development, using the results of fundamental and applied research to develop or improve useful materials, devices, products, systems and processes. Attempts to use terminology to demarcate between types of research can overlook the fluidity of scientific research programmes which encompass a spectrum of activities and multiple objectives. The problematic nature of this terminology is discussed in Sabine Clarke, 'Pure Science with a Practical Aim: The Meanings of Fundamental Research in Britain, circa 1916–1950', *Isis*, 101, no. 2 (2010), pp. 285–311. See also Benoit Godin, 'Research and Development: How the "D" got into R&D', *Science and Public Policy*, 33, no. 1 (2006), pp. 59–76; 'Focus: Applied Science', *Isis*, 103, no. 3 (2012), pp. 515–563.

were often conducted in collaboration with industrial, academic or international partners. These relationships inform the concept of a triple helix model in which knowledge generated and shared by these three sectors contributes to processes of innovation.[17] In defence research, this web of connections is referred to as the military-industrial complex, in which the infrastructure for research had,

> rather blurred edges, in that a number of organisations not funded by the MOD may undertake R and D which has a military application, or which is supportive of and/or complementary to military R and D programs.[18]

GRE scientists were also involved in the provision of advice to industry and the public, supplying technical advice to their parent departments, representing the UK in international fora, acting as expert witnesses, maintaining national standards and operating unique testing facilities.

2.1.1 Government attitudes to public sector science

Three reports published during the 1960s identified areas where the state could improve its performance in managing and disseminating scientific research and incorporating science into its policy-making. A 1961 report from the Office of the Minister for Science (the Gibb-Zuckerman report) identified the need for government departments to have stricter criteria when selecting large-scale R&D projects, and to conduct better financial scrutiny and tighter supervision once the projects were under way.[19] This evaluation was followed in 1963 by a closer look at the organisation of civil science (the Trend report) and then the 1968 Fulton report which considered the role of specialists in the civil service.[20]

The Fulton committee came to the view that specialists were under-utilised in the wider civil service, observing that, 'many scientists, engineers and members of other specialist classes get neither the full responsibilities and corresponding authority, or the opportunities they ought to have.'[21] It also suggested that certain executive activities

---

[17] Etzkowitz and Leydesdorff, 'The dynamics of innovation', p. 113.

[18] P. Wells, 'The Military Scientific Infrastructure and Regional Development', *Environment and Planning A: Economy and Space*, 19, no. 12 (1987), pp. 1631–58 (p. 1634).

[19] Office of the Minister for Science, *Report on the Committee on the Management and Control of Research and Development*.

[20] Trend, *Organisation of Civil Science*; Civil Service Commission, *The Report of the Committee on the Civil Service*.

[21] Ibid., para. 17.

across government could be hived off into agencies and that the principles of accountable management should underpin the civil service, concepts that were to become key elements of the programme for civil service reform in the 1980s.[22] The report argued for the improvement of management and diversification of managers across the civil service, stating:

> To function efficiently, large organisations, including government departments, need a structure in which units and individual members have authority that is clearly defined and responsibilities for which they can be held accountable. There should be recognised methods of assessing their success in achieving specified objectives.[23]

The Fulton inquiry had been set up in 1966 by the Labour Government which came to power in 1964. Under Harold Wilson as Prime Minister, Labour's plans for reform and modernisation included the promise to use the 'white heat' of a scientific and technological revolution to transform Britain.[24] With the *Science and Technology Act 1965* the Government set out plans to expand the recently-established Ministry of Technology (MinTech) as part of a strategy to reinvigorate British industry by directing a larger proportion of government expenditure on R&D into civil research.[25] This new department became the largest single dispenser of R&D funds in the country, becoming responsible for the Royal Aircraft Establishment (RAE) which Wilson felt should be more concerned with civil research.[26] The Building Research Station (BRS) was also absorbed into MinTech for a short period before passing to the Ministry of Public Building and Works which in turn became part of the new Department of the Environment (DOE) in 1970.[27] Shortly afterwards BRS, the Fire Research Station and the Forest Products Research Laboratory (FPRL) came under common management as the Building Research Establishment (BRE).[28]

With Tony Benn at the helm of MinTech, a Green Paper was published which proposed that 'a contractual relationship between Government laboratories and their 'customers' is essential if the programmes and size of these establishments are to be directly related to

---

[22] Boden et al., 'Men in White Coats', p. 271.
[23] Civil Service Commission, *The Report of the Committee on the Civil Service,* Vol. 1, para. 145.
[24] Harold Wilson, 'Labour's plan for science', speech delivered at Scarborough (1 October 1963); Edgerton and Hughes, 'The Poverty of Science', p. 421; David Edgerton, 'The "White Heat" Revisited: The British Government and Technology in the 1960s', *Twentieth Century British History*, 7, no. 1 (1996), pp. 53–82.
[25] The *Science and Technology Act* 1965.
[26] Edgerton, *Warfare State*, p. 246.
[27] Courtney, 'Building Research Establishment Past, Present and Future', p. 286.
[28] Ibid.

real needs.'[29] The Permanent Secretary in the department saw attitudes beginning 'to point decisively to redeployment and reduction … of the numbers in the government-financed establishments'.[30]

While the Green Paper went no further, the idea of a 'contractual' relationship was articulated again in the 1971 Rothschild report produced under a Conservative government, representing a recalibration of how government departments and their research establishments were expected to interact.[31] The Conservatives had been working with a team of business leaders while in Opposition during the 1960s to explore possible ways to improve government organisation and decision-making.[32] After they won the 1970 election and Edward Heath became Prime Minister, this team of businessmen continued its work from within the Civil Service Department where a method called Programme Analysis and Review (PAR) was developed to encourage departments to question the management of their budgetary resources in achieving programme goals.[33] According to Theakston, Sir Derek Rayner, the then chairman of Marks & Spencer and a member of Heath's team,

> was amazed to find that there was no financial management infrastructure of the type he knew in business, that the head of finance was not an accountant, and that top management … saw its job as simply keeping to the rulebook.[34]

PAR was one element in the government's effort to streamline Whitehall, set out in the 1970 White Paper *Reorganising Central Government* which emphasised a need to define and assign responsibility and accountability at all levels.[35] The far-reaching consequence of the 1970 White Paper for government scientists was the commissioning of the 1971 Rothschild report on government-funded R&D.[36]

---

[29] Ministry of Technology, *Industrial Research and Development in Government Laboratories: A New Organization for the Seventies* (London: HMSO, 1970), p. 11.

[30] Richard Clarke, 'Mintech in Retrospect—II', *Omega*, 1, no. 2 (1973), p. 140.

[31] Lord Rothschild, *The Organisation and Management of Government R. and D.* (London: Central Policy Review Staff, 1971).

[32] Kevin Theakston, *Leadership in Whitehall* (Basingstoke: Macmillan, 1999), p. 228.

[33] Minister for the Civil Service, *The Reorganisation of Central Government*, Cmnd 4506 (London: HMSO, 1970), p. 14; Denis Saint-Martin, *Building the New Managerialist State: Consultants and the Politics of Public Sector Reform in Comparative Perspective* (Oxford: Oxford University Press, 2000), p. 73.

[34] Theakston, *Leadership in Whitehall*, pp. 228–29.

[35] Minister for the Civil Service, *The Reorganisation of Central Government*, p. 15.

[36] Rothschild, *The Organisation and Management of Government R. & D.*

Lord Rothschild was a former scientist and business executive who had recently been appointed to head a up a new policy unit within Cabinet Office, the Central Policy Review Staff (CPRS). He came from a varied background in scientific research, with his academic studies in zoology leading to his election as a Fellow of the Royal Society in 1953. He chaired the Agricultural Research Council 1948–58 and then went into industry, joining Royal Dutch-Shell in 1961 where he rose to become co-ordinator for research across the corporation.[37]
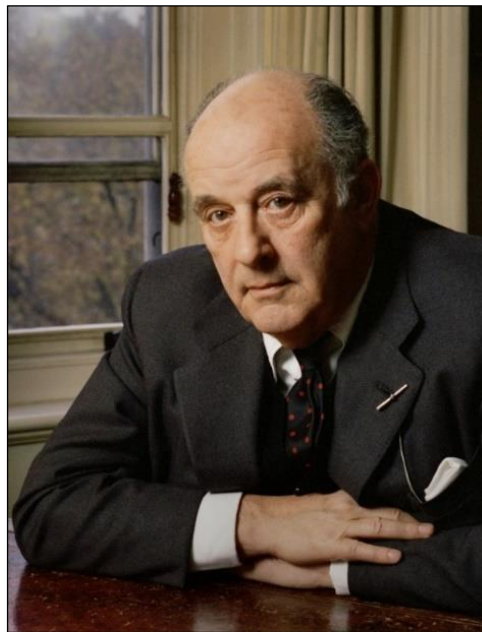
2.3 *Portrait of Victor Rothschild by Bern Schwartz, 1976.*
© National Portrait Gallery

A review of the arrangements in the research council system and administration of public research council system was conducted at the same time, and the two reports were published together in a Green Paper in 1971 that was followed by a White Paper the following year.[38] The Government welcomed Rothschild's recommendation that,

> applied research and development commissioned by the Government should be controlled in accordance with a 'customer/contractor' principle which is already being applied in certain areas.[39]

---

[37] Jon Agar, 'Thatcher, Scientist', *Notes and Records of the Royal Society*, 65, no. 3 (2011), pp. 215–32 (pp. 221-2); Kenneth Rose, 'Rothschild, (Nathaniel Mayer) Victor, third Baron Rothschild (1910–1990), Zoologist and Public Servant', *Oxford Dictionary of National Biography* (Oxford: Oxford University Press, 2004).

[38] Frederick Dainton, *The Future of the Research Council System* (London: Council for Scientific Policy, 1971); Lord Privy Seal, *A Framework for Government Research and Development*, Cmnd 4814 (London: HMSO, 1971); Lord Privy Seal, *Framework for Government Research and Development*.

[39] Lord Privy Seal, *A Framework for Government Research & Development*, p. 1.

Now normally referred to as the Rothschild report, it focused on applied R&D primarily with reference to the operations of GREs. It emphasised the themes of efficiency, accountability and commercialisation that had surfaced in the 1968 Fulton report, 'to ensure that the organisation and management of R. & D. is logical, flexible, humane and decentralised.'[40] It crucially recommended that the relationships between parent departments and their research establishments should become one of customer and contractor to make clear where accountability lay, so that 'each person in the system has clearly defined responsibilities.'[41]

Rather than scientists setting the research programmes, the department was expected to take responsibility for setting objectives and budgets and prioritising between different R&D projects. On these matters the departmental chief scientist would advise the departmental customer while a Controller R&D located within the department represented the laboratories as the contractor. The Controller R&D had the power to sub-contract departmental work out to universities or other extramural organisations, and it was with the Controller R&D that accountability lay for expenditure on equipment.

2.1.2 Implications of the customer-contractor relationship

Rothschild was outlining a framework in which 'the efficiency of Government R. & D. can be maximised' while challenging scientists' autonomy in setting their own research agendas:

> However distinguished, intelligent and practical scientists may be, they cannot be so well qualified to decide what the needs of the nation are, and their priorities, as those responsible for ensuring that those needs are met.[42]

The principles outlined in the Rothschild report generated fierce controversy among the professional scientific community, particularly those working within the research council system. The result of the report was that a third of the funding which had been disbursed via the DES Vote to universities and research council institutes was reallocated to other departments who then acted as customers commissioning research from the research

---

[40] Rothschild, *The Organisation and Management of Government R. & D.*, p. 1.
[41] Ibid.
[42] Ibid., p. 4.

council institutes.[43] The intention was to give departments 'an increased influence over the pattern and direction of the work'.[44]

The 1972 White Paper did not give R&D any special status as a government activity: 'Applied research and development are necessary to achieve many of the government's objectives, but they cannot be regarded as forming a distinct function of government.[45] Williams sees the report as signifying the emergence of some scepticism among the political community in supporting the scientific community's quest to keep pace with their international peers.[46] His assessment was that British scientists felt seriously threatened by this changing attitude, with the ensuing period of consultation and debate 'unprecedented in the interest it aroused, and unprecedented too in the ferocity with which it was often conducted'.[47] Government commitment to supporting R&D both in the public and private spheres remained evident in the 1976 establishment of an Advisory Council on Applied Research and Development (ACARD) to act as an advisory body to Ministers, yet the Rothschild report marked the point at which GRE scientists were required to embark on a different way of interacting with the parent departments.[48]

However as Parker points out, since a significant proportion of the defence budget was spent by the research establishments extramurally with firms under contract, they were familiar with the principles laid out in the Rothschild report from working with their industrial contractors.[49] The creation of the Procurement Executive (PE) as part of MOD in April 1971, which aimed to rationalise the procurement activities of the armed services, 'consolidated and sharpened the application of the principles of customer-contractor relationships within the Department'.[50] Similarly the new requirements boards introduced at the Department of Industry (DOI) in the 1970s signalled a focus on improving the

---

[43] Roger Williams, 'Some Political Aspects of the Rothschild Affair', *Science Studies*, 3, no. 1 (1973), pp. 31–46 (p. 42). See section 4.2 for an explanation of the Vote system.
[44] Lord Privy Seal, *Review of the 'Framework'*, p. 12.
[45] Lord Privy Seal, *Framework for Government Research and Development*, p. 4.
[46] Williams, 'Some Political Aspects', p. 42.
[47] Ibid.
[48] Lord Privy Seal, *Review of the 'Framework'*, p. 3.
[49] Miles Parker, 'The Rothschild Report (1971) and the Purpose of Government-Funded R&D—a Personal Account', *Palgrave Communications*, 2 (2 August 2016), p. 3.
[50] Civil Service Department, *Government Organisation for Defence Procurement*; HC Deb 26 April 1971 vol 816 cc 163-94; Lord Privy Seal. *Review of the 'Framework'*, p. 19. The term 'procurement' embraces research development and production, as well as the placing of contracts.

setting of objectives and priorities.[51] Increasingly DOI research establishments were expected to earn part of their income from industrial R&D contracts.[52]

Chris Peel worked at RAE from 1967. While his recall of dates is hazy, what he does remember is that the creation of PE brought 'big changes' to the way research programmes were defined:

> In those days, I suppose I'm talking about the sixties, seventies and early eighties, the establishment was autonomous, was self-regulating, so Director RAE would have a grant effectively every year and how he spent it within his departments was up to him, but he was scrutinised by a combined board of industrialists and government referees if you like. After we switched to strictly MOD-owned programmes and MOD-owned establishment then we went onto a project management basis and that was the big change, so individual projects were then put forward to the Ministry of Defence for approval or rejection or modification or whatever and for funding on a case by case, project by project basis, so it was quite a big shift in the way the business was done.[53]

Anthony Bravery explained how staff at the FPRL (later absorbed into BRE) had to change their way of thinking:

> It was not good enough just to say we're working for government, we're working for the tax-payer, it was a question of who in government is saying yes I'm prepared to pay for that … the beginnings of a very big culture change which of course ultimately led to full privatisation.[54]

The succeeding period of Labour government (1974–79) brought uncertainties and dissatisfaction for many civil servants with civil service-wide reductions in staff numbers and disputes regarding pay awards.[55] These led to concern among scientific civil servants over the future provision of expertise. A 1980 report on MOD research establishments noted that the enforced reductions in staff and restrictions on recruiting had led to 'severe distortions in staff structure'.[56] A 1981 report from the RAE Space Department reflected 'the severe setbacks both in staff and resources being suffered right across the Defence establishments', commenting that,

> the distribution of staff … heavily weighted in the 50–60 group, will continue to produce problems and the loss of expertise. […] This capability will be hard to sustain unless measures are taken … to replace our current experts with experienced people.[57]

[51] Philip Gummett and Michael Gibbons, 'Government Research for Industry: Recent British Developments', *Research Policy*, 7, no. 3 (1978), pp. 268–90 (p. 268).

[52] Michael Gibbons and Philip Gummett, 'Recent Changes in the Administration of Government Research and Development in Britain', *Public Administration*, 54, no. 3 (1976), pp. 247–66 (p. 264).

[53] Peel, Track 3 [00:05:34–00:06:38].

[54] Bravery, Track 7 [00:03:21–00:03:51].

[55] Lowe, *Official History, Vol. I*, pp. 199–209.

[56] Ministry of Defence, *Steering Group on Research and Development Establishments: Consultative Document* (London: HMSO, 1980), p. 23.

[57] TNA, *DEFE 72/213*. 'Reviews of work of Space Department, Royal Aircraft Establishment (RAE), 1977–1981'.

Steve Rooks' observation about Farnborough during the 1990s indicates the long-term effects of that recruitment freeze: 'The experts I was working with, most of them were 10 or 15 years older than me. I was making a concerted effort to bring a pipeline of graduates through to try and fill that gap.'[58]

Consequently when the Conservatives came to power in 1979, civil servants, including scientists, had already experienced significant disruption in their working lives with the implementation of policies regarding the organisation of the civil service and government scientific research.

2.2 Conservative policies in the 1980s

The election of the Conservatives under Margaret Thatcher in 1979 heralded even greater upheavals for civil servants as ideas developed by the New Right began to translate into policy formulation. These ideas supported a 'strong state' on law and order while emphasising individualism, personal freedom and the primacy of markets as the route to ensuring the efficient distribution of goods and services.[59] New Right antipathy to the level of state involvement in the economy saw reinvigorated commitment from the Thatcher government to the ideas that Heath had laid out in 1970 to improve efficiency in the civil service.[60] This description from a senior civil servant in 1980 indicates that many aspects of the civil service were considered ripe for improvement:

> Working conditions are poor and deteriorating … office accommodation, modern facilities, mechanical aids, etc. are inadequate or downright bad … The ability to cope with staff who, while not inefficient in an absolute sense, cease to fit or to be moveable is severely limited …departmental management has no ability to be flexible in terms of incentives for exceptional merits and performance.[61]

The Conservative programme of reform to improve the value of the public sector to the taxpayer encompassed GREs. GREs were exposed to the same scrutiny exercises and efficiency measures that were introduced across the civil service, along with the promotion of managerialism and the expectation of increased commercial activity.

---

[58] Rooks, Track 5 [00:51:36–00:52:00].
[59] John Greenwood, Robert Pyper and David Wilson, *New Public Administration in Britain*, 3rd edn (London: Routledge, 2003), p. 4.
[60] Clarke and Newman, *The Managerial State*, pp. 34–55.
[61] TNA, *PREM 19/149*. 'Letter from Sir Jack Rampton to Margaret Thatcher, 2 May 1980'.

2.2.1 Scrutinising departmental research activities

Notions of efficiency in the civil service that had been articulated in the 1970 White Paper *Reorganising Central Government* were propelled forward by the Thatcher administrations of the 1980s.[62] Within a matter of weeks of coming to power in May 1979, the Conservative Government made its intentions clear to,

> make major savings in the size and cost of the Civil Service over the next few years. Ministers in charge of Departments are accordingly conducting a radical review of their activities in order to identify possible savings from the improvement of efficiency and the curtailment or elimination of functions.[63]

These intentions were formalised in the 1981 White Paper *Efficiency in the Civil Service*.[64] BRE and RAE were included in various review processes that began to focus on costs and the devolution of some establishment activities to the private sector as a way of reducing staff numbers. For RAE, the MOD's response was to set up a committee 'to see whether more of the work now done in the ministry's R&D establishments could and should be done in industry or the universities.'[65] The committee identified other changes that could improve efficiency such as rationalisations and the contracting out of support services.[66] At the DOE, Secretary of State Michael Heseltine promptly embarked on a review of BRE, 'a consultant's study of the scope for cost recovery and a fundamental examination of that Establishment'.[67] For government scientists such as Roger Courtney, the dissatisfaction of the 1970s were now being compounded by the renewed focus on civil service reform:

> This [BRE] is an organisation where a lot of staff who had been there a long time perceived … [they] had been under attack for quite a long time. The staff reductions that took place at the end of the seventies, beginning of the eighties … clearly bit hard. […] You were then from 1979 onwards working in a political context in which the civil service felt unloved. I mean no question about it … private sector good, public sector bad.[68]

Scrutiny exercises was undertaken by members of the Efficiency Unit in which they observed and assessed certain operations of government departments to identify areas of activity which could be rationalised or reduced.[69] The Efficiency Unit had been

---

[62] Moore, *Margaret Thatcher: The Authorized Biography. Vol. I,* pp. 455–481.

[63] HC Deb 11 June 1979 vol 968 c 68W.

[64] Minister for the Civil Service, *The Reorganisation of Central Government*; Efficiency Unit, *Efficiency in the Civil Service*, Cmnd 8293 (London: HMSO, 1981).

[65] MOD Steering Group, *Consultative Document,* p. i.

[66] Ibid., p. v.

[67] TNA, *PREM 19/772.* 'Letter from the Secretary of State for the Environment to Lord Soames, Lord President of the Council, 12 March 1981'.

[68] Courtney, Track 18 [00:12:41–00:13:34].

[69] Hennessy, *Whitehall*, pp. 589–598.

established in the Cabinet Office by the new Conservative Government, with Derek Rayner returning to Whitehall as its head, and contemporaries remember that Thatcher gave him 'free rein' to identify ways to improve the management environment in the civil service.[70]

2.4 *Portrait of Sir Derek Rayner, 1975*
© Marks and Spencer plc. Courtesy of 'The Marks & Spencer Company Archive'.

Rayner had set out his expectations for managers and management in the civil service in 1973:

> The leader in management areas is considered as important in Whitehall as the good all-round administrator or policymaker. […] Unless a manager is allowed to recruit to his organisation the skills and experience which he needs, and unless he is party to any decisions to move or alter that mix of skills, it is quite unfair to judge him on overall management performance. […] A manager must have sufficient freedom of action and discretion to enable him to … demonstrate that he recognizes the importance of the individual.[71]

In this he was supported by senior officials in the service who had taken the recommendations of the Fulton report seriously and were open to change.[72] His vision to

---

[70] Clive Priestley speaking at 'The Civil Service Reforms of the 1980s: The Genesis and Initial Implementation of *Next Steps*', seminar held 17 November 2006, Centre for Contemporary British History, 2007, p. 70.

[71] Derek Rayner, 'Making Room for Managers in Whitehall', *Management Services in Government*, 28, no. 2 (1973), pp. 62–63.

[72] Theakston, *Leadership in Whitehall*, p. 227; See also Lowe, *Official History, Vol. I*, pp. 235–278.

achieve lasting reforms included the expectation that Ministers would participate more actively in the management of their departments:

> Ministers and Permanent Secretaries must be held accountable for their management of resources. One of the factors to be taken account of in promoting people to top jobs within the Civil Service must be their ability to manage as well as their ability to deal with policy matters; it is a question of balance.[73]

However this idea was resisted by many members of Thatcher's cabinet, including John Nott, at that time Secretary of State for Trade, who told the Prime Minister that, 'unhesitatingly I see myself as a politician, not a staff manager'.[74]

Supporting services in R&D and allied scientific establishments were the focus of one of the first Rayner scrutiny exercises, following concern expressed by Ministers over 'the scale of supporting staff and the comparatively small amount of work which is contracted out to the private sector.'[75] Thatcher requested that the review pay attention to the 'return on the investment in research—this is especially important in defence', indicating the focus on being able to demonstrate value for money from government expenditure.[76] The findings included over-provision of services, wasted land and buildings, lack of cost awareness and too much bureaucracy, provoking Thatcher to comment: 'I am appalled that after all our efforts such gross inefficiency still exists.'[77] Thatcher's comment represents an increasingly hostile attitude towards the civil service that emerged at all levels of society during the 1970s.[78]

In addition, despite a reduction in staff numbers during the 1970s, Rayner's team felt that tendencies among staff 'towards self-sufficiency, spreading out to use up accommodation available and subsidising work because it is interesting, is worrying.' The expectation from the Rayner review was for 'increasing cost-awareness and accountability in the establishments generally, upgrading the managerial responsibilities of scientists, moving towards financial control by scientific objective rather than inputs, through responsibility budgets for Directors.'[79]

---

[73] Treasury and Civil Service Committee, *Civil Service Manpower Reductions*, 22 July 1980, HC 712–I 1979–1980, p. 81.
[74] Lowe, *Official History*, *Vol. I*, p. 249.
[75] TNA, *PREM 19/772*. 'Memo from Lord Soames to the Prime Minister, 8 January 1981'.
[76] Ibid.
[77] TNA, *PREM 19/772*. 'Memo from Derek Rayner to the Prime Minister, 9 June 1982'.
[78] Lowe, *Official History*, *Vol. I*, p. 195.
[79] Cabinet Office, *Review of Support Services*, p. 24.

As civil service reform got underway a parliamentary committee report highlighted the lack of available information on government expenditure on R&D activities, voicing concern that there was too rigid a distinction between basic and applied research which meant that certain areas of research were being neglected.[80] In its response the Government stated they would ask ACARD and the Advisory Board for the Research Councils (ABRC) to periodically review the links between basic and applied research as part of the government focus on realising economic benefit from public expenditure on R&D.[81] In the resulting reports private sector involvement was increasingly included in discussions about the future of R&D activities.[82]

The Government also agreed to the publication of an *Annual Review of Government Funded R&D* which covered the spectrum of civil and defence research in academia, industry and government departments, although figures for defence research were not initially included.[83] For the OECD measuring research and development (R&D) was important as it was seen as a driver of economic growth, and interpretations of this role of R&D in the British economy was to affect government attitudes to the R&D that they sponsored.[84] While on secondment from BRE to the Cabinet Office Roger Courtney worked on creating consistency in the review despite the fluid definitions and interpretations of R&D activities:

> The difficulty was trying to identify what the various components were and whether the terminologies matched. [...] Is that applied research or not? […] Inevitably one type of work does blur into another, you were saying to people you should use *Frascati* definitions … you were culling data from, what, 25 different departments perhaps, there was a real issue in trying to make it as consistent as you could.[85]

---

[80] Science and Technology Committee, *Science and Government*, 12 November 1981, HL 20–I & 20–II 1981–82.

[81] Catherine M. Cunningham and Robin Nicholson, 'Central government organisation and policy making for British science and technology since 1982', in Robin Nicholson, Catherine M. Cunningham and Philip Gummett (eds), *Science and Technology in the United Kingdom* (Harlow: Longman, 1991), pp. 27–43 (p. 28).

[82] Advisory Board for the Research Councils, *Report of the Working Party on the Private Sector Funding of Scientific Research* (London: HMSO, 1986), p. 3; Advisory Council for Applied Research and Development, *Exploitable Areas of Science* (London: HMSO, 1986); Advisory Council on Science and Technology (ACOST), *Defence R&D* (London: HMSO, 1989).

[83] Office of the Prime Minister, *Science and Government: Government observations on the First Report of the House of Lords Select Committee on Science and Technology*, Cmnd 8591 (London:HMSO, 1982), pp. 6–7; Agar, *Science Policy under Thatcher*, p. 27.

[84] Godin, 'Research and Development', p. 66.

[85] Courtney, Track 13 [01:01:00–01:02:06].

The published data immediately offered policymakers the ability to analyse and compare departmental expenditure on R&D, as Courtney remembered:

> [It] raised some quite pointed questions about the expenditure on agricultural research …
> that I think was perhaps the major thing that came from that first one, a real questioning
> of [what] we were spending.[86]

The Government continued to endorse Rothschild's customer-contractor principle as the basis for departmental research transactions, but a 1979 review of the 1971 report's implementation had identified patchy success. One of the challenges faced by departments was in strengthening their capabilities in order to operate as 'intelligent' customers when formulating research requirements.[87] Research directors complained about receiving too many short-term commissions and the difficulty of redeploying staff to match the developing policy needs of their department.[88] There was also the extra time and costs involved in the administration generated by contracts.[89] As government departments strove to get a better grasp on departmental expenditure, new ideas about management and accountability were being introduced across the civil service.

2.2.2 New Public Management

The 1980s saw the emergence of international 'megatrends' in public administration that aimed to achieve savings in public expenditure, improve public services and make government more efficient.[90] These trends included efforts to limit the growth of government, a move towards automation and privatisation of public services. Hood gave these trends the label 'New Public Management' (NPM) which he describes as the convergence of successive waves of managerialism in the public sector with administrative reform doctrines based on ideas of user choice, transparency, competition and incentive structures.[91] In the UK, implementing NPM involved 'creating the right conditions for managers to manage', with senior managers being given the 'freedom' to use their discretion in decision-making while adopting private-sector styles of

---

[86] Courtney, Track 13 [00:54:17–00:54:47].
[87] Lord Privy Seal, *Review of the 'Framework'*, p. 5.
[88] Ibid., p. 6.
[89] Confirmed in Parker, 'The Rothschild Report'.
[90] Christopher Hood, 'Public Administration and Public Policy: Intellectual Challenges for the 1990s', *Australian Journal of Public Administration*, 48, no. 4 (1989) pp. 346–58 (p. 346); Pollitt and Bouckaert, *Public Management Reform*, p. 6.
[91] Christopher Hood, 'A Public Management for All Seasons?', *Public Administration*, 69, no. 1 (1991), pp. 3–19 (p. 5).

management.[92] Other major elements were the setting of performance standards, greater emphasis on controlling output (focusing on the results of scientific research activities rather than the processes), cost-cutting and developing a more commercial outlook.

The Financial Management Initiative (FMI) introduced by the Conservative government in 1982 was one manifestation of this trend in public sector reform.[93] Activities and budgetary processes were examined across departments as a way of improving control over expenditure, thereby offering the taxpayer better value for money. FMI aimed to provide a much clearer picture of how resources were being used and how much programmes cost, providing the information needed to manage by performance. In setting up their own internal management systems which measured output and performance, departments could follow the lead of Michael Heseltine while he was Secretary of State at the DOE (1979–1983).[94] Like Rayner, Heseltine had a successful background in the corporate sector, having set up and run a publishing business which produced the periodical *Management Today*. He applied his commercial experience to his political role, developing a new management and information system for Ministers called MINIS that aimed to improve civil servants' capacity to be effective managers.

When Heseltine moved from the DOE to become Secretary of State for Defence in 1983, information gathered by MINIS formed the basis for proposals for reorganisation of the MOD announced in a 1984 White Paper.[95] Described as 'the latest of a very long series of attempts by Ministers and officials to control a complex and unwieldy organisation', the goal of the reorganisation was again about efficiency, with 'a regime of executive responsibility budgets to provide financial and organisational discipline' being presented as the key to securing 'maximum cost-effectiveness' in an era of escalating costs.[96]

---

[92] Efficiency Unit, *Efficiency in the Civil Service*, p. 3; Per Lægreid, 'Accountability and New Public Management', in Mark Bovens, Robert E. Goodin and Thomas Schillemans (eds), *The Oxford Handbook of Public Accountability* (Oxford: Oxford University Press, 2014), pp. 324–38.
[93] National Audit Office, *The Financial Management Initiative* (London: HMSO, 1986), p. 1.
[94] Kate Jenkins, *Politicians and Public Services: Implementing Change in a Clash of Cultures* (Cheltenham: Edward Elgar, 2008), p. 57.
[95] Ministry of Defence, *The Central Organisation for Defence*, Cmnd 9315 (London: HMSO, 1984).
[96] Defence Committee, *Ministry of Defence Reorganisation*, 15 October 1984, HC 584 1983–84, pp. vii–xxxvii; Ministry of Defence, *Statement on the Defence Estimates*, *1984*, Cmnd 9227 (London: HMSO, 1984), para. 204.

Heseltine brought in another strong-minded outsider from the world of commerce, Peter Levene, to serve as Chief of Defence Procurement (CDP) during 1985–91. Levene initiated a series of reforms in defence procurement that emphasised open competition for contracts and a shift away from cost plus contracts (in which the supplier is paid the cost of the project plus a percentage profit) towards fixed price or incentive contracts.[97] His assessment of the prevailing attitude among the MOD scientists at that time was:

> We are here and we are scientists and we are here in the pure nature of our art to further the boundaries of scientific knowledge and we don't want all this financial mumbo jumbo imposed on us. […] I'm exaggerating obviously, but that's what we were looking at.[98]
> 🎧▶

Similarly the DOE conducted a further review of BRE in 1986, concluding that the organisation 'should be managed by reference to money rather than manpower numbers' and that it 'would benefit from operating more on commercial lines with greater freedom to manage.'[99]

2.2.3 Attitudes to public sector science

While civil service reforms and NPM directly impacted departmental research establishments, changing Conservative attitudes to science policy during the 1980s affected other sections of the science community. Gibbons et al. identified a global trend in science policy from the late 1970s towards the linking of scientific enterprise to industrial innovation and competitiveness.[100] Dasgupta and David interpreted US science policy as seeking to curb the budgets of scientists while directing their work towards objectives that were perceived to have better economic paybacks.[101] As Cohen et al. observed, the conduct of science was modified and repurposed according to 'emerging political, economic and social environments'.[102]

The arrival of the Conservative government under Margaret Thatcher did not stimulate a clear articulation of science policy in the same way that the 1971 Rothschild report

---

[97] Michael Bell, 'Leaving Portsoken—Defence Procurement in the 1980s and 1990s', *The RUSI Journal*, 145, no. 4 (2000), pp. 30–36; James, 'Organisational Change', p. 511.

[98] Peter Levene, interviewed by Emmeline Ledgerwood, London, 2019, BL C1802/22, Track 1 [00:16:12–00:16:32].

[99] Henry Chilver and Peter Harrop, *Review of the Building Research Establishment and Customer Arrangements* (1986).

[100] Gibbons et al., *The New Production of Knowledge*, pp. 157–160.

[101] Dasgupta and David, 'Towards a New Economics of Science', p. 487.

[102] Cohen, Duberley and McAuley, 'The Purpose and Process of Science', p. 234.

defined Heath's administration, yet many academic scientists soon felt under threat.[103] These scientists, typically occupied on basic research in research council institutes and in academia, were adversely affected by the impact of two policies. First, while the Conservatives maintained a constant level of funding for basic research through the DES Science Vote, this budget was stretched as it compensated for cuts made in 1981 to the separate stream of funding to universities that supported the infrastructure of scientific research.[104] Secondly, the amount of research commissioned by government departments from scientists in these settings fell due to tighter departmental budgets.[105]

At the same time the Conservatives were developing their position regarding the role of the state in industry. Part of this included the debate about 'how far Government should provide support for technical progress in industry, or where the boundary should lie between research and development in government establishments and in the private sector.'[106] This was not a new discussion. Fifteen years earlier, when asked to comment on the proportion of civil work conducted at the Atomic Weapons Research Establishment, the Secretary of State for Trade and Industry answered:

> There may be a need for more research to be done, but the question at issue is whether civil research of this sort should be funded by the Government or industry.[107]

One story from David Dunford about a visit Thatcher made to RAE illustrates Conservative attitudes to the role of government-funded R&D:

> [The Manufacturing Technology group] was unfortunately abolished because Mrs Thatcher said you can't do manufacturing in a government research lab, you're not allowed to do that. Manufacturing's done in industry.[108]

Chris Peel remembered 'a general feeling within the commissioning and purchasing parts of MOD that industry should take responsibility for its own kit,' told through this story about one of RAE's industrial partners:[109]

> Ministers of State went out round British industry warning them that they would have to take up the cudgels and my good friends in British Aerospace came to me and said, 'Oh we've had this funny Minister chap up here telling us we've got to do it all, so we're recruiting 200 materials scientists.' I said, 'good luck with that' and they did, and about

---

[103] Agar, *Science Policy under Thatcher*, p. 1.
[104] Education, Science and Arts Committee, *The Future of the Science Budget*, p. xix.
[105] Advisory Board for the Research Councils, *A Study of Commissioned Research* (London: HMSO, 1983), p. 7.
[106] Civil Service Department, *Review of the Scientific Civil Service*, p. 5.
[107] HC Deb 18 January 1971 vol 809 c 502.
[108] David Dunford, interviewed by Emmeline Ledgerwood, Farnborough, 2018, BL C1802/02, Track 2 [00:54:12–00:54:22].
[109] Peel, Track 2 [01:06:07].

> two years later they sacked them or converted them all into aircraft jobs because they couldn't sustain it. It's the wrong thing to do in industry. Industry's got a very clear focus on its products and how to develop them and sell them, not into doing stuff that you know is somewhat academic and perhaps a bit obscure.[110]

The Government became more specific about what kind of scientific research it was prepared to fund, first laid out in its response to a 1987 parliamentary committee report on civil research:

> Industry must take the initiative for its R&D programmes. This requires commercial decisions reflecting market forces. Government support is only considered where a worthwhile and viable project is at risk through failure of the market mechanism.[111]

Conservative policies for the funding of research programmes increasingly became delineated by terminology.[112] In his exploration of the factors that led to the decision to withdraw from 'near market' research, Agar identifies the parallel emergence of the Conservative commitment to funding 'curiosity-driven' or basic research as a driver of economic growth.[113] Following ideas that the health and progress of the economy was determined by entrepreneurial activity and free competition between private enterprises, the Government developed the idea of its role as a champion of entrepreneurs rather than following an industrial strategy of investing in specific sectors or firms.

These ideas were formalised in the 1988 White Paper *DTI – the Department for Enterprise*.[114] Hughes and Edgerton describe this as a move towards an 'anti-technocratic' position: 'a rejection of standard arguments relating science and technology to social and economic progress'.[115] In terms of science policy, this translated into support for basic research for the role it was perceived to play in stimulating innovation. This was reflected in the expansion of ACARD in 1987 to include more representatives from the academic science community, along with a change of name to the Advisory Council on Science and Technology (ACOST).[116]

---

[110] Peel, Track 4 [00:30:22–00:31:03].
[111] Office of the Prime Minister, *Civil Research and Development: Government Response to the First Report of the House of Lords Select Committee on Science and Technology*, Cm 185 (London: HMSO, 1987), p. 5.
[112] Kogan and Henkel, *Government and Research*, p. 8.
[113] Agar, *Science Policy under Thatcher*, pp. 94–6.
[114] Ibid., p. 423; Department for Trade and Industry, *DTI- the Department for Enterprise*, Cm 278 (London: HMSO, 1988).
[115] Edgerton and Hughes, 'The Poverty of Science', pp. 419–20.
[116] Cunningham and Nicholson, 'Central government organisation and policy making', p. 36.

However this development in science policy was not the primary impetus for organisational change in GREs. Rather the nature and pace of change was driven by the wider programme of civil service reform and the requirement for an increasing commercial outlook, as illustrated in this excerpt from an interview with RAE space scientist Desmond King-Hele:

> We got a new head of department in 1980 and he was completely Thatcherian. I remember the first thing he said when he addressed the department was that, 'No-one owes us a living, we've got to make money,' or something like that. And I thought, oh, heavens, this is ridiculous, because what happened was very sad really that each of the scientific specialities in turn was destroyed in the RAE by all sorts of methods.[117]

Departmental scientific research was considered no differently to the many other civil service activities that were all undergoing scrutiny, as indicated in this assessment of civil service reform from the union which represented scientific civil servants:

> Many of its measures were designed in isolation, following fast upon each other without allowing time to evaluate the consequences. The civil service became a vast experimental laboratory for ideologically-driven ideas, few designed with the special nature of the civil service in mind.[118]

This attitude ties in with Agar's argument that Thatcher's pre-parliamentary experience as a professional research scientist, with her insider knowledge of scientists' arguments for special status (see page 41), 'made her impervious to claims that science was a special case.'[119]

2.3 From agencies to privatisation in the 1990s

Increasing attention on whether government departments delivered value for money had come with the passage of the National Audit Act in 1983. Departmental activities were reviewed by the new National Audit Office (NAO), including assessments of whether the Government's efforts to improve efficiencies in the civil service through managerialism had taken hold.[120] Evidence of the slow uptake of new management practices caused members of the Efficiency Unit to think again. In reaction they proceeded with a study

---

[117] Desmond King-Hele, interviewed by Paul Merchant, Farnham, 2010, BL C1379/13, Track 12 [00:23:46–00:24:24].
[118] Institution of Professionals, Managers and Specialists, *Civil Service 2000 – A Strategy for the Civil Service in the 21st Century* (1995), quoted in Anne Beesley, 'Strategic Change in a Government Laboratory: The Case of the Building Research Establishment' (unpublished PhD thesis, University of Manchester, 2000), p. 62.
[119] Agar, *Thatcher, Scientist*, p. 226.
[120] NAO, *The Rayner Scrutiny Programmes, 1979 to 1983* (London: HMSO, 1986); NAO, *Ministry of Defence: Management of Work at Research Establishments* (London: HMSO, 1986); NAO, *The Financial Management Initiative*.

that led to the Next Steps report and proposals for the creation of executive agencies, a move to improve management by going beyond the creation of new internal systems to the redesign of organisational structures.[121]

As a result, RAE and BRE were transformed from GREs firmly embedded in the civil service to organisations destined for privatisation. This section describes the move of BRE and the defence research establishments to executive agency status, and how the operating frameworks of these new arm's length bodies propelled their eventual transfer into the private sector. Agency status brought opportunities and expectations for individuals to assume greater responsibilities while meeting requirements for accountability, yet the successful transformation of GREs into agencies ultimately made the case for them to be pushed even further from the centre. As one of Thatcher's special advisers on science policy argued, 'there is a strong case for privatisation of the Government Research Laboratories which would take the customer-contractor principle to its logical conclusion'.[122] As the focus of organisational change in the GREs moved from internal processes to the institutional frameworks and governance during the 1990s, so that logical conclusion became the destiny for the case study establishments.

2.3.1 Re-thinking civil service reform

In 1986 Derek Rayner's successor as head of the Efficiency Unit, Robin Ibbs, commissioned members of his team to assess the success of the FMI and the scrutiny programme.[123] Designed as a financial initiative, FMI had not made a substantial contribution to the Efficiency Unit's long-term objective of creating wider culture change among civil servants through developing a commitment to management and value for money.[124] The *Next Steps* report proposed a very different approach to the improvement of management of public sector entities with the establishment of agencies 'to carry out the executive functions of government within a policy and resources framework set by a department.'[125]

---

[121] Kate Jenkins, Karen Caines and Andrew Jackson, *Improving Management in Government: the Next Steps* (London: HMSO, 1988).

[122] Office of the Prime Minister, *Civil Research and Development*, p. 4; TNA, *PREM 19/2252*. 'George Guise to Margaret Thatcher, 10 March 1987', quoted in Agar, *Science Policy under Thatcher*, p. 89.

[123] NAO, *The Financial Management Initiative*, p. 2 and p. 11.

[124] Colin Thain and Maurice Wright, *The Treasury and Whitehall; the Planning Control of Public Expenditure 1976-93* (Oxford: Oxford University Press, 1995), pp. 66–69.

[125] Jenkins, Caines and Jackson, *Improving Management in Government*, p. 9.

Departments were required to review all their activities against five options: abolition, privatisation, contracting out, transfer to an agency or continuing as a departmental task. For the agencies that were then created, strategic control remained with the Minister and Permanent Secretary, but the internal management teams assumed independence as to how they met departmental objectives.[126] These arrangements were codified in framework documents which set out the delegated responsibilities for the new arm's length bodies. Some 63 per cent of civil servants were transferred to executive agencies during the period 1989–95.[127] This served a useful function for the Government as the staff could be counted differently so it could be argued that the civil service was being reduced in number.

The 1986 review of the BRE had already recommended that it should be run more along commercial lines, paving the way for BRE to become an agency in April 1990.[128] In MOD various internal reviews were conducted during the 1980s, leading to a 1988 feasibility study which saw the need for fundamental changes in the way MOD did business with the research establishments.[129] These changes included a much sharper customer-supplier relationship, new financial, managerial and operational systems, and must greater freedom to obtain non-MOD business. The feasibility report recommended the creation of a Defence Research Agency (DRA) which became a reality in April 1991. This was seen as an essential step in putting the defence research establishments on a footing which would enable them to attract and retain skilled staff and to allow MOD to obtain better value for money.[130] At the same time a 1989 external analysis of defence research concluded project management in defence procurement needed an overhaul and that GRE scientists were no longer capable of supplying the necessary level of expertise for a totally intramural informed customer capability.[131]

---

[126] Ibid.
[127] Rebecca Boden et al., 'Administrative Reform of United Kingdom Government Research Establishments: Case Studies of New Organisational Forms', in Deborah Cox, Philip Gummett and Katharine Barker (eds), *Government Laboratories: Transition and Transformation* (Amsterdam: IOS Press, 2001), pp. 77–96 (p. 79).
[128] Courtney, 'Building Research Establishment Past, Present and Future', p. 288.
[129] Farnborough Air Sciences Trust archives. 'Letter from Donald Spiers, Controller Establishments Research and Nuclear Programmes to Establishments staff, 16 March 1989'.
[130] Ibid.
[131] Matthew Uttley, 'Contracting-out and Market-testing in the UK Defence Sector: Theory, Evidence and Issues', *Public Money & Management*, 13, no. 1 (1993), pp. 55–60; ACOST, *Defence R&D*, p. 29.

2.3.2 What did executive agency status mean?

John Houghton, Director General at the Meteorological Office in the 1980s, spoke about the objectives behind executive agency status in an interview for OHBS:

> The big organisational thing that came along as a result of the government's finances … came from Margaret Thatcher who was trying to, you know, get more professionalism again into government of a sensible business kind, and she saw a lot of bodies in government who were not properly accountable in a serious sense, and should be given, you know, much more freedom of action. The object of the agency … was for the Met Office to have its own budget, have its own programme, costed programme each year, and just like any other business, and to have aims and intentions and all these things and also to have targets of different kinds.[132]

Agencies and the more entrepreneurial staff within them flourished with new freedoms and managerial arrangements. The organisations began to operate as self-financing businesses subject to targets agreed with the parent department and were freed from limits on staffing and expenditure. The chief executive was answerable directly to Ministers for the agency's performance.[133]

DRA came into existence just as the end of the Cold War ushered in a new era of international relations. John Chisholm, the new chief executive, remembered that,

> Margaret Thatcher had asked the question 'Why did we still have 14,000 involved in defence research when we'd won the Cold War, so shouldn't something be done about that?' The notion was that it must be a big asset for the country, why don't we try and commercialise it, not privatise it, but commercialise it.[134]

An internal strategy document summed up the challenge for DRA as providing 'the service required for less money'.[135]

To achieve cost savings and improve efficiency, plans were drawn up to rationalise the 54 MOD sites and assess the provision of support services.[136] This involved withdrawal from 19 locations to concentrate most research activities onto 12 sites, and staff reductions of about 2000 people.[137] This meant upheaval and transformational change that many interviewees refer to as being more disruptive than eventual privatisation. Chris Peel describes the process as, 'scrapping and consolidating and selling off'.[138]

---

[132] John Houghton, interviewed by Paul Merchant, Aberdovey, 2007, BL C1379/45, Track 6, transcript p. 161.
[133] Courtney, 'Building Research Establishment Past, Present and Future'.
[134] John Chisholm, interviewed by Emmeline Ledgerwood, Rickmansworth, 2019, BL C1802/23, Track 4 [00:49:24–00:50:05].
[135] Defence Research Agency, *Corporate Plan 1992–97*.
[136] 'The shape of things to come', *DRA News*, April 1992, p. 3.
[137] 'Tomorrow's DRA', *DRA News*, October 1992, p. 4.
[138] Peel, Track 6 [00:15:02].

> Before there was privatisation there was a merging of the establishments … basically because they were unaffordable. That's a bigger change than the privatisation almost. The Second World War had produced a lot of necessary activity and as things changed perhaps became overmanned and too many establishments. … A lot of ground possessed, a lot of airfields, test sites.[139]

This excerpt from the interview with Andrew Cahn, a senior civil servant at the Ministry for Agriculture, Food and Farming at that time, indicates the justification for such measures:

> When you went and visited some of these research institutes you did get a sense of sort of comfort and pretty small-scale activity. I didn't actually think the policy was entirely wrong. I thought it was taken to extremes … I thought it was right to amalgamate quite a lot of their research institutes and be much more demanding of them. And give them much clearer requirements and what we wanted from them. I think life had been quite comfy for everybody and Mrs Thatcher made it uncomfortable.[140] 🎧 ▶

At BRE the move to executive agency status in 1990 was less physically disruptive for staff, since some stages of rationalisation had already taken place. Timber research at Princes Risborough had moved to the BRE site at Watford in 1988, while fire research followed later in 1994.[141] Roger Courtney, director of BRE in the 1990s, saw agency status as representing 'the final stage in BRE's transition from a centrally-funded organisation concerned essentially with scientific research to one which provided a range of professional services, including research, for a variety of customers within and outside Government'.[142]

In 1993 the Defence Research Agency (DRA) moved to Trading Fund status which meant it no longer received a block grant from the department but instead had to recover the cost of its work item by item from its customers, the majority of which were within the MOD. The new managerial freedoms combined with the realisation of capital assets gave impetus to the implementation of change, as John Chisholm, CEO of the new agency, explained:

> [In] that early part of it DRA had tremendous autonomy. And could get on with it. Of course all within an envelope, and that envelope was funded by our ability to sell land and since we had a heck of a lot of land we were able to get on with that, generate the capital … very little downward interference.[143]

---

[139] Peel, Track 3 [0:38:10–00:38:54].
[140] Andrew Cahn, interviewed by Emmeline Ledgerwood, London, 2019, BL C1802/14, Track 1[00:31:44–00:32:28].
[141] Courtney, 'Building Research Establishment Past, Present and Future', p. 286.
[142] Ibid., p. 288.
[143] Chisholm Track 5 [00:05:35–00:07:05].
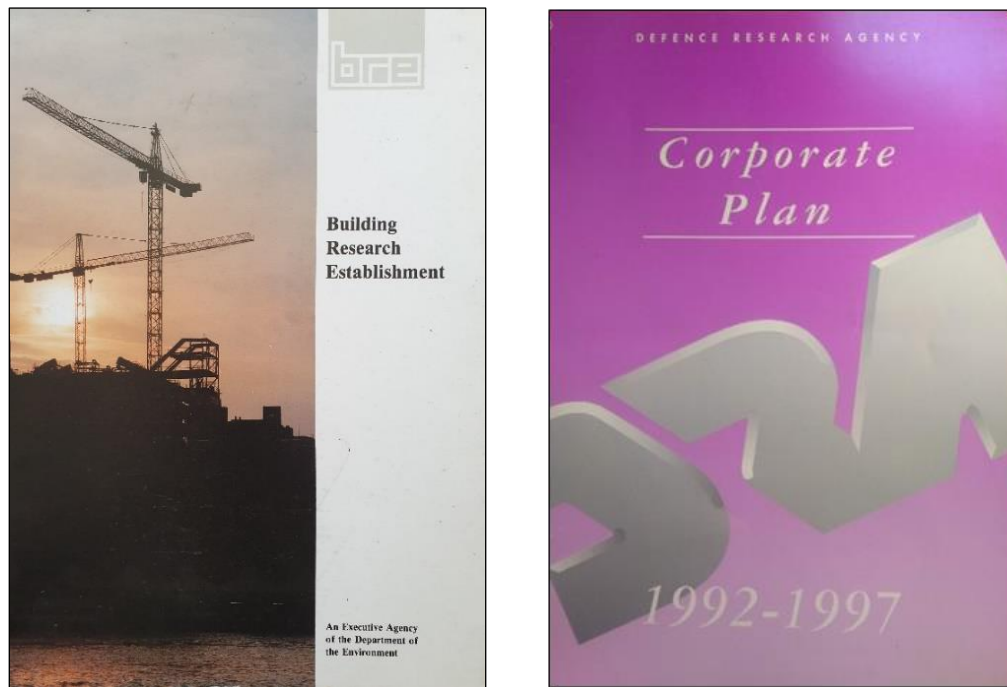
2.5 *Examples of the corporate literature published by the new executive agencies.*

Chisholm acknowledged the upheaval incurred: 'Constantly it was a matter of consolidation, of reorganisation that had been a world in which they [the scientists] had always lived.'[144] Key laboratories were refurbished as part of the programme which was funded by a £200 million rationalisation fund from MOD.[145] At Farnborough activities were moved from the old site to a new, adjacent technology park with open plan offices and purpose-built facilities. For some staff this move represented the end of an era, for others it signified the launch of a flexible organisation that could respond to changing customers' needs.[146]

Demonstrating value for money was an integral element of the Thatcher campaign for efficiency in the civil service and drove an increased requirement for accountability. The introduction of a New Management Strategy at MOD created distinct management areas that placed greater responsibility for accountability on MOD staff: 'In future we will ... come under the scrutiny of the National Audit Office and other bodies ensuring that we give value for money.'[147] DRA was very much geared towards MOD as its primary

---

[144] Chisholm, Track 5 [00:36:00].
[145] 'New lab represents "the cutting edge"', *DERA News,* February 1996, p. 12.
[146] 'Loss of laboratories signals end of scientific data collection', *DERA News*, March 2001, p. 14.
[147] 'Revolutionary changes afoot', *DRA News*, Sept 1992, p. 4.

customer, so that changes in the procurement side of MOD were reflected by the creation of new internal structures in DRA. As the agency gradually diversified its customer base, it shed its divisional structure based on scientific disciplines to create a flatter organisation, what CEO Chisholm saw as 'the need to arrange ourselves in a way that our new non-MOD customers will find more relevant'.[148] Similar corporate-style arrangements were put in place at BRE, as Anthony Bravery outlined:

> We tended to have operational units that were related to our key personnel and in the days when we were fully government-funded that was about disciplines, so we had mycology, microbiology, we had entomology, but when we were moving away towards products and services for the working world as it were, we went away from being chemistry and physics and so on, we went to the application side and the structure was linked to the market as it were.[149]

Executive agency status fundamentally altered the GREs' position and role in the research landscape, a shift that steered the organisations towards the private sector.

2.3.3 The final stage

Staff speculated that the creation of agencies was one step on an inevitable path to privatisation, following the privatisation of a few departmental research laboratories in the early 1980s (see Appendix 2). On creation executive agencies became subject to a 'Prior Options' review process after three years of operation to assess whether another mode of ownership, such as a move to the private sector, should be adopted.[150]

Just as the new executive agencies were being set up, changes in Conservative party leadership saw John Major become Prime Minister in 1990 and led the Conservatives to victory in the 1992 general election. A new Office of Science and Technology (OST) was set up alongside the Efficiency Unit in the Cabinet Office.[151] The OST was assigned responsibility for civil science policy, and immediately began work on a study which noted that science and technology spending had been 'inhibited by over rigid distinctions between near and far from market R&D'.[152] It concluded that the 1987 withdrawal of

---

[148] 'Divisions go in move to a flatter structure', *DERA News*, April 1997, p. 1; John Chisholm quoted in 'Planning ahead—the process begins', *DERA News*, December 1999, p. 1.
[149] Bravery, Track 8 [00:24:00–00:24:47].
[150] Courtney, 'Building Research Establishment Past, Present and Future', p. 288.
[151] TNA, *Office of Public Service and Office of Public Service and Science*, <https://discovery.nationalarchives.gov.uk/details/r/C704> [accessed 14 June 2021].
[152] Peter Levene and W. D. P. Stewart, *Review of Allocation, Management and Use of Government Expenditure on Science and Technology* (London: HMSO, 1993), p. 3.

government support for 'near market' research had resulted in negative consequences for collaboration between the public and private sectors. This review informed the 1993 White Paper on science and technology which aimed to put wealth creation at the heart of science policy-making, while acknowledging the ongoing challenge of deciding where to allocate resources across the spectrum of scientific research activities:

> The decision for Government, when it funds science, as it must, is to judge where to place the balance between the freedom for researchers to follow their own instincts and curiosity, and the guidance of large sums of public money towards achieving wider benefits. [153]

The study paid particular attention to the use of the customer-contractor principle in the disbursement of government funding on research, finding that it was still unevenly applied across departments. It recommended that government departments should diversify their supplier base through a fully competitive commissioning process open to both public and private suppliers. Of particular relevance to those scientific civil servants working in the newly created agencies was the conclusion:

> We find the objections to privatisation of GREs largely unconvincing, especially where there is a reasonable prospect of changing the GREs' cultures, extending their capabilities and customer-base, and reducing their costs. [154]

This was restated in the White Paper, along with the proposals of how the Government would proceed:

> The Government believes that many of the services currently provided by its research establishments could be carried out in the private sector. … The Government therefore intends to undertake a scrutiny of the public sector research establishments to review, sector by sector, the future status of establishments, looking in depth at privatisation, rationalisation and different options for ownership.

This statement marked a distinct shift in policy. Previously organisational change in GREs had been part of a wider programme of reform across the civil service. The 1993 White Paper focused on examining the research establishments specifically as cases for privatisation, leading initially to a round of scrutinies of public sector establishments which were occupied with civil research, including BRE. [155]

---

[153] Gummett et al., 'The Changing Central Government of Science and Technology', p. 239; Office of the Prime Minister, *Realising Our Potential: A Strategy for Science, Engineering and Technology,* Cm 2550 (London: HMSO, 1993), p. 2.
[154] Levene and Stewart, *Review of Allocation*, p. 72.
[155] *Multi Department Scrutiny of Public Sector Research Establishments,* 1994.

At the same time the MOD conducted a series of studies that looked at how the MOD could pursue a transformation into a more business-like organisation:

> Now we need to encourage clarity of purpose and a sense of personal accountability and responsibility, rather than management by committee and consensus which all too often is used as an excuse to avoid or dilute these responsibilities.[156]

The resulting programme of cuts included further rationalisation of the MOD research establishments to achieve additional staff and financial savings, bringing all non-nuclear science and technology organisations into a single executive agency called the Defence Evaluation and Research Agency (DERA). Rather than managing activities according to scientific disciplines, the new structure reflected corporate research 'aimed at maintaining and developing the defence science and technology base' and contract research aimed at meeting 'the specific needs of the armed forces, linked to particular equipment requirements.'[157]

A 1994 review of the implementation of executive agencies noted increasing diversification in how these agencies were structured, 'the only element of unity which will be left, besides ethical standards, will be the uniform tag of being a civil servant'.[158] Over time a variety of organisational forms emerged for the administration of government-funded science and technology activities, from those that remained wholly owned and managed by the state in public ownership, those that were government owned but run by private companies, and those that transferred fully into the private sector (see Appendix 2).

The final impetus for privatisation came from a combination of factors rather than a strategic focus on civil service reform or the role of government-funded R&D. First was the increasing ambiguity of agencies in terms of accountability. Individual decision-making in agencies and a requirement for commercial confidentiality could impede effective accountability through the traditional parliamentary methods of questions to

---

[156] Malcolm Rifkind, 'Front Line First', *RUSI Journal*, 139, no. 6 (1994), pp. 1–6 (p. 2).
[157] Ministry of Defence, *Front Line First: The Defence Costs Study* (London: HMSO, 1994), paras. 417–420.
[158] Sylvia Trosa, *Next Steps: Moving On* (London: HMSO, 1994), para. 2.17 and p. 38; Jonathan Tonge, *The New Civil Service* (Tisbury: Baseline, 1999).

Ministers or select committee inquiries.[159] The tension between agencies' remit for greater autonomy and the concern within parent departments that agencies would pursue their own objectives was summarised by Roger Courtney as:

> The theme in the eighties was essentially the executive agency as a way of seeking to put private sector disciplines into a public sector operation and I think it then took time for both the benefits and perhaps the inconsistencies of that approach to become evident.[160]

Courtney remembers Michael Heseltine's view of the new organisational arrangements:

> I think he came to the view that, in a sense, executive agencies which were not particularly close to the real business of government were neither fish nor fowl, and that there wasn't an overwhelming need for government to own these bodies, whatever use it might have of them.[161]

As an agency BRE's activities has shifted towards providing a range of services to different customers, with a particular focus on environmental matters such as energy efficiency and sustainability.[162] Membership of the European Union during the 1970s had brought a new role contributing to the setting of Eurocodes on which BRE was employed for many years. Martin Wyatt, who became CEO of BRE after privatisation, explains how these developments influenced the organisation's prospects:

> Building science was pretty mature. there were new vistas to do with sustainability and things, but Government wasn't going to pay for that, they were running down building regs. The future for BRE as an agency in government was not looking rosy so whilst the staff here would have cheered to the rooftops had it been abandoned, they'd have been cutting their own throats in our view.[163]

The 1997 election and the arrival of Labour in government heralded the eventual organisational outcomes which involved the Government having to provide longer-term guarantees of future work. After a prior options review of BRE, it had been announced in November 1995 that BRE would be transferred to the private sector.[164] Martin Wyatt, who led the management buy-out team that set up the not-for profit BRE Trust, recounts an anecdote about how the prospect of a general election galvanised the privatisation process for BRE:

> What happened was towards the end of the Thatcher years, when they knew they were going to lose the election in '97, Heseltine sent an edict out across all departments saying

---

[159] Barry Winetrobe, 'Next Steps and Parliamentary Scrutiny' in P. J. Giddings (ed.), *Parliamentary Accountability: A Study of Parliament and Executive Agencies* (Basingstoke: Macmillan, 1995), pp. 33–51 (p. 35).
[160] Courtney, Track 14 [00:59:00–00:59:32].
[161] Courtney, Track 18 [00:02:20–00:02:47].
[162] Courtney, 'Building Research Establishment Past, Present and Future', p. 288.
[163] Martin Wyatt, interviewed by Emmeline Ledgerwood, Watford, 2018, BL C1802/04, Track 4 [0:44:59–00:45:21].
[164] Courtney, 'Building Research Establishment Past, Present and Future', p. 289.

we have now got to privatise anything and everything we can before the election is called.[165]

The term privatisation itself was closely associated with the Conservatives but in effect the incoming Labour government under Tony Blair continued the programme.[166] For DERA CEO John Chisholm, Labour's arrival offered the opportunity to propose a new structure for defence research:

> During the Major regime we basically created DERA as a successful organisation, it was trading successfully, winning business, slowly developing its non-MOD business and actually generating cash, it was the very success we were having in the defence market however that was causing us our trouble because other defence companies were understandably complaining and that gets to be very difficult because it's very hard to run an organisation not to be successful. […] The noise from industry began to creep up from '95 onwards. […] I said to the incoming administration 'you will kill us if you continue to own us. […] When the new Labour government came in, I studied what they had said in their manifesto and picked up their theme of a Third Way, which I liked, which I thought was a good description of what we were trying to do. We were trying to build a successful organisation with a public good agenda but nonetheless doing it within an innovative and incentivised environment so it could be really sparky.[167]

Chisholm proposed a privatisation arrangement whereby DERA should continue operating according to a clear public good agenda, but with financing via flotation on the stock exchange.[168] The 1998 Strategic Defence Review included an announcement of plans to shift DERA towards a public-private partnership arrangement, however political concerns about the impact on UK-US collaborative research led to an arrangement whereby DERA was split into two organisations in 2001.[169] One remained as a government agency with the public good agenda, the Defence Science and Technology Laboratory (Dstl). The bulk of the technology and testing activities went into the second organisation which operated as a trading fund called QinetiQ until becoming a public-private partnership. QinetiQ was floated on the stock exchange in 2006.

These assessments of privatisation from Roger Courtney and John Chisholm indicate that it was the final phase in what many interviewees experienced as a continuum of transformation:[170]

---

[165] Wyatt, Track 4 [00:00:33–00:00:57].

[166] Peter K. Falconer and Kathleen McLaughlin, 'Public-private partnerships and the "New Labour" Government in Britain', in Stephen P. Osborne (ed.), *Public-Private Partnerships: Theory and Practice in International Perspective* (London: Routledge, 2000).

[167] Chisholm, Track 8 [00:07:24–00:10:33] and Track 6 [00:43:18–00:44:48].

[168] Chisholm, Track 8 [00:22:50].

[169] Defence Committee, *The Defence Evaluation and Research Agency*, 6 July 1998, HC 621 1997–1998, para. 35.

[170] Gummett et al., 'The Changing Central Government of Science and Technology', p. 244.

> One shouldn't think of the privatisation as a vast immediate change in the way things worked. It wasn't. It followed a period in which there had been some change and it was succeeded by a period in which there was an underlying guarantee and therefore a continuity in the relationships that took place between the establishment and the people that immediately it was serving. So yes, it was clearly a significant change in organisational status and in due course clearly in culture but not necessarily one that was immediately translated into different styles of work.[171] ∩ ▶

> One of my senior people said to me that he had been there since the sixties and his whole [working] life had been a process of downsizing, he'd never been in an organisation that was growing and developing so it was not a pleasant experience for everyone who went through it, but it was not something that hadn't been done before.[172] ∩ ▶

Vic Crisp's comment neatly summarises the outcomes for BRE that could also be applied the other research establishments that went through privatisation:

> I think most people thought it would be mean the end of BRE as we know it. And to some extent, it has been, it's a very different animal now, earns most of its money doing quite different things and not a great deal of basic research anymore. It does support basic research but most of it is given to the associated university departments. It seems to be quite a successful model actually.[173]

2.4 Conclusion

This chapter has outlined the changing government attitudes to the funding and organisation of research between 1970 and 2001. At the beginning of this period the management of GREs came under review resulting in the Rothschild recommendations for a customer-contractor relationship between GREs and their parent departments. During the 1980s change in GREs was largely determined by Conservative ideological aims to create a leaner and more efficient whole civil service, driven by the NPM public sector reform agenda.

While the reform processes of NPM were not conceived as a deliberate precursor to privatisation, the expectation that public sector entities such as executive agencies should operate more like private firms paved the way for their transfer of the case study organisations into the private sector. As GREs met requirements to develop more commercial outlooks and competitive behaviour, they demonstrated their viability as independent entities. Operating in a quasi-autonomous way, the executive agency organisational form proved difficult to sustain when the civil service lines of ministerial accountability became unacceptably blurred. Agency status demonstrated that the GREs

---

[171] Courtney, Track 20 [00:15:40–00:16:45].
[172] Chisholm, Track 7 [00:22:06–00:22:53].
[173] Crisp, Track 8 [00:16:20–00:16:57].

could successfully contract out some of their functions and operate in a commercial environment. Consequently in the 1990s they were subject to more focused consideration from the Conservatives as potential candidates for privatisation. The processes of privatisation were then driven forward under the Labour government that came to power in 1997.

Conservative attitudes regarding the role of state-funded R&D in stimulating industrial performance resulted in a separate strand of policy-making that was articulated as a withdrawal from 'near market' research. The framing of these policies, by assuming clear demarcations between different types of research, created artificial boundaries that were difficult to apply on a practical level.[174] In outlining the progress of change in GREs, this chapter has shown how civil service reform coincided with science policy, so that the transfer of many GREs into the private sector occurred in parallel with the withdrawal of state support for 'near market' research. Government support for scientific research activities became concentrated on 'curiosity-driven' research in academia and research council institutes, while the Conservative expectation that industry would step in to continue the applied R&D that the state no longer wished to support was not realised. These developments converged to create a period of upheaval across the national research landscape.

This examination of policy-making has highlighted how the need for culture change was acknowledged as an integral element in the successful implementation of civil service reform. However as Paul Cannon commented, 'it was a political decision to do these things without actually a full understanding of the ramifications for people along the way.'[175] The following chapters seek to understand those ramifications by exploring how change was experienced by individual scientists and analysing individual accounts for what they tell us about the long-term impact of change on the cultivation of deep expertise and relationships between government and science.

---

[174] Laura Cruz-Castro, Luis Sanz-Menéndez and Catalina Martínez, 'Research Centers in Transition: Patterns of Convergence and Diversity', *The Journal of Technology Transfer*, 37, no. 1 (2012), pp. 18–42 (p. 23).
[175] Cannon, Track 4 [00:36:23].

3. A career in government science

The organisational changes in GREs fundamentally altered the structures and practices which determined government scientists' working lives. There is no single defining moment of dramatic change from which to make a 'before' and 'after' evaluation of how their working lives changed. Instead interviewees' reflections about their careers coalesce to show the typical features of everyday working life in the GREs at different stages in this process of change. This chapter, along with Chapters 4 and 5, focuses on understanding GREs during the stages when they were firmly attached to their parent departments. From this understanding I then move on in Chapters 6 and 7 to evaluating the implementation and impact of organisational change in GREs.

During the earlier years of the period 1970–2005 the progress of government scientists' careers and their ways of working were determined by the overlap of two working worlds—science and the civil service. This created an institutional culture peculiar to the GREs. In this chapter I consider the motivations and influences that steered my project participants into a career as a scientific civil servant, drawing out common threads in interviewees' stories about developing an interest in science, why they applied to the scientific civil service and their expectations for career progression. I use interviewees' descriptions to portray their early lives, focusing on aspects of their family backgrounds and educational opportunities that contributed to the development of an interest in science. I then discuss their development as scientists after leaving school, whether that involved direct entry into the scientific civil service, higher education or experience in industry, drawing on the interview material to understand interviewees' motivations for becoming a government scientist in a GRE. Finally, I evaluate the expectations and aspirations that my interviewees associated with a career in the scientific civil service.

Chapter 4 then focuses on descriptions of the sites, technologies, people and activities that together allowed for the production of knowledge in a GRE, using interviewees' accounts to identify the norms that were associated with working in a GRE before commercialisation. Chapter 5 discusses the elements of a working life in a GRE which bonded scientists together through a workplace culture. As embodied in the name scientific civil servant, interviewees had dual identifies which were shaped by the

institutional environment in which they worked—that of public servant and professional scientist.

3.1 Becoming a scientist

Details of early life and education recounted by participants who went on to use technical or scientific skills in their work reveal stimuli and influences that were particular to the era and locale in which they grew up. This section sets their individual histories against the backdrop of the period and the society in which they developed as scientists. As Kohler points out, 'because laboratories are so integrally a part of their times and places, lab history is of necessity also social history.'[1] Interviewees' stories are not just stories about becoming and being scientists, but about the world in which they became scientists. Their stories of change in the GREs illustrate wider cultural changes that occurred across British society in the latter part of the twentieth century.[2]

The interviewees who worked as scientific civil servants joined the service during a 20-year period that ran from the late 1960s to the late 1980s (see Appendix 4). Accounts of growing up, education and early adulthood therefore span a period that begins with the immediate years after the Second World War and continues into the 1980s. Commonalities across the interviews emerge from anecdotes of individual experiences, building up a picture of the social context in which these interviewees matured into prospective working scientists. This section sketches that picture, focusing on details that illuminate the position that science and technology held in society and the instances whereby growing up in this particular period influenced interviewees' routes into the working worlds of science.

3.1.1 Childhood backgrounds

For the older interviewees in this group, born in the 1940s and 1950s, the residual effects of the Second World War were very much part of their childhood, and a few shared personal memories of wartime. Shirley Jenkins was the only interviewee to be born in the 1930s before the outbreak of war. As a young child living in Kent during the Second

---

[1] Robert E. Kohler, 'Lab History: Reflections', *Isis*, 99, no. 4 (2008), pp. 761–68 (p. 765).
[2] Ibid.

World War, she would visit the local barrage balloon site with friends, ever conscious of aircraft overhead:

> We were under one of the main flight paths for things going into London of course. […] The V1s … they were always coming over us and it was just about where we were, where the engines would cut out for their final dive into London, so we were quite happy if the engines were still going, if they came over silently then it was a bit more of a worry they could come down any time. […] You were very much aware of all the fighters and bombers and dogfights, it was an interesting, exciting time for kids ... you would actually see them.[3]

Remarks about childhood indicate that at that stage in their lives the Second World War was in the very recent past, such as this comment from Vic Crisp:

> There was still the potential threat of National Service until quite late in my school days when National Service disappeared, I remembered some of the guys in the sixth form were carted off for National Service.[4]

Many of the older interviewees grew up in an era defined by a sense of service to the nation, with parents or relatives who had served in various capacities during the Second World War[5] or were called up for National Service.[6] Wartime service included technical,[7] educational,[8] transportation[9] and nursing roles.[10] This short excerpt about Alan Gray's father tells us about both the wartime need to develop technically trained personnel during the Second World War, and the post-war focus on developing nuclear defence capabilities as geopolitics transitioned into the Cold War:

> As the war started he was an air-gunner, I think on Wellingtons, but the trouble was they were losing so many aircraft so quickly that Dad was taken off because they were losing the technical people who they had trained before, they hadn't built up a huge cadre of young men to do the sort of job that the technicians were doing ... the RAF kept him on the ground safe somewhere doing something rather strange … in research establishments and in the RAF. […] Dad worked on the V bomber force in the Black Shed.[11] […] His particular bent was on the development of aircraft weapons systems for specific purposes, so he modified all sorts of aircraft and did all sorts of rather strange jobs and included in that was the work he did on the V bomber fleet.[12]

---

[3] Shirley Jenkins, interviewed by Emmeline Ledgerwood, Farnham, 2019, BL C1802/17, Track 1 [00:17:27–00:18:35].

[4] Crisp, Track 1 [00:26:43–00:27:05].

[5] Phil Catling, Shirley Jenkins, Paul Cannon and Robyn Thorogood.

[6] Roger Courtney.

[7] David Dunford, Alan Gray.

[8] Sarah Herbert, Anthony Bravery.

[9] Alan Gray.

[10] Sarah Herbert.

[11] The V bomber aircraft were designed to carry nuclear weapons and came into service during the 1950s. The Black Sheds on the Farnborough site were an extensive groups of aircraft hangars that were built before the First World War.

[12] Alan Gray, interviewed by Emmeline Ledgerwood, Malvern, 2019, BL C1802/12, Track 1 [00:03:33–00:04:43].

The older interviewees describe post-war childhood homes that were being transformed by the introduction of novel appliances or technologies, the arrival of which were occasions to celebrate, as Paul Cannon remembered:

> The day the telephone went in … this makes me feel so old. And when the central heating went in [...] that was just glorious for my poor mother, she would come down early in the morning and she would be the one who made up the fire.[13]

They predominantly remember family lifestyles that were self-sufficient rather than affluent; as Chris Scivyer put it, 'money was tight but we never went lacking anything.'[14] Childhoods are remembered through accounts of happy activity. Interviewees went fishing and sailing, enjoyed train spotting, walked the dog, played sport, belonged to the school chess club, were members of the scouts or guides or sea cadets, learnt to play musical instruments, sang in church choirs, participated in amateur dramatics, collected stamps, sewed and read. They were also expected to be self-sufficient and independent, making their own way to school from the age of four or five, or roaming the neighbouring environs unsupervised.

Descriptions of childhood past-times include those which might be construed as predicting a technical leaning, such as playing with Meccano and Lego or Chris Peel's hobby of carrying out chemistry experiments at home.[15]

> I had a Boys' Own compendium of science, black and yellow covers, it had a chapter in the chemistry section on explosives—how to make your own, from TNT and gelignite, guncotton, you know, pretty much nitroglycerin. […] I went through the lot making them, one by one.[16]

Others such as Mike Westby speak about technical activities such as doing DIY around the house or getting absorbed in parents' interests:

> My father was a very enthusiastic member of the Nottingham Society of Model Engineers. […] His garage was a completely equipped workshop with a number of machine tools, the whole panoply, you could make anything you like in there. So I grew up with that from my earliest memories being around engineering, manufacturing, making things, understanding how machines work, they always fascinated me.[17]

Some commonalities across the interviews indicate the contemporary technological fascinations. One is an interest or experience among interviewees and their fathers in the

---

[13] Cannon, Track 1 [00:23:42–00:24:19].
[14] Scivyer, Track 1 [00:43:55]. Also David Dunford, Vic Crisp, Paul Cannon and Ian Linsdell.
[15] Gooday, 'Placing or Replacing the Laboratory', p. 790.
[16] Peel, Track 1 [00:25:32–00:26:07].
[17] Mike Westby, Track 1 [00:11:05–00:11:46].

technology of radios.[18] A number of interviewees' fathers, for example David Dunford's, were responsible during the war for operating radios or training fellow servicemen on how to use the technologies of war:[19]

> He was a wireless operator in the RAF Coastal Command and he built two radios, in fact he used to build radios before he even started there, he used to get the valves and bits and pieces and build radios.[20]

In describing his teenage enthusiasm for amateur radio, Paul Cannon reminds us of a world in which international travel had yet to become commonplace:

> There is nothing more wondrous, or in that era at least, than building your own crystal set and just with two or three components and an earpiece, being able to hear the radio, the light programme. Just phenomenal for me, inspiring. […] I would go to evening classes at Southgate Technical College so that I could learn what I needed … to become a ham. […] People lose this wonder these days, everybody's got their mobile phones, their TVs or whatever, back in the sixties to be able to sit in your bedroom and be able to listen to people talking from Australia, it was just incredible. It's hard to explain but you had no hope, it didn't cross my mind, that I would ever go to Australia—youngsters today wouldn't feel that.[21]

The other common theme of childhood is a passion for aviation, often accompanied by ambitions to become a pilot.[22] Phil Catling's account is a good example:

> A teenager interest—I was very keen on aviation with the local airport being next to us in Portsmouth at the time, I had ambitions to be a pilot or air traffic controller, I bought lots of aircraft magazines, I visited air shows, airports to get the tail numbers off aeroplanes, not a train geek but an aeroplane geek, Airfix models, […] enjoyed aviation films. I had no big career aspirations at the time other than to be flight-related and enjoyable.[23]

These childhood interests did not necessarily determine future career choices, although for Cannon, now a world expert in the field of radio science and space weather, his 'hobby became a career effectively'.[24] Sarah Herbert sees her observation of nature as 'the sort of nearest I got to science as a child',[25] going on to remark:

> I really and truly, apart from the fact that I did extremely well at maths at school, I didn't really think in any way I was going to do [anything] scientific … I was going to be an artist, wasn't I?[26]

What their early lives show, with examples of interests in radio communications and aviation, is an attraction to the idea of science as an instrument that could bring the world

---

[18] Roger Courtney, Alan Gray and Sarah Herbert.
[19] Roger Courtney, David Dunford, Sarah Herbert and Anthony Bravery.
[20] Dunford, Track 1 [00:24:57–00:25:11].
[21] Cannon, Track 1 [00:32:24–00:37:56].
[22] David Dunford, Steve Rooks, Mike Westby and Shirley Jenkins.
[23] Catling, Track 1 [00:01:07–00:01:48].
[24] Cannon, Track 1 [00:46:21].
[25] Herbert, Track 1 [00:13:35].
[26] Herbert, Track 1 [00:18:58–00:19:10].

together, science as a vehicle to reach beyond the ordinary experience, science as an excuse to create and experiment with heroic and exhilarating technological wonders. Their accounts hint at the many presentations of science which were on offer during their childhoods: the victorious science of the Second World War, with its power to produce destructive military might; the surveillance science of the Cold War, covert and distrustful; the science of the space race, with its aura of excitement and fanciful adventure; and the straightforward, do-it-yourself science that went on in garden sheds or children's bedrooms. When looking for evidence of direct influences on interviewees' choices of career, this is more apparent when examining their educational progress through secondary school and beyond.

3.1.2 Education

There is significant consistency in interviewees' school educational backgrounds, in that all those who joined these research establishments before they became executive agencies had been educated at state schools. Many interviewees speak of parents who wanted their children to take advantage of educational opportunities that they themselves had not been offered. Remarks from Paul Cannon, Shirley Jenkins and Mike Westby show that they were brought up by parents who saw education as an opportunity for social mobility:[27]

> They were both interested in education, I think they'd come from an era when people didn't realise their potential … they were keen that we worked hard at school and yet I rarely felt any pressure. […] I didn't have any background of university education in the family.[28]

> They wanted me to have an education which they didn't basically, to go as far as I could, they were very supportive.[29]

> Both my grandfather and my father had a great belief in education as a way of getting on in life, breaking out of the strictures of where they'd been.[30]

In many families these aspirations and attitudes were tied up with the selective education system whereby performance in the 11+ exam for grammar school entry could resonate far into adulthood.[31] These excerpts from Sarah Herbert, Ian Linsdell, Paul Cannon and Robyn Thorogood show the range of attitudes associated with passing the exam:

---

[27] Peter Mandler, *The Crisis of the Meritocracy: Britain's Transition to Mass Education since the Second World War* (Oxford: Oxford University Press, 2020), p. 207.
[28] Cannon, Track 1 [00:09:44–00:11:55].
[29] Jenkins, Track 1 [00:38:04–00:38:16].
[30] Mike Westby, Track 1 [00:10:14–00:10:24].
[31] Mandler, *The Crisis of the Meritocracy*, pp. 32–49.

It became very important that I passed to go to the grammar school so she [Herbert's mother] wouldn't have to pay fees any longer to send me to a private school. A grammar school was going to be acceptable. That sounds awfully snobby but it was quite a class structure in the fifties and life was quite different, and people called everybody Mr and Mrs and nobody used first name terms.[32]

[Passing the 11+] was a turning point in my life because I went from not being thick to being intelligent, just overnight. […] That stuck with me, to a degree you then try and live up to that.[33]

There was a lad who lived next door who also passed the 11+ that same year and his parents did not want him to go to grammar school. ... I think it was down to social strata aspects, I don't think the neighbours wanted their child to get ideas above his station.[34]

I was a bit of a failure when I failed the 11+, well I was a real failure […] there was an extreme difference between the Ilfracombe Grammar School and the Ilfracombe Secondary Modern School.[35]

While many parents of interviewees used technical skills or scientific qualifications in their occupations, working as engineers,[36] science teachers, [37] a pharmacist[38] and indeed government scientists,[39] few of them had been to university themselves. This was an opportunity that was opening up for their children during the 1960s with the 1962 Education Act whereby the state took on payment of tuition fees and students gained the right to receive a means-tested maintenance grant.[40] The following year saw the publication of the Robbins report which endorsed the expansion of the universities, bringing the prospect of a university education within reach of teenagers such as Anthony Bravery:[41]

The school held up university as an aspiration for all. I think I was part of the generation [where] it was only just becoming an obvious option, I had several friends who were the first generation in their family to go to university, and I was quite unusual in the fact that my Dad had been to university, he was the first in his family, and one of the very small number in his generation. [...] A university option was definitely on the cards.[42]

---

[32] Herbert, Track 1 [00:25:35–00:25:55].

[33] Ian Linsdell, interviewed by Emmeline Ledgerwood, Titchfield, 2019, BL C1802/20, Track 1 [00:43:24–00:43:51].

[34] Cannon, Track 1 [00:10:50–00:11:37].

[35] Robyn Thorogood, interviewed by Emmeline Ledgerwood, Haddenham, 2019, BL C1802/21, Track 1 [00:14:53–00:14:58; 00:17:11–00:17:17].

[36] Vic Crisp, Steve Rooks and Alan Gray.

[37] Roger Courtney and Alan Gray.

[38] Chris Peel.

[39] Carol Atkinson, Susan James and Wendy Westby.

[40] Robert Anderson, *University Fees in Historical Perspective,* 8 February 2016 <http://www.historyandpolicy.org/policy-papers/papers/university-fees-in-historical-perspective> [accessed 26 October 2020].

[41] Committee on Higher Education, *Higher Education: Report of the Committee Appointed by the Prime Minister under the Chairmanship of Lord Robbins, 1961-63*, Cmnd 2154 (London: HMSO, 1963).

[42] Bravery, Track 2 [00:09:03–00:11:05].

Support from parents or relatives was a noticeable factor in many interviewees' progression through the educational system. These accounts from Shirley Jenkins, Steve Rooks, Sarah Herbert and Susan James show how closely some interviewees' parents influenced decisions about their A levels:

> I wasn't at all sure I wanted to do [sixth form] initially ... but my father decided I was going to stay, no messing around, I was going to stay for A levels. I would have liked to have stayed with doing some languages but there wasn't any opportunity, you either did arts or sciences for A levels, there was no mix-and-match possible at that stage.[43]

> My father came from a working-class background and all the way through school, I think it would be true to say, he was pushing me to do sciences and engineering. […] Because of his influence I guess I kind of got pushed into it, I would have gone for English, French and History, and ended up doing English, Maths and Physics.[44]

> When it came to the Fifth Form we had the option of doing Physics. I didn't know what Physics was at all, but it was different and I was quite an adventurous person and I thought I would do Physics because it was different, we hadn't done it before had we? … At that stage I rebelled and said 'I'm not doing Art, I'm doing Physics, Maths and Chemistry for A level', and my parents were just horrified because in a million years that was not they expected me to say or do.[45]

> I was influenced by my Dad … I enjoyed playing musical instruments. [...] I thought at one stage I'd like to do sound recording in a studio, but then Dad introduced me to Dr Graham Rood, who was heading the acoustics group at RAE, and he helped me with my A level project ... and that was it.[46]

Similarly, some spoke about fathers whose opinion strongly guided their university applications:

> Why did I do [aeronautical] engineering? I think my father was quite influential in that ... he was quite a strong personality, let's say, quite authoritarian really. […] Being pushed in that kind of engineering direction and being interested in aeroplanes, the two things sort of merged together and there you go, that's the result.[47]

> I wanted to be, I thought, a chemical engineer so I sat down with my Dad who had the *Telegraph* routinely and that tended to have quite a good section on careers and job adverts. […] We went right through it several times, week after week, and there was very little for chemical engineers other than oil exploration type of work … but there was a lot for materials science and so we, because my Dad definitely had a steering effect there, veered towards materials science.[48]

School teachers are not remembered as being hugely influential, with the exception of Sarah Herbert, who had very fond memories of her Physics teacher:

> He was wonderful. He opened up the Physics laboratories every lunchtime. […] We always went to the Physics labs and he bought carpentry equipment and he bought glass

---

43 Jenkins, Track 1 [00:48:27–00:48:54].
44 Rooks, Track 1 [00:02:05–00:03:03].
45 Herbert, Track 1 [00:32:23–00:33:50].
46 Susan James, interviewed by Emmeline Ledgerwood, Church Crookham, 2018, BL C1802/08, Track 1 [00:05:08–00:06:12].
47 Mike Westby, Track 1 [00:36:26–00:36:56].
48 Peel, Track 1 [00:50:42–00:51:39].

> blowing equipment and he bought electronic equipment … and we built equipment. […] It just inspired us all, it just made us much more practical. … He said, 'You know, if you went to a boys' school, you'd know all about changing a plug and all of these things.' … Afterwards, later, I saw him and he said, 'I wasn't very good when I taught you, I'd never taught Physics before', and I just said to him, 'No, you were wonderful because you inspired us.'[49]

Herbert's father was also very encouraging which was in stark contrast to her mother's reaction when she gained her Physics PhD:

> [My parents] did come up for my PhD graduation at which point my mother made it very clear, 'I just want you to know, I shall never address you or a letter as Dr, you're Mrs, it is much more important to be Mrs than be Dr.' That was what my mother said … yes! [laughs] But as I told you, she didn't really like that I'd done all this. […] Nobody in the family had ever had a doctorate, even my uncle who'd been to university ... I was the first one that had.[50]
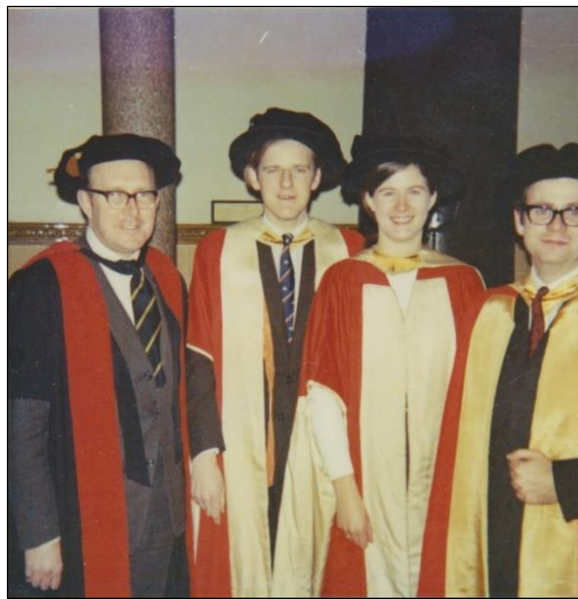
3.1 *Sarah Herbert (then known as Sarah Bishop) on her PhD graduation day, Victoria University of Manchester, 1970.*
Personal collection of Sarah Herbert.

Degree choices were also remembered as being determined by schooling or gender. Martin Wyatt felt that he chose a degree in engineering 'because I came from a secondary modern school, it was a class thing',[51] whereas for Wendy Westby, despite the fact that her father was an electronics engineer,

---

[49] Herbert, Track 1 [00:35:14–00:36:51].
[50] Herbert, Track 3 [01:07:42–01:08:46].
[51] Wyatt, Track 2 [00:12:24].

> it didn't really occur to me to think about engineering … girls at that time weren't encouraged to go into engineering anyway … I liked chemistry and it was my best subject so I kind of drifted into it I guess.[52]

However, going to university was not a prerequisite for embarking on a career in government science. Indeed GREs offered an alternative route for higher education which for some interviewees contributed to the attraction of pursuing a career in the scientific civil service.

3.2 Career prospects as a scientific civil servant

The demands of the Second World War for technical expertise and innovation cemented the position of government scientists and engineers as vital contributors to national technological advancement and the provision of expert advice.[53] After the war ended, joining the scientific civil service was recognised as a respectable way to pursue a technical or scientific career in the UK, and in the immediate post-war period had the added advantage of being a substitute for National Service. While only a relatively small percentage of science and engineering graduates went into the scientific civil service (for example in 1976 the estimate was around 5%), they, along with non-graduate entrants, could expect a secure career with well-defined routes of progression.[54] However civil service staff cuts and reforms that occurred during the 1970s and 1980s accumulated to significantly reduce the number of scientists employed by the state. The number of scientific civil servants working for government departments had hovered around 18,000 during the period 1967–80, but by 1997 the official figure for scientific researchers working in government departments was around 7,300.[55]

Joining the civil service was to enter a bureaucracy. Ridley has pointed out that one of the elements of the ideal-type bureaucracy as described by Weber is that it is a closed system, elements of which are regularised promotion, a bias towards recruiting early in life and lack of competition from external candidates.[56] Scientists trained in physical,

---

[52] Wendy Westby, interviewed by Emmeline Ledgerwood, Hedge End, 2019, BL C1802/16, Track 1 [00:49:09–00:49:55].

[53] Edgerton, *Warfare State*; Gummett, *Scientists in Whitehall*.

[54] Civil Service Department, *Review of the Scientific Civil Service*, p. 109.

[55] Ibid., p. 88; Department of Trade and Industry, *Science, Engineering and Technology Statistics 1999*, Cm 4409 (London: HMSO, 1999), p. 87.

[56] F. F. Ridley, 'Career Service: A Comparative Perspective on Civil Service Promotion', *Public Administration*, 61, no. 2 (1983), pp. 179–196 (p. 180).

biological or mathematical sciences, engineering or, to a lesser extent, social sciences, were recruited into the scientific officer class and worked on a variety of state-sponsored activities spread across the extensive network of departmental research establishments (see Appendix 1.) Many did a 'tour' in departmental headquarters in Whitehall, and some were drafted into a scientific unit within the armed services or in an embassy overseas as a scientific counsellor.

When my interviewees became government scientists, they entered a working world that was very clearly defined by the organisational framework of the wider civil service, both horizontally and vertically. In this section I use interviewees' accounts to describe the career management structures that were in place before organisational change gained momentum in the 1980s.

3.2.1 Why apply?

A 1980 review of the scientific civil service recognised that it was dealing with many similar questions to those raised in a similar review in 1965.[57] These included the number of scientists employed in government in comparison with other sectors, their recruitment and career management, the need to provide scientists with management training, and the desire to increase the number of scientists working on policy formation in the upper tiers of the civil service.[58] The 1965 Tennant committee observed that, 'that security of tenure is a decided attraction to a number of those who are welcome recruits to the Scientific Service.'[59]

The majority of my interviewees chose to embark on a career in a GRE either as school-leavers or recent graduates, the point at which most recruits entered the scientific civil service. Some worked for a time in the private sector or, in one case, served in the army, thereby gaining experience of working environments outside government-funded research.[60] For school leavers who were looking for an opening to put their schooling in science into practice, joining a GRE offered opportunities on both the practical and

---

[57] Civil Service Department, *Review of the Scientific Civil Service*; HM Treasury, *Organisation of the Scientific Civil Service*.
[58] Civil Service Department, *Review of the Scientific Civil Service*, pp. 4–5.
[59] HM Treasury, *Organisation of the Scientific Civil Service*, p.13.
[60] Vic Crisp, Martin Wyatt, Carol Atkinson, Chris Scivyer, Alan Gray, Shirley Jenkins, Paul Cannon and Robyn Thorogood.

educational fronts. This story from David Dunford describes how he came to join the RAE at the age of 16:

> I didn't plan to leave school at 16, I had started my A levels [but] my father said, 'If you don't get the grades you need to have a job'. So I applied for a job at Larkhill[61] as an Assistant Scientific Officer [and] the scientific training officer for the RAE, Jerry Lewis, was one of the panel. [...] At the end of September I had a letter saying … we'd like to invite you to Farnborough and offer you a job. […] In the letter they were very careful, they offered you education by day release, they offered you the engineering training via support from the local technical college. […] I thought actually perhaps this is an opportunity, I wanted to do more practical work and to do those sorts of things, so I said yes, aged 16¾. […] The hands-on bit, I think that was the back of the decision that I would begin to play with science. You know I wouldn't have to go through this academic route, I could go and do it. I could practically go and do it.[62]
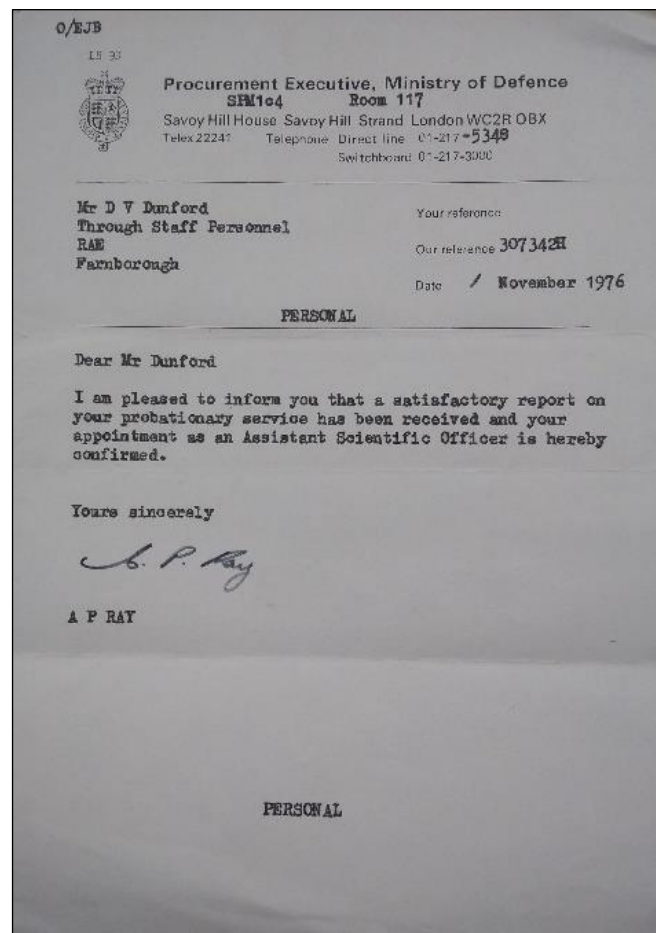
3.2 *David Dunford's letter of appointment as an Assistant Scientific Officer, 1976.* Personal collection of David Dunford.

Phil Catling was also attracted to the practical side of working at Farnborough:

> I was aware of the RAE, its reputation and its closeness to aviation, that was the next best thing to flying for me, so I wrote them a letter with my interests and was invited for interview. […] I had an ambition to have hands-on, not sit behind a desk. […] I was

---

[61] Larkhill refers to the Royal School of Artillery ranges on Salisbury Plain in Wiltshire.
[62] Dunford, Track 1 [00:07:33–00:10:30; 00:43:13–00:43:27].

enthused by the human factors, the man-machine interface issues and the science behind that interaction.[63]

Shirley Jenkins joined the scientific civil service as a scientific assistant in 1954 soon after leaving school:

> I decided I didn't want to go to university … I wanted to go and work and maybe do some studying part-time or something. It was a matter of seeing what was available. The civil service seemed one of the opportunities. […] [Science] was just something that I wanted to do and I thought I could do it as well as other people could! So I know it was unusual—very unusual—for women at that stage to want to go into that sort of field but I didn't see why I shouldn't do it, let's put it that way. [...] I was always interested, and I've always thought of myself in some ways as much more like a boy than a girl. When I was a child I used to behave like one so mentality wise I had sort of, probably, felt quite masculine I suppose and I could do it and I could fit in, so that was it.[64]

Twenty years later, Susan James' application after finishing her A levels in 1979 was the result of her interest in music:

> When I finished my A levels, I chose not to go to university but there was a moratorium on recruitment at RAE. [...] My Dad said just keep applying, show enthusiasm, show you want to do it. That did pay off because as soon as the moratorium was lifted Graham [Rood] came back to me and said are you still interested. […] The focus into the acoustics group at RAE was all driven from that one [A level] project, 'The Physics of Sound'.[65]

Others joined having completed their undergraduate degrees. Chris Peel became aware of what was on offer at RAE while at Birmingham University:

> It was simply by the fact that industrial placements were advertised on the department's noticeboard and I saw the one for RAE … that's where the interest kicked in.[66]

There was a certain prestige associated with working in the GREs which were recognised as centres of excellence, with Farnborough being lauded in the 1960s as the largest research centre in Western Europe.[67] Mike Westby was certainly drawn to RAE's reputation: 'It's one of those things where you know what you're joining and it has an august history behind it, that is part of it, you know what you're joining and there's a certain amount of pride in being associated with that.'[68]

---

[63] Catling, Track 1 [00:03:22–00:06:51].
[64] Jenkins, Track 1 [00:52:25–00:52:57] and Track 2 [00:07:32–00:08:37].
[65] James, Track 1, [00:07:43–00:08:15; 00:14:02].
[66] Peel, Track 2 [00:06:01–00:06:32].
[67] Lighthill, 'The Royal Aircraft Establishment', pp. 28–54.
[68] Mike Westby, Track 4 [00:14:24–00:14:40].

Joining the scientific civil service was described by John Chisholm as an aspirational destination for university science graduates, 'only the very best got in […] It was a real challenge to get through their process.'[69] Paul Cannon explained the options:

> Certainly, in those days for British graduates … the scientific civil service sat in between the two extremes of university and industry and for me it was very attractive option. […] It was certainly a very respectable job … a very valid career route. […] It gave me the option of undertaking research again in a moderately open environment. Yes, there were targets, even in those days you had to do things that were useful, but it was relatively flexible and it was relatively open. Yes, you were undertaking classified work sometimes but a lot of it was also unclassified, so it was a nice interface with the other worlds.[70]

Interviewees saw a future in the GREs where they would be valued as members of a global community of professional scientists and where they would have opportunities and freedom to work on interesting research. This was considered by many to be a good compromise between academia and industry, as Anthony Bravery realised once he started job-hunting:

> I didn't actually say to myself I'd like to work for government, I was looking at the jobs that were advertised. […] I quite liked the idea of government research because it seemed to be more open-ended, less focused than going to work in industry. […] Industry tends to be much more focused on the company's targets of course, whereas in the government research institutes of that time, you were free to do more original research. Whereas in university it was a blank sheet of paper type research, it would be whatever the department's specialities were, and the members of research staff, or in industry it was very focused, and government was between the two.[71]

Roger Courtney and Mike Westby had similar explanations on why scientists joined the civil service:

> The great body of scientists in the service didn't have any particular desire to go and work in Whitehall, they joined in order to do research in whatever was their favoured subject, and they were very happy in an environment where you looked as much to the scientific community, whether that was in the universities or in the international whatever, as it was into what you might say was the policy community. That was their milieu, and they didn't particularly want to go and work elsewhere.[72]

> While I didn't want to do a PhD, I was kind of interested in researchy-type stuff and the RAE was doing research whereas obviously industry was design to manufacture, it's just subtly different. […] If you're on the manufacturing side you are a smaller cog in a bigger machine, and your vistas are quite a lot more restricted, certainly at an entry level. By joining the research side you'd have a lot more visibility, responsibility, freedom maybe, less constraints as a new starter.[73]

These quotations from Chris Peel and Vic Crisp encapsulate other reasons for applying—job security combined with the likelihood of a stimulating working life:

---

[69] Chisholm, Track 3 [00:24:04].
[70] Cannon, Track 3 [00:14:50–00:17:11].
[71] Bravery, Track 2 [00:25:42–00:30:56].
[72] Courtney, Track 9 [0:51:44–0:52:47].
[73] Mike Westby, Track 1 [01:04:58–01:05:47].

> It had a very good career structure so that you would see how your career would be mapped out in terms of grades and promotions … you could see a progression. […] I don't really think that the money side of it was really of any particular weight, the much more important thing was that it was an interesting job.[74]

> Despite the rigidity of the hierarchy and so on we did do a lot of interesting things that were ... self-generated. You were doing things that you thought were important ... we got to fairly high levels in the scientific community—interesting conferences and interesting places to go so there were lots of plusses on that side. […] Some people will always go for the financial reward, but there are plenty of others who are very bright who weren't driven by money, they would want to do interesting things.[75] ∩ ▶

Again, for Robyn Thorogood the promise of having time to focus on some research in a GRE offered a welcome alternative to working in the construction industry:

> Working for John Laing, I enjoyed it enormously, but I got het up quite often. There was never time to make a proper decision, having to do it on the hoof all the time, which is a great skill, but I was always feeling I wanted to explore further.[76]

The 1965 Tennant review noted that the number of applicants to the scientific civil service with university degrees or HND (Higher National Diploma) qualifications was increasing in comparison to the number of applicants straight out of school. This suggests that responsibility for training of scientists was already becoming more concentrated in universities and higher education institutes with the expansion of the university system and the availability of grants. The review also showed that the number of vacancies in established posts considerably exceeded the number of people recruited, suggesting that there were more openings at that time in the civil service than in academia.[77] Those who had remained at university to do postgraduate study were presented with the knock-on effect of the university expansion and the resulting increase in a qualified scientific workforce, as Roger Courtney and Vic Crisp discovered:

> The fundamental realisation that I had was that I did not want to be a university lecturer. There was a very good piece of advice that I received ... which said the Robbins expansion has taken place, the people five years older than you are going to be occupying those positions all the way up, universities are not a place to be. […] But I did like research, so that made me look for a job in research.[78]

> There was no further expansion in university life, i.e. no jobs, and I looked around for a kind of researchy-type job and finished up looking at the scientific civil service etcetera etcetera.[79]

---

[74] Peel, Track 2 [00:43:03–00:45:22].
[75] Crisp, Track 5 [00:06:23–00:07:03] and Track 6 [00:33:28–00:33:44]
[76] Thorogood, Track 2 [01:21:53–01:22:16].
[77] HM Treasury, *Organisation of the Scientific Civil Service*, p. 10.
[78] Courtney, Track 6 [00:05:49–00:07:00].
[79] Crisp, Track 1 [00:01:23–00:01:39].

Interviewees such as Mike Westby speak about being attracted to the public service ethos that is still part of his job at Dstl (see section 5.2):

> I think what draws most people—it sounds a bit pretentious really—is doing something which is nationally worthwhile, not just making money for some shareholders. Most of the work is technically very interesting and in many ways we have more freedom of action than you would have in industry because we're not always looking at the bottom line which makes a profit. That's not what we're there for and that's quite liberating in many ways. A lot of people find that very attractive, it's not the secrecy element, it's that we can do technically interesting work. For quite a lot of people it's like working in a university but probably with more stability and security.[80]

For Sarah Herbert, the RAE was simply somewhere she could continue working on materials science:

> I wanted to work in materials research, it was as simple as that, I didn't even want to work in aerospace. […] I didn't know one aeroplane from another aeroplane. Aeroplanes would go over and everybody would rush out and say that's a Buccaneer going over there etcetera etcetera … well it didn't mean a lot to me.[81]

There are also elements of personal and practical factors that contributed to these career choices, in that both Sarah Herbert and Wendy Westby applied for jobs at RAE because their husbands were already employed there. For recent graduates such as Mike and Wendy Westby, there was an added benefit of being able to live in RAE housing for three years:

> It was a good way of helping new graduates to get on their feet, although the accommodation wasn't very good. Fairly basic houses without central heating. […] It was very cheap ... we could save up a deposit to buy a house.[82]

Carol Atkinson and Chris Scivyer both applied for roles at BRE because it was a local employer. These accounts demonstrate that interviewees gave a range of explanations about why they applied to join a GRE.

3.2.2 How the system worked

Once appointed, scientific staff were employed in individual departments on the basis that common terms and conditions were applied across the scientific civil service. As some of the excerpts quoted above indicate, the level of pay was not necessarily the top priority for a new entrant. However the total package could be superior to that offered in industry.[83] One witness to a parliamentary committee in the mid-1970s pointed out

---

[80] Mike Westby, Track 4 [00:19:34–00:20:37].
[81] Herbert, Track 4 [00:55:05–00:56:40]. The Buccaneer was an attack aircraft designed in the 1950s for the Royal Navy.
[82] Wendy Westby, Track 2 [00:05:05–00:06:09].
[83] Lowe, *Official History, Vol. I*, p. 206.

that government scientists were sheltered from government income policies and benefited from fixed pay increments.[84] Some interviewees such as Roger Courtney and Carol Atkinson reflected on how they had benefited from the civil service pay arrangements:

> It was virtually unknown for somebody not to get their annual increment ... it didn't matter whether you had been judged totally outstanding or marginally competent, the way of rewarding someone who was outstanding was to put them on the promotion list, not to push them up their pay scale. That was the only tangible way that I knew I was doing alright when I appeared on promotion lists. […] One of the things perhaps I've appreciated much more in the last 15 to 20 years was the fact that you really didn't have to worry about your income. You might complain that civil servants were not very well paid but on the other hand the money was always there in the account at the end of the month, and the pension was accumulating.[85]

> When I got my first pay packet to my total amazement … I had far more money than I'd ever had at GEC because there was a non-contributory pension scheme. […] You had shorter working hours and you could earn two extra days holiday a month with the flexi time, it was unbelievable really.[86]

These remarks indicate how the improvements in civil service pension scheme arrangements that were introduced in the early 1970s, whereby pension payments were insulated from inflation, increased the attraction of being employed by the civil service.[87] For Steve Rooks' father, as a businessman who had been made redundant during the 1980s recession, at that time the civil service represented job security:

> He kept telling me that you need to get a career where you're not going to be knocked by these effects. In his mind, at least, the civil service was the place to be because it was a career for life, guaranteed pension and so on, and pushed me in that direction.[88]

Complaints from scientific civil servants about pay and prospects were more in relation to civil servants in other streams than with their peers in industry.[89] Anomalies arose due to the development of different scales of pay in different streams. These were described by the chair of a 1982 inquiry into civil service pay as,

> interface problems where in the technical and scientific civil service a particular grade of officer is liable to be paid less on his scale than the industrial civil servant whom he is supposed to be supervising because the industrial civil servant with a different union has

---

[84] Science and Technology Committee, *Industry and Scientific Research*, 24 March 1976, HC 23–i–xx 1975–76, p. 280; See also J. R. Starr, 'Civil Service Careers', *Physics Bulletin*, 31, no. 8 (1980), pp. 264–264.
[85] Courtney, Track 10 [00:26:57–00:28:14] and Track 16 [00:12:36–00:13:28].
[86] Carol Atkinson, interviewed by Emmeline Ledgerwood, Hemel Hempstead, 2018, BL C1802/06, Track 5 [00:23:15–00:23:58].
[87] Lowe, *Official History, Vol. I*, pp. 324–6.
[88] Rooks, Track 1 [00:26:35–00:26:50].
[89] T. H. Profitt, 'Great Britain', in Ridley (ed.), *Specialists and Generalists*, pp. 13–56.

> a productivity agreement and, if he has got a bonus on that, he may be receiving more than his boss.[90]

Roger Courtney referred to the different types of union membership among the staff at BRE:

> You had industrial civil servants and non-industrial, most of the service was non-industrial as it was called, but you had these industrial civil servants who would have been very numerous in dockyards for example, or serving on airfields, very skilled technicians, and in our case people in the workshops, people maintaining the site. […] They were not in the civil service unions, they actually belonged to TGW, Electrical, the unions that applied in the rest of the country.[91]

Scientists at the research establishments tended to belong to the IPCS, although those engaged in sensitive work may have been prohibited from getting actively involved. Interviewees spoke of different levels of activity in the union, if they belonged at all, but Anthony Bravery's comment reflects a general satisfaction with the terms and conditions of the job: 'I tended to go to union meetings and I supported the idea of a staff association, but I never encountered any aspect of my job or my experience as an employee which was very negative.'[92] Wendy Westby's assessment of the union was that, 'it was a bit toothless':

> When you work in what's largely a research organisation, if you go on strike for a day, nothing much happens except your work's still there the following day, the unions didn't really have much power.[93]

Even those who took a more active role in the union, such as Vic Crisp, describe relations with management as civil and pragmatic:

> It covered everything to be honest, pay and conditions, relations with all and sundry. […] It was quite time-consuming, and it was kind of interesting in that it wasn't a particularly aggressive them and us relationship with the senior management.[94]

Just as civil servants were expected to show neutrality in their conduct, so as professional scientists they prided themselves on adhering to an ethos of objectivity and neutrality that did not naturally lead to political activity. This was described as a 'traditional hesitation to speak out' by a group that lobbied for scientists' rights in the 1980s.[95] Vic Crisp spoke

---

[90] Treasury and Civil Service Committee, *Civil Service Pay,* 8 November 1982, HC 19–i 1982–83, p. 11; J. Megaw, *Inquiry into Civil Service Pay: Report of an Inquiry into the Principles and the System by which the Remuneration of the Non-Industrial Civil Service should be Determined*, Cmnd 8590 (London: HMSO, 1982).

[91] Courtney, Track 9 [0:31:30–00:32:35].

[92] Bravery, Track 8 [00:50:43–00:50:56].

[93] Wendy Westby, Track 6 [00:08:11–00:08:37].

[94] Crisp, Track 2 [00:47:10–00:48:20].

[95] 'British science in decline. Evidence prepared by Save British Science for the House of Lords Select Committee on Science and Technology, 3 June 1986', quoted in Agar, *Science Policy under Thatcher*, p. 3.

of the rare instances of union protest at BRE, such as in reaction to the mid-1970s civil
service pay freezes:

> Roger [Courtney] and I have a dubious distinction of being the only two members of BRE
> who've ever led the troops out of the gates [laughs]. […] A lot of people weren't terribly
> comfortable with the idea of striking and so on, and even the two strikes that we did have,
> there were quite a few people who would take leave to [avoid] being on strike.[96]

Once in the system, the prospects for promotion and pay increases were clearly
understood by members of the scientific classes such as Mike Westby, who saw it as a
system 'very much modelled on the military':[97]

> Everyone was dreadfully grade-conscious. There were different vertical things so
> engineers were not scientists were not administrators. […] It had a very regimented rank
> structure … what hoops you had to jump through and what experience you needed to gain
> to get from one place to the next was fairly clear when I joined. The system had been the
> same for so long, and everyone knew how things worked and nothing had changed for a
> very long time. […] There was a very high expectation that if you want to get from A to
> B you need to do X, Y and Z and if you've done X, Y and Z you would get from A to B
> so it was all quite predictable and quite straightforward, not necessarily easy but you kind
> of understood what the rules of the game were.[98]

Each rung on the well-defined ladder through the hierarchy was accompanied by a set
pay increment that at times frustrated Vic Crisp:

> It didn't take long to realise that some people coasted along, and some people worked
> very, very hard indeed, and they would both get an increment, the same.[99]

However, Susan James and Carol Atkinson had a very different perspective on what it
took to move up this ladder, suggesting that their experiences may have been gender-
related:

> You would never have made your way up the ladder if you were just coasting, you had to
> prove yourself at every increment and that went through several different stages of review
> at different levels of senior management. [100]

> There was a lot of resentment over grades and perceived unfairness and who got promoted
> and who didn't get promoted. I did get annoyed over people getting promoted over me
> who weren't very capable … if I had to report to somebody on particular things who really
> didn't know what they were doing, it was a little aggravating. […] I think the grade thing
> and the hierarchy bothered an awful lot of people.[101]

Being considered ready for promotion depended on a system of annual appraisal and
review that recognised length of service as much as performance. Annual Staff Reports
involved assessment of performance, fitness for promotion and training needs; Job

---

[96] Crisp, Track 1[00:35:03–00:35:53] and Track 4 [00:26:38–00:26:53].
[97] Mike Westby, Track 2 [00:15:20].
[98] Mike Westby, Track 2 [00:15:33–00:15:41] and Track 3 [00:12:13–00:13:16].
[99] Crisp, Track 4 [00:22:22–00:22:34].
[100] James, Track 6 [00:05:17–00:05:31].
[101] Atkinson, Track 6 [00:30:41–00:31:27].

Appraisal Reviews were an opportunity for an individual to discuss their role with a senior colleague; and career development interviews were forward-looking discussions with a senior officer outside the normal line of management. Chris Peel described the system:

> In the old RAE you would have a seniority hierarchy based on rank, position if you like, and within that you would also have the seniority that progressed because of years in service. So there would be an annual increment and the annual increment would be slightly adjustable by management and each person would be reviewed for suitability to promotion on an annual basis and a report would be issued written on each person's performance. The person themselves would start filling in the form and then the management would complete it, so an annual review if you like. That was fairly rigorous and well managed.[102]

The next stage was to get past a promotion board, described by Mike Westby as, 'the proper civil service third degree, three middle aged gentlemen in suits and me on the other side of the table.'[103] However the system was not infallible, as he explained:

> There was a lot of treacle in the system, a lot of stickiness. Certain places were very by the book, so I was quite lucky when I started … the department was quite encouraging of people going for promotion. […] It was a real control mechanism, it was very slow progress up through the rank structure. It wasn't necessarily a good thing.[104]

Similarly, Steve Rooks recounted how 'the regulations and rules in the civil service at the time made life quite difficult for me … as a scientist I got less than the engineer in the same office as me'.[105] Nevertheless many interviewees appreciated that the system appeared to offer clearly defined routes for promotion.

3.2.3 Career paths and expectations

Civil servants could only progress directly upwards within their stream, with no opportunity to move across horizontally into a position in a different stream unless they had risen to the very senior open structure level at the top.[106] Personnel management was handled by departmental divisions who relied on the results of the appraisal system to decide upon the direction of scientists' careers, as experienced by Mike Westby:[107]

> Under the RAE you didn't really move, you stayed where you were and careers were kind of externally managed. You did move somewhat but it was a managed move … it wasn't driven by the work but to broaden your career, give you a different flavour of experience … often on promotion, but it was a kind of managed structured career development.[108]

---

[102] Peel, Track 5 [00:00:21–00:01:21].
[103] Mike Westby, Track 4 [00:37:11–00:40:38].
[104] Ibid.
[105] Rooks, Track 6 [00:20:54–00:21:27].
[106] Civil Service Department, *Review of the Scientific Civil Service*, p. 68.
[107] Ibid., p. 121.
[108] Mike Westby, Track 5 [00:44:41–00:45:19].

As scientists working in a bureaucratic hierarchy, interviewees' accounts conform with Mallon et al.'s assessment of public sector careers in science.[109] These combined elements of a career of advancement, where success is measured in terms of hierarchical position, with elements of a career of achievement, in which progress is scaled in terms of increments of skill and a position within a network of practitioners. At some stage in their careers, scientific civil servants would come to a juncture that 'confronts researchers in R&D organisations as they and their employers make and provide occupational choices to follow either management or professional scientists' trajectories'.[110] However advancement was mainly controlled by the number of retiring senior officers, and career progression was affected by policies to reduce civil service staff numbers during the late 1970s.[111] Fewer scientists who were marked eligible for promotion were moving up to the next grade, leading them to protest that their conditions of service had been suddenly altered.[112] The authors of the 1980 review of the scientific civil service warned that 'posts cannot be created simply to maintain career prospects … the needs for the work, not the individual aspirations of staff, must determine the number of posts at any level'.[113]

Shirley Jenkins' description of her first role shows the varied nature of the people working in her section, while Chris Peel explained the hierarchy at RAE in the 1960s:

> I was a scientific assistant, I was the lowest of the staff people, there were industrials who were doing the mechanical things, working and we had cleaners of course […] but mostly in our area it was nearly all scientific staff. […] The boss was an SPSO … there seemed to be a few other sort of PSOs and SSOs who were doing more mathematical stuff, the sort of scientific side of it, whereas the labs were building and testing things. In the labs there were mostly experimental officers, assistant experimental officers […] the scientists they lived in offices, they didn't come into the labs very often as far as I can remember.[114]

> The career structure for the scientist was ASO, SO, SSO—dadidadida—until you came to what was called a career grade which was a PSO, and any decent recruit was expected to be able to get to PSO and then pretty much stop. Within a division you might have 15 to 20 PSOs, maybe a couple of individual merit, SPSO or higher. You might have within a division eight section leaders, something like that, one division head. Within the department above it you might have four or five divisions with a division head for each one. […] Once you went beyond the PSO career grade you either had to be a special merit promotion or an administrative promotion. [115]

[109] Mallon et al., 'Careers in Public Sector Science', p. 396.
[110] Turpin and Deville, 'Occupational roles and expectations', p. 141.
[111] Civil Service Department, *Review of the Scientific Civil Service*, p. 13 and p. 45*; Lowe, *Official History, Vol. I,* pp. 199–203.
[112] Civil Service Department, *Review of the Scientific Civil Service*, p. 46; Mortimer and Ellis, *A Professional Union,* pp. 313–333.
[113] Civil Service Department, *Review of the Scientific Civil Service*, pp.45–7.
[114] Jenkins, Track 2 [00:22:59–00:24:31].
[115] Peel, Track 3 [00:54:32–0:55:56].

DCSO

Leaps tall buildings with a single bound
Is more powerful than a locomotive
Is faster than a speeding bullet
Walks on water
Gives policy to God

SPSO

Leaps short buildings with a single bound
Is more powerful than a tank engine
Is just as fast as a speeding bullet
Walks on water if the sea is calm
Talks with God.

PSO

Leaps short buildings with a running start
Is almost as powerful as a tank engine
Is able to avoid speeding bullets
Walks on water in indoor swimming pools
Talks with God if a special request is approved

SSO

Can just clear a small hut
Loses a tug-of-war with a tank engine
Can fire a speeding bullet
Swims well
Is occasionally addressed by God

HSO

Makes high marks when leaping small huts
Is run over by locomotives
Can handle a gun
Dog paddles
Talks to animals

SO

Runs into buildings
Recognises locomotives two times out of three
Is not issued with ammunition
Can stay afloat if using a Mae West
Talks to walls

ASO

Trips over doorsteps
Says "I see no trains"
Wets himself with a water-pistol
Stays on dry land
Mumbles to himself

DIVISIONAL CLERK

Lifts tall buildings and walks under them
Picks locomotives off their tracks
Catches speeding bullets in her teeth
Freezes water with a single glance
Because .... SHE IS GOD

3.3 *Satirical poem (anonymous) about the scientific officer grades at RAE.*
Personal collection of Phil Catling.

There was a separate path for exceptional researchers to continue developing deep expertise on an individual merit promotion (IMP) scheme, becoming deep experts within the specialist stream. The system made visible the importance and value placed by the scientific civil service in specialist knowledge producers by creating a separate career path for them. In the GREs, a small proportion of scientists who made 'outstanding and continuing scientific contributions to their job' could be recommended for the IMP scheme, which relieved them of administrative duties once they moved beyond the PSO grade. Roger Courtney explained the system: 'If you were an exceptionally able and highly regarded scientist or engineer or indeed any sort of professional it was possible for you to be graded higher than your management responsibilities would warrant in recognition of your contribution to your subject.'[116] In 1980, up to one in five of the grades above PSO were filled by 'special merit' scientists such as Chris Peel:[117]

> It stemmed from the old scientific research idea of having basically an administrative career progression or a science career progression, and everybody who came in as a scientist should have been able to get to their career grade which was PSO but thereafter there were two options open to you. Remain as an individual scientist or switch into administrative roles. […] I had to convince my then boss that I didn't want to become an admin wallah because he'd earmarked me to run a division and I said, no, I don't want to do that, I want to stay in the individual merit scientist role … from my point of view running the admin side was completely boring and a waste of space, but that's a personal attitude, some people like it.[118]

The status associated with being an outstanding scientist was evident from Chris Peel's experience of becoming a chief scientist in the organisation: 'I was either the highest paid scientist or the second highest paid in DERA … I was highly promoted and highly paid for doing that job.'[119] IMP scientists embodied the deep expertise which government invested in cultivating through the funding of GREs, representing the pinnacle of following a technical career path in the scientific civil service. However Martin Wyatt, the first CEO of the privatised BRE, pointed out the drawback in associating specialisms with promotion into the top civil service grades:

> You couldn't really go above Grade 7 unless you were a recognised expert … and you couldn't go from Grade 6 to Grade 5 unless you were an internationally recognised expert. […] The way you become a recognised international expert is to so narrow the field that there is very little competition. […] When you drilled down to what their expertise was it was sometimes of no use to man nor beast, it was simply the way they worked the system.[120]

---

[116] Courtney, Track 9 [00:35:32–00:35:57].
[117] Civil Service Department, *Review of the Scientific Civil Service*, p. 40.
[118] Peel, Track 6 [00:00:43–00:01:20] and Track 3 [00:48:25–00:49:32].
[119] Peel, Track 6 [00:51:33].
[120] Wyatt, Track 3 [00:18:55–00:20:05].

A more forgiving assessment came from Edward Bullard about the scientists he directed at NPL during the 1950s:

> After a few years' work a man acquires a vested interest in his problem. He is the expert in it, perhaps the first expert in the country. He is a member of international committees for discussing it. He knows all the other experts. His emotions and feelings as well as his intellect are wrapped up in it.[121]

However a career in government science did not necessarily mean becoming a specialist, as Paul Cannon and Phil Catling were careful to point out:[122]

> You have to be careful not to look on this through rose tinted specs. […] The majority of the people who worked in the research establishments were generalists, you're talking to me as a specialist. […] There weren't many individual merit scientists and that reflected the number of people that were required. Most people needed to be generalists.[123]

> I don't like that word 'expert'. Jack of all trades! It broadened because very quickly as additional responsibilities increased, from doing the experiments to pulling the simulator together to networking to getting the pilots in to writing reports to giving presentations and then managing those programmes. […] I knew I was never going down a technical specialist stream where you were a single man or woman entity in a particular sacred position.[124]

This was the case for the majority of scientists in GREs when advancement lay in the management and administration of research, as Roger Courtney and Anthony Bravery recognised:

> If I went up anywhere, I would go up a management route. I never regarded myself as an extremely good scientist …. I was a pretty good identifier and steerer of research programmes.[125]

> I fairly quickly realised I didn't just want to be at a bench in a white coat doing experiments, I wanted to organise programmes of work and things that fed together to a longer-term objective.[126]

Bravery described the responsibilities involved in progression in this way:

> One started as a junior scientist doing the research that your boss, this experienced man who had been there a long time and knew what needed to be doing, what he proposed, but it was done in consultation. You were expected to latch on to what the exercise was all about and come up with ideas with what needed to be done, where should the emphasis be. Then you would progress from doing the work, actually playing with test tubes and inoculating the fungus and putting them in the incubator and weighing the blocks beforehand and weighing them afterwards to see how much the fungus had digested, you did those things as a junior scientist but as a more senior scientist you planned the work and you guided, instructed your technicians or your junior scientists in how to do it. Then when the results came in, you'd sit down with them and you would be involved in

---

[121] Edward Bullard, 'What makes a good research establishment?', in Cockcroft (ed.), *The Organization of Research Establishments*, pp. 262–272 (p. 267).
[122] Civil Service Department, *Review of the Scientific Civil Service*, p. 122.
[123] Cannon, Track 4 [00:44:02–00:44:42].
[124] Catling, Track 1 [00:36:13– 00:37:48].
[125] Courtney, Track 10 [00:22:45–00:23:06].
[126] Bravery, Track 5 [00:40:59–00:41:16].

> interpreting the results. At a more senior level where you've got several projects to keep tabs on and maybe outputs, reports to check and drafts going for publication, you've got to be scrutinising precisely and make sure it's something that when it's published you want to be impressing people out there … you want people who are going to say, 'Wow, that's a nice piece of work there'. And then you have conferences at national and international level where you network with everybody.[127] ∩▶

While the majority of scientists in the GREs would have progressed into the administration of research, Sarah Herbert's assessment of some of her fellow section leaders indicates that not all of them were suited to management:

> I think I was a natural manager. […] Some of the section leaders, there was no doubt, were just technical and they just failed when it came to managing money.[128]

Reviews in the early 1980s of activities and staff in the GREs saw the managerial skills of scientists as lacking.[129] The 1980 *Review of the Scientific Civil Service* called for scientists to gain management and administrative skills with the aim of developing staff that would be 'technological generalists'. The 1982 Rayner scrutiny of scientific research establishments laid out how the scientific civil service would need to adapt to the rollout of the planned efficiency reforms:

> There are implications for the recruitment and subsequent career management of scientists and other specialists. If administrative and managerial skills are in future to have greater emphasis in promotion decisions, the size and skills required of the career entry may need to be reconsidered. We shall need a satisfactory mix of those who can become managers and those who will wish to remain on research. This may mean greater use of short-term contracts and research fellowships. […] I recommend that MPO should by the end of this year examine the criteria currently used in the recruitment and training of scientists and other specialists to assess whether they adequately reflect the need for a robust mix of those with potential for management and high level administration and those who are out and out researchers.[130]

A further service-wide review in 1983 again identified inadequacies in staff development, despite the launch of a new management development programme, the Senior Professional Administrative Training Scheme.[131] A 1985 study that looked at strategies to develop senior managers for the civil service admitted that 'the most difficult area will be in the Science Group where staff are engaged for often long periods in highly specialised research and have little opportunity to exercise broader skills until they reach

---

[127] Bravery, Track 3 [00:20:34–00:22:24].
[128] Herbert, Track 8 [00:39:12–00:40:14].
[129] Civil Service Commission, *Scientists in the Civil Service* (London: HMSO, 1978); Civil Service Department, *Review of the Scientific Civil Service*, p. 47 and p. 122;
[130] Cabinet Office, *Review of Support Services*, p. 18
[131] Management and Personnel Office, *Civil Service Management Development in the 1980s* (London: HMSO, 1983); Management and Personnel Office, *Review of Personnel Work in the Civil Service* (London: HMSO, 1983).

senior levels.'[132] For Roger Courtney, one problem was in the lack of training opportunities:

> In the late eighties or so, I'd gone from a job in Cabinet Office … let's say I had six people, to the Department of Energy where it might have been 20. [...] Went back to BRE had roughly 120, as Director I had 740, something like that. Now who told me about the differences and the techniques and that sort of thing? Nobody. Nobody.[133]

Whatever training was offered would be through a wide range of civil service courses or through engagement with the scientific communities, what Chris Peel described as being, 'trained in the scientific subjects by interaction with others in the field'.[134] Opportunities for scientists to broaden their horzons included working for the establishment's parent department in Whitehall or being seconded to another government department. Paul Cannon remembers that,

> most people that were going to progress through the ranks would probably go and do a tour in London … do that for two or three years and maybe come back or maybe never come back. You know there was an interchange, so people did move around ... there was a lot of flexibility.[135]

However top administrators found it could be difficult to persuade scientists to leave the establishments for Whitehall, an issue that was highlighted in the 1971 Rothschild report:

> The good scientist will be unwilling to risk his research career without positive assurance that the acquisition of administrative experience will be regarded as a positive asset in a career leading to senior posts in the scientific field as well as outside it.[136]

John Charnley, Controller R&D Establishments and Research in the MOD during the 1970s, had first-hand experience of balancing the administrative needs of the civil service against the goals of the scientists:

> My bright scientist or technical person at that stage should be in a lab working as a scientist because he's now got a bit of experience, that's his career, and (a) he wouldn't be good in London and (b) he shouldn't be in London and (c) he wouldn't thank you for coming up to London into a semi-admin post, he wants to be in the lab. So you have this dilemma of around the thirty age, you've got the scientists that I don't want in London and you've got the administrator, the bright administrator, who is making his way up the chain. So you have an asymmetry between the two chains of people which I don't think is easy to solve, frankly.[137]

---

[132] Management and Personnel Office, *Scrutiny of the Means of Identifying and Developing Internal Talent: Central Report and Action Plan* (London: HMSO, 1985), p. 40.
[133] Courtney, Track 16 [01:10:02–01:11:00].
[134] Peel, Track 3 [00:51:05].
[135] Cannon, Track 4 [00:44:40–00:45:40].
[136] Rothschild, *The Organisation and Management of Government R. & D.*, pp. 16-17.
[137] John Charnley, interviewed by Thomas Lean, Camberley, 2010, BL C1379/30, Track 16, transcript p. 264.

The managerial goals highlighted in these reviews were soon overtaken by the broader programme of civil service reforms and the adoption of NPM practices throughout the service. These were the changes that interviewees remember as having a significant effect on their career options, the consequences of which are discussed in section 7.1.2.

3.3 Conclusion

The stories of childhood related by former government scientists interviewed for this project are relatively consistent in describing families in which stability, adequate finances, state education and a certain need for resourcefulness were the norm. They show that interviewees were given independence to explore the natural world around them and grew up in an era when government policies promoting higher education encouraged individuals to see education as a vehicle for upward social mobility.

These accounts show that working in a GRE offered the opportunity for a stable career in science with the freedom to apply and develop practical skills in a research environment. For some, the offer of further education on the job was part of the attraction of applying to join the scientific civil service. For others the decision was a more practical one determined by locality or family circumstances. In the case of RAE recruits, it could simply be an ambition to work in an aviation setting. For many, the clear delineation of career paths and pay awards was an attractive proposition. The individual merit scheme allowed for those with a particular ambition to develop their expertise to advance with reduced management responsibilities.

The next chapter focuses on the everyday content of those careers. It explores the multi-dimensional nature of interviewees' working lives and the processes by which research programmes were funded and managed before the implementation of NPM.

4. Doing science in a GRE

Government research establishments (GREs) were varied sites of knowledge generation that spanned many scientific disciplines. The network of GREs were themselves a small cog in the civil service machine with a common purpose of finding solutions to government's scientific problems. An additional goal during the 1970s for the civil research establishments was the dissemination of results 'to encourage the application of science and research in British industry'.[1] Interviewees' descriptions of the working environment show that the GREs were significant actors in the landscape of national and global scientific research, participating in a community of professional scientists defined by co-operation among peers, the free exchange of ideas and a shared value system.[2] Scientists were employed to develop knowledge relevant to the policy areas of their parent departments (in these cases defence or the built environment), and to conduct research that contributed to national security and the public good.

The specific details of the content of their scientific work are not the focus of this chapter. Indeed, details of some of the projects on which interviewees worked remain beyond the public domain due to their sensitivity. The aim is to understand the everyday and social nature of scientists' working lives that emerges from the recordings, the tasks and interactions that underpinned the advancement of knowledge. Interviewees' working lives involved participation in advanced, sophisticated and ground-breaking research yet on a daily basis working life was as much about the completion of routine tasks as memorable moments of discovery and failure or phases of meeting urgent requirements. While working life consisted of encounters with extraordinary intellectual challenges and practical problems which ensured that knowledge was cultivated, nurtured, matured and then applied, to the scientists involved there was also a sense of routine and ordinariness associated with going to work. Correspondingly this research project acknowledges the distinctive nature of a professional career in science yet treats scientific research as a form of work like any other.

---

[1] Ministry of Technology, *Industrial Research and Development in Government Laboratories*, p. 7.
[2] Sheldon Rothblatt, 'The Notion of an Open Scientific Community in Historical Perspective', in Gibbons and Wittrock (eds), *Science as a Commodity*, pp. 21–75; Mody, 'The Professional Scientist'.

4.1 *Shirley Jenkins and another member of the RAE infrared group operating the trials vehicle, 1970s.*
© Ministry of Defence. Personal collection of Shirley Jenkins.

While much has been written about the guiding principles and relationships that shape scientists' working lives, the literature review showed that studies have tended to focus on scientists that worked in institutional settings such as university departments, research council institutes or industrial R&D laboratories. Here I use scientists' descriptions to assemble a portrait of what a working life in a GRE was like before the organisational changes of the 1980s and 1990s. These sections corroborate Mukerji's assessment of the motivations behind government funding of research:

> The government has interests in maintaining a *labor force* of skilled scientists available for consultation on policy issues … funding makes the expertise of scientists (the skills and knowledge they embody) more consistently relevant to state interests and visible to government agencies.[3]

The first section draws on interviewees' accounts to present the wide array of activities and disciplines in which they were engaged, while the second focuses on how these scientific activities were organised and managed.

4.1 What doing government science meant

The GREs' working environments were defined by their specific organisational arrangements, what Sismondo refers to as the 'institutional landscape'.[4] They 'belonged'

---

[3] Mukerji, *A Fragile Power*, p. 190 and p. 5.
[4] Sergio Sismondo, *An Introduction to Science and Technology Studies* (Oxford: Blackwell, 2003), p. 94.

to their parent departments which in turn were distinct entities within the much larger civil service. Importantly they were funded through the Vote system which is described below in section 4.2. Internal staffing structures followed those of the wider civil service with a hierarchy of grades. The GRE scientists tended to be occupied on what was described as applied research, yet activities ranged from the purely theoretical to those that resembled industrial production, encompassing theoretical modelling, designing and conducting experiments, building test equipment, running trials and carrying out analytical tests. In doing their work they could also be responsible for managing budgets or monitoring the progress of specific programmes, and often interacted with an extensive network of partners and collaborators both nationally and overseas.

4.1.1 The GRE environment

Within the broader scientific community the GREs were known for their history of scientific achievements and for possessing an enviable array of equipment and facilities.[5] Shirley Jenkins remembered being, 'conscious of being part of some very big, well-known prestigious organisation,' while Vic Crisp was aware that research establishments did 'weird and wonderful things.'[6] Similarly Sarah Herbert and Anthony Bravery, while their working lives were spent in establishments that were completely different in size and research focus, both felt that they were working at the forefront of their fields:

> The quality of research at the Royal Aircraft Establishment, right the way through all the time I was there until I left in 1996, was extremely high and we were seen as real scientific experts, leaders in the field. There was no doubt about it. We had done … early research on all the materials before anybody else did.[7]

> [The Forest Products Research Laboratory] was a working world that was full of fascination and intrigue and people and facilities. We were quite well funded, I almost always had the latest microscope, and I would go to universities or into industry and our equipment was usually better, more up to date. […] So in those days government science was valued and funded accordingly and it was regarded as prestige business. People would come to us to find out what the latest developments were.[8]

This account from Shirley Jenkins' of being given a rather mundane task in her first days at RAE belies the huge missions that were conducted within its confines.

> Just going into this laboratory … up on the top floor and … being given a soldering iron which I'd never seen before and I think I was just told to put this in there, rather than

---

[5] Andrew Nahum, 'The Royal Aircraft Establishment from 1945 to Concorde', in Bud and Gummett (eds), *Cold War, Hot Science*, pp. 29–30.
[6] Jenkins, Track 2 [00:22:18]; Crisp, Track 2 [00:33:17].
[7] Herbert, Track 6 [00:19:04–00:19:32].
[8] Bravery, Track 3 [00:36:15–00:37:01].

having circuit diagrams initially, just try and see if I could solder and if I could do various things.[9]

She gradually came to realise she was working on the electronics systems to go into the Black Knight ballistic missile, a research programme driven by the Cold War agenda.[10] Similarly Mike Westby's description indicates that work in GREs consisted of both the routine and the exceptional: 'Some of it was real handle cranking, just turning the handle, churning data out without any real innovation to it, just populating huge data sets. Some of it was quite cutting edge.'[11]

The sheer scale of some of the research establishments could be overwhelming, with Shirley Jenkins commenting that 'it was all designed to confuse.'[12] Susan James found: 'It was a big place, all the workshops, all the test areas and I was just very scared in those first few days of how vast it all was and getting lost.'[13] Many interviewees used the word 'vast' to convey the expanse of RAE, where staff used bicycles, cars or an internal mini-bus service to get around the site.

RAE FARNBOROUGH INTERNAL FERRY SERVICES

Service 'B' Main Gate - 5Mtr Tunnel   Table 2

	Morning Bus timings Mon-Fri	Lunchtime Bus timings Mon-Fri	Afternoon Bus timings Mon-Thurs	Afternoon Bus timings Fri	
Main Gate	0737 0745 0802 0821 0845	1300 1330 1400	1615 1648	1615	Main Gate
Q153	•	•	•	•	Q153
R21	0737 • • *0819 •	•	•	•	R21
P68	•	•	•	•	P68
C&M Hangars	via C&M Hangars •	•	via C&M Hangars •	via C&M Hangars	C&M Hangars
Y20	•	•	•	•	Y20
N&D Hangars	• 0743 •	• •	•	•	N&D Hangars
X80	0746 0759 0816 0829 0830 0900	1312 1343 1412	1628 1659	1629	X80
X80	0800 0817 0830	1215 1235 1300	1630 1645 1700	1546 1630	X80
N&D Hangars	0746 • •	• • •	• • • 1703	• • 1633	N&D Hangars
Y21	• • •	• • •	• • •	• • •	Y21
C&M Hangars	• • •	• • •	1646 • • •	1546 • •	C&M Hangars
P68	• • •	• • •	• • • •	• • •	P68
Q27	• • •	• • •	1655 1655 1710 1709	1556 1555 1640 1639	Q27
Q134	• • •	• • •	• • •	• • •	Q134
Main Gate	0756 0813 0830 0843	1227 1247 1312	1644		Main Gate
	Morning Bus timings Mon-Fri	Lunchtime Bus timings Mon-Fri	Afternoon Bus timings Mon-Thurs	Afternoon Bus timings Fri	

*-0819 From Cody's Tree to X80

Main Gate — Q153 — North Gate — R21 — South Gate — P68 — Q Hangar — C&M Hangars — Y20 — N&D Hangars — X32 — Structures Gate — X80 5Mtr Tunnel

Q134 — Q27 — P68 — Q Hangar — C&M Hangars — Y21 — N&D Hangars — X32

4.2 *RAE internal ferry timetable.*
RAE Telephone Directory, 1990.

---

[9] Jenkins, Track 2 [00:15:24– 00:15:59].
[10] Stephen Twigge, *The Early Development of Guided Weapons in the United Kingdom: 1940–1960* (Reading: Harwood Academic, 1993).
[11] Mike Westby, Track 3 [00:06:10–00:06:24].
[12] Jenkins, Track 2 [00:50:34].
[13] James, Track 1 [00:40:55].

Ian Linsdell was astonished by what he found when moved from MOD in London to work as an accountant on site at the Royal Armament Research and Development Establishment (RARDE) in Kent:

> It's one thing seeing things on paper, it's another thing entirely to see them in the flesh as it were. I had no concept of the scale of the operation—the number of people and quite frankly of the brains of the people or what they did. I had no idea at that stage what they did—which was how it was supposed to be—or just how vast the place was [with] satellite areas. […] Like a whole community, you're talking hundreds of people, vast bits of real estate. So you then start to explore the government research establishments and you find that the ARE [Admiralty Research Establishment] has these magnificent facilities all over the place, ocean basin towing tanks where they test hulls. Similar things on the airside … to find that [at Farnborough] that's actually the largest wind tunnel in Europe.[14]

The descriptions of the RAE buildings from Phil Catling remind us of the historic role GREs and their facilities played in developing new technologies for the armed services:

> I couldn't believe how vast [Farnborough] was. The building shapes were quite something … well the old balloon factory that was still there, and those shapes were there, the wind tunnel, corrugated iron wind tunnel, a mismatch of buildings. You think, this is time-warped in a sense, but it was functional.[15]

4.3 *Queen's Awards presentation evening in RAE assembly hall where RAE heritage was displayed, 1988.*
© Ministry of Defence. Personal collection of Chris Peel.

---

[14] Linsdell, Track 2 [00:40:57–00:43:17].
[15] Catling, Track 1 [00:12:08–00:12:36].

Similarly David Dunford's working environment in the materials and structures department at RAE included legacies of the Second World War:

> It was a Bristol tram shed, so it was quite a high-roofed building with offices round the outside and lots of very large testing machines, some of them came from the war, reparation from Germany, and designed really just to break materials, to understand the properties of materials. There were areas for fabricating specimens and workshops, there were some various outbuildings, there was a foundry and a forge for doing metalwork and heat treatments, and then there was a chemistry block where they did a lot of work on rubbers and adhesives and things like that. […] You go from a school science lab to a Bristol tram shed, there's a significant change in scale.[16]

In addition to the wartime legacy, the atmosphere of the GREs was defined by being part of the much larger organisation of the civil service, as Paul Cannon remembered in describing the section he first worked in at RAE:

> A red brick building, pretty tatty, painted in typical civil service colours, I always claim you can tell a civil service building no matter where you are in the world, there's a kind of feeling about and smell about it. Pretty solid building with some nice labs, lots and lots and lots of equipment, some of it old and should have been thrown out, some of it only used once a year because that was the nature of it as a piece of test equipment. […] There was a Division Leader with a secretary, and vast amounts of paper being moved around. [..] Offices for all the PSOs on their own, if you were an SSO or below then you might share, but [they] tended to be big offices. […] And there were technicians. […] The people were friendly, there was a relaxed atmosphere, I knew who my boss was I knew who my boss's boss was and that's really important to actually know where the chain of command lies. It was all so well defined. The building was pretty knocked around, it was an immediate post-war building, but everybody made me very welcome and I was very happy. ... I loved it. ... It was a gift from heaven as far as I was concerned.[17]
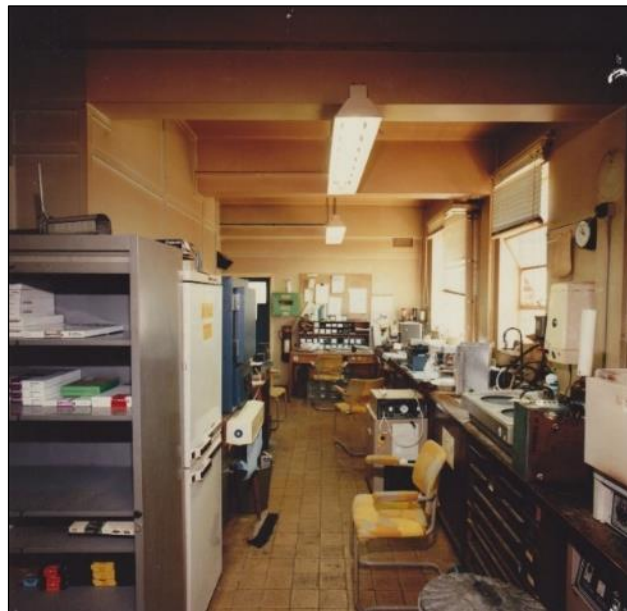
4.4 *Interior of one of the laboratories at RAE, 1987.*
© Ministry of Defence.

[16] Dunford, Track 2 [00:11:32–00:12:28].
[17] Cannon, Track 3 [00:19:35–00:21:19] and Track 4 [00:51:35–00:53:12].

Cannon's description reinforces Randle's observation that those working in research settings should not be considered as, 'a homogenous group with similar degrees of autonomy, career expectations or intellectual content in the work they carry out.'[18] However, as Chris Peel commented, 'everybody just worked together according to their abilities and their position. It was fairly broad church in that sense.'[19] Scientists such as Paul Cannon respected the competencies different people brought to the research enterprise:

> These guys were worth their weight in gold because they could do stuff that those of us with degrees couldn't. They just knew, they were craftsmen. They'd been trained to provide a different skill set so they made up a nice, rounded team.[20]

As well as the technicians—known as experimental workers in the GREs—scientists also worked closely with another group of staff, the industrial civil servants employed in workshops. This aspect of the GREs was not what Anthony Bravery had expected about his new workplace:

> A slight feeling of … surprise that it would look all rather industrial considering it was calling itself a research institute. […] Of course I hadn't thought through the fact that of course they would have workshops and machine shops, it wasn't all laboratories … to see the big structural engineering lab where they broke beams and so on was interesting.[21]

The experimental aspects of the GREs' research programmes and the annuality of the Vote system contributed to an investment in facilities and equipment that contrasted with the situation in universities when UGC equipment grants were being stretched by the mid-1980s.[22] Susan James' catalogue of the equipment used in acoustics research bears out Mike Westby's memory of 'lots of kit, equipment, shiny things.'[23]

> I can just picture the room with all the racks of equipment. We obviously had all the audio recorders, reel-to-reel, we had very tiny ones which we could just slip them into the pockets of aircrew's coveralls so they could go up and record inflight where you couldn't go with your big roving microphone. […] Then there were spectral analysers. […] There were these big level recorders and you'd get these paper traces, so if we recorded a whole sortie, a complete flight, we could look and see how the noise environment in the cockpit varied over time. […] Drawers full of microphones for different working environments. Amplifiers, loudspeakers. […] We also had the facilities, we had reverberant rooms so you could build up very high levels of noise to simulate a cockpit noise environment … the loudspeakers we've got in our current chamber I think were the ones that we bought about 30 years ago.[24]

---

[18] Randle, 'The White-Coated Worker'. p. 742.
[19] Peel, Track 2 [00:15:25].
[20] Cannon, Track 4 [00:53:18–00:53:51].
[21] Bravery, Track 2 [00:44:04–00:44:42].
[22] Education, Science and Arts Committee, *The Future of the Science Budget*, p. 118.
[23] Mike Westby, Track 1 [01:00:43].
[24] James, Track 2 [00:00:25–00:03:34].

4.5 *Susan James at work in the RAE acoustics laboratory, c. 1980.*
© Ministry of Defence. Personal collection of Susan James.

Paul Cannon's enthusiasm for the RAE's extensive facilities for communications research is evident in this extract:

> There was a transmitting station at Cove Radio which had huge antennas ... big transmittors that would radiate lots and lots of power, Cobbett Hill would have the receiving station, they were joined electrically, so one was connected to the other. […] You would take your piece of equipment out to the transmitting station or receiving station and you'd plug it in and there were staff out on both of these sites who would help to do all this. You know, I mean glorious, absolutely glorious, but boy was it expensive to maintain because you had to have at least a couple of people on at any one time. [...] They were wonderful, wonderful facitilies. I built some meteor burst equipemnt and had some built by industry and we would put that equipment into Cobbett Hill and we would run it there. [...] Yeah, what a privilege.[25]

4.6 *Paul Cannon running an experiment at Cobbett Hill, 1984.*
© Ministry of Defence. Personal collection of Paul Cannon.

---

[25] Cannon, Track 4 [00:55:22–00:58:08].

His description indicates the interactions with both human and non-human partners that made up scientific research, the elaborate hardware needed to perform the research activities and the many colleagues involved in making things happen.

However there was another very obvious aspect to the human side of the GREs, in that it was a male-dominated world. The 1980 *Review of the Scientific Civil Service* made no attempt to analyse staff diversity in terms of race or gender, rather it was concerned with numbers, qualifications and scientific disciplines.[26] While Sarah Herbert observed that, 'the researchers on our extramural contracts regularly came from other countries,' members of the scientific civil service were predominantly male, white and British.[27] This corresponds with Mody's remarks about US research organisations during the early part of the twentieth century being 'dominated by scientists and engineers from society's middle strata: white, middle-class, middle brow men.'[28]

4.7 *Members of the materials and structures department, DRA, Farnborough 1992.*
(Pam Turner, middle row, far left.)
Personal collection of Pam Turner.

The gender imbalance was very noticeable to the women who worked in the GREs, with Wendy Westby describing her first day at RAE as 'like walking into a monastery'.

---

[26] Civil Service Department, *Review of the Scientific Civil Service*.
[27] Herbert, Track 6 [00:16:25].
[28] Mody, 'The Professional Scientist'.

> There were virtually no other women there apart from the admin. ladies who were all female. There weren't many female scientists. […] I remember having a cup of tea in the staff room one day and there were about four women in there and the older female senior scientific officer said, 'Well, this is unusual isn't it, we're all women!' So, it was a bit intimidating, actually.

One story from Westby is illustrative of how this male-dominated environment could affect daily working life:

> I have small hands and I'm not a man and I need small gloves. I couldn't get gloves that fitted me for several years because they ordered in the gloves that we used in the laboratories centrally and they didn't do the small size because nobody wore them, I was wearing gloves that were half an inch longer than my fingers for several years.[29]

Anthony Bravery's comment indicates that while women were employed as scientists in GREs, they were more visible as technicians:

> I would say that almost every unit had at least one female scientist in it and there were a lot of girls who were technicians so I suppose we were reflecting an era that was just before many girls were going to university, so when it came to reaching 16, boys were starting to go on to colleges and university rather than go into work, maybe girls were more likely to be looking for a job.[30]

Phil Catling's comment about Farnborough is very similar: 'You could just count on your hand how many women were there, and of those that you saw half of those were probably in the support role.'[31] While Sarah Herbert went on from Farnborough to become an MOD desk officer in Whitehall, Alan Gray's comment suggests that even when women scientists were employed in GREs or in Whitehall, they were not necessarily noticed because they were assumed to be absent:

> There were no women in Operational Requirements. Very few of the research establishments had any women in. […] This goes on, in the MOD I never saw a woman in Main Building or Neville House at all.[32]

The women scientists interviewed for this project contributed to the research programmes in the GREs in various capacities and at different levels of responsibility. As a manager at RAE, Sarah Herbert devised particular strategies to foster co-operation with the men on her team:

> I always managed men, I never had any women scientists who worked for me […] I just didn't come across women scientists at all very much, the place where I met them later was at conferences … the number of women I saw coming up was very few. […] I didn't feel like a pioneer, I knew that I was a woman coming into a group that was not used to having a woman section leader. I was very careful about the fact that I was a woman. I did do it differently, I think, to a way a man did it, because I took the attitude that I was

---

[29] Wendy Westby, Track 2 [00:17:54–00:18:27].
[30] Bravery, Track 5 [00:01:18–00:02:00].
[31] Catling, Track 1 [00:46:47].
[32] Gray, Track 3 [00:54:04–00:54:45].

there to work with them, not on top of them. […] I always made a point of treating us like we were a team and that we were working together. […] I did that on purpose because I was a woman, it was a strategy.[33]

Interviewees' stories illuminate the challenge of navigating male-dominated environments before the establishment of equal opportunities practices in the workplace.[34] Shirley Jenkins and Sarah Herbert were aware that the civil service career structures were not designed for women who had a family:

I didn't have a driving ambition because I had children so … there were always going to be sort of limitations in what I could aspire to. […] I also wanted to stay on the practical side of things as well. I didn't want to go into any sort of an office job. I didn't want to go to London headquarters, so I was to some extent my own worst enemy.[35]

The thing was in those days all the women left the moment [they] got pregnant, they left and didn't come back to work. It was expected that you would leave. In those days there was no equality of women, and women didn't work and generally didn't have childcare and they were absolutely convinced that if I had a family I would leave.[36]

Even with the 1970s statutory provision for maternity leave, women would not necessarily choose to return.[37] However, Herbert was determined to do so, recalling that when her head of department agreed she could work part-time to accommodate her caring responsibilities, he 'patted my head, as if I was a little dog'.[38] If women did return to work after having children, they often had to accept a position with less responsibility or status. From the 1990s there was a growing awareness of the need to improve opportunities for women, with progress demonstrated by Susan James' mention of the provision of on-site childcare and six months' maternity leave by the end of the 1980s.

Women interviewees were very aware of navigating a male-dominated working environment. Carol Atkinson became CEO of BRE's post-privatisation certification business but admitted that in her early career as a researcher at GEC Hirst, 'I often overprepared because I didn't want to foul up. I wanted to show that women could be as good as men.'[39] Susan James remembered how she coped with the attention she received as a woman working in acoustics research:

---

[33] Herbert, Track 8 [00:49:59–00:51:31] and Track 6 [00:44:40–00:46:08].
[34] Civil Service Department, *The Employment of Women in the Civil Service* (London, 1971); Sally Horrocks, 'The Women Who Cracked Science's Glass Ceiling', *Nature*, 575, no. 7781 (2019), pp. 243–46.
[35] Jenkins, Track 4 [00:53:40–00:54:16].
[36] Herbert, Track 8 [00:40:23–00:40:51].
[37] Julia Slingo, interviewed by Paul Merchant, various locations, 2011–2012, BL C1379/61, Track 4.
[38] Herbert, Track 4 [00:41:35].
[39] Atkinson, Track 3 [00:37:27–00:37:37].

> One of the things I had to do was kit the air crew up with all the recording equipment, there was a lot of joking, a lot of banter … that gave me a lot of anxiety. […] I do remember being on *HMS Invincible*, we were doing noise measurements on the deck and a guy came up and said 'what on earth makes a girl like you do this job?' And I thought, 'what does he mean by a girl like me?' I think what he meant was a girl who looks like you, perhaps, because I do enjoy clothes, perhaps I wasn't in a white coat with goggles, I don't know! […] But generally, if you start talking and show you know your subject, that's all they want to know, they want to know whether you've got solutions to their problems.[40]

James' comment encapsulates what the work of government scientists was about: knowing the subject and offering solutions to problems.

4.1.2 Doing the work

The GREs constituted a training ground which produced a pool of scientific and engineering experts that were both academically qualified and with practical exposure to the needs and methods of industry. For Roger Courtney and Chris Peel this was the focus of working for a GRE, connecting the theoretical to the practical in order to achieve organisational and national goals:

> I was dealing with science as a tool for understanding the world but understanding the world with an aim in mind. So, it wasn't—to quote the phrase—science for science's sake, it was something else.[41]

> The academic end of it, they're interested in individual personal developments, rightly, their own field of influence and da-de-da-de-da. Some will be very focused on having that exploited, others will be just purely interested in the science of it: 'Can I get deeper and deeper and deeper in and not necessarily push it across?' So, there's a bit in the middle. There's that bridge of applied research that's absolutely critical at transferring from the academic area, the science area, into the applied product, and that's really my view of what the R&D in the establishments used to do, did the applied research in the middle.[42]

In his history of a US federal laboratory, Tarter also describes its role as 'connecting the two extremes'.[43] However this quotation from Steve Rooks—using the term 'corporate research' as synonymous with 'basic research'—indicates the range of activities that went on in GREs:

> In those days in research, we had two big buckets [of funding] in the science and technology area, one was called corporate research and the other called applied research. The corporate research was all about the future, really whacky research ideas, things that were ten, 20, 50 years out. People would just think innovatively, getting in labs and doing whatever they liked, really, that might have a future application, as long as it had some

---

[40] James, Track 3 [00:17:43–00:18:11] and Track 6 [00:49:02–00:49:56].
[41] Courtney, Track 3 [00:51:58–00:52:22].
[42] Peel, Track 4 [00:33:02–00:33:45]. Peel's use of the term 'bridge' echoes its use by former RAE director James Lighthill. See Jon Agar, 'What Is Science for? The Lighthill Report on Artificial Intelligence Reinterpreted', *The British Journal for the History of Science*, 53, no. 3 (2020), pp. 289–310.
[43] C. Bruce Tarter, *The American Lab: An Insider's History of the Lawrence Livermore National Laboratory* (Baltimore: Johns Hopkins University Press, 2018), p. 287.

kind of endpoint. We were involved in applied research. Each area of research, and whatever customer you were supporting, would have some kind of remit, so for example Programme 3A about helicopter survivability. In that space there would have been a top-level statement saying it's important because … UK helicopters need to be made more survivable against X, Y, Z and so on. Then the applied research programme would be looking at what can we do to take stuff that's either been generated in the corporate research programme or stuff that's available to understand how we might use it and apply it. […] Some of the corporate research would have been done at Farnborough as well, but typically a lot of the other sites would be doing it, Malvern [RSRE] for example was very much a corporate research site.[44]

Sarah Herbert and Paul Cannon, referring specifically to defence research, had a different understanding of what scientists' work in the GREs was for:

[Government] don't fund it in order to develop a product, it isn't commercial, they fund it in order that MOD can develop a pool of knowledge so that when they come to buy equipment off defence firms, they actually have some knowledge of the technologies that are in the product they are trying to buy. So, they actually fund research to get what they call intelligent customer status. […] They have got the knowledge through the research establishment to be able to assess this purchase correctly.[45] ∩ ▶

Certainly in the 1980s, it's a longer-term process, it's a longer-term vision. […] You're looking to build capability first for the military—you have to always remember who you're doing the work for and who's paying the bills—but on top of that you're trying to build capability that they can call on in future. It's like a bank ... you have to deal with the project, and that's your current account, but you have to put money in the deposit account for the future.[46]

Anthony Bravery's analogy was of government paying an insurance premium:

Scientists sitting in a lab in the middle of Buckinghamshire doing idiosyncratic work with fungi and a Minister sat in the 16th floor of Marsham Street agonising over house values … our role was to be there like an insurance policy. We haven't got a problem, great, we'll just keep paying the premium, i.e. paying for the lab, but when a problem arises you better come up with the goods, you better be right, and you better be sure you can answer the parliamentary question for us so we don't get a load of political brickbats from the Opposition or from industry or wherever else.[47]

In carrying out their work, scientific civil servants were engaged in what Latour has described as 'technoscience' to acknowledge the fundamental interactions between humans and technologies in knowledge production.[48] Mukerji has also pointed out that,

it is easy to think of science as a purely intellectual activity … [yet] it is the combination of people and machines, organized to accomplish certain analytic processes, that constitute the techniques of the laboratory. And it is the development and use of these techniques that give scientists their sets of useful skills.[49]

---

[44] Rooks, Track 2 [00:42:11–00:44:24].
[45] Herbert, Track 7 [00:23:21–00:24:23].
[46] Cannon, Track 3 [00:39:14– 00:40:08].
[47] Bravery, Track 3 [00:25:11–00:26:00].
[48] Latour, *Science in Action,* pp. 174–5.
[49] Mukerji, *A Fragile Power*, p. 128.

Interviewees were very likely to be using a portfolio of capabilities that included high levels of theoretical knowledge and practical engineering skills, often developing new techniques themselves in order to investigate their research questions.[50] Excerpts from the interviews with Sarah Herbert, Chris Peel and Wendy Westby illustrate this process.

> When I first went [to RAE] it was very much a DIY environment. We were in the very early days of using carbon fibre composites …we used to have small amounts of material, they're made up of layers of fibre, it was a little bit like dressmaking, putting the patterns of these fibres together in various directions, but we had a press that would press pieces about a foot square and we had to operate those presses ourselves. […] I used to have to bond on all the end plates to be held in the machine so I used to have to cut up end tags and bond them onto the end, then I would test them in test machines. [...] Sometimes I would take photographs under a microscope of the fractures, I developed my own photographs in the darkrooms, printed all my own prints. […] There was an absolute multitude of equipment and methods and techniques that I learnt how to use because I had to do absolutely everything […] and most people did at that particular stage.[51]

> Yeah it was hands on stuff, we would pour molten metal ourselves, we would forge and roll ourselves, using rolling mills, forging presses, we were well-equipped, and [had] the staff. We had a selection of experimental workers and assistant scientific officers and what have you who would support the activity, but the scientific staff pitched in and did a fair bit of the practical stuff. Even quite senior people doing practical stuff.[52]

> Part of the skill in analytical chemistry is to develop the analytical method on the piece of equipment—it's not just a case of putting the sample in and it gives you an answer. A certain amount of background reading, building on that really. […] If [the sample] required dissolving and basically how it reacted with other compounds … getting advice from manufacturers. The method development was really because a lot of the samples were research samples, therefore a standard method didn't already exist, so you had to develop something to suit the new materials.[53] 🎧 ▶

4.8 *Wendy Westby at work in a chemistry laboratory on the Farnborough site, 1991.*
© Ministry of Defence. Courtesy of Wendy Westby.

---

[50] Sismondo, *An Introduction*, p. 90.
[51] Herbert, Track 3 [01:20:31–01:22:28] and Track 5 [00:07:20–00:07:48].
[52] Peel, Track 2 [00:10:24–00:10:59].
[53] Wendy Westby, Track 4 [00:05:04–00:06:49].

These extracts present a picture of an innovation environment where individual creativity and a can-do attitude was a necessary skill to deploy alongside the practical and theoretical capabilities. Being a problem-solver was part of the culture of working as a scientist in a GRE. This was fostered by a managerial style remembered by interviewees of vague instructions and the absence of close supervision by their superiors. Paul Cannon's remit for investigating meteor burst communications was, 'I was given very loose targets as I recall which was, you know, "understand it, see what needs doing, maybe develop a UK experimental system."'[54] These accounts from Sarah Herbert, David Dunford, Anthony Bravery and Shirley Jenkins are some of the many references to the level of supervision from managers:

> There was very little direction at that time at all. There's no wonder that they altered how materials research worked because nobody really told me what to do, so I worked out a research programme of my own, not perhaps very inventive to start off with, but it taught me how to make the composites.[55]

> We were left to our own devices. People were committed, they wanted to understand … a lot of the individuals had been involved in the development of materials, the Comet accidents and understanding materials, there was a lot of experience there, a lot of practical knowledge that was focused on understanding and growing.[56]

> In a sense we were left to our own devices to do the right thing and to know what the right thing was. We knew that our principal objective was to provide robust technical and scientific advice to Ministers where there were going to be policy decisions, that drove what we did, we knew the science, we knew the technology and we knew where the gaps in the knowledge were.[57]

> Just did it and tried it, then it was done properly in the machine shops. You were allowed to do those things in those days. If you wanted a piece made up in the workshops you didn't have to get it approved or drawn up properly or certified and everything else, you sketched it out and took it along to somebody who would work out what you were trying to do and make it for you.[58]

This light touch had its drawbacks depending on the quality of the personnel, as Paul Cannon observed:

> There were extremely good people, extraordinarily able people, they were doing extraordinarily good work, world class with a star, I mean they were really good, and then there were people who were doing some really poor work. Admittedly most people were in the middle [but] without doubt money was being wasted on this really poor work. People would reinvent the wheel. As a youngster it did used to drive me round the twist, I have to admit, but having that freedom allowed for these extraordinarily able people doing extremely good work.[59]

---

[54] Cannon, Track 3 [00:25:04].
[55] Herbert, Track 5 [00:01:47–00:02:17].
[56] Dunford, Track 2 [0:24:45–00:25:07]. Soon after the de Havilland Comet entered service in 1952, three of the aircraft crashed after breaking up in-flight.
[57] Bravery, Track 4 [00:07:08–00:07:44].
[58] Jenkins, Track 2 [00:48:15–00:48:44].
[59] Cannon, Track 4 [00:23:42–00:24:43].

Work was also conducted beyond the office and laboratory space and often experienced as exhilarating, such as when Phil Catling was conducting trials for new technologies to add to pilots' helmets:

> When I was in the weapons group there was work there to do with weapon aiming from Canberra aircraft with very early prototype helmet mounted display, little CRT mounted on the side of the pilot's helmet and a little TV camera in the front of the aeroplane. I'd go off to various disused airfields with my boss and we'd have to blow up tanks, not blow, blow them up, but inflatable tanks. So they were there, arrange them in certain orientations for aircraft to fly in and people would analyse the results afterwards, so exciting times.[60]

4.9 *Phil Catling wearing equipment to test eye tracking ability under vibration, 1975.*
© Ministry of Defence. Personal collection of Phil Catling.

Shirley Jenkins worked on a programme that used an airborne spectrometer to collect measurements of the spectrum of the sun. Her role was a mix of observation flights and 'painstaking, time consuming work' on the ground. She flew around 1,000 hours in Canberra and Comet aircraft adapted by the RAE for scientific research:

> Pretty well all the seats were taken out, just enough seats for the observers who were in there … just racks of equipment that were bolted to the seat rails. […] We'd be flying at anything from 1,000 feet up to 40,000 feet for two to three hours. … [In the Comet 2] we had to wear oxygen masks if we were flying at high altitude. […] It was interesting doing experimental work trying to sort of tie up the measurements in the chamber in the lab with the measurements you had from the air. The measurement bit was tedious but understanding what was happening was interesting. The whole lot was interesting.[61]

---

[60] Catling, Track 1 [00:13:48–00:14:43].
[61] Jenkins, Track 4 [00:02:08–00:03:04] and Track 3 [00:24:41–00:25:11].

RESTRICTED

2.1 Aluminium Alloys

Title	Job No(s)
Effects of Cu in high strength Al-Zn-Mg-Cu alloys	MT1/16B01/06
Objective	Principal Investigator(s)
To determine the effects of S phase precipitates on stress corrosion resistance and strength	C J Peel
	1974/75 1.3SSP
	1975/76 0.1SSP

Progress A survey of the literature on high strength Al-Zn-Mg-Cu alloys had revealed that little research had been made into the role of Cu in determining the stress corrosion behaviour and strength of these alloys. In particular the possibility of modifying the composition of the fine precipitates had not been explored. It was thought that, from electrochemical considerations, it may be beneficial to precipitate some S phase (Al_2CuMg) in place of some of the normal η phase ($MgZn_2$) in order to obtain good strength and stress corrosion resistance. Two alloy compositions were therefore chosen, from considerations of equilibrium constitutional data, for electron metallographic investigation.

Having produced two alloys for preliminary microstructural studies, a final 20 kg melt has been cast, containing Al-4.4%Zn-2.7%Cu-2.1%Mg-0.2%Zr, for stress corrosion and tensile testing. The alloy has been tested in the form of 33 mm plate in five heat treated conditions. Electron microscopy revealed that after ageing at 120°C mainly η phase ($MgZn_2$) precipitated in the matrix and grain boundaries, but after ageing at 210°C a mixture of η phase and S phase (Al_2CuMg) had occurred. X-ray analysis in a scanning transmission electron microscope revealed that the grain boundary particles contained Cu after this high temperature ageing. Two further conditions involved 5% cold rolling before ageing and this was found by electron microscopy and electrochemistry to have increased the amount of Cu precipitated, at both ageing temperatures. Some of this Cu was in the form of S phase.

Stress corrosion tests revealed that cold work before ageing at 120°C increased the short transverse threshold stress from 138 MPa to 207 MPa with little change in the 0.2% proof strength of 480 MPa. The cold rolling before ageing at 210°C reduced the threshold stress from 84 MPa. The stress corrosion resistance of material aged ½ hour at 210°C plus 120 hours at 120°C was >276 MPa. No simple relationship was found between the amount of S phase precipitated in the matrix and the stress corrosion resistance, eg the three treatments that precipitated large quantities of S phase gave threshold stresses ranging from <84 MPa to >276 MPa with approximately the same proof strength of 365 MPa. Ageing at 120°C after cold rolling gave the best combination of properties, ie a short transverse threshold stress of 207 MPa and a 0.2% proof strength of 474 MPa. A final report has been written .
(ECD February 1976)

Report(s)

C J Peel "Precipitation of S phase in High Strength Al-Zn-Mg-Cu Alloys" RAE
          TR 75062 June 1975

4.10 *Technical report written by Chris Peel, 1975.*
Research and Development Report, RAE Materials Department, 1975.

Interviewees recognised that observation was a fundamental element of their work, as was the recording of those observations and writing up the results. Latour refers to this central aspect of a scientist's work as inscription, and interviewees such as Anthony Bravery, Paul Cannon and Sarah Herbert spoke about the centrality of writing to the progress and satisfactory completion of their work.[62]

> Usually you start by writing a proposal, the experiments you're going to carry out, and that's probably something, even if you're not getting approval for it, you're getting reinforcement, reassurance, you have it reviewed. What you're going to try and aim to do, title, objective, method, how you're going to carry it out, what equipment you're going to

[62] Latour, *Science in Action*, p. 64.

need, and what data you're going to gather. […] Then you're recording your results so that's writing or recording in some way, and then it's reporting, because you want to place it all on record for your own use, never mind anybody else's. Then if you're going to publish it goes a stage further, so in the middle of all that you're actually filling test tubes or weighing things or pouring things or cutting and chopping and what have you, so there are practical experimental operations going on, but it's all still being recorded. […] It's [the same] in the field, all the material's out there but in their hand is a notebook and they're recording the results ready to write them up.[63]

You've got to get your ideas over, and actually … as you write you learn, as you write you understand, it's only by trying to create a clear and unambiguous statement about something that you do that last stage of thinking.[64]

Always in my scientific work we always kept huge details of the experiments, the observations, the measurements, recorded them in lab books, dated them all, we were always very fussy about doing that.[65]

What becomes apparent is that while the GREs were organised along scientific disciplines, the range of tasks and activities undertaken by interviewees encouraged their development as engineers as well as scientists, as Roger Courtney discovered once he joined BRE:

It became clear to me that as a physicist, if you weren't in a university you turned into something else. You might turn into an electrical engineer, or in my case, you turned into some form of mechanical engineer, but I was not trained in mechanical engineering, I did the best that I could.[66]

David Dunford found that the practical working environment of RAE enabled him, 'to grow up in that sense as a scientist and engineer.'[67] As their careers progressed, Paul Cannon and Sarah Herbert found they needed to have both sets of skills:

You'll find many, many good scientists are superb engineers and it's just a necessity. […] If you're going to do experimental physics you're going to have to work at the boundaries of contemporary engineering as well, it's just the way it is.[68]

Once I started to work on structures, I was in a very applied field. [...] At a detailed level there is science, and engineering is the application of it. By the time you're working on composite structures you are applying materials science to structures, you are becoming more of an engineer. It's semantics. [...] Physics includes mechanical forces etcetera but really the whole science of loading something and fracturing it etcetera is becoming very close to engineering. I was on the borderline. I was quite happy to be called an engineer.[69]

These extracts demonstrate that scientists in the GREs often worked on their own initiative, combining theoretical knowledge with practical skills to carry out their work

---

[63] Bravery, Track 5 [00:27:05–00:29:00].
[64] Cannon, Track 5 [00:07:33–00:08:00].
[65] Herbert, Track 6 [00:38:23–00:38:41].
[66] Courtney, Track 7 [00:10:06–00:10:32].
[67] Dunford, Track 1 [00:42:10].
[68] Cannon, Track 2 [00:37:56–00:38:54].
[69] Herbert, Track 10 [00:21:10–00:22:37].

in a variety of settings. I now turn to the network of relationships with colleagues and collaborators that characterised scientists' working lives.

4.1.3 Working relationships

Interviewees refer to forging many different types of working relationships with internal colleagues, researchers in other GREs, administrators in Whitehall, industrial and academic partners and international peers.[70] Roger Courtney explained that,

> the nature of that sort of research establishment is that there aren't that many people who will go there just to do science. They'll have an interest, they'll have a wish to be engaged elsewhere, in a wider circle.[71]

Chris Peel, as a special merit scientist who became a chief scientist at RAE with responsibility for air accident investigations, personified Courtney's description:

> It was the people around you … quite a lot of involvement with all sorts of folk that perhaps you wouldn't have got if you were in industry, and you almost certainly wouldn't have got in university. I must have been dealing with 100 companies, all the MOD people, all the RAF people, Civil Aviation Authority, Department for Transport, Department for Trade and Industry, French Government, Canadian Government, American Government … you know, it was a big raft of interactions.[72] 🎧 ▶

4.11 *Chris Peel showing the Duke of Kent components from major aircraft accidents in the Failures Investigations Laboratory, RAE, 1987.*
© Ministry of Defence. Personal collection of Chris Peel.

---

[70] Whelan, 'Management of Scientific Institutions', p. 320.
[71] Courtney, Track 8 [00:16:55–00:17:33].
[72] Peel, Track 6 [00:55:16 –00:56:00].

The working relationships described in this section were incredibly stimulating, acting as pathways in a complex exchange network through which knowledge was transferred between the various public sector and industrial R&D communities. Steve Rooks remarked on how experts would get to know each other by working in the same field:

> Through things like our NATO groups and projects that industry were involved with you got to know these people, whether they were BAe Systems or Rolls Royce or universities, or SMEs or MBDA [a missile systems manufacturer]. So you knew who the people were, so there was probably a little bit of poaching because you'd have a world expert in DRA who might retire but there would somebody in BAe Systems who was also using the same software or whatever, so it would be natural to say, 'Do you want to come and work in government for a bit?'[73]

4.12 *David Dunford (far left) with members of the Boeing test crew in the 5-metre wind tunnel, Farnborough, 2003.*
Personal collection of David Dunford.

Each interaction served as a node in a web of knowledge communication, sometimes through formal written delivery such as journal articles or technical reports, sometimes through personal attendance at official meetings or giving conference presentations. There was also the more informal process that came through working alongside colleagues and collaborators, the absorption of tacit knowledge which Collins describes as 'knowledge that is not explicated'.[74]

---

[73] Rooks, Track 2 [00:54:25–00:55:00].
[74] Harry Collins, *Tacit and Explicit Knowledge* (Chicago: University of Chicago Press, 2010), p. 1.

A key fixture in those processes of knowledge transfer were the coffee and tea breaks that brought team members together, remembered by most interviewees as 'very important networking opportunities'.[75] David Dunford outlined how he benefitted:

> Coffee breaks were actually intellectual discussions a lot of the time, people would talk about where they were, what they were doing, various things like that, if they'd been to a conference, or people would pose a problem or an understanding. It was done in a very kind of informal way, but quite an important way. As a youngster I learnt from the people around me. There wasn't a structure to it, you talked to them and you understood and discussed your problems or challenges or what you'd achieved, and they would provide some insight. It was excellent.[76]

These breaks offered the chance to get to know colleagues better on a personal basis, with Sarah Herbert providing a memorable example:

> We all went to tea breaks, yes, we all mixed in, the grades were very much crossed and mixed, it was quite a social life. […] Indeed the superintendent when I first got there, absolutely brilliant man … was also a Morris dancer and at our tea breaks he would come and chat to us, and when he wanted to talk to you a bit about how Spanish people did flamenco dancing he would swirl his makeshift skirt and show you a bit of dancing round the lab.[77]

While Mody comments that, 'scientists are people, given to infighting as much as to in-group camaraderie', it is noticeable that there is no mention in this set of interviews of any particular disputes with colleagues.[78] It is the word 'camaraderie' that is repeatedly used to describe the atmosphere within working teams, such as in these remarks from Phil Catling. Paul Cannon and Ian Linsdell:

> Peers working with, we were spread across the organisation, met with them socially afterwards, It was a good sort of camaraderie. Very good support from immediate line managers and senior section leaders. If you had an idea that was not kicked into touch, saying that's irrelevant, [rather] let's explore that further.[79]

> We used to socialise together, and yes there was a hierarchy but it was very light. People used to just respect each other for who they were. We'd go to the pub together … we'd go to each other's weddings.[80]

> Friday lunchtime culture. […] Whatever the team was, we would go down the pub on a Friday, there was a little bit of peer pressure to come, most people did. […] It was a good bonding, team building thing to do. [...] It was worth it to get the camaraderie that you got out of something as simple as going to the pub on a Friday.[81]

---

[75] Bravery, Track 3 [00:08:17].
[76] Dunford, Track 7 [00:03:33–00:04:11].
[77] Herbert, Track 5 [00:15:15–00:18:09]. Herbert is referring to Nicholas Wadsworth.
[78] Mody, 'The Professional Scientist', p. 170.
[79] Catling, Track 1 [00:13:19–00:13:47].
[80] Cannon, Track 6 [00:01:57–00:02:37].
[81] Linsdell, Track 7 [00:27:30–00:28:36].

4.13 *Farewell party for Robyn Thorogood (seated) on his transfer from BRE to Whitehall, 1981.*
Personal collection of Robyn Thorogood.

However the office arrangements could inhibit openings to interact with colleagues as Steve Rooks discovered when he first started at RAE, suggesting that not everyone felt a sense of belonging or camaraderie:

> It was very isolated on the Farnborough site ... I was in a building called T70 right at the end of the runway and whilst there were about 80 people in that building over three floors, they were in offices and you probably didn't even know, unless you were in a meeting, the people in the offices opposite you. Closed doors, so as a youngster going in there, it was quite a lonely time.[82]

Paul Cannon also experienced how individual teams operated in silos:

> We were the 'beyond line of sight' communications section and there was a 'line of sight' section. It was probably 40 steps to get from my office to where the 'line of sight' people were, but how often did I walk across there? Very rarely, once a week, once a fortnight. They were fine people but they were doing what they were doing and I was doing what I was doing.[83]

In this web of interactions, the staff in the in-house libraries served as a useful focal point that connected researchers together, as Carol Atkinson remembered: 'If you were wanting to work on something, they'd say, "Have you thought about going to talk to Fred, Albert,

---

[82] Rooks, Track 6 [00:07:48–00:08:17].
[83] Cannon, Track 3 [00:56:17–00:56:48].

Ermengard?", whatever.'[84] The BRE librarians' specialist skills also helped Atkinson to cultivate relations with civil servants in Whitehall who were responsible for commissioning research:

> I had David in the library coming up with things in Hansard. I'd work out from the organograms who was who, pick up the phone and have a wee chat over the phone with them, persuade them that it would be a good idea for me to pop in and see them and have a coffee.[85]

Paul Cannon remembered the camaraderie that also existed between scientists and civil servants in Whitehall:

> We used to have major field reviews as they were called, that would be led by the division leader and even by the departmental head, with help from the section leaders. […] There was so much to-ing and fro-ing of staff from the research establishments into Whitehall, so the science teams in Whitehall [...] the people had nearly all worked in the research establishments. […] People were colleagues but they were friends so there was good camaraderie between the two.[86]

Relationships with civil servants in Whitehall influenced the programme of work commissioned by central government. As a senior manager Martin Wyatt commented:

> It was an educational process for me to understand how the department worked and took decisions and how the politics worked, a lot of politics involved. […] Interpersonal relationships and who you could lobby and who you couldn't and who actually took the decisions and who didn't, and you had to learn that.[87]

Staff at the GREs with specialist expertise could also be called upon as expert witnesses; an example is Chris Peel's provision of evidence in air accident investigations or to 'advise British industry when it had problems … they would also come to us with their broken bits.'[88] At the other end of the spectrum, GRE scientists were dealing with requests for information from industry and the public. Chris Scivyer mentioned completing 100 roadshows in which he displayed public information about radon.[89] Knowledge exchange was also very much pursued through the academic route of peer reviewed publications, as David Dunford explained:

> Firstly you had to write papers, that's the fundamental issue, you have to translate your knowledge into something that's publishable so you write papers or book chapters or various things like that, and because you write papers you attend conferences and when you attend conferences you meet like experts from around the world … at the time we were able to travel to conferences … you create a network and that network is the bit that gives you the global recognition, because they are experts.[90]

---

[84] Atkinson, Track 8 [00:34:08].
[85] Atkinson, Track 5 [00:40:54–00:41:12].
[86] Cannon, Track 3 [00:26:58–00:27:24] and Track 5 [00:02:35–00:03:03]. Sarah Herbert and Alan Gray both worked in Whitehall.
[87] Wyatt, Track 3 [00:53:18–00:53:10].
[88] Peel, Track 2 [00:47:05]; 'Brief guidelines for expert witnesses', *DERA News*, December 1997, p. 14.
[89] Scivyer, Track 4 [00:21:0].
[90] Dunford, Track 3 [00:37:23–00:38:20].

The progress of research programmes relied on interactions with external advisors from academia and industry, known in BRE as the panel of visitors.[91] Anthony Bravery explained:

> We wrote the programme and that programme was validated if you like by the fact that we used to have liaison meetings, collaboration meetings with peers in the industry, in universities and research associations. They were our monitoring process if you like.[92]

GREs also had strong connections with universities and industrial partners due to the departmental funding criteria which usually required that a proportion of the establishment's funding allocation to be spent extramurally. These three-way bonds have been described as a triple helix structure of research.[93] Mike Westby became aware of these links soon after joining RAE as a graduate, when he found himself back in his old department at Southampton University:

> We sponsored a lot of research in universities, we used to have about eight PhDs on the go at any given time […] it's a very cost-efficient way of getting basic research done. Research assistants worked very hard for very little money because they're going to get a PhD at the end of it, they hope. A lot of the real fundamental research used to be done in universities.[94]

Sarah Herbert, who also 'knew a lot of the heads of departments in universities, a lot of Professors', described the symbiotic relationship she developed with an industrial extramural contractor when the Government began looking for greater collaboration between GREs and industry:

> They wanted money out of DTI to do their research and asked me if I would help them put their research proposals together. They would come to me with their very, very whacky ideas and I'd show them how to write it and how to make the case out to DTI. […] Because they weren't used to doing research, they weren't used to writing proposals, they were a smallish firm they were not used to getting this sort of money from people. […] He would pay us to do some of the scientific work at Farnborough, so I brought money via him into DERA to do research work. […] This was how it started to work in that industry's research was collaborative and we collaborated with industry.[95]

These partnerships could be very stimulating, as Paul Cannon explained:

> There was the opportunity ... of having contractual work with industry, so that was interesting if you chose the right industrial group. […] We're not talking industry here in terms of making washers or something or other, we're talking industry in terms of making high technology pieces of equipment and some of these people in industry were extraordinarily able, that was always nice.[96]

---

[91] *BRE Annual Report 1989,* p. 33.
[92] Bravery, Track 4 [00:18:56–00:19:20].
[93] Etzkowitz and Leydesdorff, 'The Dynamics of Innovation'. See also Sanderson, *The Universities and British Industry*.
[94] Mike Westby, Track 2 [00:02:33–00:02:59].
[95] Herbert, Track 5 [00:55:59–01:00:30].
[96] Cannon, Track 4 [00:47:49–00:48:30].

Atkinson's remembers from her days in industry at GEC Hirst that RSRE was 'hardly a competitor', but Martin Wyatt remembered 'quite a lot of friction between academia and the state research centres', suggesting that these collaborative relationships were not always straightforward.[97] Competition also existed internally, notwithstanding the tea-break camaraderie described above. The organisation of GREs meant that overlaps were inevitable; research was spread across a multitude of defence and civil establishments, some of which were focused on the needs of only one of the armed services, and within each one there was further compartmentalisation into sections that did not interact. The possibility of overlaps challenged scientists' sense of ownership over their particular area of knowledge work, as Sarah Herbert indicated:

> There was this danger of duplication. … it caused people, without it being in any way vicious or aggressive, to feel it that was a bit competitive, he's doing my work sort of thing. What's he doing that for? […] Probably happened more on the everyday properties rather than the highly innovative stuff, but there certainly was some duplication. [...] The MOD stopped funding the services separately—the different research establishments for air, land and sea—and put all their research budget into one bucket effectively and tried to get everyone to work together so it wasn't duplicated.[98]

Another set of relationships in the defence research establishments was between military personnel with technical expertise and the civilian scientific staff.[99] These personnel acted as the interface between the services' operational requirements teams, the defence research establishments and the MOD's procurement arm. Alan Gray described what was expected of him in this role at RSRE: 'One of the primary jobs of the technically trained officer was to advise non-technical people … and to go the other way, which is very important, to advise the scientists on what was actually the requirement.'[100] As a scientist Paul Cannon often interacted with the resident military liaison officer:

> When [we were] part of government, there was always a military liaison officer assigned in some sense to the division or department that we worked in. Quite often these were people that were on their last tour of duty, quite often they were really quite senior, you would sometimes get a full or half colonel doing these sorts of jobs, they were great liaisons into the military for your ideas but also when you wanted to get something done somewhere on a military base. They would get on the telephone, talk to the OC, explain the situation [...] the liaison officer would have an office in the department, often next door to the division leader, they were so important to make things happen. [...] Typically we might get someone from the signals regiment, they were professional military guys so it wasn't their job to have a PhD in communications theory, but they knew enough of the practical problems so they weren't going to have you develop a piece of equipment that could not be used by the soldiers, they knew what the problems were, that's why they were there.[101]

---

[97] Atkinson, Track 4 [00:30:37]; Wyatt, Track 3 [00:47:19].
[98] Herbert, Track 7 [00:53:36–00:54:55].
[99] Edgerton, *Warfare State*, p. 125.
[100] Gray, Track 2 [00:51:20–00:51:36].
[101] Cannon, Track 5 [00:14:24–00:18:00].

There were also global networks in which GRE scientists participated. Overseas conference participation was very common, as was participation in international scientific organisations. BRE representatives, for example, contributed to EU standards committees or took a leading part in the work of the international body for construction research, the CIB (Conseil International du Bâtiment).[102] Many interviewees, such as Steve Rooks and Susan James, participated in collaborative activities that brought international scientific experts together to build and share knowledge:

> [This trial] was fantastic, it was on one of the highest mountains in America ... clear air basically for measurements, no pollution or anything. So we had probably about 15 nations on the top of this mountain, all there for two weeks measuring military aircraft flying at them, but the whole thing was just an amazing adventure because you got to meet some fantastic people from industry and governments.[103]

> The Americans always seem to have done it bigger and better—we've done this, we've done that. […] This was one of the beauties of the NATO working forum when you get all the nations' experts together in a room and you get to know each other. That's when really good work gets done … as a group you can progress a piece of work much better than an individual institution on its own.[104]

4.14 *Steve Rooks (middle row, fifth from right) with aircraft measurements trials team, California, USA, 1995.*
Personal archive of Dr. S. Rooks.

When such partners collaborated on highly sensitive areas of research that were not for the public domain, these relationships also fufilled another function, as Rooks explained:

> A lot of the peer review outside of academic publications has tended to be through our international partners—similar organisations in the Five Eyes community.[105] […] They

---

[102] Tony Bravery and Roger Courtney.
[103] Rooks, Track 5 [00:11:36–00:12:36].
[104] James, Track 6 [00:51:28–00:52:33].
[105] Five Eyes (FVEY) is an Anglophone intelligence alliance between Australia, Canada, New Zealand, the United Kingdom and the United States of America.

bring all these people together and have a review each year, and things spin out from that, we can normally get a good feel for how good we are and vice versa, so you get that international credibility.[106]

The value of all these working relationships was in their capacity to foster knowledge exchange and knowledge production. The following section considers the foundations on which those relationships were built, the funding and management regimes of the GREs.

4.2 The management of scientific research in GREs

This section focuses on the systems in the civil service through which scientific research programmes were set and funded in the decades before and immediately after the Rothschild report, systems which were then transformed during the reform programme of the 1980s and 1990s. This observation from Vic Crisp encapsulates how ideas about the management of research programmes evolved in the 1970s:

> To be honest in the early days there was not a huge pressure at all because the research establishments until that time pretty much ran themselves. They got chunks of money from their parent departments and to a large extent they decided what to do. But this was at the time of the Rothschild report … and things were beginning to change when I first went there, they were beginning to be talking about having to have proper customers and all this kind of thing.[107]

Until the organisational changes of the late 1980s created executive agencies, those 'chunks of money' that financed research programmes in the departmental establishments came through funds approved through the Supply Estimates process. In this process requirements for the financing of public services are submitted by the Government to Parliament, which are considered and voted on in Parliament before money is disbursed through the Treasury.[108] GREs 'enjoyed the luxury of a fixed income stream, with costs controlled by rigid adherence to staffing targets'.[109] Whatever remained in the budget after staff costs went on capital expenditure.

The process whereby government scientists could apply for funding for an R&D programme is outlined in a 1979 MOD training course 'Management in Research and

---

[106] Rooks, Track 4 [00:00:46–00:01:35].
[107] Crisp, Track 2 [00:37:28–00:38:03].
[108] Geoffrey C. Beard, *Government Finance and Accounts* (London: Management and Personnel Office, 1982), p. 42; HM Treasury, *Supply Estimates: A Guidance Manual* (2011), <https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/220744/estimates_manual_july2011.pdf> [accessed 7 July 2021], p. 6.
[109] Stephen Robinson, 'Government Management of Defence Research since the Second World War', in Bud and Gummett (eds), *Cold War, Hot Science*, pp. 393–415 (p. 397).

Development'.[110] Scientific civil servants would be asked during the summer to specify their financial needs for the following year and beyond. These requests would be channelled upwards through the section and division heads to the research establishment's finance department which would prepare a long-term costing for whole establishment. This costing would be broken down under headings such as salaries and wages, stores, travel and subsistence and capital expenditure.

Establishment directors would then submit their costings to the senior MOD officials in Whitehall that oversaw the defence research programmes. Led by the Controller R&D Establishments and Research (CER), this team would assess and co-ordinate the various bids for funding from all the defence research establishments to produce one bid for a department-wide research programme. The bid was then submitted to a team in the MOD General Finance branch where it was amalgamated with similar costings from the army, navy and air force before being submitted to the Treasury.

Once the Treasury had reviewed and agreed the MOD estimates, they would be considered by the Cabinet during the autumn against costing estimates received from all government departments. Final estimates for all departments would emerge by late winter, and they would be presented to Parliament as the Vote on Account early in the following year; this explains why this channel of government expenditure is known as 'the Vote'. The resulting Supply and Appropriation Acts allowed money approved by Parliament to be drawn on by departments to spend on research programmes for which they had specifically requested funds. A similar process would have operated between the BRE and the senior civil servants responsible for research in the Construction Directorate at DOE.

Under the Vote system ultimate accountability for the financial management and performance of the research establishments lay with the departmental Minister, while the two accounting officers in the MOD were the Permanent Secretary and the Chief of Defence Procurement. The Fulton report observed that in this system, where the Minister could be questioned in Parliament about departmental activities, decisions tended to be

---

[110] 'Defence Finance', in Ministry of Defence, *Management in Research and Development Training Course* (1979).

passed up the hierarchy of the civil service to ministerial level. The bureaucratic system of rules and processes meant that those operating in the lower ranks of the civil service were not assigned authority to make decisions, and consequently did not necessarily feel personally accountable for the performance of the establishment.[111]

Derek Rayner identified aspects of this system which he believed severely constrained the operations of civil service managers:

> The accounting systems and time cycle for financial judgments which have to match the requirements of public accountability and annual budgets, and in most areas the absence of a profit motive.[112]

The civil service accounting system focused on stewardship and control of the money that was disbursed rather than tracking expenditure, as Martin Wyatt found when he joined BRE:

> Everything was run on a cash basis not on accrual accounting which was again odd to me. So BRE would often go £30 million overdrawn and then somebody in the government would just send it £30 million so it was back in the black again. […] So they used cash accounting, they didn't use business type accruals of costs and expenses and incomes so you could never really break out what the costs were.[113]

The annual budgets, or annuality, exerted a strong influence on the way expenditure in the research establishments was managed. Ian Linsdell worked as an accountant for MOD, and explained the vagaries of the system:

> The Vote system did not lend itself to a true appreciation of what it ought to have cost. Under the Vote system government allocates the amount of funds as per the long-term costings, which is what we were providing. If it so happened that throughout the year your spares usage or capital assets or requirement was less than it might have been, or your material spend wasn't everything it might have been, it was not in your interest to underspend the budget. So under the Vote system every year inevitably you would have an end of year splurge where people would buy all sorts of things just to spend the budget and thus justify the allocation for next year.[114] 🎧▶

An anecdote from Mike Westby illustrated what this meant in practice:

> Finance meetings were quite hilarious in some ways in that the level of detail that quite senior people used to go to because they had so very little freedom of action. Budgets in pre-agency days, you'd have budget lines allocated to specific things and you couldn't move money from one to another. So I got my office painted twice in three years because the building and maintenance budget was a bit over full and it was the biggest sin of the civil service at the time was to underspend. […] It didn't need painting ... but somebody else being under, you know desperate for money in another area, there was nothing you could do about it. You couldn't move money from one budget to another […] The division head would be Senior Principal Scientific Officer, Grade 6, quite senior. [...] He'd be

---

[111] Civil Service Commission, *The Report of the Committee on the Civil Service*, paras 145–7; Dillman, 'Enduring Values', p. 884.
[112] Rayner, 'Making Room for Managers in Whitehall', pp. 62–63.
[113] Wyatt, Track 3 [00:31:27–00:31:56].
[114] Linsdell, Track 2 [00:32:27–00:33:40].

> worrying about whether we buy a computer for £1000 while at the same time he'd be managing a budget which I guess would run into hundreds of thousands or millions of pounds but most of it was pre-allocated in certain directions and you couldn't move money around.[115]

Robyn Thorogood felt that annuality was an impediment to success:

> I very much developed the view that anything that's been privatised, where it succeeds—to some extent—is due to release from the annual government funding. It's nothing to do with, 'Is it government or is it private?' Moving from one to the other you get away from this constraint of annual government funding.[116]

These assessments are echoed in the evidence given by Derek Rayner to a parliamentary select committee in 1980: **'**The annuality rule whereby if you do not spend money by the end of the financial year you forgo it. Therefore, you accelerate expenditure to prevent it.'[117] Vic Crisp's experience at BRE bears out Rayner's analysis:

> We had some smart operators. By and large at the end of the year when the finances are totted up, most departments underspend. … Quite often people were embarrassed by this and would say to others, 'Can you spend some money quickly?' My first group head was an absolute whizz at getting money this way and spending it quickly. He would always have a kind of shopping list in his back pocket and he was always niggling, saying, 'What would you do, Vic, if you had x amount of money, what would you buy tomorrow?' … so end of financial year there'd always be this breakneck bid to spend some dosh because it became available.[118]

Robinson has noted that the need to spend any surplus cash gave 'defence scientists a clear advantage over their colleagues in industry and the universities, for whom lack of access to the most advanced test equipment was a running sore.'[119] However the absence of capital accounting made investment in fixed costs difficult, so that 'the contrast between government and industry accommodation has been stark'**.**[120]

Scientists were involved in the priority and planning exercises which fed into the supply estimates process.[121] They drew up their requests for financing which informed discussions in Whitehall about future research programmes. The GRE director produced an annual report based on scientists' contributions which was discussed during an annual review with CER who represented the GREs as the suppliers of research, while the department operated as the customer. Within MOD were project directors who managed

---

[115] Mike Westby, Track 2 [00:07:33–00:09:06].
[116] Thorogood, Track 7 [00:59:46–01:00:16].
[117] Treasury and Civil Service Committee, *Civil Service Manpower Reductions*, p. 63.
[118] Crisp, Track 7 [00:15:15–00:16:21].
[119] Robinson, 'Government Management of Defence Research', p. 397.
[120] Ibid.
[121] 'MOD Aims and Objectives', in MOD*, Management in Research and Development Training Course*.

the projects within which they commissioned research activities from the GREs.[122] In DOE the procedures for identifying potential areas of research varied. Ideas from researchers funded by departments and research councils were taken into consideration alongside consultation with local authorities, research associations and advisory committees made up of external experts.[123]

Scientists' involvement in this process of setting research agendas gave them a sense of autonomy. They exercised a measure of control over the design of the research programmes commissioned by civil servants in Whitehall by guiding them over the directions the research should follow and providing estimates for the costs of their own areas of research. However, there was a drawback associated with this arrangement. Government departments, as the customers for research, needed to rely on the advice of scientists yet as the experts in their field, those scientists were heavily invested in and enthusiastic about their own research areas. The 1979 course material recognised this was a risk by instructing R&D specialists: 'Do not therefore abuse your power by choosing a solution which "appeals" to you, be objective and practical.'[124]

It was this situation that Robyn Thorogood wanted to get away from after he undertook a review of the research commissioned by the Construction Research Management team at DOE headquarters in Whitehall:

> It taught me a lot in then taking a more strategic view … saying from here we [in DOE] must develop our strategy as to what subjects we want to fund, we mustn't let BRE wag our tail which was what was happening.[125]

There was a view among the research providers that the customer in Whitehall lacked the necessary 'intelligence' to be capable of putting requirements together without their input. Carol Atkinson remembers working on a government contract at GEC Hirst, and she came to the same conclusion as the Fulton committee that the cohort of senior civil servants lacked sufficient people with scientific credentials:

> I would sometimes see parts of the specification—because we were supposed to be creating something—and it didn't make sense. You'd go back and you'd ask all sorts of questions and you'd get unsatisfactory answers … you'd get it through a chain of different people. [...] I did pick it up from RSRE as well. They used to get very frustrated with

---

[122] 'Role of the R & D Establishments', in MOD, *Management in Research and Development Training Course*.
[123] Chilver and Harrop, *Review*, paras 2.28–29.
[124] 'The Service Customer', in MOD, *Management in Research and Development Training Course*.
[125] Thorogood, Track 6 [00:08:52–00:09:31].

whoever was giving them contracts to work on that they didn't really understand. They'd probably done Greek at Cambridge.[126]

As a manager before and after commercialisation in the GREs Chris Peel could see the pros and cons of both systems:

The bad news with the old system was if you didn't watch out they [the scientists] just became embedded in what they did and as long as they were funded they'd carry on almost without guidance or any particular direction … that's being a bit harsh. The bad news about the new system was in principle it puts a huge load on the customers trying to work out exactly what they really want and what you end up doing is basically having them react to proposals you put to them, so neither system is perfect. You could say that the old system did allow a real expert to follow his instincts and trends without constriction from the need to get funds to support what he was doing specifically and then the bad news is he might go off down a blind alley … so you can see good and bad in both types of approach.[127]

Supervision of the establishment research programmes relied on what Chris Peel described as,

due diligence and review by external bodies, in particular British industry coupled with British government, so we had industrial supervision of our programme, we had people from British Aerospace looking at our programme deciding yes that looks as if it's just what we need … they could be quite strongly influential.[128]

However this quotation from Steve Rooks about his early days at Farnborough in the early 1990s indicates that once the money had been received from the departmental Vote, there was minimal internal supervision or accountability on how it was spent:

There was a heck of a lot of money in those days so invariably there was never a lot of pressure on having to meet budgets. I never had anything turned down. There was a drive to make efficiencies which we were all very conscious of, I saved lots of money in what I was doing … but you weren't really held to account.[129]

As a PhD student at Nottingham University, Robyn Thorogood was funded by the MOD to investigate the steering of vehicles through clay, and experienced a laissez-faire attitude from the department:

Apart from visiting, and I went down once or twice [to the research establishment], MOD really kept a hands off approach to all I was doing, they certainly didn't interfere, they probably didn't really effectively manage what I was doing other than say, 'great, carry on'.[130]

Some interviewees remember their first reactions to the system when they joined the civil service, such as Carol Atkinson:

---

[126] Atkinson, Track 4 [00:39:17–00:40:04].
[127] Peel, Track 3 [00:08:24–00:09:27].
[128] Peel, Track 3 [00:09:41–00:10:00].
[129] Rooks, Track 2 [00:46:04–00:46:37].
[130] Thorogood, Track 4 [00:08:57– 00:09:21].

> What shocked me more than anything, the complete lack of management in the public sector, really really sloppy, really bad attitudes.[131]

Atkinson came from a job in industry with GEC Hirst, and her judgment may derive from the fact that the management system that she was familiar with was simply different to the one used in the civil service rather than worse. Despite the Conservative rhetoric regarding the need for improved efficiencies in public sector organisations, state projects and nationalised industries operated according to a different set of expectations and restraints that produced alternative measures of success.[132] However these examples of how annuality affected spending would have supported the case being made by advocates of improved management and efficiency in the civil service.

4.3 Conclusion

This chapter has shown that GREs were an integral element of the national and international research landscape. In the conduct of government-funded scientific research GRE scientists were not operating solely within the framework of the civil service but were actively engaged with the broader community of professional scientists. They interacted with colleagues within the civil service but also liaised and collaborated with peers in academia and industry in carrying out the research commissioned by their parent departments.

GRE scientists embodied Latour's understanding of scientists' work as both a social and scientific activity that is undertaken by a range of people with different skill sets.[133] The interview material shows that scientists' work in the GREs ranged from the theoretical to the applied, and that they acted as both producers and conduits of knowledge. They were as likely to be looking down microscopes as engaging with policymakers in oak-panelled offices in London, to be conducting field trials on the national peripheries as travelling the world to network with international peers, to be designing or building prototype technologies in workshops as taking stock of supplies or wiping down the lab bench, to be checking a departmental budget as writing a conference paper.

---

[131] Atkinson, Track 4 [00:58:23–00:58:31].
[132] William Ashworth, *The State in Business* (Basingstoke: Macmillan, 1991), pp. 186–208.
[133] Latour, *Science in Action*, p. 1.

The rubrics and frameworks of the civil service determined the direction and financing of research, with research programmes decided through interactions between scientific civil servants working in the GREs and in central government. Interviewees did not speak specifically about designing research programmes to meet the strategic objectives of policymakers. Rather their accounts reveal the perception that they had the freedom to use their own initiative and individual skills to determine the progress of their work. This reflects the nature of the funding system that gave scientists in the GREs a strong sense of autonomy.

The descriptions of scientists' work show how GREs were sites of skills development and knowledge production which enabled the cultivation and development of expertise. This created a particular institutional culture which I now describe in Chapter 5.

5. The culture of government scientists

Chapters 3 and 4 used interviewee descriptions to outline the frameworks on which the working lives of government scientists were built in the 1960s, 1970s and into the 1980s: the civil service career structures, the physical aspects of the GRE environments, relationships with colleagues and partners and the departmental funding arrangements. This chapter continues to draw on interviewee accounts to consider the ways these elements of working life shaped the workplace culture of the GREs.

During the period when the majority of my interviewees joined the scientific civil service, the organisational and funding arrangements of GREs differentiated them from other public sector research organisations, university departments or industrial R&D laboratories. Within these arrangements a particular combination of activities, opportunities and reward systems encouraged coherence in staff values and outlooks. Interviewees' accounts show how these arrangements fashioned an institutional culture which influenced scientists' behaviour and expectations. This chapter shows that for many scientific civil servants, part of the attraction of working in a GRE was that the workplace culture was perceived to be different to that of a university department or an industrial R&D laboratory.

Clarke and Newman argue that the post-war British welfare state was built on a commitment to bureaucratic administration and professionalism, resulting in what they describe as 'a bureau-professional regime'.[1] Various groups of professionals had proved indispensable in providing the knowledge and expertise needed to support the expansion of the welfare state.[2] Ferlie et al. noted that as a result 'one distinctive feature of public sector organizations is that they are highly professionalized. Public service values combine therefore with the values and standards of the professions to create a complex pattern of influences.'[3]

---

[1] Clarke and Newman, *The Managerial State*, p. 13.
[2] Ibid., p. 7.
[3] Ferlie et al., *The New Public Management in Action*, pp. 165–166.

In the GREs, that pattern of influences was formed through the intersection of two sets of values, the ethos of the civil service with the norms and values of professional scientists. Roger Courtney encapsulated this in his comment about scientific civil servants: 'Either they thought they were working for government, or they thought they were doing scientific research'.[4] The resulting combination of values resulted in an expectation and appreciation among scientific civil servants of autonomy in the workplace, educational opportunities, established patterns of career progression and the promotion of specialist expertise. New recruits absorbed the values and ways of doing things from their peers, in turn perpetuating the ethos to the newcomers that came after them. The following sections explore the interview passages that reveal how the values derived from both professional science and public service contributed to defining this culture.

5.1 Operating as professional scientists

Mody has described the institutions of professional science as helping scientists to 'pursue esoteric topics and to pronounce on public matters' thereby manufacturing 'a reputation for objectivity and autonomy'.[5] He clarifies the ways in which they do this: 'Organizations and means of communication (societies, journals, etc.); codes of conduct and jurisdictions of expertise; codified training and standards; specialized tools, clothes and workplaces.'[6] Professional scientists, as managers and researchers, were the backbone of the GREs. Consequently their values permeated all levels of the GREs.

Interviewees primarily saw themselves as professional scientists working in government, rather than public servants who did science, confirmed by these comments from David Dunford:

> In your own mindset, you're not a civil servant who turns up as an EO in a work and pensions office, you're there as an engineer or a scientist, that's your professional career and that's what you do. We realised we were working for the national good, certainly when I started that was the case [yet] I didn't really think of myself as a civil servant, in fact in the whole of my career I never thought of myself as a civil servant. I was employed by the civil service … but I was a scientist at the Royal Aircraft Establishment, DRA, DERA, QinetiQ.[7]

---

[4] Courtney, Track 16 [00:19:20–00:20:21].
[5] Mody, 'The Professional Scientist'.
[6] Ibid. See also Morrell, 'Professionalisation', pp. 980–989 and Ferlie et al., *The New Public Management in Action*, pp. 165–94.
[7] Dunford, Track 7 [00:46:55–00:47:51].

Roger Courtney described how this outlook derived from BRE's history of regarding itself as an independent scientific organisation:

> BRE wasn't the tool of anybody … and a lot of people came from that era, and if they hadn't come from that era, they had absorbed the ethos. […] People didn't necessarily buy into the idea that, 'Government owns us and therefore we do what the Government says'. No, no, no. 'We're scientists and we do this'. I had 350 or so people of independent mind whose job it was to challenge things … they were critical minds.[8]

In a 1956 review of the scientific civil service, McCrensky observed members distinguishing themselves 'as a separate corps with their own leadership. This enhances their morale and prestige'.[9] Part of that morale derived from a tendency among professional scientists to regard science as somewhat distinct from other fields of intellectual activity. The highly complex and esoteric nature of scientists' work which is beyond the comprehension of most people creates an aura of distinction and separateness that scientists use to their advantage in arguing for special treatment and status.[10] Gieryn has shown that scientists have used ideological ideas about the purpose and value of science to distinguish their work and its products from non-scientific intellectual activities and garner support for their pursuit of authority and resources in their work.[11] An example of this can be seen in this comment from Chris Peel when speaking about why he studied sciences:

> I think I preferred the greater detail that comes with science and engineering, there's not much—without being rude to your good self—there's not an awful lot behind the arts subjects, whereas there's a vast array of stuff in the science and engineering world.[12]

Section 3.2.1 showed how the GREs were regarded as an attractive working environment due to their close resemblance to academia, as Roger Courtney outlined:

> I was very conscious in the early years there that it was very much like a university in terms of the focus on research without the distraction of students. [...] It was a remarkably privileged position to be paid for what I was doing, because obviously I enjoyed it, it was very interesting and there was a lot of freedom. […] In a way you see that was a legacy of the wartime experience, the culture of the scientific civil service was I think very much moulded in the war with a very free exchange and lots of imports from the university sector.[13]

Jenny Constant, who worked at RSRE, gave a very similar assessment of how her boss operated:

---

[8] Courtney, Track 16 [00:23:13–00:24:53].
[9] McCrensky, 'Scientists in the British Civil Service', p. 570.
[10] Mukerji, *A Fragile Power*, p. 10.
[11] Gieryn, 'Boundary-Work and the Demarcation of Science from Non-Science', p. 789.
[12] Peel, Track 1 [00:29:38–00:29:54].
[13] Courtney, Track 9 [00:16:03–00:17:21].

> Parkie ran the physics department as a university department, basically. In fact, people called it the University of Malvern. As well as what we were actually working on, there were weekly and monthly talks and seminars given by other people. […] It was very much the expectation that you would go to these things that weren't directly relevant to what you were doing. That was very much the atmosphere of it.[14]

Sarah Herbert spoke about how this created an environment for the development of deep expertise:

> People stayed at RAE for the whole of their working lives, a lot of people worked in their area for the whole of their working lives, they were really quite expert. Now some of them could have been a bit blinkered as to the industrial significance and just loved the science, but some were much more aware of the application. […] They had people with superb expertise but I'm not sure they were always respected as much as they should be [...] because they were seen as being very academic and not seen as being in the real world.[15]

However as someone coming into BRE from industry, Martin Wyatt was aware that the academic nature of the organisation was not necessarily compatible with the users of their research in industry:

> Of course they were research scientists, they wanted to do good research, they wanted a building to blow up, which they did, and they wanted a building to burn down, because this would make their names as scientists. Nobody else in the world was doing research at that scale. […] [BRE] was organised around academic silos so it would have the material scientists together irrespective of whether they were fire material scientists or structural material scientists … because that's what you have at a university. […] The organisation was more academic than functional as far as the outside world was concerned.[16]

Mirowski and van Horn have described the expectation in academia where 'authorship credit in journals is framed as a "reward" for scientific effort, linked to an identifiable personality.'[17] The cohort of scientists in the GREs shared similar value systems with academia yet the civil service career management structures meant that advancement did not depend on individual achievements to the same extent. For the many scientists working on classified defence research, the publication of research findings was not an option, as these remarks from Mike Westby and David Dunford show:

> A lot of the areas I've worked in over the years, people don't tend to have public reputations, so you don't hear about these people out of the field if you like. […] The work we're involved in tends not to get publicly aired very much.[18]

---

[14] Jenny Constant, interviewed by Thomas Lean, Powick, 2013, BL C1379/98, Track 3, transcript p. 58.
[15] Herbert, Track 6 [00:24:32–00:24:57] and Track 8 [00:21:35–00:21:51].
[16] Wyatt, Track 3 [00:29:22–00:29:36; 00:45:38–00:46:39].
[17] P. Mirowski and R. van Horn, 'The Contract Research Organization and the Commercialization of Scientific Research', *Social Studies of Science*, 35, no. 4 (2005), pp. 503–48 (p. 531).
[18] Mike Westby, Track 2 [00:24:28–00:25:02].

> They chose to be involved in aircraft trials and work directly for the customer, I've got friends who love that, that was their life, they enjoyed every minute of it. They weren't affected, they still had the same career progression.[19]

The need to remove publication as a requisite for advancement in the scientific civil service meant that in some respects this career offered the best of both worlds, with the promise of intellectual stimulation where the pressures of academic life were removed, as Paul Cannon and Vic Crisp explained:

> There were people who went in with not huge aspirations but … who were smart enough to get a job in a university but didn't want a job in a university… because universities had their own pressures. As an example, if you're a very introverted but brilliant scientist, you probably don't want a job in a university because it would be sheer hell for you to have to teach and interact with so many people. What you had was a job option … where you weren't expected to talk to people, you could kind of get on and do something that was vital for the country and satisfying for you as an individual and you paid your taxes and you became a vital member of the community of the United Kingdom.[20]

> I said 'What's it like at BRE then?' and I could almost see him smiling down the phone line. He said, 'Mmm, it's a bit like university without the bloody students.' So that sounded okay.[21]

Nevertheless many interviewees expressed the importance of getting work published. In contrast to industry where the results of research remained confidential, unclassified research findings in GREs were often written up and published in the open academic literature. As Anthony Bravery said, 'we wanted our name in print because that was status, but we wanted peers, and colleagues, people working in the same area to know what we'd done'.[22]

> Our objective in life was not to get our salary at the end of the month, it was to publish a paper that somebody in Germany or France or Switzerland would say, 'that's really good stuff', so being recognised nationally and internationally as somebody who knew their stuff, who was doing good new work was the big motivator, and that was true all the way from the head of the department right down.[23]

Vic Crisp noted that, 'you weren't going to get promoted without doing something significant.'[24] His analysis indicates the extent to which BRE saw itself as an academic research organisation:

> We were like any other research organisation, your career went better if you got results and you got publications. Getting it out into the research journals was always a good thing. What probably didn't happen enough, certainly in the early days, was making the effort to turn research into practical guidance. I saw a change while I was there from the

---

[19] Dunford, Track 3 [00:40:30–00:40:50].
[20] Cannon, Track 4 [00:38:52–00:40:19].
[21] Crisp, Track 2 [00:33:45–00:34:02].
[22] Bravery, Track 5 [00:20:56].
[23] Bravery, Track 3 [00:19:24–00:19:56].
[24] Crisp, Track 2 [00:38:52].

emphasis being on getting the results into a journal to making sure that once you'd gone past that stage you got it into the publications of say CIBSE … the Bible for the engineers who applied whatever we found.[25]

Publications therefore became as much for the benefit of the consumers beyond academia—government departments, industry or the wider public—as for building up the academic credentials of the research teams, as Phil Catling commented about work at RAE:[26]

The thrust really for any papers would have been more so into [Jane's] *International Defence Review* where your work would be reported to that defence community. Where work or papers would have gone into academic journals may have been more on the theoretical side of things for people at [RSRE] Malvern.[27]

The output of reports and papers mattered when it came to the annual appraisal, particularly if a scientist was pursuing the IMP route, as Roger Courtney explained:

You wanted to publish in the appropriate journals to establish the validity of what you were doing and your professional standing, and you also wrote for more application type literature. […] If somebody was not publishing in peer reviewed literature there would certainly be a question, they would be encouraged that they should be.[28]
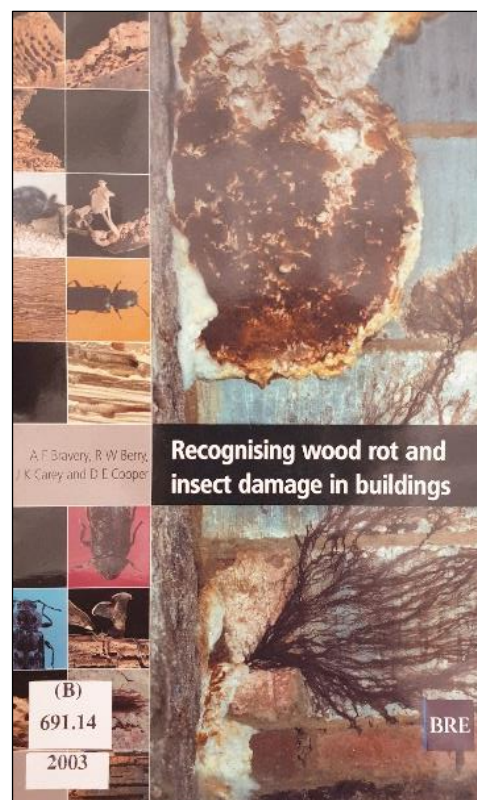
5.1 *Front cover of guide written by Anthony Bravery and colleagues, BRE, 2003*.

---

[25] Crisp, Track 8 [00:58:06–00:59:10]. CIBSE: The Chartered Institute of Building Engineers, UK.
[26] Cohen et al., 'The Purpose and Process of Science', p. 240.
[27] Catling, Track 2 [00:00:29–00:00:55].
[28] Courtney, Track 9 [00:20:06–00:24:05].

Career progression relied on a commitment to expanding academic knowledge, as Paul

Cannon's comments indicated:

> I liked the appraisal system …. you knew exactly where you were going and you knew
> what you needed to do to get the next promotion and you even knew roughly what pay
> rise you would get with it. The second reporting officer would give you advice on where
> you were going, whether you were likely to go forward, what holes you might have in
> your knowledge, what you ought to mug up on. [29]

Cannon also appreciated how the civil service career structures cushioned scientists in

the GREs from the challenges of forging a career in academia:

> Getting a university job is really hard and it's really demanding on your family. The
> process requires a couple, maybe three postdocs, research assistant jobs, quite likely in
> different universities, and then the competition is fearsome to get a permanent post in the
> universities. I'll be honest, I couldn't face the thought of doing that, moving from one
> place to another.[30]

Those civil service structures also contributed to a separate strand of values that

interviewees spoke about, those of a public servant.

5.2 Working as a public servant

The defining characteristics of the civil service—rules, legality, impartiality, due process

and a public service ethos—meant that those working in it were valued for showing

'personal integrity and honesty, detachment and balanced judgement, and service in the

public interest.'[31] Some of the quotations in the previous section demonstrate how the

values of professional scientists in GREs were intertwined with those of public service,

such as Paul Cannon's remark about doing something vital for the country, or David

Dunford's recognition that he was working for the national good.

Working for the public good was an organisational goal that many interviewees were

happy to adopt for themselves, in line with Clarke and Newman's assessment of notions

of public service as a settlement between 'two modes of co-ordination, bureaucratic

administration and professionalism'.[32] Steve Rooks spoke about the attitudes of the

scientists who worked for him:

> Overall, a lot of the scientists that I've managed, they are all passionate about doing the
> right thing. They're not there for the money necessarily, they're there because they feel
> they are giving a service whether it's to a person on the front line or whatever, the Home

---

[29] Cannon, Track 3 [00:51:21–00:53:07].
[30] Cannon, Track 3 [00:12:20–00:13:03].
[31] Dillman, 'Enduring Values', p. 885. See also Lægreid, 'Accountability and New Public Management',
p. 324.
[32] Clarke & Newman, *The Managerial State*, p. 4.

Office Board of Control. Because of that if you channel their energy and direction and give them the space to do the right job and freedom to do it then they're brilliant.[33]

For Chris Scivyer, joining BRE meant, 'you'd help to change the industry. Probably the thing I'm most proud of in some respects was to help to change the building regulations in a couple of things.'[34] Chris Peel and Anthony Bravery explained how they felt about being a public servant:

Certainly in the early days I liked it, I liked the government duty, I liked the fact that we'd be advising customers who were in the Ministry or the Royal Air Force. It was purposeful, being a civil servant in the Ministry of Defence.[35] 🎧▶

I very quickly latched onto the culture of public service and I enjoyed that. […] When you're still only in your mid-twenties to feel you're doing somebody a service and making life easier for them and saving them money perhaps, it was a nice feeling. […] I was always proud and still am today to have been a public servant—the awareness that I was a servant, I wasn't doing a job, I was serving somebody, I was there to provide support, service, advice, whatever. […] Fairly widespread too that you had a responsibility to the public at large to spend the money wisely and to be effective and appropriate, doing the things that would serve the public good. […] Many of us felt that it was our job, it wasn't written down as a job description, it was our job to look for the public interest. […] One of the things that was sad about privatisation was that we were no longer public servants and we were no longer on tap to help the general public. […] We were never a loafing-about, tea-drinking bunch of idle so-and-sos who got gold-plated pensions and didn't have to work very hard, which was the public perception which was being peddled for a long time. […] People used to be publicly proud to be a public servant, and I think nowadays people tend to keep their head down quite a bit.[36]

Ian Linsdell remembered generalisations being made about the civil service ethos by consultants who assumed that private sector practices were superior: 'The view was that we were a civil service culture and that we needed to be shaken out of it.'[37]

There's a certain expectation from the public on civil servants … not helped by *The Two Ronnies* classic joke: 'Civil servants have been banned from looking out the windows in the morning so that they've got something to do in the afternoon.' That was a common conception of the civil service, whereas actually I found most people I came across did a reasonable day's work for a reasonable day's pay, and quite often would do more. So you were always quite wary of saying you were a civil servant. particularly because the percepetion was that your pension arrangements were way over the top, whereas what we were told as civil servants was, 'this is why your pay's depressed because you've got such a good pension.'[38]

Mike Westby found that by introducing himself as a civil servant, assumptions were made about his working life:

---

[33] Rooks, Track 3 [01:02:23–01:03:01].
[34] Scivyer, Track 3, [00:15:10].
[35] Peel, Track 6 [00:54:43–00:55:06].
[36] Bravery, Track 3 [00:15:15–00:16:40; 00:44:28–00:46:17] and Track 9 [00:15:02–00:15:53].
[37] Linsdell, Track 8 [00:34:24].
[38] Linsdell, Track 3 [00:18:48–00:20:01]. *The Two Ronnies* was a British television comedy sketch show aired by the BBC 1971–87.

> I think a lot of people would find it genuinely very interesting and quite staggering, some
> of the things we do which we don't talk about and can't talk about. It's either a useful
> camouflage or very frustrating when you describe yourself as a civil servant—the
> Whitehall pen pusher, the paperclip counter etcetera you really, really, really are not, but
> you can't explain why not and what you actually do.[39]

Some interviewees expressed negative views about the civil service, such as Carol

Atkinson who became a civil servant later in her career:

> When I joined BRE [from industry] I thought I was going to be doing something that was
> kind of more worthwhile and you have this sort of image that the public sector … is going
> to be really much better somehow and I just found it really disgustingly corrupt and
> wrong.[40]

In Martin Wyatt's view civil servants could exhibit an attitude of moral superiority:

> I was many times told that I was from business, I was immoral, all of business is immoral
> and we're civil servants and we're clean and wonderful and good. […] I'm playing this
> up I know, you know I'm telling you a story at the end of the day, but it was true. There
> is a huge gap in ethos between the two, and the civil service looks down on business in
> general. They are civil servants because they didn't want to be in business, they were
> better than that, they were purer than that, they wanted to do public good.[41]

This shows the potential for government scientists to exhibit virtuous superiority when

ideas about the value of public service joined forces with scientists' ideas about science's

distinctive attributes which made them eligible for special treatment.[42]

Working as scientists within the civil service hierarchy could be problematic. In their

1964 discussion of the most suitable organisational structures for scientific work,

Cotgrove and Box referred to arguments that bureaucracies created problems of

communication, which was exactly what Carol Atkinson experienced, despite the role of

paper trails in demonstrating accountability:[43]

> I said [to my boss], 'Why all this hierarchy? Why all the writing notes upwards and
> downwards and not just going and talking to people and asking questions?' […] 'This is
> how the civil service works. And you'd better learn and understand it and do things
> formally.' […] There was a tremendous formality … they called everything minutes and
> records, they had files for this and files for that. … It was very difficult to go sideways, it
> was very up and down. You couldn't go and talk around. I was very miserable.[44]

However the civil service hierarchy, and its role in career management, meant that there

was one important difference between GREs and scientific research environments in

---

[39] Mike Westby, Track 8 [00:21:50–00:22:17].
[40] Atkinson, Track 2 [00:28:42–00:29:05].
[41] Wyatt, Track 3 [00:24:01–00:24:36].
[42] Turner, 'Public Science in Britain'.
[43] Stephen Cotgrove and Steven Box, 'Scientists and Employers', *New Scientist*, 7 May 1964, pp. 362–64.
[44] Atkinson, Track 5 [00:25:25–00:27:01].

academia and industry, the relative absence of competition. As John Chisholm noted, 'it's a competitive environment in a [university] research lab, you are out for yourself to prove something, you are certainly not taking the wisdom from the seniors, you're trying to make your own way in it.'[45] None of my interviewees referred to instances of scientific controversy or priority claims, the manifestation of the competition that is understood to drive scientific progress.[46] Some mention that that different teams working in similar areas of research could develop competitive attitudes, what Sarah Herbert referred to as 'the danger of duplication' (see page 135), but in the main government scientists did not have to compete against each other for promotion. For Edward Bullard, director of the National Physical Laboratory (NPL) 1950–55, there could be a negative consequence to a lack of competition in that scientists' creativity diminished: 'If a man feels he is fixed in a job for life he is less likely to remain bright and original than if he has the expectation that success and outside reputation will lead to a better job elsewhere.'[47]

Nor were they exposed to the competition of operating in a commercial environment, as Alan Gray explained about his colleagues at RSRE:

> Why did they work here and not at Racal? Or Thorn EMI? Or Ferranti etcetera. Why didn't they go there when they were looking for a job after graduating? The answer is that when you came to Malvern you were divorced from all the commercial arguments. If you were a scientist here it was irrelevant whether or not your work was going to make money. […] The development of thermal imagery, the development of LCDs took place there. No one at the time thought, 'My word, we're going to make a vast amount of money out of this,' so it wasn't pursued in industry. […] Some had come in from academia and some left to [go to] academia, so there was a relatively close relationship with academia, and of course with commercial companies, but the critical thing in the research establishments is that your ethos was defence and your aim was to produce something valuable for defence. So you were not bound by the ideas of commerce. You were given the opportunity to go into areas that other people had not gone into before and commerce would not wish to go into.[48]

RSRE did patent some of its discoveries, as Gray emphasised: 'Queen's Award to Industry, which recognises patents, there were 12 flagpoles out there in RSRE days'.[49] However Sarah Herbert's assessment was that her colleagues at RAE 'weren't very

---

[45] Chisholm, Track [00:16:53–00:17:16].
[46] Thomas Kuhn, *The Structure of Scientific Revolutions* (Chicago: University of Chicago Press, 1962).
[47] Bullard, 'What Makes a Good Research Establishment?', p. 271.
[48] Gray, Track 5 [00:16:10–00:17:13] and Track 3 [00:36:58–00:38:22].
[49] Gray, Track 6 [01:07:59].

commercially minded'.[50] David Dunford and Roger Courtney also identified the difficulties in being entrepreneurial within the GRE organisational framework:

> If you sit in a research lab and you can't influence the way it's exploited, it's frustrating. The only way it can be exploited is by an organisation who needs the technology and can exploit it, which in the UK is industry. It was very, very difficult as an individual to cross that bridge. You just couldn't do it, unless it was so outstanding that it could be dragged out of the establishment, and carbon fibres is a good example. It was never going to get the necessary energy within the organisation. The energy within the organisation was there to help the MOD.[51]

> There was very little incentive for entrepreneurial activity or imagination or even reaction to developments … could we help the industry exploit new developments in different ways? Well, no, not really, not very easily, not unless it became something that was recognised that Government wanted to do.[52]

Nevertheless, Herbert spoke about patenting as a routine way of recording prior knowledge:

> I think sometimes when I wanted to publish something that was on a new materials design, then the patent office would be shown my paper or report before I gave it at the conference. I seem to now remember, I used to have to write a little description about it and they would shove it into a patent. But the majority of things they put out because they were actually making record of prior knowledge … protecting us so that if someone else tried to patent it, the MOD wouldn't have to pay because we had prior knowledge.[53]

However, as previously noted in Chapter 4, Mukerji has argued that the purpose of government-funded research was not necessarily about kick-starting innovation, but partly to maintain a 'labor force of skilled scientists available for consultation'.[54]

5.3 Developing and elevating specialists

While an outwardly visible scientific reputation was not required for individual advancement, the development of scientific excellence and specialist expertise in the GREs was highly valued as much by the customers in Whitehall as by the scientists themselves. The GREs were organised to promote the advancement of specialists and the development of specialist expertise that catered specifically for government's needs. In the case of defence research, GREs provided the environment to develop deep expertise that could not be cultivated elsewhere. One mechanism that enabled this development of experts within GREs, an expectation of the departments above and the scientists within,

---

[50] Herbert, Track 6 [00:28:20–00:30:16]. See Graham Spinardi, 'Industrial Exploitation of Carbon Fibre in the UK, USA and Japan', *Technology Analysis & Strategic Management*, 14, no. 4 (2002) pp. 381–398.
[51] Dunford, Track 4 [00:35:26–00:36:16].
[52] Courtney, Track 16 [00:14:44–00:15:35].
[53] Herbert, Track 6 [00:30:33–00:31:17].
[54] Mukerji, *A Fragile Power*, p. 5.

was the IMP scheme that elevated those with exceptional scientific expertise (see page 106). Secondly scientists' education was supported at all levels through offering staff opportunities to study at undergraduate, graduate and doctoral level. GREs acted as an important pathway for scientists to develop and consolidate their skills through higher education, many of whom had joined the scientific civil service straight from school and for whom the concept of attending university had been unrealistic. Consequently, GREs acted as vectors for upward social mobility that Mandler has identified as being strongly associated with education until the 1970s.[55]

It was a distinguishing feature of the GREs that they expected and encouraged scientific staff at all levels to 'go through this academic route', as David Dunford said (see page 95).[56] They supported those with the appropriate competencies to progress academically, often as a requisite for promotion.[57] Shirley Jenkins' experience when moving up from scientific assistant led to her becoming one of the very first students to gain a Diploma of Technology from Northampton Polytechnic Institute:

> I got promotion to AEO [assistant experimental officer] provided I went on this new course they were setting up. Something in between a degree, where people had no practical experience but lots of theoretical knowledge, and an apprenticeship where they didn't have the same level of theoretical knowledge but lots of practical stuff. So the idea was you had two terms at college and then you worked for six months to get some practical experience and end up with a nice rounded person, that was the idea.[58]

Susan James' boss pushed her to pursue further education throughout her career:

> I went over the road, there was the Farnborough College of Technology and I did an HNC in Applied Physics. […] I couldn't have been more lucky when I look back on it really, he wouldn't let me not do the HND and the endorsement courses, and he very much encouraged me to go on and do an MSc at South Bank on day release. […] He was like that with my career, he wouldn't let me rest, he kicked my backside all the way through all my promotions and everything, I look back on it and think everybody needs a mentor. If I hadn't met Graham Rood, I don't know where I'd be.[59]

Phil Catling described what was paid for when he was supported by RAE through an Applied Science degree at the Royal Military College of Science at Shrivenham:

> I was an army kid, familiar with the army background. Three years full time, full pay, everything paid for apart from your mess bill, T&S [travel and subsistence] home paid

---

[55] Peter Mandler, *RHS Presidential Address: 'Educating the Nation III: Social Mobility'*, 27 November 2015 <https://royalhistsoc.org/rhs-presidential-address-by-peter-mandler-educating-the-nation-iii-social-mobility/> [accessed 4 November 2020].
[56] Dunford, Track 1 [00:07:33–00:10:30; 00:43:13–00:43:27].
[57] Dunford, Track 4 [00:20:35–00:20:54].
[58] Jenkins, Track 1 [00:52:25] and Track 2 [00:35:57–00:36:32].
[59] James, Track 1 [00:55:21–00:57:05; 00:06:58–00:07:15].

for, halls of residence, three square meals a day plus a tea, there's nothing not to like as a civilian going there and I could cope with that.[60]

Sarah Herbert remembered the progression of one of the experimental officers in her team: 'Through studying and everything he went from five O levels right the way up to a degree, so it was great, I was really pleased he did so well.'[61] Despite his initial motivation to avoid academia by starting work aged 16, Dunford realised: 'If I wanted to progress a career, I had to have an academic track record that was strong.'[62] In time he was granted unpaid leave and an allowance to complete a Materials Science degree at Bath University, and then his fees and expenses were paid to complete a PhD with Imperial College in London.[63]

The GRE structure encouraged the development of deep expertise by offering scientists terms and conditions and career structures that protected them from the need to pursue new openings or consider relocations in order to progress. Government's unique needs for specialist expertise offered the security for scientists to develop deep expertise and perceptions of autonomy that scientists felt were a necessary element of working life as a professional.

5.4 Autonomy and time-keeping

For GRE scientists, as for members of other professions, their status as professionals engendered a sense of entitlement to special privilege and respect which entitled them to autonomy and high social reward.[64] The concession and expectation of autonomy was one of the trade-offs between scientists and their funders in government that Mukerji observed in her study of oceanographic researchers in the USA: 'The Government may limit the subjects scientists study and their methods for research and analysis, but they do not control the ways scientists use their research materials to address the world of science.'[65] Gieryn has commented that 'once scientists accumulate abundant intellectual authority and convert it to public-supported research programs, a different problem faces

---

[60] Catling, Track 1 [00:21:27–00:21:54].
[61] Herbert, Track 5 [00:39:48].
[62] Dunford, Track 1 [00:34:04].
[63] Dunford, Track 4 [00:21:15].
[64] Joseph A. Raelin, 'The Basis for the Professional's Resistance to Managerial Control', *Human Resource Management*, 24, no. 2 (1985), pp. 147–75 (p. 147); Randle, 'The White-Coated Worker', p. 740.
[65] Mukerji, *A Fragile Power*, p. 192.

the profession: how to retain control over the use of these material resources while retaining autonomy from controls by government or industry.'[66]

Scientists have long argued for autonomy as a fundamental requirement for a working environment that stimulates creativity and scientific innovation.[67] Mukerji observed that during the Cold War period debates about the advantages and disadvantages of thinking in an 'open' society meant that US scientists were encouraged to believe they had a good deal of autonomy and that it was very good for them.[68] She refers to 'the idealized role of the scientist: the independent thinker and investigator.'[69] Agar has also commented on the rhetoric used by UK scientists on the desirability of freedom and independence in science.[70] The assumption of autonomy exercised by scientists within the GREs was strong enough to give the impression of independence. In a 1964 debate that discussed the Road Research Laboratory, one MP voiced his belief in the importance of 'its independent status'. He was firmly corrected by a colleague who had served as Minister for Transport: 'If it comes under the general auspices of the Ministry, it will not have independent status. It will be under the Minister … there is no half-way house.'[71]

There are numerous examples in the interviews of how scientists expected and experienced this autonomy, such as in this account from Sarah Herbert:

> I altered the weaves and made some of them twill weaves and some of them satin weaves to see how I could alter the mechanisms by making the woven fabric different. These were all initiatives that we did off our own bat, nobody told us to do it, we just did it. We were just trying to improve the fracture performance of these composites and we were trying to understand the mechanisms. […] It was really a bit of a free for all, but then some things could have come out of these things, and certainly a lot of understanding came out of it.[72]

There were drawbacks associated with this level of freedom, as Rooks observed about his early days at RAE:

> [The leadership] gave us so much freedom to try and do what we wanted to do … direction was there but not in the sense you were really gripped in terms of what you had to do. That's partly why the whole thing had to change. If you found something you enjoyed you could go off and do it and probably make a career of it but the end the relevance of it might not have been there.[73]

---

[66] Gieryn, 'Boundary-Work and the Demarcation of Science from Non-Science', p. 789.
[67] Clarke, *Science at the End of Empire*, p. 59.
[68] Mukerji, *A Fragile Power*, p. 191.
[69] Ibid., p. 100.
[70] Agar, *Science and Spectacle*, p. 2.
[71] HC Deb 11 Dec 1964 vol 703 c2000.
[72] Herbert, Track 5 [00:36:11–00:36:56].
[73] Rooks, Track 3 [00:40:25–00:40:53].

Mike Westby pointed out that this perception of operating independently could go hand in hand with a sense of superiority that stemmed from a GRE's status as sole provider of certain types of expertise:

> There's always been a feeling—and there's a certain arrogance to it—of, 'where else are you going to go?' that really militates against any great holding to account. It's not like if you don't like Sainsbury's you can go to Tesco. If you don't like us, well there isn't anybody else, so if you want what we're offering you have to come to us. If the customer doesn't like it there's not a great deal they can do about it apart from not do the work, which if they need it to be done that's not an option. That's been an ongoing problem. … There's never the case that if you don't do the work on time you won't get paid and they'll go somewhere else, that kind of threat really doesn't exist and that is a problem.[74]

While research scientists could act as if they deserved special treatment, managers also saw a benefit in giving them some extra flexibility as Paul Cannon and Anthony Bravery remarked:

> If you want research scientists then you want their individuality so if you want them to shine for their good and for the organisation's good, then you have to live with their individuality. So you have treat each of them differently, you have to be sensitive to them [...] you can't have a command system in a research environment in quite the same way you can in most organisations.[75]

> The main challenge is not crushing their imagination, their enthusiasm, their inspirational aspects of the way they think. […] In the scientific world that's where you've got to be careful that constraining them too much means that their intuition doesn't get a chance to play. Scientists, or people who work in a scientific arena, tend to challenge processes and procedures … tend to want to know why and want justification and sometimes you have to say, 'Look, just do it'.[76]

In an organisation where scientists rose through the ranks to become administrators of research programmes, a shared belief in the need for autonomy comes through numerous references by interviewees to having freedom in their working lives, illustrated by these quotations from Chris Peel and Sarah Herbert:

> In the early days we had autonomy … we didn't have to go off necessarily to ask our principal customers 'Could we do this?' We'd do it and we'd report it, but it would be within the package of work that we presented them with.[77]

> Whether it was the civil service, but I think it was also true of industry at the time, they allowed for a lot of innovation. There was a lot of freedom given to do the research the way you wanted to do it, whereas later than changed enormously and you were very accountable to funds and exactly what you could get out of it.[78]

---

[74] Mike Westby, Track 5 [00:39:25–00:40:16]; Tarter, *The American Lab*, p. 102.
[75] Cannon, Track 3 [00:58:54–01:00:43].
[76] Bravery, Track 5 [00:31:47–00:34:13].
[77] Peel, Track 6 [00:39:23–00:39:45].
[78] Herbert, Track 4 [00:54:19–00:54:41].

However there is plenty of evidence in the interviews about the negative consequences of this freedom, revealed through interviewee accounts of lack of management and being left to their own devices (see page 125), as Vic Crisp found when he started at BRE:

> When I first went there my then section head gave me a few books and gave me an office and said, take your time, read into this, blah blah blah. Weeks went by and I was reading away, but he didn't expect me to do anything. Eventually I went to him and I said, 'Is there something specific I can do to help with what the rest of you are doing?', so he gave me some stuff to analyse. From thereon in it became more normal.[79]

Chris Scivyer also felt rather aimless when he started at BRE:

> They had a group of statisticians at BRE, working for government—what they needed was someone who could explain to them some of the building terminology and stuff. […] I felt I wasn't really doing a lot, but as they said at the time, it's the civil service you know. Somebody in government wants an answer and we're there to provide answers.[80]

Mike Westby's uncompromising assessment of how research was directed in his department tallies with Crisp's experience:

> A lot of it was, we did what we did because that's what we did, and because that's what we'd always done. Nobody funded programmes of work, we had lines of research and it was almost always orientated towards the structure of the organisation. There wasn't the concept of the programme or the project, we just did stuff. […] We didn't have the concept of a customer. The control process was quite obscure and mainly was inertia, so we just kept on doing what we'd always done.[81]

Similarly at times Paul Cannon found the incumbent attitudes frustrating:

> I used to have a habit of saying, 'Why can't we do it?' because I would ask whether we could do something and the answer was always, 'Because we don't do it that way,' and you think this is crazy. […] Let's face it, you're in your late twenties, you're a young Turk, you don't have time to mess around, you just want to get on with it. That's what you should be doing when you're that age, you shouldn't be messing around being thwarted by the system, so patience is at a minimum.[82]

In his 2018 history of the Lawrence Livermore National Laboratory in the USA, Tarter referred to the obstacles created when staff are 'recipients of a set of duties and obligations handed down by previous generations'.[83] Mike Westby's account shows how one 'young Turk' challenged the established patterns of behaviour among his colleagues:

> We lived in a bit of a closed community, our links with the outside world were not good. We probably could have got help but we didn't. There was a very strong element of 'not invented here'. It was interesting the atmosphere we worked in … for a research section, innovation was not terribly encouraged. We used to measure forces on things, we also used to measure how hot things got, which is a feature of things travelling at very high speed, but there were also things we were vaguely aware of where you could make [other] measurements. […] There are lots of things you can do to get quantitative data out of the airflow, we never did that because two of the elderly gentlemen tried to do that in about

---

[79] Crisp, Track 2 [00:38:07–00:38:42].
[80] Scivyer, Track 2 [00:06:23–00:06:54].
[81] Mike Westby, Track 2 [00:18:38–00:19:44].
[82] Cannon, Track 3 [00:32:23–00:33:54].
[83] Tarter, *The American Lab*, p. 97.

1973 and the technology wasn't up to it, they'd failed. […] It became received wisdom within the section that that could not be done. So, we never tried it again. […] Eventually we got a very bright Cambridge Physics graduate who just made a rig and made it work because he hadn't been around long enough to learn that it couldn't be done. […] We did a lot of stuff ourselves and probably held ourselves back quite badly by doing that.[84]

Robyn Thorogood found that he soon acclimatised to the pros and cons of how research scientists conducted themselves at BRE:

I was clearly delighted to find a place that was working at the front edge of construction, as I understood it, bringing in economics and looking at the real cost of things. […] I was a bit surprised at the rather lax or leisurely way we all behaved. But then we were researchers, scientists, so we had to have time to think and do.[85]

Carol Atkinson, coming into BRE from industry, was not impressed at the attitudes to time-keeping among some of her colleagues:

They would come in in the morning and they would clock in, then they would go to the canteen and have a coffee, then they would go to the library and then they might deign to come back into the office and they might do half an hour and have a tea break. Tea breaks were very much the culture. In GEC we didn't have tea breaks for most of the professional staff.[86]

However Ian Linsdell disputed the idea that there was 'a civil service culture and that we needed to be shaken out of it', suggesting that working patterns among scientists may not have been visible to outsiders:[87]

Most people didn't work a nine-to-five straight set-up, they did the work that was required when it was required. […] There was plenty of efficiency that needed to be put into the operations, there were a number of roles that didn't add enough value, so I'm not saying that wasn't the case; what I am saying is that the work ethic, particularly within the research community, the scientists, was always there.'[88]

Nevertheless the references to freedom throughout the interviews suggest a certain tempo in the GREs, for example in this quotation from Phil Catling:

Goals and targets: they weren't set in those days, it was a case of here's a job to do, this is how to do it, you got on with it, if you had trouble then you asked for help and that help was given. People always had time for you, there weren't the pressures as there were in the latter years.[89]

Accounts from other interviewees such as Sarah Herbert and David Dunford contribute to the sense that the pace of work could not be changed:

---

[84] Mike Westby, Track 2 [00:56:29–00:59:00].
[85] Thorogood, Track 3 [00:00:22–00:01:53].
[86] Atkinson, Track 5 [00:42:09–0:42:35].
[87] Linsdell, Track 8 [00:34:25].
[88] Linsdell, Track 8 [00:34:46–00:35:50].
[89] Catling, Track 1 [00:12:55–00:13:17].

> When there were fracture investigations under the microscope … oh, it was so expensive and so time consuming … the truth of the matter was that if they needed to spend the time they needed to spend the time, you couldn't change it.[90]

> At times it wasn't dynamic enough for certain people […] it was a very relaxed atmosphere, but a very dynamic atmosphere, it's difficult to explain. It was relaxed because people knew you were doing your best, but it was dynamic because you had to generate the results, you had to understand to move on, to give the data to people so they could build things.[91]

Jenny Constant, who worked at RSRE, was aware that scientists working for MOD did not necessarily think about the cost of their time:

> Every decision was slow, buying something, ordering something, recruiting someone. We didn't think enough about the monetary value of things, we didn't think enough about how we spent our time and who was paying for it. So there needed to be change.[92]

Transferring to a role in Whitehall exposed Roger Courtney a 'very different way of doing things':

> The closeness of interactions was very different, the pace at which anything was done, of the nature of the tasks, was of course different. In the research environment you're not faced with something where maybe you need an answer by four o'clock, if you're doing something it is to a programme that has probably been worked out over a period of months, if not years, so your next milestone might be the end of the month.[93]

When the parent department issued urgent requirements, the speed in the research establishments had to pick up as scientists were called upon to fulfil their function of being at the department's disposal. Shirley Jenkins and Paul Cannon remembered these phases were in stark contrast to the more routine periods:

> Things had to happen very quickly and so it was a case of you do what has to be done and you improvise and you sort of try all sorts of different things and you don't bother too much about the paperwork. You actually felt that you were part of something and doing something which was going to be of immediate use, whereas before it was all sort of long-term stuff and you were working towards an end but there was no sort of impetus behind it. […] There wasn't the drive.[94]

> [During the Falklands War] there was a general level of busyness around to get pieces of equipment onto the aircraft in short measure, so things that would have taken probably years to grind their way through normally was done in incredibly short periods of time. Whereas there would have been a period of assessment and navel-gazing about letting a particular contract, contracts were let with industry really quickly. […] I can remember people pulling significant days during that period. You realised why you were doing the job.[95]

---

[90] Herbert, Track 10 [00:05:41–00:06:11].
[91] Dunford, Track 2 [00:25:31; 00:35:21–00:35:45].
[92] Constant, Track 6, transcript p. 127.
[93] Courtney, Track 10 [01:04:22–01:05:17].
[94] Jenkins, Track 6 [00:01:15–00:02:01].
[95] Cannon, Track 5 [00:27:32–00:28:35].

These accounts demonstrate how a sense of freedom permeated scientists' understandings of working life in a GRE before organisational change. Another feature of the workplace culture that comes through the interviews is the affection with which they referred to their colleagues with whom they worked and shared social exchanges.

5.5 Mentors and camaraderie

While some interviewees remember the organisational arrangements of the GREs into sections and small offices as inhibiting interaction and knowledge exchange, most descriptions of working life foreground camaraderie and teamwork (see section 4.1.3). These reflections suggest that the norm in the GRE was not the pursuit of individual reputation or personal gains but rather of scientists taking a certain pride and satisfaction in how their work contributed to the work of their team and the overall research programme.

Scientists in the scientific civil service were predominantly managed by fellow scientists, interacting according to the standards and rules of the professional community to which they all felt they belonged.[96] Horrocks and Lean have commented that the GREs were characterised by a paternalistic culture where senior civil servants encouraged younger promising colleagues.[97] This internal community perpetuated its own code of conduct and cohesiveness, in one way through encouraging the academic progress of new recruits, as David Dunford appreciated:

> They welcomed you. They talked to you as an individual and you didn't feel there were any boundaries. This is a 16-year old talking to some very, very able Oxbridge academic people, and if I wanted to have one memory, it would be the professionalism of the staff. They were exceptional.[98]

This account aligns with the observation by Ferlie et al. that members of a profession relate to each other on a collegial basis, borne out by Carol Atkinson's comments about when she started at GEC Hirst: 'There were some really nice chaps, like my Dad's age, you could go and talk to and things, they were kind and quite helpful.'[99] Another example of this is in Paul Cannon's story about his mentor at RAE teaching him how to navigate the system:

---

[96] Rothblatt, 'The Notion of an Open Scientific Community', p. 66.
[97] Horrocks and Lean, 'Doing It for Britain', p. 165.
[98] Dunford, Track 2 [00:12:45–00:13:13].
[99] Atkinson, Track 3 [00:33:15–00:33:28].

> Boyd Burgess took me under his wing and used to tutor me right from the beginning. He tutored me on the ways of MOD and Whitehall and to him I owe my promotions really because he knew I could cope with the science but he needed to make sure I understood the politics. I can remember him telling me stuff and then telling me it again.[100]

Many commented on the tea breaks as a valued feature of the day and the extensive range of social activities on offer to staff also consolidated a sense of community, as Ian Linsdell remembered:

> There was a huge availability of things to do, sailing, gardening, almost you name a subject, there would be a club. Chess club, whatever. Football teams, all sorts. What you tended to do is point people in the direction saying this is available to you […] they were encouraged [to take part].[101]

However this side of institutional life could get in the way of the actual work, with managers reluctant to upset the staff with whom they socialised, as Sarah Herbert found with one colleague in her section:

> I had been very good at keeping him out of the gardening club. Everybody else was such great friends with him and he was quite a mature man, he was in his fifties and I was in my twenties, nobody dared say to him, 'Come back.' […] They didn't want to be nasty to him. I was quite strict, and I plain simply told him that he wasn't pulling his weight. […] My section head said to me, 'You can't tell him off, we know him too well, he's a friend.' I said, 'Well I can, I do.'[102]

This strong sense of community may have been one of the reasons why scientists were reluctant to leave the GREs for a tour of duty in Whitehall, not so much because they would miss the scientific research but more the company of their colleagues.[103]

5.6 Job satisfaction

Cushioned within the strong civil service framework and given the autonomy they wanted, scientists developed strong attachments to the GREs that were fostered by the combination of feeling secure and valued for their special skills. This bond was reinforced by the amicable relationships with management that were nurtured through the social side of GRE life. As David Dunford commented, 'People wanted to be there, they valued their jobs and they knew the history. They knew were they'd come from, the great guys who'd worked there before.'[104] This prestige and sense of privilege promoted levels of job satisfaction that meant many interviewees were disinclined to take an active role in their

---

[100] Cannon, Track 3 [00:29:36–00:30:11].
[101] Linsdell, Track 7 [00:28:55–00:30:04].
[102] Herbert, Track 5 [00:05:09–00:05:34; 00:19:17–00:19:25].
[103] Ferlie et al., *The New Public Management in Action*, p. 187.
[104] Dunford, Track 1 [00:25:50–00:25:59].

trade union, the IPCS. MacLeod and MacLeod identified contradictory demands between scientists' aspirations for professional advancement and an active pursuit of political ideals in the early twentieth century.[105] A commentator from the 1930s described government scientists as 'either indifferent or hostile to such a movement' and 'probably more individualistic than any other body of civil servants'.[106] Similar attitudes to union participation was observed in a 1996 study of industrial scientists by Randle.[107]

Their satisfaction in their roles as government scientists was, according to Alan Gray, because 'people were far more interested in doing the science than getting promoted.'[108] This description corresponds closely to Box and Cotgrove's observation that for certain types of scientist, 'the greatest excitement is the job itself.'[109] While some accounts in section 5.4 above indicated a relaxed attitude to time-keeping and lack of drive, these quotations from Alan Gray and Susan James about RSRE and RAE respectively paint a very different picture:

> The carparks would be half full over the weekends. The place was buzzing, people were working on things, there were laboratories in every building, these weren't office buildings, this is where real work was being done, sometimes on real systems that had already come into service up to really tentative, almost certainly never going to get anywhere but you don't know until you try it. Blue sky research.[110] ⌾ ▶

> It was a vast place with so many different things going on ... it was buzzing, do you know what I mean, with real research, people just thinking let's give that a go. Let's give that a go, and it didn't really matter whether it delivered or not.[111]

This corresponds with the description given of scientists who worked at the Lawrence Livermore National Laboratory in the USA: 'Almost to a person there was great satisfaction simply in coming to work, and people approached their jobs with both high expectations and a sense of exhilaration'.[112] For many interviewees such as Steve Rooks, there was a sense of adventure within the institutional culture:

> The excitement of the work, let's not take that away, because it is incredibly exciting in most areas of work. The people they get to work with, the places they go, then the ability to work with so many different organisations. One day you could be working with the best

---

[105] Roy MacLeod and Kay MacLeod, 'The Contradictions of Professionalism: Scientists, Trade Unionism and the First World War', *Social Studies of Science*, 9, no. 1 (1979), pp. 1–32.
[106] L. D. White, *Whitley Councils in the British Civil Service* (Chicago: University of Chicago Press, 1933), p. 273, quoted in Kenneth Prandy, *Professional Employees* (London: Faber and Faber, 1965), p. 129.
[107] Randle, 'The White-Coated Worker'.
[108] Gray, Track 3 [00:40:22].
[109] Box and Cotgrove, 'Scientific Identity, Occupational Selection, and Role Strain', p. 22.
[110] Gray, Track 3 [00:34:23–00:34:57].
[111] James, Track 4 [00:12:45–00:13:09].
[112] Tarter, *The American Lab*, p. 97.

> of the best in industry, the next day you could be briefing to people overseas at a conference, so amazing opportunities like that.[113]

David Dunford commented on 'the energy within the organisation … to help the MOD … people loved that,' and how in some cases that passion meant scientists just kept on working:

> They would solve the problem without charging them ... or they would solve the initial problem and then solve the next five problems because they were interested, you know, that was the nature of what they did. [114][115]

However the nature of the workforce could present challenges to managers such as Steve Rooks:

> You've got such intelligent people on a very broad spectrum, … so you have to be constantly thinking about how people react to what you say because you get such a variety of views but also analyse everything you say, so emotions can run really, really high.[116]

Other references reinforce the impression that working in a GRE had the reputation of being fun and exciting, with Wendy Westby remembering that at times her work at DERA and QinetiQ felt like a 'paying hobby'.[117] However for Carol Atkinson, who joined BRE in 1990, it proved to be more similar to industry than she had anticipated:

> I kind of thought it was going to be more fun and more exciting and I might get a chance to do better science, so I was quite disappointed. […] I thought maybe we would be doing more science for the sake of finding things out rather than to fix a problem, being more open ended than closed in, shall we say. There was always a very, very focused objective that we had at GEC. I was hoping to do things that were more open ended.[118]

Atkinson's view perhaps indicates how the focus of the research establishments was changing as the organisational changes of the 1970s and 1980s were filtering through to GRE activities.

5.7 Conclusion

This chapter has discussed the features of scientists' professional working lives which contributed to the institutional culture within the GREs. The values associated with scientific civil servants' identities as both scientists and public servants reinforced each other in creating an expectation of status and independence in how they addressed science. Organised and funded as part of the civil service, GREs offered a distinct

---

[113] Rooks, Track 3 [01:03:24–01:03:58].
[114] Dunford, Track 4 [00:36:13].
[115] Dunford, Track 5 [00:20:24–00:20:42].
[116] Rooks, Track 7 [00:25:14–00:25:37].
[117] Wendy Westby, Track 6 [00:23:10].
[118] Atkinson, Track 5 [00:19:55–00:20:54].

working environment which offered the scientists within them the freedom to be creative and show initiative in how they carried out research. This expectation of autonomy meant that they were happy to work for the organisation's benefit and for the public good.

The culture within the GREs, perpetuated by its cohort of professional scientists, invested staff with feelings of attachment to their organisations and belonging to a special community remembered for its camaraderie and friendship. The individual was expected to develop as a scientist with the organisation's help, and the organisation's structure was designed to reward those who continued with further education with promotion. Chapters 4 and 5 have also shown how the educational opportunities offered by GREs during the second half of the twentieth century gave school leavers an alternative route to university in pursuing academic qualifications and development as a professional scientist.

This assessment in this chapter adds to Shapin's study of industrial scientists in the US by showing that scientists in another distinct institutional setting shared aspirations and behaviours typically assigned exclusively to scientists in academia.[119] In many respects GRE scientists adhered to the values of the academic scientific community by participating in the peer-review publication process and networks of knowledge exchange.

The patterns of progression determined by the civil service framework relieved scientists of some of the pressures that professional scientists experienced in other settings, such as the need in academia to build up a personal record of achievement. This allowed for the sustained focus that led many GRE scientists to develop deep expertise, unlike their professional peers in industry who were occupied on projects designed to meet commercial goals. However the realities of working within the civil service structures acted as a constraint that could inhibit the exercise of those freedoms and the sense of competition that drove innovation. A lack of pressure had positive and negative influences on GRE scientists' approach to scientific research. Most interviewees recognised that alongside the positive aspects offered by the civil service ways of working, such as a sense of freedom and excitement, were negative elements such as inertia and budgetary constraint. The more critical assessments of the *modus operandi*

---

[119] Shapin, *The Scientific Life*.

come from interviewees with experience of other settings, such as Carol Atkinson who had worked in industry or Alan Gray who had served in the armed forces. In these settings they may have been accustomed to different criteria of success. There is evidence that these negative ways of working were difficult to change. This points to the extent to which the culture was embedded at different levels of the organisation, in that scientists advanced into managerial roles and acted according to their values as scientists in allowing staff the freedom to operate autonomously.

This management approach would be curtailed with the implementation of NPM which introduced a very different management ethos into the research environment. The next chapter focuses on the processes whereby NPM and commercialisation created a different system of norms and values in the workplace which disrupted scientists' expectations about working life. Chapter 7 then considers the longer-term impact of organisational change on the development and status of specialists and their relationships with government.

6. Competing values: new ways of managing and accounting for research

'All of a sudden management became the Holy Grail.'[1] This short quotation from Sarah Herbert encapsulates the emergence of New Public Management (NPM) in the 1980s. This engendered a profound shift in the civil service organisational culture 'from a bureaucratic ethos of office to a managerial regime'.[2] As discussed in section 2.2.2, introducing NPM into the UK public sector combined the promotion of managerialism and the application of new doctrines such as competition, outsourcing, and incentive structures. These processes brought the *modus operandi* of public and private research environments closer in line and led to permanent changes in the types of research that was commissioned by government, and how that research was conducted.

The roll-out of NPM was experienced differently by different parts of the civil service. In the case of the GREs, Boden et al. identified shared characteristics among the government science laboratories that intimated they were not necessarily suitable candidates for NPM:

> Tradition, cognitive complexity leading to contractual problems, the perceived need for close collaboration and co-operation between providers and users, the fact that some of this activity may have no obvious commercial "customer", and the imperatives of policy making makes the application of NPM potentially problematic here.[3]

Scientists' memories of this period of public management reform provide first-hand accounts of how some of the potential issues identified by Boden et al. affected the GREs. This chapter does not attempt to assess whether the implementation of NPM led to an improvement in efficiencies in the GREs and their successor organisations. Rather I draw on the individual lived experiences of interviewees to consider how the implementation of NPM affected scientists' working lives.

Variations in interviewee assessments of change often reflect the roles interviewees held in the organisation and whether they had previous experience of working in industry (see pages 35–37 and Appendix 4). Interviewees remember how the application of NPM introduced competition and pressures that were not part of the existing culture described

---

[1] Herbert, Track 6 [00:51:46].

[2] Hood, 'A Public Management for All Seasons?'; Andrew Dunsire, Keith Hartley and David Parker, 'Organizational Status and Performance: Summary of the Findings', *Public Administration*, 69, no. 1 (1991) pp. 21–40.

[3] Boden et al., 'Men in White Coats', p. 268.

in Chapter 5, creating a process of cultural change in the workplace.[4] This process was summarised by Phil Catling based on his experience as a middle manager during the agency years:

> It was quite a breeze of change I would say … brigading the establishments first into DRA and then into DERA. It was a new culture for us where accountability became quite high, became key. Client relationship management, account management became key. Winning business obviously key and there was a big drive at middle management level for training in those areas. Small groups came together to form larger groups, so from having been a manager of a small section of maybe three or four people it was grown up to 50. You had issues with how the new organisation then interacted with MOD, so there's a framework document put in place for that.[5] 🎧 ▶

Accounts such as this provide insight into the practical realities of adjusting to the systems and values associated with NPM, when scientific civil servants had no choice but to adapt their working practices to new performance criteria. An understanding emerges of how the processes of commercialisation and civil service reform affected interviewees' deeply held values about working both as public servants and professional scientists. The following sections describe the changing expectations of managers and staff, the increasing focus on delivering customer contracts and the requirement to adopt a more commercial outlook, all of which added momentum to the process of culture change.

6.1 Different concepts of accountability

Through the scrutiny exercises carried out in the early 1980s (see section 2.2.1), Derek Rayner came to the conclusion that there was 'a staggering double flaw in civil service management' due to a lack of useful financial management information and a widespread 'fuzziness' of accountability.[6] He explained to a parliamentary select committee:

> Unless individuals are held accountable—and that does not mean heads of departments—in terms of management information, departments will not manage as well as they ought to, so there is a need for greater accountability down the line and measurement of performance down the line to which people will respond.[7]

Reforming the civil service organisational frameworks and management structures involved converting a regime that tracked processes to one that measured and recorded outputs and results. Responsibility and accountability shifted down the hierarchy towards the individual civil servant. As Lægreid has commented, 'instead of being integrated

---

[4] Lægreid, 'Accountability and New Public Management', p. 324.
[5] Catling, Track 2 [00:18:15–00:19:35].
[6] Cabinet Office, *Review of Support Services*, p. 24; Theakston, *Leadership in Whitehall*, p. 239.
[7] Treasury and Civil Service Committee, *Civil Service Manpower Reductions*, p. 71.

elements of responsible, collective public bodies, public administrators are supposed to be autonomous and entrepreneurial and pay attention to signals they receive from their clients or customers.'[8]

A 1989 review of defence procurement processes indicates the challenge that MOD faced in improving accountability:

> The MOD's arrangements for procurement have evolved in such a manner that knowledge and technology flow throughout the organization is a complex process which does not allow clear identification of accountabilities for the decisions regarding the identification, development and eventual use of those technologies essential for incorporation into defence equipment.[9]

The transformation of research establishments into executive agencies represented another effort to improve accountability, with the practicalities laid out in the DRA in-house newspaper:

> DRA will need to operate very much like a commercial organisation, preparing budgets, monitoring cash flow, invoicing customers, collecting rent from Lodger Units and buying services from MOD that we currently obtain at no charge.[10]

Internal structures in the GREs were reconfigured by breaking the organisations down into smaller accountable units, and along with new accounting systems, these smaller units enabled more visible lines of budgetary responsibility to be drawn.

Operations in the new agencies built on the customer-contractor principles laid out in the 1971 Rothschild report, and were described as bringing 'a quasi-private sector' approach to the civil service, with public sector transactions being carried out according to commercial accounting conventions.[11] Agency status enabled research organisations to operate accounting systems that for the first time reflected the full cost of the services they were providing.[12] These systems provided information that was expected to improve visibility in how government expenditure on R&D was spent. This coincided with a parallel drive from government that led to the requirement in 1989 that private sector

---

[8] Lægreid, 'Accountability and New Public Management', p. 326.
[9] ACOST, *Defence R&D*, p. 22.
[10] 'Simulated trading and the Purple Pound', *DRA News*, May 1992, p. 2
[11] Winetrobe, 'Next Steps and Parliamentary Scrutiny', p. 35. See also Andrew Gamble, 'The Thatcher Myth', *British Politics*, 10, no. 1 (2015), pp. 3–15.
[12] Anthony Beattie, 'Experience of Commissioning Research and Development', in R. Hay (ed.), *Science in Government: The Rise of the Intelligent Customer* (Scottish Agricultural Science Agency, 1994), pp. 15–20 (p. 16).

firms disclose their expenditure on R&D in their annual accounts.[13] The Conservative government wanted industry to take more responsibility for R&D and believed that if industrial firms were required to publish their R&D figures, it would influence private sector managers' awareness of and responsibility for R&D within their own organisations.[14]

Ian Linsdell and Vic Crisp recognised the drivers behind the efforts to improve accountability that came with agency status:

> [The Vote system] clearly had flaws because of the underspend/overspend element to it, and it can't be right to spend public money willy-nilly just to meet a number. Most of us recognised that at least a trading fund would be a more accountable way of dealing with public money.[15]

> It just gradually evolved to be more and more meaningful as the whole issue of who paid for what and why we were doing it became more of an issue. You had to kind of track what you were spending as part of the programme item forms to feed back in the assessment of how you'd done it and what you'd spent. So it had to evolve even before privatisation and therefore I don't think when we became a private organisation it was a huge leap to an accounting procedure that was so different to what it was before.[16]

However the stricter focus on accountability had a knock-on effect on the specialist facilities for which the GREs were renowned, as Anthony Bravery explained:

> The problem was we became so obsessed with costs and who was going to pay for it. Lots of activity ended up being called overheads, and overheads were not valued. Some of the basic processes of maintaining the facilities for example, the products and processes that we worked with, fungal collections and insect collections, for example. These were very difficult to attach a value to, but very easy to put a cost to. These became unfashionable activities when there was a lot of pressure to reduce overheads. For the first time we had numbers going around how much a square metre our lab space cost for example, which put pressure on to reduce the number of rooms that you had and the size of those rooms. […] We had lots of specialist rooms, constant temperature rooms for growing culture and fungi, carrying out tests with fungi. Lots of rooms for breeding insects, including a termite breeding house, the pressure was on to reduce these, I had a bottom line to meet.[17]

Unit managers and individual staff acquired authority for decision-making and recruitment. A stream of communications in the DRA in-house newspaper introduced staff to the fundamental elements of the new management approach:

> The redrawing of the DRA organisation chart based on product-centred business sectors; the empowerment of cost and profit centre managers, and the setting of budgetary

---

[13] Keith Robson, 'Connecting Science to the Economic: Accounting Calculation and the Visibility of Research and Development', *Science in Context*, 7, no. 3 (1994), pp. 497–514 (p. 506).
[14] Ibid., p. 508.
[15] Linsdell, Track 4 [00:34:13–00:34:46].
[16] Crisp, Track 5 [00:50:16–00:51:01].
[17] Bravery, Track 7 [00:01:21–00:02:25; 00:19:18–00:19:44].

responsibility at that level, the move from an input-controlled system to a results-based line management organisation.[18]

Chris Peel remembers it as being a positive change in DRA: 'The change in structure, how the divisions were chopped up, how the sectors were chopped up and reduced down into business groups—I think people preferred that.'[19] Similarly, the agencies also gained control of their operations, as shown in this extract from Roger Courtney's interview:

> When I became Director [of BRE] … the Property Services Agency was responsible for the buildings still, so if we wanted a new building or major repairs to a building, in effect that had to be argued with PSA and put into their schedule of priorities. It wasn't something that we could control ourselves … it was a source of considerable frustration. One of the things that was a benefit of becoming an agency was that you collected responsibility for all these sorts of things.[20]

The key parts of DRA were run as profit and loss centres, and profit was seen as the significant indicator in the progressive reduction of costs, and therefore the most important performance measure in changing the size and shape of the DRA.[21] Steve Rooks remembered this change:

> We started becoming much more pressurised … we started operating profit and loss statements so you were … at the higher level then being tracked against annual budgets and spends, whether that was people's research or infrastructure.[22]

However Anthony Bravery remembered that it brought positive aspects to his managerial role in that 'we didn't have to keep going up the line and seeking approval for spends.'[23]

Agency status also brought 'enthusiasms for initiatives such as Total Quality Management systems'.[24] By adopting these systems an organisation committed to continuous improvement involving the review of work processes, collection of work-flow information and analysis of outputs which then demonstrated its ability to offer customer satisfaction and meet regulatory requirements.[25] Steve Rooks remembered the implementation of ISO 9001:

> [It] was very new to an organisation like a research establishment trying to put in place standard management practices through ISO 9001. […] We had internal audits where the auditors internally would take the ISO framework and then come and sit with you and look at how you are running your team and compliance with that and evidence. Simple

---

[18] 'ICAS [Improved Commercial Accounting System] comes of age', *DRA News*, April 1993, p. 4.
[19] Peel, Track 7 [00:17:08].
[20] Courtney, Track 8 [00:07:06–00:08:20].
[21] 'Establishing corporate goals', *DRA News*, April 1992, p. 2.
[22] Rooks, Track 2 [00:48:54–00:49:15].
[23] Bravery, Track 7 [00:21:15].
[24] Clarke and Newman, *The Managerial State*, p. 119.
[25] J. Richard Hackman and Ruth Wageman, 'Total Quality Management: Empirical, Conceptual, and Practical Issues', *Administrative Science Quarterly*, 40, no. 2 (1995), pp. 309–42.

> things like 'Where's your plan for the team, where's your performance agreement with this individual?' […] It was starting to bring consistency in, by making sure people had to follow the processes … a lot of effort went into that.[26]

However the expectations for managerial freedom and accountability embodied in NPM challenged the conventions on which civil servants' work was based—ultimate accountability to Ministers.[27] Roger Courtney spoke about the contradictory nature of executive agency status:

> There was a good deal of funny money around. Yes, you were trying to operate as a business but you were operating with civil servants so there were definite constraints about what you could do and what people could do to you.[28]

Ambiguities over lines of responsibility and whether executive agency personnel were answerable to Parliament contributed to arguments for privatisations.[29] In the meantime, while these inconsistencies were emerging, a new cadre of managers had the challenge of applying the new systems.

6.2 Evolving expectations of managers and management

A desirability for scientific civil servants to expand their managerial skills had been identified in the 1980 *Review of the Scientific Civil Service* and the 1982 Rayner scrutiny (see section 3.2.3).[30] For Mike Westby, the focus on management that was stimulated by organisational change meant 'it was almost like a new class emerged of the sort of management types'.[31] However these were not the technological generalists envisioned in the 1980 review. Instead new management roles emerged in which technical capability was an asset but not necessarily expected.[32]

One role that emerged was the business group manager (BGM). BGMs were appointed to lead the cost centres in DRA that replaced the divisional sections. Ian Linsdell explained what the role encompassed:

> Cost centre management, business group management, health and safety, corporate governance, project management, reporting, reviewing, being compliant with all objectives within the organisation, being legally compliant … I was the internal facing

[26] Rooks, Track 6 [00:29:24] and Track 7 [00:30:16–00:31:13].

[27] Lægreid, 'Accountability and New Public Management', p. 324.

[28] Courtney, Track 13 [00:03:10–00:03:36].

[29] Thain and Wright, *The Treasury and Whitehall*, pp. 66–69; Giddings (ed.), *Parliamentary Accountability*.

[30] Civil Service Department, *Review of the Scientific Civil Service;* Cabinet Office, *Review of Support Services,* p. 18.

[31] Mike Westby, Track 6 [00:44:02].

[32] Civil Service Department, *Review of the Scientific Civil Service*, p. 42.

> part of the business. […] Once a year at business planning time every BGM would be required to go in front of the board and tell them what their plans were, what their budget was, what the targets were, who they were aiming for, who the customers were, what the business was like, those sorts of things, which was quite—for me—nerve-racking.[33]

Some BGMs felt liberated by the additional responsibilities, such as David Dunford who felt that 'there was a real need to make decisions, to try things and make decisions and we were given that empowerment to do it.'[34] They were responsible for communicating and implementing change within their teams, as Phil Catling described:

> So all the changes that were taking place and being promoted, you were the one interface between the staff and the senior management, so you were cascading what was happening, you were trying to justify why it was happening, trying to keep the staff happy throughout those changes which you did your best at. […] Trying to sort of communicate those changes and get their buy in was a difficult time […] managing staff, their expectations, morale and gaining their support for corporate initiatives.[35]

Another significant change was the transfer of responsibility for personnel from the central department to the managers within the business units, as Martin Wyatt remarked:

> In the civil service you do not manage your staff, the Personnel Department manages your staff, so if a junior member of staff comes to me and says I've got this problem, you say go and see Personnel. You're not trained to deal with it, it's not part of your responsibilities. […] That was one of the biggest culture shocks post-privatisation when I told them they were responsible for their staff, not Personnel. […] So the managers managed science and they managed research programmes, they did not manage staff in that sense. […] In my mind it was wrong. For God's sake if a member of your team can't come and talk to you about their personal issues and you can't help them and show that you're interested in their career and whatever, how does the relationship work?[36]

Steve Rooks welcomed these developments:

> I could see the importance of having more professional line management and people that were skilled and qualified to lead and develop people. [Before] when it came to dismissals or big staff issues it would always end up getting dealt with in the senior echelons of the organisation which was stupid because it needed to be done at the right level.[37]

Chris Peel remembers that the evolution of this new role presented the challenge of finding people to fill it, people who were good at personnel management and business management yet also those with some technical understanding. His comments show how responsibility for running scientific research programmes moved away from scientists to managers that did not necessarily have technical knowledge:

> The habit … that caused some difficulty was the imposition of managers from outside. There was an attitude that business knew how to manage things better than the establishment, so we had a whole raft of business development type characters coming in

---

[33] Linsdell, Track 8 [00:39:18–00:40:28] and Track 7 [00:10:04–00:10:27].
[34] Dunford, Track 8 [00:41:31].
[35] Catling, Track 2 [00:25:56–00:26:22] and Track 3 [00:00:36–00:01:07].
[36] Wyatt, Track 3 [00:34:00–00:35:42].
[37] Rooks, Track 3 [00:39:16–00:39:37].

> from all sorts of places and some were very good, but an awful lot were rubbish. […] The business was absolutely about local people who were really expert talking to government customers directly, not having a general industrial-type attitude towards it, and they wouldn't know the technology that was held in house. [...] Actually finding suitable business managers to run these small groups was quite a tricky issue.[38]

David Dunford saw that one of problems associated with bringing in managers from outside was that they might not comprehend how the staff, however idiosyncratic, were fundamental to the value to the organisation:

> You had to appreciate the value of the individuals. That's one of the reasons why people who came in from outside failed. They couldn't empathise with the individuals; they didn't understand how they worked or why they worked. […] Some of them were a nightmare, but you couldn't get rid of them because they had the knowledge, they were valuable.[39]

Alongside the arrival of new types of managers was another transformation in the way research was managed. For Chris Peel, this marked a 'watershed ... a specific change in the way R&D was governed'.[40]

> The introduction of project management—or resistance to it—was about at the end of the RAE as an individual establishment, and DRA came in pretty much with project management. The establishments were bundled together into bigger units, project management was introduced. I don't think the introduction of the larger grouping into DRA had anywhere near the same effect or influence as the shift to project management.[41]

Martin Wyatt and Chris Peel spoke about how the shift towards project management affected the juggling act of managing staff with niche specialist expertise:

> What happens in organisations like BRE is keeping people busy, especially when they're specialists and you haven't got specialist work for them, or fee-earning work. […] It's [the manager's] job to win the work with the team to keep them busy … it's his job to divvy the work up, see that everybody is pulling their weight equally and that there's enough work to keep them all busy.[42]

> At the end of the day it's the guy at the bench that's earning the money, doing the work, and if his MOD or DTI or whomever customer is happy with what he's doing and keeps funding him, that guy's going to keep his head down and the rest of it is almost irrelevant to him. Then you've got a poor business group manager who's trying to collect all the beans together and make sure that all of his troops are properly funded and therefore this business group will develop enough income and make profit so that he can report to his managers, 'Yes we're surviving and growing'. What would tend to happen is you'd get feast and famine … you could go from feast to famine in a year. […] Alternatively you could be too lucky and end up with too many opportunities, too much work and not enough folk. It was a different way of managing, it was more done around the immediacy of funds coming from particular projects once it became QinetiQ.[43]

---

[38] Peel, Track 5 [00:06:32–00:08:48] and Track 6 [00:06:20].
[39] Dunford, Track 6 [00:25:02–0:26:09].
[40] Peel, Track 4 [00:27:34].
[41] Peel, Track 4 [00:27:54–00:28:40].
[42] Wyatt, Track 6 [00:03:55–00:04:31].
[43] Peel, Track 6 [00:07:21–00:09:37].

Project management changed the dynamics among staff and brought new pressures on their managers, as David Dunford noted:

> When project management kicked in it became a lot more structured, agree milestones, agree dates, you agree all those things, you agree the cost. [...] A lot of scientists at Farnborough were happy in their own box, doing the things they liked to do within their tight team. That was a bit of a challenge with the arrival of projects and having to be more flexible about what you did. Working for other people who you may not have necessarily got on with and being told to work with other people ... that did create some problems, absolutely.[44]

For Sarah Herbert this shift diminished the job satisfaction she had enjoyed as a section leader in RAE, prompting her to look for a role elsewhere:

> As we got more and more towards a trading fund and QinetiQ looming in the distance, they did start to change the roles. Instead of having a section head looking after a section, when I left they had an HR manager and a technical expert and then they had a project manager, and all of a sudden the research team find themselves managed by three groups, not one person. [...] I had as a section leader been doing all three ... but then they started to divide the job of managing the research programme between a project manager and a technical expert and the project manager would have had all of the money and they wanted me to be the technical expert, and I had been used to being able to control what I spent my money on in the research and I was unhappy in that particular situation. When a job came up to apply for a job in MOD I was pretty quick to do it.[45]

At RAE, Paul Cannon had liaised with the extra-mural manager whose role was similar to that a project manager but someone who had more technical knowledge of the research programme:

> In those days there was an extra-mural specialist for the department I guess ... so clearly I had to be tutored through the process of writing the specifications and the tendering process and all rest of it. We had this specialist ... he was so helpful, again, people seemed to have just that little bit more space and ... when we had the project meetings he would come to the meetings and chair the meetings, it wasn't me. He would chair the meetings and I would provide the technical input to support him, which I think is very different from today where you get a generalised project manager. [...] Whilst they understand some of the issues of the programme, they don't understand it in the details that this EMR specialist understood.[46]

Wendy Westby also remarked on this shift:

> My impression is that project managers moved away from being people who knew about the technical side of the projects they were managing to just being professional project managers who didn't necessarily know about the technical side, they relied on the technical leads to deal with the technical side.[47]

As the management of discrete areas of research gradually became the responsibility of project managers, and new opportunities opened up for scientists who decided to follow

---

[44] Dunford, Track 7 [00:05:10–00:05:18] and Track 4 [00:31:44–00:32:19].
[45] Herbert, Track 8 [00:27:52–00:29:41].
[46] Cannon, Track 3 [00:34:23–00:36:39].
[47] Wendy Westby, Track 5 [00:30:27–00:30:57].

that career path. Staff were actively encouraged to consider becoming certified project managers, and Ian Linsdell could see that their contribution to the delivery of research projects became more important:[48]

> I was particularly aware of them the minute we became DRA. They had existed before but there was a driver on the performance of projects from that point because it gets recorded and the outputs distributed. As we progressed you then expected more and more from your project managers.[49]

For both BGMs and project managers, the focus was on tracking outputs and performance which created an environment for more robust managerial accountability.[50] In the research establishments, this meant that new ways of measuring the production and delivery of knowledge came into force.

6.3 How performance was measured

Derek Rayner believed that measuring performance in government was not as easy to do as in business 'because business has other more convenient yardsticks.'[51] When it came to measuring performance in government R&D before the advent of NPM, David Dunford described it simply as 'you were measured by the number of technical reports you produced'.[52] Steve Rooks also saw reports as an important measure of productivity:

> Most of the outputs for work I was involved with would have been reports, so you would have agreed at the start of the year what your research is going to do and then you would identify points in time when you would produce a report that would deliver against it.[53]

Once the establishments became executive agencies, Roger Courtney as director of BRE was very clear about what needed to be measured : 'Basically we were selling time, there was very little that we sold in the way of product or use of facilities. Overwhelmingly our income was selling of time. Percentage of utilisation was absolutely key.'[54]

To determine charge out rates, the costs of running research facilities were assessed, taking into account their capital value and the costs of maintenance, likely utilisation rates and operating costs.[55] Once those rates had been determined, it was then a case of

---

[48] 'Project management roadshow', *DERA News*, December 1996, p. 5.
[49] Linsdell, Track 7 [00:50:50–00:51:28].
[50] Pollitt and Bouckaert, *Public Management Reform*, p. 147.
[51] Treasury and Civil Service Committee, *Civil Service Manpower Reductions*, p. 70.
[52] Dunford, Track 3 [00:38:48].
[53] Rooks, Track 2 [00:49:34–00:49:49].
[54] Courtney, Track 16 [00:53:07–00:53:42].
[55] 'Establishing corporate goals', *DRA News*, April 1992, p. 2.

convincing scientific staff to book their hours to projects. As Ian Linsdell commented, 'there was always an aversion to booking to projects because they didn't want to overcharge their friends in the MOD' (see page 133).[56]

While Chris Peel pointed out that 'the basic idea of having a job number and partitioning your hours and having a budget for that job number was in place many years before QinetiQ', interviewees who were in management positions remembered that the idea of accounting for time was problematic and unpopular among their staff, with what David Dunford refers to as the 'stigma' of unassigned time. A study of scientists in another government-funded laboratory observed: 'They simply resented the requirement to account for the seamless web of their day in the segmented bureaucratic and financial manner.'[57]

Martin Wyatt, who became CEO of the privatised BRE, was aware that getting staff to complete the timesheets scrupulously was difficult as their utilisation rates would directly affect how they would be viewed at the next round of redundancies:

> Again, if you spent out on this project and this [other] project's got money you just put your time down for the project that's got money, don't you? This was a problem that carried over to the private sector that was very difficult to deal with, because they wouldn't be honest. […] This went on all over the place so you didn't know what the true cost of what you were doing was.[58]

For managers such as Ian Linsdell, the system for recording time provided the intended information on staff performance:

> I'd have utilisation reports which [showed] who was doing what. I would look at booking profiles. […] When you're looking at a big spreadsheet, typically you can see those that are booking all their time to projects because they're really valuable, and that's all they think about. Others you would find they would book fractions of hours to odd codes. Some people made an industry of discovering what all the codes were and seeing if they could book to them. Eventually we tried to make it that you had to have permission to book to various codes.[59]

A scientist's letter about deployment forms published in the DRA in-house newspaper gives an idea of the consequences of using timecodes:

> I have just received a memo informing me that the funds for one project has reached its 'limit or financial allocation' and that I should not book hours to it. I still have work to do on this project and in order to complete it, I will book hours to another project, thereby

---

[56] Linsdell, Track 6 [00:02:57].
[57] Law and Akrich, 'On Customers and Costs', p. 208.
[58] Wyatt, Track 3 [00:37:54–00:38:33].
[59] Linsdell, Track 7 [00:40:17–00:41:43].

> inflating the cost of that project. [...] At the end of the year when my hours are totted up, if I have too many admin. hours then I look inefficient and don't get my pay rise.[60]

Phil Catling noted how the scientists in his team began to realise how the system impacted future remuneration:

> It was the accountability, it was the fact that they would be accountable for what they were doing, bringing in those objectives that they had to beat for the pay awards.[61]

Performance measurement became firmly embedded as the organisations transitioned into the private sector. Steve Rooks remembers how the conduct of performance reviews changed:

> It started becoming a lot more evidence-based performance review—same thing that's gone on everywhere really—but you would then have to make sure that you collected evidence that your objectives were SMART and at the end of the year needed to make sure you could provide your line manager with absolute clarity on what your achievements were ... you'd be scored.[62]

The new methods of assessment gave managers such as Ian Linsdell the tools to reward those with promise:

> There was a feeling that if you worked hard for it you were going to get recognised which was largely the case. Pay was very much performance-related and if you saw a rising star you were going to back them.[63]

However Shirley Jenkins felt that the new systems affected how researchers operated, even for those who, like her, remained within government after DERA was split in 2001:

> It then became much more important to do things on time and on budget and whether you actually achieved anything became sort of less important. Prior to that it was a matter of achieving things. Time and budget were in there, but they weren't the drivers at that stage. [...] You were aware, even in Dstl, there was some sort of commercialisation aspects to the way things were being done. [...] Forms, more accountability in sort of report writing, quarterly reports had to happen ... sticking to budgets. It became much more important to write your reports and have a nice glossy report on time, whether you actually achieved anything in that quarterly period seemed to have less importance, the important thing was getting the report written.[64]

Her sentiments were echoed in what David Dunford missed about the previous system: 'We weren't tied by cost codes per job, we were tied by the desire to achieve something, a slightly different mentality to what we see nowadays.'[65]

---

[60] 'Deployment: time for a rethink', *DRA News,* November 1993, p. 10.
[61] Catling, Track 4 [00:56:51–00:57:04].
[62] Rooks, Track 3 [00:43:51–00:44:17]. SMART objectives are defined as specific, measurable, achievable, realistic and time-bound.
[63] Linsdell, Track 9 [00:09:29–00:09:42].
[64] Jenkins, Track 7 [00:21:41–00:22:16; 00:43:55–00:45:26].
[65] Dunford, Track 4 [00:12:13–00:12:28].

Keeping track of their time was one aspect of the push for the organisations to become more customer focused, for example through the implementation of standards such as ISO 9001 which were designed to provide customer satisfaction. While the requirements of the departmental customers had always determined the goal of any research programme, scientists' ability to influence the direction of travel diminished. At the same time the research agencies began cultivating new customers alongside their existing customers in government departments.

6.4 Meeting customer expectations

Beginning with the Rothschild report, the NPM reforms continued to seek a clearer distinction between those civil servants in Whitehall who commissioned research, and those who carried out the research in the establishments. The allocation of funds was placed squarely with the customer, that is to say with the teams in Whitehall who acted as the proxy customer for the taxpayer, using public funds to pay for research services that supported the public good.[66] The Rothschild report had emphasised the role of GREs as contractors or suppliers to the customer parent departments, yet for the scientists lower down the hierarchy who had no contact with civil servants from the Ministry, this sometimes remained a rather nebulous concept. While the move to commercialisation meant that many scientists continued working for the same customer in government, the formalisation of terms and agreed deliverables made the contractual relationship more real to those staff who were engaged in technical activities rather than the management of research programmes.

Implementing management systems such as ISO 9001 included examining what was understood by customer relationships both within and beyond the organisation, as Roger Courtney remarked:

> It was a very detailed look at the whole operation of the organisation to say, 'How do we do things better?' How do we get the whole operation into a customer-focused mode because there is the external customer but the deliverer to the external customer is an internal customer for something else that's happening?[67]

Anthony Bravery commented on how staff at BRE felt about the changing expectations:

> Fairly quickly we became an executive agency when the pressures got even greater for customer contractor relationships, that's where some of the staff who had a long history of being government scientists and working in one financial regime found it very difficult

---

[66] Beattie, 'Experience of Commissioning Research and Development', p. 16.
[67] Courtney, Track 17 [00:19:00–00:19:31].

> indeed to suddenly see their work was not scientific research, it was a service to a part of government or an industry client. The biggest effect was that we felt that we were public servants and we were in quite high demand from people for advice … a lot of pressure to charge.[68]

Carol Atkinson commented on the risk that scientists did not understand they were bound to the terms of the contract:

> Most of them simply wanted money to carry on doing the things they were interested in doing and they weren't overly worried. There was a tendency too that you'd get a contract to do something and they would actually do something else and then you would have a big problem with getting them to do enough of what was supposed to have been done. It wasn't easy.[69]

At the same time David Dunford encountered resistance from existing clients when it came to putting relationships on a contractual basis:

> It was still seen that, 'Oh, you're a government entity, you're paid for by the government, so why should we have a contract?', and that was an issue. The perception of what RAE was or DRA was or DERA was, 'you're government, we've paid for it by the taxpayer', and it was difficult. It was a very difficult thing to overcome.[70]

There was growing expectation from customers in government for money to go towards generating dual-use knowledge or technologies that could be used in both the defence and civil sectors, as Sarah Herbert remarked:

> Slowly it became important that your technology was transferable over into the civil sector, partly because it would get the prices down but in the end you might, for example, get the civil sector of aerospace to do some of the research for you and it would be cheaper for MOD. […] From the late 1990s onwards the feeling was in particular the MOD wanted the civil aerospace industry to do a lot of research that wasn't pure military but things that could be used across a lot of disciplines. […] They wanted to use their money for things that were primarily military and would not be done by the civil sector.[71]

Pam Turner witnessed this change of focus in the inquiries she dealt with as a librarian at Farnborough:

> It was a great change of the way people were working, they were working on contracts, not just for the MOD, but any organisation, so it was a completely different sort of information they wanted. It was interesting in a way because it was even broader, it was really trying to employ those techniques learnt through defence in a different kind of context.[72] ∩ ▶

---

[68] Bravery, Track 7 [00:14:57–00:16:07].
[69] Atkinson, Track 7 [00:45:58–00:46:26].
[70] Dunford, Track 7 [00:15:45–00:16:07].
[71] Herbert, Track 5 [00:47:53–00:49:26].
[72] Pam Turner, interviewed by Emmeline Ledgerwood, Fleet, 2018, BL C1802/05, Track 3 [00:27:55–00:28:18].

Roger Courtney noticed a 'substantial change in the orientation of the work' at BRE as the focus of government policy changed, and Susan James observed a similar trend at DERA:

> The work that might have been done to improve the process of construction no longer featured very prominently. … if the government was not about supporting industry in the way of helping it to be more productive, then BRE research would not do that either. […] What the research became very much about was the support of legislation, the support of environmental policy, public safety, building regs became a very important driver of research. [73]

> In the mid-nineties (possibly) they rejigged how research would be funded and they developed something called the applied research programme and the corporate research programme. So corporate research was really about blue skies research stuff, way out on the horizon, whereas the applied research was about how can we apply what our current knowledge is to the here and now problems. That was when we really had to start identifying the programme of research but almost then saying what we were going to get out of it. […] Then you felt you were quite in competition ... it really had to be the flavour of the month who got the funding. […] It then became very much more a question of what the MOD's immediate problems were and how could we apply what our current knowledge was to solve those problems. [74]

The new executive agencies were required to generate sufficient income to meet targets set by the Treasury, however there was no obligation for departments to spend their funds with the former establishments. Phil Catling remembered a grace period when, 'there wasn't a total fall off from MOD funding, so you had that cushion. It was a case of how you manage that declining budget.' [75] Similarly Vic Crisp observed:

> There was certainly an element of government wanting to spend less in this whole process and therefore running down its programmes [however] things didn't change overnight, things evolved. Customers didn't suddenly say stop doing all that, we're going to put it out to competitive tender. It didn't work that way, it was a gradual change over a number of years. [76]

An indication of the changing attitudes held by departmental customers is given in Robyn Thorogood's account of his move from BRE to join the research management team in the DOE in Whitehall. Once established, he set about broadening the team's horizons when it came to commissioning new research as an 'intelligent' customer:

> When I started setting strategies for subjects they [at BRE] immediately said 'Oh no, no, no, we'll do that for you,' and I said, 'No, that's something we need to do.' And I made a bid for having one of their bright staff to come and work for me so we did it that way ... [thinking] he will develop the strategy with a knowledge of what's going on in BRE but he'll also assess what's going on elsewhere and where opportunities are and what subjects we should look for in the future. [77]

---

[73] Courtney, Track 12 [01:08:17–01:09:06].
[74] James, Track 4 [00:39:35–00:41:31].
[75] Catling, Track 2 [00:20:46].
[76] Crisp, Track 8 [00:48 23–00:48:52] and Track 5 [00:56:04–00:56:19].
[77] Thorogood, Track 6 [00:10:26–00:11:30].

Thorogood was aware of a tendency among scientific staff in the GREs to fine-tune an area of research rather than branching into new ones:

> There was a tendency—as there would be—to develop a strategy that used the expertise you've got. I said, 'We've got to step out of that. We perhaps don't need so much structural engineering now, if we spend more time researching that all you'll do is carve another quarter inch off the size of a beam.'[78] ⌂ ▶

Working relations were put on more formal basis as commercial contracts replaced the custom and practice which had been in place with parent departments, characterised by the friendly relations between Whitehall civil servants and the GREs. Keeping to the terms of the contracts limited how scientists could address the problems of scientific research, altering the long-standing ways in which scientists completed work for their customers in MOD, as Ian Linsdell remarked:

> With a lot of our guys it was saying 'if it's not in the contract, you're not doing it' when they want to add bells and whistles to whatever it is. […] To try and get that mentality into our guys and into the guys on the MOD side … it was very much we've always done that, we always do the best job we can.[79]

This formalisation of the relationships between the research commissioner and the research establishment diverted scientists away from research to dealing with administration, while the customers needed to become more 'intelligent'. A 1983 report had noted that the move to contractual arrangements increased the money spent on administration, indicating that the management practices associated with NPM did not automatically improve efficiency.[80]

This is confirmed by the experiences of civil servants both in the agencies and Whitehall. The chief executive at the Natural Resources Institute, an executive agency of the Overseas Development Agency, found that, 'writing, monitoring and enforcing contracts is an expensive business … I think we have underestimated just how expensive the process can be.'[81] A former scientific adviser at the Department of Food and Rural Affairs has argued that the time spent on contract management work was at the expense of scientists' capacity to provide analysis and advice, while evidence to a 1993 parliamentary committee suggested that 'bureaucracy was on the increase'.[82]

---

[78] Ibid.
[79] Linsdell, Track 7 [00:53:29–00:54:44].
[80] Advisory Board for the Research Councils, *A Study of Commissioned Research*, p. 6.
[81] Beattie, 'Experience of Commissioning Research and Development', p. 19.
[82] Parker, 'The Rothschild Report'; Science and Technology Committee, *Defence Research Agency*, 7 July 1994, HL 24–I & 24–II 1993–1994, p. 27.

However comments from interviewees Wendy Westby and Shirley Jenkins show that bureaucracy was a problematic aspect of working life at Farnborough both before and after organisational change:

> At that point [RAE] I felt that there was an awful lot of bureaucracy and certainly it felt that the administrators had got a bit out of hand, it wasn't something you would get in a private company. If you wanted to order something it went through this whole chain of people and it took a month before they actually sent the order off site to the company that you were ordering the goods from which made the job quite difficult sometimes, or you had to get it from stores. […] some people on the support side got in the way of getting the job done, I felt.[83]

> By the later stages it got to a main planning for the whole of the establishment, and it was just such a long-winded process, things just fell by the wayside. They just didn't get done […] things took much, much longer to do.[84]

As responsibility for setting requirements was placed more firmly within the customer, so the existing structures of the research organisations were questioned, as Roger Courtney outlined about BRE:

> There's a balance to be had. Do you put the emphasis on the expertise, which is vital in an organisation like BRE, or do you put the emphasis on who you're working for so you look after that customer? And how do you balance the two because any particular part of the expertise may be serving three or four or more customers?[85]

The new senior management team at DRA set out to make the organisation more customer-facing through a flatter structure, developing a work programme 'that is customer-led rather than supplier-generated'.[86] For David Dunford this involved cultivating new kinds of customer relationships:

> We [then] had this kind of outward looking, non-MOD type remit to go and engage with industry in a more structured way. So they were beginning to structure themselves in what I would call a more professional way—rather than just the links existed because of the people, it was more of an agreement between the companies to share and to work together.[87]

Chris Peel spoke about managers becoming more attuned to diversifying their customer base:

> As a government establishment we had four sources of income basically, MOD (very important number one customer if you like), Department for Trade and Industry and the European Commission—government funders—and we would regularly bid to all three of those. Then we would have potential collaborations with industry, and purchase from industry for specific things, but generally speaking that wasn't a favoured source of income during the establishment years. As it goes more and more private, so the

---

[83] Wendy Westby, Track 2 [00:16:59–00:18:47].
[84] Jenkins, Track 5 [00:24:09–00:25:42].
[85] Courtney, Track 19 [00:44:57–00:45:28].
[86] *DRA Corporate Plan 1992–97*, p. 7.
[87] Dunford, Track 7 [00:11:35–00:12:50].

> alternative sources of income become more important, partly because of state aid,[88] partly because of dwindling central [government] funds, partly because we're privatised. So industrial funding, separate funding, becomes more and more important and anywhere that's got money becomes a potential target if you've got the technology that suits. It could be a regional development agency, it could be a private firm, it could be an international arrangement, a foreign firm.[89]

However he went on to comment on how the pressure to find funding could influence the research programme:

> Funding for new ventures became harder and harder and harder to latch on to. It can drive you into doing silly things, getting into bed with the wrong sort of people for the wrong reason and that happened to us on a few occasions, we chose the wrong partner for the wrong reason because there was money there.[90]

Vic Crisp was also sceptical about the value in pursuing multi-partner projects:

> It was an awful business getting European money it was really hard work because you had to have partners all over the bloody place. The amount of money that went into gaining a contract was probably bigger than the frigging contract because it took so much effort, but it was seen to be the right thing to do.[91]

What was difficult for Roger Courtney as director of BRE was persuading scientific staff to think about working for new customers:

> There were plenty of people in the organisation who … had joined in a very different era. They weren't too sure that selling their expertise to industry was what they wanted to do. […] One had lots of conversations about it basically seeking to persuade people that the world was changing.[92]

The need to cater for the customer and offer competitive prices brought subtle changes in managers' attitudes to staff and recruitment. Realising a return on the value embodied in the staff made it difficult for Anthony Bravery who remarked, 'when we priced our contracts, built into that was the overhead element of the staff', yet there was at the same time a 'pressure as to avoid putting things down to overheads.'[93] Once utilisation rates became key to measuring the successful delivery of research contracts, recruitment strategies began to change. Comments from Anthony Bravery and Susan James echo the concerns raised in an internal news item which stated that 'the concept of seed corn recruitment—with emphasis on development and potential—is lost'.[94]

> Succession planning became very difficult as we moved away to this new form of structure, this market-facing structure because it meant we didn't know whether we really

---

[88] State aid is state spending which can give organisations an advantage that potentially distorts competition.
[89] Peel, Track 6 [00:28:38–00:29:59].
[90] Peel, Track 6 [00:46:01–00:46:40].
[91] Crisp, Track 8 [00:56:20–00:56:45].
[92] Courtney, Track 16 [00:19:20–00:20:21].
[93] Bravery, Track 8 [00:09:34].
[94] 'Recruitment strategy vital for DERA and country', *DERA News*, April 1998), p. 4.

> should be recruiting a new microbiologist or an entomologist or a preservation chemist. It was a question of, 'What are we most likely to be able to get funding for?' […] So we started then to become more generalist.[95]

> Graham spent hours with me in the lab, I'd watch what he did … one-on-one training, and that's where it's all going wrong now, no succession planning, we can't charge the customers enough money to have somebody sit next to me. […] All of this deep expertise is just going to die a death.[96] ⌂ ▶

As Ian Linsdell stated, without paying customers, certain areas of research just fell away:

> It does come down to the P&L at the end of the day, either that knowledge is generating income or it's not; if it's not generating income or not going to generate income then it's dropped is the pragmatic, harsh reality of it.[97]

Another consequence was that it proved more cost-effective to use more junior staff, as Linsdell discovered:

> Dare I say it, over time you would end up with the same people being on the wrong end of the utilisation stats. Sometimes that was because they weren't that great. Sometimes it was because they were quite senior and for a project manager to employ them was quite a big charge out rate to go on one hour when I could have six hours of this person doing it. The theory is actually your Level 7 should be contributing more in that one hour than the level 2 does in six hours, but it never fully worked out that way ever.[98]

NPM and commercialisation therefore promoted a change of organisational outlook from one of public service to customer service centred around setting and meeting targets, accountability and contracting out. The following section reviews how NPM contributed to an increasingly competitive in the GREs.

6.5 Competing values

The 1991 White Paper *Competing for Quality*, introduced by the John Major government of 1990–92, built on the initiatives to improve financial management in public sector activities by focusing on improving standards in public services.[99] Known as the Citizen's Charter, public sector organisations were expected to publish service standards and put in place processes that would enable dissatisfied citizen customers to complain or seek redress. These organisations were encouraged to consider contracting out services through competitive tendering if that offered better value to the taxpayer, and to see the relationship between the state and its customers (taxpayers) as a contractual one.[100]

---

[95] Bravery, Track 8 [00:26:36–00:27:04].
[96] James, Track 1 [00:45:39–00:46:31].
[97] Linsdell, Track 6 [00:18:38–00:19:01].
[98] Linsdell, Track 7 [00:37:53–00:38:42].
[99] *Competing for Quality*, Cm 1730 (London: HMSO, 1991).
[100] Public Administration Committee, *From Citizen's Charter to Public Service Guarantees: Entitlements to Public Services*, 15 July 2008, HC 411 2007–08.

The launching of the charter signifies another phase in the programme of public sector reform that had begun a decade earlier, a phase in which competition was seen as offering the potential to achieve economies and improve public sector performance. Competition had already been permeating different areas of the research establishments at all levels, for example at the MOD, Peter Levene had introduced more competition into the defence procurement process. However John Chisholm, CEO at DRA, remarked on how the prospect of competition was viewed by staff in DRA:

> For a very long time there had been a concern in the research establishments that the idea of introducing customers would end up with the customer spending the money with someone else and therefore there would be no jobs left. […] In my experience that is always true of any organisation that has been a monopoly supplier, they are desperate about the possibility of competition. So, there was considerable anxiety.[101]

He explained how he and other senior managers at DRA defined its competitive basis on becoming an agency:

> We defined our role as being a facilitator … not going into direct competition with industry and building things ourselves. That's a choice, I could have made a different choice there, if somebody other than me had been brought in, somebody from manufacturing industry, they might have done that instead. … My view was that we didn't have the skill base for that. We had an intellectual skill base which was pretty much second to none that could really understand and conceive and could give very sound advice as how the Ministry of Defence could gain benefit from science and technology.[102]

Steve Rooks and David Dunford were supporters of the new strategy that offered opportunities to broaden the organisation's horizons:

> I guess it was trying to build this professional highly-skilled brand for an organisation that was world-leading, so people wanted to reference work in this sector by DERA or DRA. […] I quite liked those changes as we became DERA … some of the ideas that were coming through I thought were great. […] All the professionalisation of processes was really good. [103]

> It excited me as I thought it would give us the freedom to operate differently, and we'd already started before QinetiQ was formed to grow our business in North America.[104]

Other interviewees, such as Paul Cannon, Anthony Bravery and Carol Atkinson speak about how scientists responded to the novel challenges and stimulation of the commercial outlook:

> It was hard to break into these areas but … it was fundamentally an exciting time and you couldn't be weak. There wasn't the opportunity to be weak, you just had to keep on going. When I look back on it, goodness it was hard work. [...] I'm too driven so give me a

---

[101] Chisholm, Track 6 [00:03:14–00:04:09].
[102] Chisholm, Track 6 [00:33:13–00:34:14].
[103] Rooks, Track 2 [01:02:10–01:02:25; 01:06:40–01:07:09].
[104] Dunford, Track 4 [00:44:19–00:44:30].

challenge that's mildly plausible and I will need to demonstrate to you that it can be done. I didn't buy into the full commercialisation, but I certainly bought into a lot of what was going on at this point. There was a dichotomy though because as soon as we started playing in a civilian field, industry called foul and you can understand that. We had all the advantages of being a government agency with all the financial security that came with it, and we were playing around in this civilian field, so as soon as we did that we opened ourselves up to having to be commercialise. [...] If we weren't going to be commercialised we needed to be put back in our box to some extent to just go back to doing military work.[105]

Some of them were just such self-starters that you tell them you needed £300,000 and they'd go out there and beaver away at all hours that God gives until they got it, others were more fatalistic about it.[106]

One of the reasons I was really keen to do what I did with certification in a sense was that BRE could help to solve problems in the world in a way that it hadn't been able to do when it was part of government. We could actually create things that were bigger and better in a good way, that made a positive difference, rather than just responding to what paymasters wanted us to do. So, we could notice something that wasn't right, we could pull together teams of people to think about how you could make it better or solve the problem, and then we could introduce standards and encourage people to apply for testing or inspection or certification on those standards so you could drive improvement that way. That's what, in the end, I loved about doing certification.[107] 🎧▶

Alan Gray commented that the value of the GREs lay with 'the people, not the laboratories, not the facilities.'[108] Roger Courtney was very clear that BRE's competitive edge lay in its staff and how the establishment's reputation was bound up with their expertise:

We were trying to exploit the status of individuals that we had and if we could, of course, the breadth of what we had. Clearly we could do some things on a larger scale or slightly differently from what might be obtained elsewhere because of specialist facilities, but more than anything else people just wanted BRE attached to what was done. They knew that if they had a piece of work done and they could wave the report around and it had BRE on it then that would be quite powerful. To be honest, that's what we traded on.[109]

Carol Atkinson acknowledged that there was a fine line that managers needed to tread in building commercial awareness into the workforce yet retaining that competitive edge that was embodied in the scientists:

I know that people started trying to take on people that were more commercial … but that more often than not meant that we took on people who were more cowboy-ish and I tried very, very hard to try and make sure that we mostly took on bloody good scientists.[110]

---

[105] Cannon, Track 5 [00:51:53–00:54:29].
[106] Bravery, Track 8 [00:07:34–00:07:47].
[107] Atkinson, Track 5 [00:58:40–00:59:30].
[108] Gray, Track 5 [00:32:17].
[109] Courtney, Track 16 [00:31:30–00:32:58].
[110] Atkinson, Track 8 [00:11:30–00:11:53].

A common reaction among the long-serving GRE scientists was that that they and their work did not belong in a commercial environment, with commercial activity regarded as unprofessional.[111] Martin Wyatt gave his interpretation of how scientists' professional identities affected their reaction to operating competitively:

> So what is happening is like self-regulating, they don't mind making a profit but they don't want to make a lot of profit because it's a bit unseemly. It's not what scientists do. 'How can I make a big profit and be doing the right thing by my client?' is the question that's going through their head. If there's a bit of money left in the project, they think, 'I'll do a bit more work'. I never cracked that, it is part of the nature of this sort of organisation, its focus will never be on the bottom line. You won't get that sense of commercial competition between managers.[112]

As chief executive of the Natural Resources Institute, Beattie held a senior position in the world of government research and came across similar negative attitudes to commercialisation:

> I have some concern that the research community believes that what it does will not fit easily or satisfactorily into the world of contractual relations and markets. It is somehow special, and sooner or later the proponents of contracts and markets will realise this and go away – leaving researchers to go back to a golden age. I am not myself persuaded that the market for research services is intrinsically different from the market for other professional services.[113]

Business units in different parts of DRA/DERA began to compete against each other to win work from MOD or industry, a process that Phil Catling saw as leading to the demise of some groups:

> There were pockets where you said, crumbs, we're doing that work and another organisation like Malvern [formerly RSRE] would be doing very similar work, and you could be chasing the same people. […] It certainly made you more competitive internally for winning work. […] Where the groups were distinct, it wasn't too much of a problem, it's where the groups overlapped. The Malvern people were more aggressive for health care opportunities, some of their patents that got granted and some of their work did get exposed in the health care environment. […] They [DRA/DERA] found they were trying to address too many markets … a lot of initiatives withered on the vine and died. That's why they then focused on defence and security, its core market.[114]

These efforts were part of the Conservatives' drive to successfully exploit government-funded research. In Steve Rooks' words: 'Margaret Thatcher's view was that all the crown jewels were somewhere in government, let's get them out into industry and prosperity for the nation, I guess that's behind a lot of it.'[115] This led to an array of schemes aimed to promote knowledge transfer between government-funded research

---

[111] Mody, 'The Professional Scientist'.
[112] Wyatt, Track 6 [00:38:12–00:39:11].
[113] Beattie, 'Experience of Commissioning Research and Development', p. 20.
[114] Catling, Track 3 [00:18:02–00:20:26].
[115] Rooks, Track 2 [01:02:36].

institutes and industry. In 1985 the MOD set up the private firm Defence Technology Enterprises to 'ferret' out research that had the potential to be exploited commercially and sold to industry.[116] Much later the MOD sought to encourage industry to capitalise on discoveries made at DERA with the establishment of the Defence Diversification Agency in 1999 and Dual-Use Technology Centres.[117] The strategy to become more commercial included patenting new technologies or systems for future development, but as already indicated in section 5.2 (see page 154), this was not as straightforward as it sounded for organisations that originated in the state sector. David Dunford explained:

> The patent licences were sold, but of course you have no revenue once you have sold the patent licence. We could never make product. You see the research establishments never made product, so you never got the maximum return. We couldn't invest so you could never get the return and I think the agency model was geared at trying to explore whether that was possible. […] We had an enormous patent portfolio which to protect costs a fortune ... why are you spending all that money when it can't be exploited? They never really worked that out. I think that was one of the issues with DERA and QinetiQ. Everyone thought there would be a lot of revenue there but in reality I don't know how many were taken up.[118]

The former research establishments also began to compete against firms with whom they had previously collaborated. According to the DRA's first chief executive who preceded John Chisholm, the agency 'started by projecting a fairly aggressive, competitive and commercial image' in line with the Government's wishes.[119] The status of research establishments in relation to their industrial peers and international counterparts became ambiguous, with complaints that the new executive agencies had unfair competitive advantages due to their history of government funding and in their role as both suppliers and advisers to government. The nuances of the problem were highlighted when the UK's NPL began operating in the US market while the US National Institute of Standards and Technology was prohibited from doing so:

> The international measurement system relies on free exchange of information between national standards institutes. Some have expressed concern that NPL in its more commercial form could exploit some of the information exchanged for its own benefit.[120]

---

[116] Graham Spinardi, 'Defence Technology Enterprises: A Case Study in Technology Transfer', *Science and Public Policy*, 19, no. 4 (1992), pp. 198–206.

[117] Jordi Molas-Gallart and Tom Sinclair, 'From Technology Generation to Technology Transfer: The Concept and Reality of the "Dual-Use Technology Centres"', *Technovation*, 19, no. 11 (1999), pp. 661–71.

[118] Dunford, Track 6 [00:10:14–00:11:05].

[119] Science and Technology Committee, *Defence Research Agency*, p. 25.

[120] Whelan, 'Management of Scientific Institutions', p. 320.

The new organisational status brought 'a growing intrusion of "commercial confidentiality" into hitherto public areas'.[121] It also brought a closing down of knowledge sharing, witnessed by David Dunford through the internal competition that developed between business units:

> It was a tremendous change personally, a tremendous change in how you thought, what you did and how you behaved to others. […] You are a bit more coy when you run a business. You don't want to let too many things go, you need to keep a few things in your back pocket, whereas when you started in research, you'd share everything because you're in a secure environment. [...] Knowledge to some extent is power, is benefit, is revenue, and it's how you manage that knowledge so you don't dilute the power and the revenue. […] It's a complete reversal, of stopping being open and sharing what you think. Because you have a different model, you need to survive.[122] ⌒ ▶

Paul Cannon realised that existing partners in industry were less prepared to collaborate with DERA as privatisation became a viable prospect:

> In the past where I would have let a contract with a company to do something, they were now thinking, 'Well, do I really want to provide access to all that IP and then have all these bright ideas from our company picked up by this DERA organisation that is going to become commercialised?' […] It became a very difficult situation […] Privatisation became almost inevitable ... it was almost our own enthusiasm. The constraints were off and our enthusiasm to do these things to some extent was probably our downfall.[123]

Increased competition also manifested itself internally as staff promotion prospects became linked to utilisation rates and being booked to projects, as Ian Linsdell experienced:

> Some people were extremely pro-active … in seeking work, they would literally walk round, 'Give us a job', that type of mentality. Others would just say, 'I've nothing to work on, I'm going to book 20U',[124] and wait for somebody to find work for them. [...] Usually those type of people you could see had a different future in front of them.[125]

Wendy Westby, an analytical chemist, explained how the new organisational management structure forced her to take charge of her own work schedule rather than relying on her team manager to book her to projects:

> In theory when the resource management system came in, it was your resource manager's responsibility for selling your time but really, because they had something like 40-50 people to look after, it came down to that they were being fully utilised. A lot of pressure on individuals to make sure they sold all of their time to project managers and that they were fully utilised. I think [it] wasn't so difficult for the people who were working in research teams on one or two or three research projects, but when you're in a support function you might be doing two or three things for different people every week. And nobody wants to be the person to pay for the half an hour it took to fix the piece of

---

[121] Winetrobe, 'Next Steps and Parliamentary Scrutiny', p. 35.
[122] Dunford, Track 6 [00:21:23–00:22:36].
[123] Cannon, Track 5 [00:55:00–00:56:30].
[124] 20U was the code for unused time.
[125] Linsdell, Track 7 [00:39:08–00:39:55].

> equipment that's unexpectedly broken down. That system didn't really work very well for my team.[126]

Her next comment reveals the extent to which scientists' mindsets changed by accepting that they had to generate work for themselves even within the confines of the organisation:

> I'd built up my own customer base within the organisation and people got to know about me by word of mouth. I didn't really have to go out there to look for work. […] Everyone knew everyone else, there wasn't any formal system for getting in work ... it was like a village environment.[127]

A May 1998 letter to *DERA News* gives another insight into the impact of reforms on the morale of individual researchers. A manager returning from a three-year secondment to MOD wrote about how attitudes had changed:

> People were no longer constrained either by grades or by a rigid management structure. However, something was clearly not quite right. Individuals no longer 'owned' a problem and were certainly not so prepared to put in extra effort to get a result. […] Our system of matrix management has effectively removed the feeling of being part of something permanent.[128]

The formalisation that came with projects and time allocation affected staff attitudes, as David Dunford remarked: 'I think the ethos changed. Before, when you had an open structure, you communicated freely. When you work on a project, there's a bit of self-preservation.'[129]

6.6 Conclusion

This chapter has drawn on the interview material to present individual reflections on the impact of NPM on the scientists who worked in GREs. These show that NPM was experienced in different ways depending on the interviewee's position in the organisation during the period of organisational change, and that organisational change was remembered as bringing both benefits and downsides to interviewees' working lives.

Interviewees who occupied managerial roles generally remembered the changes in internal management processes and structures as having a positive outcome for the organisation, often describing this in terms of becoming more 'professional'. During this period new types of managers emerged with expanded responsibilities as the internal

---

[126] Wendy Westby, Track 4 [00:19:55–00:21:12]
[127] Wendy Westby, Track 4 [00:21:29–00:22:03] and Track 2 [00:35:44–00:36:12].
[128] 'I've seen a big change in morale in three years', *DERA News,* May 1998, p. 14
[129] Dunford, Track 5 [00:40:02–00:40:16].

structures were repurposed for project management, increased accountability and a focus on delivering contracts. Interviewees who took on the new managerial roles during the transition from state to private ownership spoke about having an increased capacity to make decisions, the unfamiliar ability to exercise control over their own budgets and being in charge of career management for members of their teams.

Accounts of the multi-faceted nature of these roles indicate that interviewees with managerial responsibilities were empowered by the increased authority and highly stimulated by the goal of making commercialisation work. They spoke of the novelty of being able to operate in an entrepreneurial way when it came to cultivating new customers beyond government. However the excitement of aiming for new organisational objectives was accompanied by a need to cope with new pressures, 'nerve-racking' moments and the self-imposed imperative that they 'couldn't be weak'. However for Sarah Herbert the emergence of different types of managers led to her decision to move from Farnborough to work in Whitehall since she felt the opposite, in that her authority and ability to manage had been compromised.

Interviewee descriptions of the shift to project management and the increasingly commercial outlook convey a more negative experience for the staff that they managed. The most memorable element of this shift was that individual scientists were required to account for their time. Their utilisation on projects, made visible through the hours recorded on timesheets, became a key component in the successful delivery of customer contracts and in the measurement of their performance which informed their promotion and remuneration prospects. The need to account for their time provoked feelings of resentment among the scientific staff who had until then enjoyed a sense of autonomy in the way they were able to address their work (see Chapter 5).

While interviewees who held the new managerial positions generally enjoyed increased control over their actions, for the working scientists the common assessment was that organisational change had the opposite effect by reducing their control over their work. In addition, the organisation evolved into one that was geared to formal contracts with a wider range of customers that stretched beyond government, and one that was seen as offering a service rather than doing research. This meant that scientists lost the sense of public service that had previously given them pride in working for the civil service.

This chapter has indicated the complexity of experiences recounted by those who worked through the implementation of public sector reform in these GREs, showing there was a range of consequences depending on interviewees' position in the changing organisation. Interviewees' experiences of the implementation of NPM show that NPM practices did not naturally integrate with what Clarke and Newman described as an existing 'bureau-professional regime'.[130] The following and final chapter looks in greater detail at how cascading effects of NPM led to the changing ethos that Dunford observed. It examines the impact of adjustments to the frameworks that had hitherto shaped government scientists' careers, and shows how the implementation of NPM, combined with the shift to executive agency status, created an environment in which the organisational culture had little alternative but to change.

---

[130] Clarke and Newman, *The Managerial State,* p. 13.

7. Commercialisation and the fate of specialists

The new commercial rationale on which the research organisations began to operate disrupted the foundations on which government scientists' careers were built before the 1980s. Changing organisational priorities associated with commercialisation were to have knock-on effects over the direction in which research was steered and the types of scientist recruited to drive it forward. Scientific civil servants who had previously felt secure in their dual identities as public servants and scientists were confronted with shifting career prospects and changing values.

Hood has commented that NPM aroused strong and varied emotions among bureaucrats, some of whom saw it as the destruction of a distinctive public service ethic and culture.[1] Culture change was a process that occurred in many other areas of the public sector and nationalised industries, one that affected the identities of the organisations and the individuals working within them. This statement from Malcom Rifkind, Secretary of State for Defence in the early 1990s, shows that culture change was acknowledged as a necessary element in achieving the goals of organisational change:

> It has always been clear, but particularly since the inception of NMS [New Management Strategy in the MOD], that organisational change alone could not deliver improved efficiency and management effectiveness unless it was matched by new, more flexible methods of working; and that these in turn required changes in 'culture'—that is to say the values and attitudes which condition both what and how work is done. [2]

Interviewees' memories of working through these changes show the impact and consequences of national policies on their working lives that accumulated to engender a process of culture change in the workplace. In the GREs culture change was experienced by managers as an expansion in their ability to take decisions and responsibilities for their teams, whereas for the staff in those teams it brought a fundamental shift in how they were expected to carry out the scientific work. The introduction of goals and targets constrained their expectations for autonomy, while opportunities to develop their scientific credentials were reduced.

---

[1] Hood, 'A Public Management for All Seasons?', p. 4.
[2] Rifkind, 'Front Line First', p. 6.

These changes in GREs were part of a broader process that Gibbons et al. argue was a transition to a new mode of knowledge production.[3] Scholars had already predicted that commercialisation and market forces would affect the kinds of scientific research that would be undertaken and the criteria by which scientists' work would be valued.[4] The following sections assess the positive and negative outcomes of this transition described by interviewees, paying particular attention to the changing position of specialists. Their accounts show that over time these developments had broader implications for the status of scientific expertise in the GRE successor organisations. The first section considers the effect of adjustments in the institutional frameworks on individual career paths while the second shows how organisational change affected the ways interviewees behaved in their capacity as professional scientists. The third section considers the long-term implications of commercialisation on the role of specialists in these organisations and the demise of certain areas of research.

7.1 Adjustments to the organisational framework

The drive for commercialisation and improved efficiencies comprised two main strands of change which affected government scientists as individual employees. One was the transformation of internal structures, management processes and customer focus that has been dealt with in Chapter 6. The second was the physical aspect, in that rationalisations of the government research network involved site closures, relocations and redundancies (see page 73) accompanied by rebranding exercises that severed connections with the institutional past.[5]

In the case of scientists employed in defence research, the workforce was split between the resulting state and private sector entities. Dstl and QinetiQ. For some these changes represented the loss of the sense of belonging to a secure, sociable world in which they felt in control of their own work. For others it signified the removal of an archaic environment that stifled creativity.

---

[3] Gibbons et al., *The New Production of Knowledge*.

[4] Rothblatt, 'The Notion of an Open Scientific Community', p. 25; Gibbons et al., *The New Production of Knowledge*, pp.17–46.

[5] Private email communication, 11 August 2018.

7.1.1 Rationalisation of defence research

Site rationalisations and relocations were experienced as significant, disruptive change by scientific civil servants working at BRE and in defence research.[6] This section focuses on those working in defence research since the split of DERA into QinetiQ and Dstl added an extra additional layer of complexity and uncertainty to the process of privatisation. These processes proved drawn out, with plans for some relocations announced 10 years after the split.[7] Interviewees' experiences illustrate Bud & Gummett's observation that 'the organisational history of the British defence research establishments is, then, in a certain sense, a history of concentration into smaller, more multifunctional units … serving wider constituencies.'[8]

Descriptions from Paul Cannon, Wendy Westby, Mike Westby and Ian Linsdell indicated the upheaval caused by organisational change:

> The first impact that we really understood was a reduction in the overheads which meant getting rid of superfluous sites. […] Then we had to get rid of equipment. Some of the stuff was donkeys' years old and should have been thrown out years before, DRA forced us to throw out that equipment because there was a reduction in number of buildings available. […] In the end what came out of this was a new HQ building down at Farnborough. [...] Somewhere in all of that we were moved from Farnborough to Malvern … I'm not even sure anybody really knew quite where it was going in the end. Perhaps the board did, perhaps John Chisholm did know right from the beginning where this was all going, I don't know. [...] A coalescing of people, equipment, facilities all in one place.[9]

> There was a lot of influx from other DRA sites at that time because the research work was dwindling. They were closing smaller sites and pooling everybody. A lot of people got moved. […] There was a kind of a bit of a shuffling around and a bedding in sort of process where we all worked out what we were going to do and how we were all going to fit in together.[10]

> What really changed during the agency times … wasn't so much recruiting, because we had freedom to recruit, it was that we saw great movements of staff who were redeployed very freely. People moved around a lot more ... as the work ebbed and flowed.[11]

> They reorganised on a regular basis, so I went through many iterations where business groups were attached to different profit centres or different hierarchies. Sectors or divisions were sliced in many different ways, it did confuse the customers, but the idea was it got us away from the thinking of the previous research establishments. I guess it was successful, although it may have been overdone a little bit.[12]

---

[6] Beesley, 'Strategic Change in a Government Laboratory', pp. 155–160.
[7] Dstl Secretariat, 'Dstl Departure from Fort Halstead and Loss of Energetic Materials Subject Matter Experts', 10 February 2015 <https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/403718/20150210.pdf> [accessed 30 April 2021].
[8] Bud & Gummett, 'Introduction', p. 18.
[9] Cannon, Track 5 [00:42:04–00:45:30].
[10] Wendy Westby, Track 3 [00:00:49–00:03:17].
[11] Mike Westby, Track 5 [00:43:51–00:44:37].
[12] Linsdell, Track 7 [00:45:54–00:46:45].

As Mike Westby commented, staff complaints were not necessarily about the reorganisation, but the way it was handled:

> I don't think there was a great deal of hostility to the idea of the agency ... some of the implementation, it was quite clumsy and heavy handed, I think that's what rubbed people up the wrong way. […] The way we worked changed quite radically, quite rapidly, but I don't think that was resisted. That wasn't seen as a bad thing, in many ways that was seen as a good thing […] what was unpopular with a lot of people was this deliberate, very aggressive rebranding.[13]

The anticipation and reality of operating in a commercial environment, combined with the dismantling and remodelling of the extant frameworks, provoked a mixture of emotions as a sense of loss ran in tandem with the excitement of new horizons and opportunities. Interviewees' accounts demonstrate the emotional attachment that staff felt towards the GREs and their heritage, indicated by Ian Linsdell's comment about the staff at the National Gas Turbine Establishment adjacent to RAE: 'Most of those guys were there man and boy, so understandably had huge affinities for the organisation.'[14] This was acknowledged in a report in the in-house newspaper which stated, 'there are many important issues facing the DRA as we move to a Trading Fund, but perhaps none has generated more concern or more emotion than the future of our major research facilities.'[15] Even relative newcomers such as Mike Westby were affected:

> Even having only been there less than three years, when DRA was set up you do still feel a bit of loss, there is a degree of loyalty to the establishment as it was, as you joined it. To find somebody coming in and messing around with it didn't feel very appropriate.[16]

Rationalisation brought the unwelcome prospect of relocation. Alan Gray noted that one of the benefits of working as a scientist in a GRE was the stability, bringing real benefit to personal as well as professional lives:

> As the years went on towards 2000 … we began to see things which were really very disturbing. Now think about being a scientist in Malvern. What is the one thing that you think would be most concerning to you? You have lived here probably all of your professional life, what would be the thing that would worry you? […] The answer was move.[17]

The GREs' historic links to one of the armed services could also affect how scientists felt about relocation, as Steve Rooks found out when organising his team's move from Farnborough to Portsmouth: 'all our staff were saying we don't want to be there when

---

[13] Mike Westby, Track 4 [00:15:17–00:16:32].
[14] Linsdell, Track 8 [00:11:34].
[15] 'Major facilities: asset or liability?' *DRA News*, April 1992, p 2.
[16] Mike Westby, Track 4 [00:14:40–00:15:05].
[17] Gray, Track 5 [00:44:02–00:44:48].

it's the home of the navy'.[18] Paul Cannon was 'pretty unhappy about moving' when he

was relocated along with 20 colleagues from Farnborough to Malvern in the mid-1990s:

'We really stuck together in the early days, we were the newbies even though we'd been

working for Her Majesty for many good years, we didn't really understand our way about

the place.'[19] Relocations had an unavoidable impact on scientists' personal

circumstances, as Steve Rooks realised in the run-up to the DERA split:

> It got to a point maybe a year or so before when areas of the business would have been
> identified as to what would be going to what part, and that's when it started becoming
> quite personal. You realised that people's careers are really going to be impacted by this.
> […] Some of the more senior people were very anti it, saying this is going to screw up a
> major crown jewel for the UK, taking apart the research establishments. […] Lots of
> conversations and rumblings going on, but then we also had people who were quite excited
> about it, people that wanted to go into the private side.[20]

One of the immediate outcomes of these plans was that those top-level staff who did not

like the proposals simply left the organisation, as Paul Cannon experienced:

> It was a big, big issue ... it required significant number of recruits to be brought in over
> the ensuing years. You lose a substantial number of your best people because they are the
> ones that can go and get another job. Pretty male-dominated, so the assumption was that
> the wives would follow, but why should the wives follow? The wives had jobs […] every
> time these big moves take place there's always significant attrition for very good personal
> reasons.[21]

Steve Rooks spoke about a similar trend in his team and the difficult decisions that were

needed to ensure capability was preserved:

> One of my really proud moments was when certain areas of the department were
> becoming pretty fragile and we were losing people who were either retiring or were
> leaving. A great achievement for me was going in to bat at budget and saying that unless
> I have £1.5 million to invest in some junior staff I'm not going to be able to deliver when
> we get to Portsmouth. […] I remember standing up in a Talkback to the staff saying 'I'm
> going to be brutally honest that there will be members of the department who are junior
> now that are going to really benefit from this, and there will be others that sadly I can't
> invest in, because I'm going to have to invest in the areas that are important to get us to
> Portsmouth.'[22]

Staff such as Ian Linsdell were forced to think about whether their career would be best

played out in the private or public sector:

> [In general] those that wanted a more secure, or at the time perceived to be more secure
> employment, would have preferred to go to Dstl. Most of us that stayed with QinetiQ saw
> it as opportunity and a chance to do a bit better than we would have done under civil
> service terms.

[18] Rooks, Track 5 [01:01:43].
[19] Cannon, Track 4 [00:07:47].
[20] Rooks, Track 3 [00:14:27–00:15:29].
[21] Cannon, Track 4 [00:08:08–00:09:32].
[22] Rooks, Track 5 [00:04:42–00:05:53].

Paul Cannon explained why he chose to stay with QinetiQ:

> I will confess that my heart was in many ways to go into Dstl because I felt that I was a civil servant. The reasons I didn't? […] One was that I really didn't want to move my family again. [...] The selfish part of it as well was that I could see right from day one that Dstl were going to have to become very heavily programme-management oriented and very light on the DIY stuff, and I was still interested—I still am—in doing the science and engineering. I didn't think I'd be able to do it there. It's proven to be true.[23]

The rationalisation programmes demanded staff cuts across the board, with an inevitable reduction in areas of research, as Andrew Cahn remembered:

> There's no doubt that a lot of traditional areas of excellence were stopped and good teams were disbanded. Organisations, institutions with strong cultures, were dissolved and you lose a lot of good stuff and you get a lot of bitterness in those circumstances.[24]

Sarah Herbert gave an example of an area of work that was susceptible to these forces:

> The areas that I saw that could become more extinct were the theoretical modelling areas … models that were quite unique, that only lived in a few people, and it would take them quite a long time to develop these models and get them working. […] More at risk than say the experimental investigation—people believe their eyes, but models are always theoretical.[25]

However two comments from the same interviewee—Chris Peel—reveal an ambiguity about which activities at Farnborough remained attractive to their customers. Taken together, these comments indicate how commercialisation was seen to have affected the whole range of activities undertaken by the GREs.

> Anything that had a scientific or long-term aspect to it would struggle more than things that were very much oriented towards proving equipment was viable or sorting immediate problems with equipment or service applications. It would be more the academic end that was struggling. I think that's true universally.[26]

> The three aspects to the establishment's work: the R&D pure bit, the innovative bit—MOD still definitely wanting that, other customers definitely wanting that. Applied research translation into practical product—difficult; difficult to fund internally, difficult to find external sources because it's expensive. Totally important, but [the question is] who owns what and all the rest of it. Then the evaluation tests and evaluation still definitely wanted.[27]

Rationalisation meant that many staff at Farnborough were transferred from the array of buildings that populated the old site into a new complex with open plan offices. David Dunford and Wendy Westby saw this as having a negative effect on how colleagues interacted:

---

[23] Cannon, Track 6 [00:27:08–00:28:34].
[24] Cahn, Track 1 [00:27:31–00:27:55].
[25] Herbert, Track 8 [00:18:36–00:19:37].
[26] Peel, Track 4 [00:23:50–00:24:15].
[27] Peel, Track 7 [00:48:35–00:49:09].

The biggest change was when we moved away from the old site, in my case from R50 building, over to A7 in the Cody Technology Park. There weren't rooms for having coffee breaks, it was an open plan office and you had a lab, so the chance to interact was a lot harder. OK, teams were roughly co-located but you didn't have this cohesive element of meeting at half-ten or eleven o'clock or whatever and have a chat together about various things. The chat was from the lowest to the divisional superintendent, so you had a good understanding of what was going on. At the time I don't think I appreciated it, but you learn a lot just from the chatting and talking and you realise how important it was in the understanding you had in your day-to-day job.[28]

We were in a big open plan office on the ground floor, all of the labs were on the first floor some distance away, so there was a bit of a hike, you couldn't just pop round the corner into the lab, you had to go in and stay there. [...] A lot of people didn't like the open plan offices when we first moved in. […] It's very disruptive to have people walking past your desk all the time.[29]

The waves of organisational change and privatisation also affected access to repositories of knowledge as the provision of internal libraries staffed by information professionals was reduced. Susan James remembered the library with nostalgia:

We don't have a library as such at QinetiQ … the old RAE library was fantastic, it smelt like a library when you walked into it. […] They decided that it was all going to go to just digital copies, we were given the chance to go along and take books if they were relevant and then the rest of them, there was just a big skip outside and they chucked all these books into a skip. It was quite heart-breaking really.[30]

7.1 *The main library at RAE, 1970.*
© Ministry of Defence. Personal collection of Pam Turner.

---

[28] Dunford, Track 7 [00:07:29–00:08:28].
[29] Wendy Westby, Track 4 [00:47:11–00:49:52].
[30] James, Track 4 [00:18:31–00:19:15].

Shirley Jenkins noticed that as organisational investment in the libraries and librarians diminished, the institutional history was not preserved:

> One thing that did happen then I guess is that all of the old work went by the board, reports were destroyed and everything like that, and so there was an awful lot of reinventing the wheel at that stage it seemed to me. People were dreaming up things to do that had been reported but all the old work was lost. […] All the reports, everything, the archives, just seemed to be destroyed and people were starting again, which was an awful waste. […] I don't know if DRIC [Defence Research Information Centre] even still existed at that stage.[31] ⌂ ▶

Creating separate identities for both of DERA's successor organisations proved a lengthy process. Rebranding campaigns were poorly understood among the existing network of partners and customers, as Susan James, Steve Rooks and Alan Gray remarked:

> When we first became QinetiQ if you went to the States or to these international groups they didn't know who QinetiQ were. […] All of their history had been with RAE. […] One thing that's always grated … quite often these organisations have said we want to be seen as a world leading, world renowned organisation and you think, we always were. RAE was world renowned and some of the scientists won these major prizes. […] We shouldn't have lost that, and to have to rebuild it and re-establish seems a bit of a shame.[32]

> The whole drive at the start was to make sure that QinetiQ was a success. […] Industry and academia kind of lost trust in the brand of Dstl because everyone was selling the QinetiQ image. I would go to meetings and people initially couldn't understand the difference anyway, if you said you were from Dstl, they'd say what is it, never heard of it. […] The amount of times I went down to D&ES [Defence Equipment & Support] and they'd say, 'Where are you from?' and they'd look at you with a quizzical face, and I'd go we're part of the MOD, we're you. [...] We kind of lost that identity, with some of that comes the prestige and reputation that we'd had. […] For a lot of people their identity was Farnborough, RAE.[33] ⌂ ▶

> Dstl's logo was ridiculous. It was in brackets, [dstl], lower case. They didn't even get the font right so computers couldn't produce the font, it was barking. It was very frustrating that people who were being paid were doing that and not doing science, very frustrating in a science organisation.[34]

However Steve Rooks pointed out that geopolitical events of the 2000s, such as the outbreak of the Iraq War in 2003, forced these organisations to adapt and move forward:

> I guess what I'm trying to say is there was a whole lot of stuff happening that took the attention away from 'the old days' which was DERA and DRA into a rapidly changing world, probably took the focus off a little bit about whingeing about how great it used to be.[35]

---

[31] Jenkins, Track 7 [00:50:08–00:52:03]; 'Hunt down those missing reports', *DERA News,* June 2000, p. 11.
[32] James, Track 7 [00:32:09–00:33:46].
[33] Rooks, Track 2 [01:04:35–01:06:05].
[34] Gray, Track 6 [01:05:53–01:06:24].
[35] Rooks, Track 7 [01:05:32–01:05:50].

The need for rationalisations and reductions in staff numbers inevitably meant redundancies. Many scientists who joined the scientific civil service in the expectation they would remain there until retirement were faced with redundancy, but for some, this was in fact an attractive prospect as Carol Atkinson pointed out:[36]

> The ones that had been there before privatisation and were there afterwards, quite a lot of them were upset and angry … because they hadn't been made redundant. They actually wanted to be laid off because they would have had huge civil service redundancy packages. Some tried to be so bloody awkward that Martin [Wyatt] did in the end lay a few more off because they were just counter-productive and just couldn't be managed.[37]

Anthony Bravery explained the difficulties faced in selecting staff for the voluntary redundancy scheme:

> I had two senior members of staff who were becoming quite close to retirement who didn't really want to have to become involved in the full rigours of privatisation. […] They were heads of their programmes and both world experts, and I agonised quite a bit over it. Technically I was supposed to put the priority on people I didn't any longer need and people who were in areas that were going to be difficult to operate commercially—neither of which applied—but on the other hand they were the two most expensive members of staff. Given they had a long track record of being totally loyal, honest, professional people I thought, look why would I insist that these guys had to spend the last two or three years of their working life in an environment they don't want to be in and not actually going to be enjoying?[38]

However relocations and redundancy were not the only way in which scientists' careers prospects were affected, as the following section discusses.

7.1.2 Career paths and progression

Interviewee accounts confirm observations made by Pollitt and Bouckaert that the abandonment of the concept of a unified civil service meant that terms and conditions of employment were set locally, while promotion became linked to results.[39] Career paths mirrored the shift in organisational focus from administration of scientific research by civil servants to management of research in a commercial environment. Management became the clearer route for advancement as less emphasis was placed on the provision of clear technical paths, while individuals became more responsible for career direction and booking to projects. For those in management positions this could equate to more stimulating and rewarding career prospects but for those who were more suited to a technical or specialist career path, options began to close down.

---

[36] *DRA Corporate Plan 1993–97*, p. 21.
[37] Atkinson, Track 8 [00:03:13–00:03:43].
[38] Bravery, Track 8 [00:54:00–00:55:23].
[39] Pollitt and Bouckaert, *Public Management Reform*, p. 77.

John Chisholm commented on how the civil service personnel system had inhibited managers within the GREs:

> They had very little control over their staff, they couldn't choose staff, they couldn't sack staff, they couldn't deal with their non-performance.[40]

The transition away from the centralised system eventually led to responsibility for recruitment being assigned to smaller business groupings.[41] Changes in the DRA arrangements for personnel management began in 1993.[42] Line (resource) managers took over responsibility for filling jobs and making promotions, while a review of the pay and grading arrangements heralded the end of pay increases linked to annual staff reports and pay ceilings within grades.[43] For John Chisholm, the new arrangements at DRA provided 'a more continuous path for an individual to develop and advance, without putting arbitrary road-blocks in their way in the form of fixed grade hurdles.'[44]

For some managers such as Sarah Herbert, the new arrangements that came in with executive agency status offered flexibility over staffing:

> All of a sudden I realised I had managed to get more work than I had people in my section and I was allowed to recruit my own staff which I did … I ran my own interviews … I went out and found them. If I knew of people just about to get their PhDs in universities on some of my contracts, I would ask them if they wanted a job and if they'd apply.[45]

Chris Peel outlined the pros and cons of the new career management system:

> Recruitment I think was better in QinetiQ because the old establishment method was you were joining the scientific civil service … you weren't necessarily recruited in against a particular job. In the business group you'd say you'd need a bloke or a lady to do such and such, and interview specifically. […] I would have said to be honest that the old Ministry [appraisal] method was more thorough, more by formalised process. In QinetiQ it might have been a little bit more haphazard, more down to the BGM and what he wanted, so performance reviews were, I don't think, as well done.[46]

Yet however much freedom the managers now had in recruiting staff, this was ultimately determined by how successfully the team was holding its own in a commercial environment, summed up by John Chisholm as: 'buoyant areas rapidly attract new staff,

---

[40] Chisholm, Track 7 [00:18:55–00:19:20].

[41] Richard A. Chapman, 'Change in the Civil Service', *Public Administration*, 72, no. 4 (1994), pp. 599–610 (p. 609); 'CAT tackles recruitment problem with business process analysis', *DRA News*, February 1993, p. 5.

[42] *DRA Corporate Plan 1993–97*, pp. 21–22; 'Personnel matters', *DRA News*, November 1992, p. 2.

[43] 'Vacant posts and new promotion arrangements', *DRA News*, February 1993, p. 3, 'Personnel matters,' *DRA News*, August 1993, p. 2.

[44] John Chisholm, 'Pushing at the boundaries: the management of change in the Defence Evaluation and Research Agency', speech to Public Finance Foundation, July 1996, p. 11.

[45] Herbert, Track 7 [00:03:11–00:03:48].

[46] Peel, Track 7 [00:19:27–00:20:42].

declining areas organically shed them without the need for obtrusive senior management interference.'[47] This was the experience of Chris Peel and Carol Atkinson:

> As you progress through to the fully commercialised privatised QinetiQ it would be more and more oriented around a group having a particularly good financial position and doing well business wise and saying we need more staff because we're growing, and other groups saying we're struggling to make money, we can't take on any more staff.[48]

> BRE was forever having to lay people off because the people who were running that part of the business didn't seem able to get money in.[49]

Chris Scivyer also saw promotion becoming associated with the success of a project:

> As things went on that annual staff review seemed to change and after privatisation really that sort of approach disappeared. If I'm honest, it became very difficult to know how you can progress—if you were in a whizz project you might see people moving up.[50]

There were mixed experiences in the changing management of promotions and careers.

A number of interviewees spoke about benefitting from the emerging opportunities to pursue a more individual career path, as Anthony Bravery appreciated:

> Merging with BRE, agency status and finally privatisation, every time in my career that I thought, 'Time I moved on, what shall I do next?', some opportunity opened up which played to where my ambitions lay, right to the end.[51]

For Ian Linsdell, organisational change was 'quite liberating' in offering new opportunities:

> I was fortunate in achieving some promotions etcetera which I almost certainly wouldn't have done under a civil service background. […] In the civil service I would never have come across a John Moreton who immodestly recognised my potential and then proceeded to give me a series of roles that gave me success and remuneration.[52]

Steve Rooks started work at Farnborough just as RAE became DRA, and his comments reflect some of the improvements that agency status brought to career management:

> That's my biggest unhappiness, I guess, about my career in the civil service is that I remember my father telling me, 'Go into the civil service, you'll have great training' and all the rest of it, but there was no real structure. […] All the courses I've ever gone on have been courses I've spotted and thought I'll go and do that. […] It's totally different now because we really do invest in people, [but for me] it was very much self-driven. […] In a government science and technology organisation, the courses that you need to go on to help you develop your career within it are leadership, technical expertise, technical review, working with industry … none of that stuff was ever there.[53]

---

[47] Chisholm, 'Pushing at the boundaries', p. 11.
[48] Peel, Track 5 [00:03:18–00:03:42].
[49] Atkinson, Track 8 [00:13:40–00:13:49].
[50] Scivyer, Track 4 [00:04:02–00:04:38].
[51] Bravery, Track 5 [00:45:44–00:46:07].
[52] Linsdell, Track 9 [00:08:50–00:11:40].
[53] Rooks, Track 7 [00:34:21–00:36:49].

Ian Linsdell found commercialisation brought increased job satisfaction as more was asked of him: 'I wasn't fulfilling my potential … in my civil service life I was able to coast along. […] I only began to be stretched when I entered DRA.'[54]

> I was probably too comfortable. I was a guy who was on a steady progression, being told by a succession of managers that I would progressively reach a certain level. In the end I actually accelerated beyond that level and stayed at a high level for quite a while which I wouldn't have done under civil service terms.[55]

Linsdell also saw how colleagues took advantage of a new tactic for managing their own careers, corresponding with Mallon et al.'s observation of the emergence of a 'subjective' career, whereby individual behaviour rather than the organisational structures played a larger role in determining career progress:[56]

> Particularly in my latter years I started to see people leave the organisation because they had a better opportunity in another organisation, and then come back to us in a more senior role again after that. People would start to see 'There's more to my career than just being a civil servant progressing, I can actually accelerate, take it in different directions.' You'd take it in a business direction as opposed to a technical direction … the first BGMs were prime examples of people that went from a technical role to a more business-oriented role.[57]

Mike Westby felt that the criteria for promotion became much more casual:

> There was no external auditing of the process. It was far more free and easy, which was a great advantage to me at the time. A lot of the old civil service process, the rigour and formality evaporated quite quickly, it all became a little bit more Wild West … managers had far more freedom to do as they saw fit with very little control over their actions.[58]

There was a fine line to tread in meeting the criteria of the new system compared to the clear-cut promotion system of the civil service, as Wendy Westby remarked:

> The money side of it had an impact on your ability to get promotion. Effectively you could do yourself out of a job if you weren't careful, if you got over promoted and then nobody wanted to pay for your time because you were too expensive. […] That wasn't really a thing with the civil service, there was more of a hierarchy, more of a structure, more dead men's shoes.[59]

Susan James spoke about affordability being a key consideration in QinetiQ when an employee was looking for promotion and an associated pay increase:

> If somebody wants to go up a level they have to make a business case now, they have to say 'Have we have got the work and the requirement for a person in this role?' … you have to do a lot of fighting to get people up the ladder or up to the next level.[60]

---

[54] Linsdell, Track 4 [00:44:09–00:45:02].
[55] Linsdell, Track 9 [00:10:06–00:10:32].
[56] Mallon et al., 'Careers in public sector science', p. 397.
[57] Linsdell, Track 7 [00:49:21–00:50:23].
[58] Mike Westby, Track 4 [00:37:21–00:38:06].
[59] Wendy Westby, Track 5 [00:06:09–00:06:46].
[60] James, Track 6 [00:20:15–00:20:44].

Anthony Bravery was aware that relationships between individuals began to play a bigger role in promotion prospects:

> As a private consultancy we didn't have to do it according to any rule book any more, but it kind of took away the aspirations in a way, and the expectations. People saw it more if you got on OK with your boss you might get promoted, whereas in the past it was about how well you'd done if you were writing papers that were being published, if you were going to meetings, conferences and people were asking you for your views on things.[61]

Many staff regretted that aspects of the civil service system were removed with long-term consequences, as Phil Catling and Mike Westby remembered:

> One of the quite emotional subjects was the stage when DRA decided to do away with grades, the civil service grades, which everyone came to love and introduce levels, that was a particularly difficult period of convincing staff of the changes taking place. [62]

They also need to become accustomed to the new performance and development agreements drawn up between managers and staff, as Phil Catling and David Dunford commented:[63]

> That was a move away from just saying what you were doing, how much time you were spending and being assessed. […] You now had performance objectives that you were being measured against. […] It took a lot of bedding in, and it also took a lot of getting right to interpret what people had achieved.[64]

> We used to have what we called resource managers, technical, they used to look after their team and they would set the metrics for the individual. So, for a graduate we would expect them to assimilate certain knowledge, work on programmes, write reports. […] We didn't set financial targets at the lower level, certainly not in selling their time to projects and all the other things. I thought that was a very poor metric … you can tell if a person is valued or not by other mechanisms. For the more senior members they were given some targets on customer interaction and future programmes which you can measure directly. For experts, those that are academics that we want as consultants, it's more about papers published or citings or various things like that.[65]

Carol Atkinson felt there was a negative outcome to performance measurement:

> Setting individuals performance targets encourages them to think of themselves as individuals that are working on their own and … the reality of life is that you know you need lots of people. It's good to have performance targets for teams but as individuals it just encourages individual competition.[66]

These comments from Chris Peel, Sarah Herbert and Paul Cannon reveal aspects of how the new processes differed from the previous system:

> When we went into commercial activity it was far less formal, it was far more about individuals being seen to be doing a good job and a group of managers sitting round the

---

[61] Bravery, Track 8 [00:42:38–00:43:12].

[62] 'Career policy under the spotlight', *DERA News*, December 1998, p. 4; Catling, Track 3 [00:01:21–00:01:46].

[63] 'New review process is just the job', *DERA News*, September 1995, p. 12.

[64] Catling, Track 3 [00:08:58–00:09:35].

[65] Dunford, Track 8 [00:30:49–00:32:14].

[66] Atkinson, Track 6 [00:41:48–00:42:16].

> table and saying 'Jillian Bloggs has done well, she should have a bonus of so and so and a salary improvement of such and such, Fred's not done such a good job keep him where he is' sort of thing.[67]

> Bonuses would come into our pay structure, and a bonus sometimes was a way of rewarding you for what you did but not giving you a pay rise, because it only came that year.'[68]

> By the time we got to QinetiQ … the system became more and more ad hoc. Pay rises were ad hoc ... ostentibly they were based on how valuable you were to the business ... the link to an annual appraisal which was based upon measurables once a year had very much disappeared. […] The questions were very heavily oriented to my value to the business, not my technical skills, so was it important what I was doing, did the customer think it was important? A complete change of philosophy.[69]

For Paul Cannon, his role and status associated as a technical expert suffered when he became answerable to a project manager:

> When we got privatised then the various jobs were very much formalised. So within QinetiQ you would have a project manager who was responsible for the job … it did not matter how senior you were as a scientist, you worked for the project manager. […] I struggled with it enormously … I found it really hard to be dictated to by somebody else who didn't understand the project … it was difficult to be instructed what to do by somebody who was two or three grades [below] you and 20 years younger than you. That also translated across into the hierarchy of annual reporting … the youngsters who were doing the annual review also found it incredibly embarrassing.[70]

The devolvement of career management to internal managers had the consequence of putting 'increasing emphasis on the responsibility of the individual to think about his or her own future plans and goals', as this quotation from Wendy Westby illustrates:[71]

> For me promotional progression became a whole lot more difficult, because I wasn't working for a line manager who I saw on a daily basis, I probably only saw my line manager maybe once a month. It almost felt like working for yourself but without the financial responsibility. […] When the annual report system changed, it became a whole lot more woolly, less structured.[72]

One of the most persistent complaints from staff was the perceived loss of a clear and valued scientific or technical career route, with some staff feeling that most of the training budget was earmarked for developing corporate skills.[73] Interviewees' comments about project management becoming a route for advancement resonate with Clegg's description

---

[67] Peel, Track 5 [00:01:23–00:01:54].
[68] Herbert, Track 8 [00:27:24].
[69] Cannon, Track 6 [00:10:32–00:11:23; 00:15:36–00:15:58].
[70] Cannon, Track 6 [00:03:57–00:08:37].
[71] Cabinet Office, *Career Management and Succession Planning* (London: HMSO, 1993), p. 31.
[72] Wendy Westby, Track 3 [00:05:45–00:10:57].
[73] 'Training budget takes no account of corporate courses', *DERA News*, August 1999, p. 14.

of a post-bureaucratic organisation.[74] Clegg identified the cultivation of a culture of ambition and a method of circulation through programmes and projects, with project leadership becoming a complex elite layer to pass through but also a fast route of upward mobility in the organisation.[75] This was a trend observed by Shirley Jenkins: 'In the longer term that the people who were ambitious to get on would probably leave the technical side altogether—that would be the preferred way of getting on.'[76] Wendy Westby, Steve Rooks and Alan Gray commented on the attractions of going up the management route:

> It was easier to get promotion as a manager than as a pure technical specialist. I had a colleague who moved on to become BGM by her early thirties. […] She was ambitious and wanted that promotion so she managed it by making sure she moved into the right jobs.[77]

> I got promoted more quickly than I would have done if I'd stayed in the technical axis, so by 2000 I found myself going up the management leadership line.[78]

> Most of the people who became managers either in QinetiQ or Dstl were not people who I would put into management … but these were the people who saw promotion, ambition, money.[79]

Sarah Herbert explained how reduced budgets for research and changing priorities in central government meant that certain teams could not survive, confirming Raelin's comment that 'should market conditions change, requiring advanced or different skills, then the professional may find that he or she has become redundant':[80]

> QinetiQ made a lot of people redundant once they had to become competitive and have to look after the money line. I know because the research I was funding [in MOD] was strategic, long-term research, but long-term research has to be taken up by other parts of MOD or industry and developed further, and frequently it wasn't [...] at the end of six years somebody else had to take it up and do it. […] Some of those teams that were doing the strategic research, because nobody picked it up, some of those teams just disappeared.[81]

Ian Linsdell indicated the difficulty this posed for the managers who had to handle these situations:

---

[74] 'Develop your project management skills within DERA', *DERA News,* March 1997, p. 6; Stewart R. Clegg, 'The End of Bureaucracy?' in Thomas Diefenbach and Rune Todnem (eds), *Reinventing Hierarchy and Bureaucracy—From the Bureau to Network Organizations* (Bingley: Emerald Group Publishing, 2012), pp. 59–84 (p. 73).

[75] Ibid.

[76] Jenkins, Track 7 [00:40:29]; 'Career paths—do they exist in DERA?', *DERA News*, June 1998, p. 14.

[77] Wendy Westby, Track 5 [00:07:05–00:08:17].

[78] Rooks, Track 3 [00:33:34–00:33:47].

[79] Gray, Track 6 [01:06:39–01:06:58].

[80] Raelin, 'The Basis for the Professional's Resistance to Managerial Control', p. 159.

[81] Herbert, Track 7 [00:27:18–00:28:17].

> They were asking an extant team of seasoned managers in that area to close their own business which, while they were very professional people, didn't sit well with them. When I was in the aerospace division for many years, I got to know all of the people within that division personally, I knew everybody's name. it's very hard to then turn round and say I'm sorry but you're off now.[82]

For DERA staff who became QinetiQ employees, the scare of redundancy became a regular feature of working life, as Susan James has experienced:

> It's a surprise every time… some people have been put at risk four or five times now, so it is very unsettling. Nobody feels secure … whereas when we were RAE under government Vote funding there was some sort of security, you felt you had a job and that job was going to last if you wanted it to. [...] The first rounds did filter dead wood but then it came to a stage where actually you need a certain number of people to keep a capability running.[83]

Changes in management and career structures, the rationalisations and signs of impending privatisation prompted some interviewees such as Phil Catling to join the union for the first time.

> I've never been a trade unionist or felt much for it or needed trade union representation. […] With the redundancies looming then I was keen to hear what the unions were doing so I did join towards the end. Their involvement was ... not militant at all.[84]

Catling's description is borne out by the absence of references in the interviews to organised activity in protest at privatisation.[85] Written records held in the BRE archive also suggest that the negotiations that accompanied ownership transfer were cordial, despite the discontent expressed by staff in meetings that covered their changing employment conditions, redundancy agreements, transfer of pensions and union status.[86] One reason for this may be that by the late 1990s unions had come to accept the roll-out of the government's privatisation programme, as suggested in Ian Linsdell's description of negotiations over redundancies:

> If we needed to change practices or any aspect of the business we would consult with the unions, explain what needed to change, and get the unions to buy in on behalf of the members to that process. [...] In large measure the people we negotiated with were aware of our objectives … and were looking to help us achieve it in the most pragmatic manner.[87]

---

[82] Linsdell, Track 8 [00:14:14–00:16:00].

[83] James, Track 4 [00:54:48–00:56:05].

[84] Catling, Track 4 [00:45:48–00:46:33].

[85] The closure of the Modern Records Centre at Warwick University during 2020–21 due to Covid-19 blocked further research into union activity during the privatisation process.

[86] BRE Archive, 'Correspondence and minutes of meetings between BRE staff, civil servants and union representatives, 1996'.

[87] Linsdell, Track 8 [00:17:16–00:18:05].

Commercialisation therefore had significant impact on career paths. The next section discusses how interviewees perceived organisational change affected their ability to conduct themselves as professional scientists.

7.2 A different way of working

The interviewee accounts show how NPM interfered with the values and behaviours that scientific civil servants associated with working life in a GRE (discussed earlier in Chapter 5). In their study of scientists in the Australian Commonwealth Scientific and Industrial Research Organisation, Turpin and Deville identified the emergence of tension among staff when research managers were thought to be making decisions calculated on the basis of financial return rather than on the basis of scientific excellence.[88] Whereas previously GRE scientists expected their work to be assessed according to its contribution to the research programme and the circulation of written outputs, organisational change transformed how they addressed their work and the criteria on which their performance was judged.

7.2.1 Less freedom in research

Commercialisation forced the working environment of GREs to transform from one which offered 'researchy-type' jobs to somewhere that was more akin to an industrial R&D laboratory or a technical services organisation, precisely what some interviewees had chosen to avoid at the start of their careers (see the Mike Westby quote on page 97). One of the most frequent observations by interviewees about the process of change is the loss of freedom.

This quotation from Paul Cannon demonstrates how effectively the oral history interviews reveal what this process of commercialisation meant for individual working government scientists. It is important for illustrating how it was the transfer from the working environment of the civil service into the private sector that proved to be so challenging, in contrast to scientists who chose at the outset to pursue a career in industry.

> The problem for those of us that had been in the civil service was that we had to adapt to a new way of working. We'd been recruited to be civil servants … and we developed a civil service mentality of public service. We'd learnt to have those freedoms and we expected to have those freedoms, and when we moved into a more market driven approach then that wasn't possible. We were conditioned to believe that it should be possible. If

---

[88] Turpin and Deville, 'Occupational roles and expectations', p. 155.

we'd all worked in industry in the first place, we wouldn't have had the same stresses and strains. It was hugely, hugely stressful for most people. I'm not saying the management was bad at all, I'm not saying from the top down people were being uncaring, it was simply that the demands of the new role were not ones that people adjusted to.[89] ⌂ ▶

While the organisational reforms created an environment in which managers were afforded greater freedoms, individual scientists' expectations of professional autonomy were no longer fulfilled in the same way. For Susan James this was evident in being bound to contracts and timeframes:

Now you always have to know the outcome of your research before you start it. It's not true research as it was in Dad's day where they could say, 'Oh I think that looks good, let's go and try that' and they had a chunk of money and if it didn't work it didn't matter, they weren't contractually bound to have a defined outcome. He will say he had the best days of government-funded research and development.[90]

References to freedom tend to be tinged with regret for an environment that has disappeared, one in which strength lay in individuals' ability to be creative and innovative. Paul Cannon described his understanding of what changed with the managerialism:

One of the disadvantages that we saw as we became DRA and DERA was that with all the management processes that actually constrained the way we did things, we produced far less poor work—so that was really good—but I also felt that we lost those extraordinarily able people who didn't have the freedom to do the things that they would have done in the past. [...] The idiosyncratic people who … quite often manage to do something that's rather special. That's less and less acceptable I'm afraid in modern science, which is a shame. […] This applies to the universities as well … you're being measured the whole time so you're constrained in what you can risk doing at any time.[91]

Susan James and Sarah Herbert also reflected on the limitations that they felt commercialisation imposed:

It feels very piecemeal, we only ever have a small bit of funding to try this out and a small bit of funding to try that out. There's not one big, nice research programme that says if we did this, this and this, will it give us the answer? … We almost have to know what we're going to deliver before we've even started the work, which means it's not really research.[92]

Deadlines were perhaps a bit foreign. […] The trouble is you can't predict how research is going to go if you start to be more commercial and working with industry more. […] What you have to accept is that at the end, the result might not be the result you want. It might be a result that indicates more work needs doing. […] The older they [the scientists] were, the longer they'd been there, the more they objected.[93]

---

[89] Cannon, Track 4 [00:31:11–00:32:53].
[90] James, Track 1 [00:22:21–00:22:59].
[91] Cannon, Track 4 [00:24:44–00:26:27].
[92] James, Track 7 [00:52:28–00:52:58].
[93] Herbert, Track 8 [00:02:23–00:03:59].

For Paul Cannon, it meant devising different approaches to ensure he delivered the expected outputs:

> You developed new strategies for doing things. […] You would have kind of thought about something for ages before you wrote, that doesn't work when you're doing things against a timesheet, what you do is you start writing on day one before you even know anything. So you lay out the report and put the title there and then you start writing things because then if you run out of time you have at least got something. It's a different way of thinking but it's much harder to manage staff in those circumstances. Maybe it's hard to manage because you have to manage them, in the old days you didn't have to manage them because it was all quite airy fairy.[94]

Susan James commented on how the systems for billing customers affected another aspect of doing research:

> There's never any thinking time. You could cost in a literature search at the beginning to understand what's gone before but quite often that's the bit that gets chopped off because you need to reduce the budget. So ... perhaps it's not as robust as it could be. Whereas before I always felt we did a really good robust scientific exploration, now it's 'right we've said we'd do this and OK, so we're not quite sure what's going on over here, but we'll just have to park that.' [...] It's not as deep and robust as the kind of research we did in the past.[95]

Anthony Bravery commented that customers 'were ticking boxes if the output met a specific policy or strategy need, but they couldn't approve whether it was a good piece of research or not.'[96]

> Peer review became less and less important because the customer who was paying for it wasn't interested or competent to judge the scientific and technical rigour of it, it was the results and what they meant what they wanted. So one of the things that I found quite difficult was to encourage my people to see that it wasn't the science that had to be meticulously described, it was what the results were and what they meant. You've got to bear in mind what the customer wants out of this piece of work, not whether it was scientifically robust or whether you'd omitted to make reference to something Rudolf in Berlin had just recently published.[97]

As GREs became more customer focused, scientists were expected to view their work in monetary terms, as Martin Wyatt remarked:

> So it was changing the culture. Yes, we want more private sector work but we don't actually want to give it away at half price. You guys have got to start understanding your intrinsic value to clients and be prepared to ask for it.[98]

Scientists were therefore being asked to value their work in terms of billable hours rather than as a contribution to knowledge. Academic achievements were still valued by the organisations, but the emphasis was subtly different, changing from one of celebration

---

[94] Cannon, Track 5 [01:09:33–01:10:21].
[95] James, Track 5 [00:04:41–00:05:55].
[96] Bravery, Track 6 [00:00:52].
[97] Bravery, Track 5 [00:17:02–00:18:29].
[98] Wyatt, Track 5 [00:05:51–00:06:04].

when scientists' work was recognised by a learned society or published in a peer-reviewed journal to making use of academic reputations as a marketing tool. Steve Rooks explained this outlook:

> Primarily if you look at the commercialisation potential of DERA I guess it was trying to build this professional highly-skilled brand for an organisation that was world-leading. […] By having more academic and cutting-edge research, then clearly [there might be] spin-out potential. […] We were encouraged to produce papers, not just end products that might be exploited, trying to build networks overseas, go to conferences, get leverage through other nations' work.

Alan Gray commented, 'they wanted letters after my name' and Sarah Herbert noted a similar trend: [99]

> All of a sudden they told us that we had a responsibility to promote our excellence really in the scientific community. […] They started saying to us join professional institutions, give papers at conferences, promote yourself widely. That wasn't true when I first joined but there became a phase when looking after your career and what your CV would look like and how you were respected in the international community and the scientific community became very important.[100]

Ian Linsdell spoke about people being positively encouraged to present papers, while the launch of a new journal *Defence Science* by DERA was another vehicle for showcasing DERA research findings. 'Clearly we didn't want to give away the crown jewels but that's also an excellent method of advertising to make people aware of the capabilities that we had in house.'[101]

One of the expectations of commercialisation was that value could be extracted from the GREs by patenting ideas that had originated within them. However just as Mukerji commented that 'many scientists are simply [not] entrepreneurial enough', so Ian Linsdell came to the same conclusion about Farnborough: [102]

> The reality in my time is that we weren't very good at it. At that time, we didn't possess the people with real entrepreneurial experience to deal with that sort of thing. We ran all sorts of mini competitions for ideas but nothing that I can recall seriously that ever got off the ground as a result.[103]

While Martin Wyatt found 'there were pockets of people who were very entrepreneurial and who were creative and went after private money',[104] the 2002 NAO report pointed out that the type of science involved in commercial activity, such as filing a patent, did

---

[99] Gray, Track 6 [00:57:14].
[100] Herbert, Track 5 [00:45:52–00:46:31].
[101] Linsdell, Track 8 [00:30:30].
[102] Mukerji, *A Fragile Power,* p. 10.
[103] Linsdell, Track 9 [00:04:06–00:04:41].
[104] Wyatt, Track 3 [00:49:17].

not hold equivalent status for professional scientists as publishing in academic journals.[105] Carol Atkinson explained it from a scientist's point of view:

> I kept being told to patent various things I'd invented but in honesty the process seemed so long and tedious and usually there was something else my bosses were putting me under more pressure to do, I never got very much further with any of it. […] There was also something about the patenting thing that I didn't like because it locked away ideas and research that will have built on other people and other things … so I'm a bit ambivalent regarding the whole thing to do with patents. I can see that an inventor needs to be rewarded for his or her invention but at the same time, allowing and encouraging other people to use the ideas … means that you might be able to develop better and newer things.[106]

Susan James' comment indicates that seeing any research ideas become reality, whether commercial or not, was not that common:

> It was quite unusual to actually research something, see it come through and get into front line use. Lots of things get developed but just fell by the wayside.[107]

While RSRE at Malvern developed a reputation for translating innovative defence research into marketable technologies (see page 154), it was not a given part of the activities in every GRE , as Vic Crisp commented:

> You know BRE made its name, if it had a name, investigating disasters. […] I always felt our people could find something wrong with almost anything ... they'd be bloody good at it ... but getting them to say how something could be invented, bloody hard work. Very few people can do that it seems to me.[108]

According to Sarah Herbert and David Dunford, the creativity that led to innovations and inventions was constrained by the increasing demands for scientists to account for their time and meet targets:[109]

> I think the thing that got lost in it all was, as they became more management orientated, accountable for the money they spent, tried to get industry to do some research etcetera, was the ability to just innovate. New bright ideas coming out of it started to disappear.[110]

> As the structure of the funding changed and became more project-driven, more project-oriented with more cost control, more structured delivery in time, I think that changed the nature of what I would call innovative research. The customer changed, the customer was focused on an outcome that he wanted to pay for, and you had to try and deliver that outcome. You didn't have the free rein to explore your ideas … as in the past.[111]

---

[105] NAO, *Delivering the Commercialisation of Public Sector Science*, p. 2.
[106] Atkinson Track 4 [00:05:55–00:06:18] and Track 6 [00:20:04–00:20:43].
[107] James, Track 7 [00:42:52–00:43:04].
[108] Crisp, Track 6 [00:02:25–00:03:17].
[109] Michael Gibbons, 'Science's New Social Contract with Society', *Nature*, 402 (2 December 1999), pp. C81–84.
[110] Herbert, Track 5 [00:50:35–00:51:31].
[111] Dunford, Track 7 [00:04:22–00:04:57].

Phil Catling shared the opinion that privatisation had an impact on the ability of GREs to be innovative:

> In days of old you could have an idea and with Vote funding that idea would be funded and you would progress it to its logical conclusion. More and more it's now a case if there's no customer you can't push an idea. There was an innovation budget, but I can't remember how you would tap into that. […] Everything obviously privatised is market-driven. No market, no requirement, no customer, no requirement. I think a lot of the innovation probably died or withered as the business model changed to where it is today.[112]

The customer focus that came with commercialisation therefore disrupted their ability to be creative or innovative. Competition also percolated into the knowledge-sharing relationships that had previously defined how GREs scientists worked with peers within the organisation and beyond its peripheries.

7.2.2 Changing interactions with peers

Organisational change fundamentally altered long-standing mechanisms of knowledge-sharing between scientists in the GREs and their peers in industry, universities and other public sector laboratories. Activities that fostered knowledge exchange were not necessarily compatible with the increasingly competitive stance of the executive agencies and privatised organisations. The process of writing up the results of the research became more focused on customers' requirements rather than articles aimed at the professional scientific community. This was as true in Dstl (which remained part of government) as in the privatised QinetiQ and BRE, as Steve Rooks recounted:

> It took a long time before you started recognising that things had changed. The biggest thing for us was that we were now being asked to stop being an academic organisation. […] You had a load of people from the DERA days that had previously been all excited about doing academic research and producing papers. […] When we went to Dstl that stopped overnight. because we were effectively told that you are not here now to publish that, you are here to act as the intelligent customer to integrate knowledge that's out there. That was quite a big shift.[113] […] We would be the integrators but not the real doers of work.[114]

Rooks expanded on the effect of this different rationale on staff:

> If you were somebody who'd joined the organisation x years before because you loved using kit and loved being in labs and loved doing experimentation, then that was why we started seeing people move back across the fence into QinetiQ or the opposite. You still had labs in Dstl but very much focused on sensitive work. So it affected different parts of the business and different people in different ways. […] The organisation is very different now, the pace of change now is that while they enjoy what they're doing, they don't get the buzz they used to have, it's more of a treadmill job, they come in and do their job and

---

[112] Catling, Track 4 [00:35:24–00:36:20].
[113] Rooks, Track 2 [01:01:22–01:02:32; 00:53:09–00:53:27].
[114] Rooks, Track 7 [00:46:59–00:47:26] and Track 3 [00:24:00–00:24:46].

they don't get a lot of time to interact and socialise in work as we used to […] we don't have that same sense of fun about it.[115]

For some interviewees' the nature of their jobs remained very consistent despite privatisation, as Susan James and Chris Scivyer remarked:

For me personally I feel I'm still working for MOD, I'm still working for the same customer in the same field, noise problems don't go away, so my job itself hasn't really changed.[116]

The majority of my working life I was working on contracts for government departments. I didn't actually change my ethos because I was still working with people in the civil service.[117]

In QinetiQ scientists' activities were reduced to focus more sharply on operating within budget, with subtle impacts on how Paul Cannon and his colleagues interacted with each other:

What did change though, what we didn't have time for, was the seminar type of thing. So we were a moderately academic bunch of people doing moderately academic work, and what we used to do, if someone was going to give a talk at a conference, we'd get the whole group together and the person would give the talk and then we'd pull it apart for two hours. But of course you can't have 10 people sitting there for two hours when they should be working on their projects which have a different cost code to the one of the speaker. So the transfer of information backwards and forwards between members of the group reduced quite significantly during that time.[118]

Similarly the contributions of BRE scientists to international meetings and committees diminished as Anthony Bravery explained:

Lots of things that were valuable activity, networking with people, you could try and spread across some different contracts. […] We had this IRG [international research group], I had the number one insect expert, the number one fungal expert and myself, really we should have been at all of those meetings because it was a business development opportunity, it's intelligence … but to get three people to an international conference in Bali for example, that's very expensive. Who's going to pay for that? […] The government decided that it wanted to not spend as much money on that, we had to cut things […] Eventually of course we ended up not servicing the committees at all.[119]

However opportunities to forge different collaborative relationships opened up with new funding schemes such as those promoted by the DTI or the European Union. For example the DERA materials science department in which David Dunford worked won a DTI contract to provide technical support to the surface engineering industry, while Sarah

---

[115] Rooks, Track 3 [00:52:53–00:54:39] and Track 6 [00:39:22–00:40:11].
[116] James, Track 7 [00:36:12–00:36:33].
[117] Scivyer, Track 4 [00:06:05–00:06:22].
[118] Cannon, Track 6 [00:49:00–00:50:00].
[119] Bravery, Track 8 [00:08:14–00:09:22] and Track 7 [00:34:21–00:34:56].

Herbert was successful in recruiting partners into the purchase of an expensive piece of equipment:[120]

> We had the very first research programme that was collaborative with industry. It suddenly became important when we were at DERA. […] It was seen we could get money out of DTI if we had a programme that was collaborative with industry. [...] I managed to get them [British Aerospace] on board, I went to Airbus, I got them on board, I got Short Brothers on board and Hurel Dubois—a little firm—but of course it's attractive to them because if they're working in a collaborative programme with Shorts and Airbus and BAe they could see what they're doing and learn from those industries.[121]

Chris Peel saw privatisation as losing 'that transference to industry type of attitude because "ah, this is ours and I can make money doing it," rather than spreading it out around the country.' David Dunford and Susan James was also aware that attitudes towards external colleagues changed:

> There were more commercial sensitivities on the work we did and the freedom to interact. [...] I think we became more commercially astute and aware and we were more careful with the information.[122]

> We [in QinetiQ] did have to be much more careful … our know-how is what we're selling now, as opposed to previously when we were all MOD, it was free exchange of information. […] As a commercial organisation you have to be careful what you say and not give away more than you've been asked or being paid to provide. You had to change your mindset from being an MOD person to a commercial organisation, which was quite tricky. It did take a while.[123]

Awareness of commercial confidentiality affected relationships with extra-mural contractors to the extent that previous harmonious arrangements became less trusting, as David Dunford outlined:

> That was real. We [had] worked closely with Rolls Royce through CARAD[124] and Airbus and Rolls Royce requested all of their documents back. [...] The argument was 'when you were an agency of the government you had privileges and when you are no longer an agency of the government then you're holding commercial information that doesn't belong to you, so we'll have it back please'.[125]

There were other descriptions of antagonism that developed between former colleagues after they were separated into QinetiQ and Dstl as these quotations from Susan James and Ian Linsdell demonstrate:

> There was an awful lot of bad feeling for probably nearly 10 years. When the split happened there was a lot of anti-QinetiQ feeling at the working level. Some of the meetings we went to were very 'them and us'. [...] Colleagues you'd worked very closely

---

[120] Dunford, Track 5 [00:11:41–00:29:03].
[121] Herbert, Track 5 [00:57:14–00:58:55].
[122] Dunford, Track 9 [00:23:40–00:24:38].
[123] James, Track 7 [00:11:42–00:12:32].
[124] The Civil Aircraft Research and Demonstration programme run by the Department of Trade and Industry.
[125] Dunford, Track 9 [00:13:45–00:14:33].

with previously suddenly were treating you like a bit of an alien and you did sense that they thought we got something out of it […] that we all suddenly got rich because we'd become this commercial organisation. They were all very wary of us and quite venomous about it. […] There was a lot of trying to build bridges and developing an understanding from both sides and regain confidence that we're still doing the research work that we always did do.[126]

It was very difficult … parts of the same section split in half, one would go to Dstl one to QinetiQ. Dstl becomes a customer, and then presumes to tell us [QinetiQ] how to do whatever it is. […] 'I want him doing it' … no, no, no … 'you want this done, we decide how it's done'. […] It was a problem.[127]

Another noticeable shift that emerges from the interview material is through the references to increasing feelings of pressure.

7.2.3 Feeling under pressure

What seems to have been a common experience among managers was the sense of pressure that accompanied the transition to commercial operations. Anthony Bravery remarked on the 'unrelenting pressure for the last six years of my working career.'[128] Phil Catling referred to the 'heartache and sleepless nights' that came with his managerial responsibilities, described in similar terms by Susan James:[129]

There's a lot of angst goes on and lots of justification to higher levels of management as to why you're behind. If you go over budget, over run, there's just a lot of justification and sleepless nights and you've got to justify your existence really.[130]

Having followed the IMP route as a special merit scientist, Paul Cannon found it difficult to balance the ingrained leaning to pursue novel avenues of research against the new strictures inherent in achieving commercialisation:

I did constantly feel under pressure. [...] For a driven person like me the consequence is that you do a lot of work in the evenings and weekends because you know you have targets to meet but you still want to explore the possibilities. So you simply do unpaid work. I'd quite often book a 40-hour week but do a 60-hour week. […] The management would have said 'we want to book these hours and charge these hours to a customer', but then we would have gone through the money so fast and we wouldn't have done the truly innovative stuff, so we used to sit at home or sit in the lab and do these things for free! [...] That's the way scientists are, you're driven by the subject and driven by the interest.[131]

---

[126] James, Track 5 [00:31:12–00:32:24] and Track 7 [00:12:48–00:13:30].
[127] Linsdell, Track 7 [00:47:48–00:48:36].
[128] Bravery, Track 8 [00:10:23].
[129] Catling, Track 2 [00:28:12].
[130] James, Track 5 [00:06:10–00:06:44].
[131] Cannon, Track 4 [00:27:42–00:29:20] and Track 5 [01:07:19–01:07:52].

Mike Westby spoke about the impact of the 'timesheet culture' in making individual scientists more aware of their own role in keeping to budgets:[132]

> Rather than just doing stuff in an area over the course of a year, all of a sudden you had a requirement specification to work for and you might be working on two or three projects funded by different customers to look at slightly different things and you'd have to worry about what you were doing on which project and book your time accordingly at the end of the week. […] All of a sudden money became something which had an impact on everybody's life. It wasn't just the more senior managers who worried about budgets. […] you had to worry about your time because that mattered from a financial perspective.[133]

Wendy Westby felt project managers did not understand what went into the delivery of the results they had requested:

> There was a lot of pressure to keep the time I spent on analysis down to an absolute minimum. […] Somebody haggling with you about the price of a service without real money, all done with hours booked to the project. […] They wanted to keep their costs down and didn't appreciate how much effort went into it.'[134]

This corresponds with Randle's findings which showed that an emphasis on project delivery reduced scientists' perception of being able to act creatively, with the 'pressure to achieve progress towards the targets and objectives of the formal project being most often quoted as the reason for failure of this less focused work.'[135] For David Dunford, there was a direct connection between the increasing pressures of commercialisation and scientists' ability to be innovative:

> There was a buzz that disappeared from this, the informal banter and all the other things, it changed. […] When you're continually up against it trying to deliver projects and generate revenue there's a responsibility on individuals. [...] I noticed there was probably a lot more stress … they won't be so creative, they'll tend to do the job. To have someone who's creative you've got to give them free time or let be a free thinker, if you're forcing them to work on projects—deliver, deliver, deliver, deliver—you lose that creativity. You lose that 'Why don't we try it this way?'. You don't get paid to try on a project.[136]

Susan James also spoke of how accounting for time affected whether senior staff felt valued:

> In RAE days you were fully utilised, there was never any downtime. You weren't constrained by working on a particular contract, there was always research under the Vote funded side of things to do or a very specific request from MOD to go and do a noise survey. […] At QinetiQ today we have to account for every six minutes ... if you've got no research then that's where you're very visible, you're not just sitting there as a resource and an expert, you're actually just an overhead. […] Now it's very different and very stressful on a Friday afternoon filling in your timesheet. […] That's when it became very visible whether your research or area of expertise was of interest to MOD or not.[137]

---

[132] Peel, Track 7 [00:14:45].
[133] Mike Westby, Track 4 [00:24:08–00:25:03].
[134] Wendy Westby, Track 4 [00:17:40–00:19:42] and Track 5 [01:03:25].
[135] Randle, 'The White-Coated Worker', p. 747.
[136] Dunford, Track 9 [00:40:03–00:42:43].
[137] James, Track 2 [00:42:45–00:43:06] and Track 4 [00:45:42–00:47:30].

In her role as an analytical chemist, Wendy Westby became aware of an increasing focus on time and costs:

> As time went on and costs were cut we lost our experimental workers … more of that type of support role was pushed onto professional staff. I think that's a change that was going on across the board in industry, not just where I worked, the squeeze on space because buildings cost money, and a squeeze on support staff because support staff don't generate income, they're just an overhead cost.[138]

In some cases, pressures on managers and their staff could have detrimental effects on their mental health, as these quotations from Anthony Bravery, Paul Cannon and Andrew Cahn indicate:

> I had research managers, very good people, internationally respected for what they knew, they found this very difficult and more than one literally crumbled under it. People who were reduced to such a level of anxiety that it was classified as nervous breakdown, they went off sometimes for long periods of time and had to be covered because the contract still had to be delivered. So, a lot of pressure brought on. [...] In the monthly management meeting we looked at progress on current contracts and looked at business development … it was a question of looking them in the eye and saying, 'What have you got going, who are you going to see, what are your ideas, what are you trying to do?' [...] For a long time, we were sustained by ongoing projects, contracts from government.[139]

> I remember one guy, I walked past his office, he was almost catatonic but there were tears streaming down his cheeks, he retired early shortly afterwards. He was a gentle man, he was a very gentle man, he wasn't tuned to being able to deal with the new world order, it just wasn't the right job for him—we're talking about the early days of DRA and the like here. My GP would always check with me how well I was mentally, was I coping, because he had so many people passing through who were involved in QinetiQ and had suffered mentally from the stress of this new way of operating.[140]

> When we had rounds of redundancies and had to make to make people redundant, it's really disheartening and more than that, it's soul destroying, I remember one particular guy in MAFF having a nervous breakdown after having sacked 100 people, it's very difficult.[141]

However Steve Rooks pointed out that stress in the workplace was also caused by the geopolitical events and changing threats that began with the 2001 terrorist attacks in the USA:

> When you say about the stress and the mental health issues of that change, I would have thought some of it would be more related to what was happening around us at the time and the pressures we were under. […] You have to remember that we had 9/11 the year we split as well, the split was in June and a few months later was 9/11. So this huge change in defence thinking and the way we operated. […] Our mindset, although it was slowly changing, [had been] about a resurgent Russia. [...] All of sudden the threat's not like it used to be any more. […] Wherever you sat, you had a major focus that impacted defence and security, and terrorism was suddenly the new big thing.[142]

---

[138] Wendy Westby, Track 4 [00:17:40–00:41:30].
[139] Bravery, Track 7 [00:30:14–00:31:54].
[140] Cannon, Track 4 [00:30:00–00:30:44].
[141] Cahn, Track 1 [00:28:49–00:29:12].
[142] Rooks, Track 7 [01:05:32–01:06:09; 01:01:39–01:03:37].

These feelings of pressure, combined with a reduction in autonomy and the changing relationships with scientific peers changed the atmosphere and ways of working in the GREs. The next section considers the longer term consequences of these processes on the position of specialists and expertise in the changing organisations.

7.3 The future of specialists and expertise

Interviewee reflections indicate that the processes of organisational change signalled a diminished status for scientific experts in the GREs' successor organisations. The shift to project management created a need for a mix of personnel that included multifunctional team members whose skills could be used on a number of projects.[143] As already mentioned in section 6.4 (see pages 186–187), this steered managers towards a more generalist recruitment policy overall. David Dunford commented, 'when you're on strict deliverables and time, you can't be one deep, you've got have the flexibility to move things round'.[144]

New entrants themselves became less attracted to following a specialised career path, as Paul Cannon observed:

> They know they do not want to be a specialist … partly they don't see a career progression for specialism, they know it's hugely risky, and it is. When you were in the civil service and building capability for the future, well there was some risk, but if you're a commercial organisation, if the money goes away, the job goes away, you're potentially redundant … you just don't want to be in that position. So, it's a very different philosophy.[145]

Some of the interview extracts used in section 7.1.2 (see page 210) have already indicated how promotion prospects shifted towards the management roles rather than via a technical path. Vic Crisp saw this as,

> more of a result of the general slimming down of the civil service in total. The technical people, there were less and less of them gradually, and therefore less and less of a kind of career structure they might follow, and therefore the whole thing became less and less attractive I think.[146]

The increasing value and status that managers were accorded in comparison to the specialists was made particularly visible with the roll-out of a share option scheme as privatisation approached. Paul Cannon was a senior technical expert yet he remembered that,

---

[143] 'Recruitment is question of finding right mix', *DERA News*, July 1997, p. 4.
[144] Dunford, Track 8 [00:43:43].
[145] Cannon, Track 6 [00:19:34–00:20:09].
[146] Crisp, Track 3 [00:48:58–00:49:20].

the scientists weren't given the opportunity of joining that share option scheme whereas the management were. It didn't matter how senior you were as a scientist; you weren't given the opportunity to join that share option scheme so that was terribly divisive. […] There were people of the same grade that I was at that were managers who had the preferential share options that I didn't, there were a lot of us in that boat. That wasn't a smart thing to do… people were more than a little irritated.[147]

As programmes were run down due to lack of customer demand or as part of the rationalisation processes, men and women who had spent their whole careers in the GREs developing reputations as special experts found that their job security and career prospects were gradually curtailed. Martin Wyatt described this trend:

I think what is very difficult ... is to develop deep knowledge of an area and retain it when the demand is up and down like a yoyo. One of the advantages of doing stuff for government was they accepted in this area they might only have a problem once every five years, but in order to solve the problem once every five years they had to pay for the work every year, because otherwise the expertise wouldn't be there. […] Some of the work government paid for, when they stopped doing it, the people had no use beyond what they did for government … their skills were entirely focused on what government needs. If government won't pay for it, you can't take a chemist and retrain them as a structural engineer because these people are so specialist and so strong in their speciality, they're not generalists. You can't just move them around the organisation, we would if we could, but we couldn't often.[148] 🎧▶

A poignant example of the fate of one such specialist was given in this story about someone who John Chisholm had worked with and was made redundant:

I felt bad about that, so I dropped in on him to say how sorry I was and how much I valued everything he'd done. […] He said, 'That's okay but I tell you what was really, really, really, really painful?' I said, 'What's that?' He said, 'Throughout my career I was always conscious that I had far more work to do than I had time and I don't think I ever went home without a full briefcase or things to do over the weekend. […] The day I retired my job was given to nobody and I was distraught, distraught, that I'd been wasting my time.'[149]

Mike Westby, who still works for Dstl, is aware of the consequences of losing such people from the organisation:

I think there's less deep expertise than there was. It's got a bit better in fairly recent times but certainly what you might call the grey beard generation, the real deep experts who'd stay in the same area for perhaps 20, 30, 40 years, they all disappeared, and nobody really followed them on. So we lost a lot of deep expertise which was not replaced. It's something we struggle with still where we did lose a generation of experts and we're trying to recreate it again.[150]

Sarah Herbert held a similar view regarding the effects of organisational change on expertise:

[147] Cannon, Track 6 [00:31:46–00:34:20].
[148] Wyatt, Track 6 [00:15:09–00:15:40; 00:05:32–00:06:04].
[149] Chisholm, Track 6 [00:26:02–00:27:15].
[150] Mike Westby, Track 5 [00:47:22–00:48:03].

> We have as a nation lost our government funded research establishments and we're now depending very highly on getting funded by somebody to do it. […] I think it technologically in the long run be detrimental. […] We're perhaps depending a bit more on the universities. [...] I think we have lost something because university students only stay there for three years and then they go somewhere else and they might take their expertise into a particular industry but that doesn't really mean that you have a body of people with expertise.[151]

Those educational opportunities that GREs offered school leavers (described in section 5.3) have disappeared, as David Dunford noted:

> To a 16-year-old, a 17-year-old, it was an incredible environment. Would it happen now? No. Impossible for it to happen now? … If you go through an academic route you tend to be already on a higher academic level. I was just privileged to be able to do it and I think now, if I look back at my career, it's the one thing I would encourage … to have this more open structure for the youngsters to come in and work, but you need to have less rigorous organisations. Project management of defined activities and outputs is very restrictive in opening minds and doing things.[152]

Both Susan James and Mike Westby spoke about how recruitment strategies affected the cultivation of deep experts:

> We don't take people in at 18, they all come in on a graduate scheme … and they don't seem to have a passion for anything, they come in, they rotate round. […] I just can't see how they develop an interest in a particular area. … Maybe that's not the way of the world anymore. […] Maybe people don't think they're going to build a deep expertise and stay in it and become a deep expert. […] Expertise—you understand the intricacies of what you're writing and you're able to justify it to somebody who's querying it. You only build that up over time and I think that's where things are beginning to fall down now, is that people are just not spending any length of time in a particular discipline. That's my concern is about how do we develop deep experts now because everybody's just moving on.[153]

> There's been a tension ever since the start of the agency shift … a continual perception, mainly by people who are deep experts, that deep expertise is not valued, and if you continue doing the same thing your career will stall at quite an early level and the people who get on move around a lot and become far more generalist and have a lot of contacts. […] It's getting the balance between the two.[154] 🎧 ▶

The effects of commercialisation on the development of deep expertise suggest there would have been a subsequent impact of privatisation on government departments' ability to act as intelligent customers. The 1986 parliamentary committee report on civil R&D had stated that 'departments should ensure that their scientific strength is adequate to conduct an informed dialogue with research contractors.'[155] While a 1993 symposium on

---

[151] Herbert, Track 6 [00:21:57–00:24:09].
[152] Dunford, Track 3 [00:03:23–00:04:04].
[153] James, Track 1 [01:02:51–01:03:56] and Track 4 [00:29:03–00:29:38].
[154] Mike Westby, Track 5 [00:46:04–00:46:42].
[155] Science and Technology Committee, *Civil Research and Development*, 26 November 1986, HL 20–I, 20–II & 20–III 1986–87.

science in government was confidently titled *The Rise of the Intelligent Customer*, the long-term consequences of organisational change revealed through these oral history interviews suggest the opposite has happened.[156] Dstl is expected to fulfil that role for MOD yet its reduced size and scope means that it needs to find other ways to maintain a certain level of expertise, as Steve Rooks commented,

> The challenge we have is then how do we then make sure that we are still intelligent enough, so we've got to do something, this is the gist of it. What I've always tried to do is try to make sure we do it with industry and we're able to put people into their labs, onto their shop floor as part of career development in Dstl so that if we're not going to do much of it anymore [ourselves] … that means we're still intelligent and we understand what's going on.[157]

Anthony Bravery and other former BRE scientists believe that privatisation has had serious, sometimes tragic consequences for government's ability to monitor the construction industry:

> They couldn't be intelligent in the way they needed to be. Do you know this is one of the reasons you hear people complaining about government wasting money on contracts, because they've commissioned the wrong thing? […] This comes back … to the dismantling of government research institutions populated by people selected from industry and academia as being expert and independent, because their pay-check doesn't depend on them saying the right thing. […] I firmly believe—personal view again of course—Grenfell,[158] if there had been the right kind of relationship between the old FRS, Fire Research Station, and government, the scientists at FRS would have seen what problems were developing and would have had the opportunity to investigate them, even do tests and say to the building regulations [body] … you can't let this happen.[159]

Carol Atkinson was also doubtful about government's ability to consider technical problems:

> I don't think they [the department] knew what they were doing, I think they'd been misled by figures in the construction industry and swayed often too easily […] I think that's a big problem with civil servants that I don't think that many civil servants have got enough experience of the industries that they are supposed to be serving to challenge them and to work out how to make things better. […] I don't think there's anywhere enough very good technical people in government.[160]

Privatisation meant that the scientific civil servants who had previously circulated through Whitehall on their 'tour' in London were no longer represented in central government. This raises the question of where central government departments then

---

[156] Hay (ed.), *Science in Government: The Rise of the Intelligent Customer*.

[157] Rooks, Track 7 [01:26:46–01:27:30].

[158] In June 2017 a fire in Grenfell Tower, a block of flats in West London, caused 72 deaths. Initial reports from a subsequent public inquiry found that the construction of the building's exterior did not comply with regulations.

[159] Bravery, Track 7 [00:36:53–00:38:12].

[160] Atkinson, Track 7 [00:43:29–00:44:50].

turned to access similar expertise once its internal cohort of technical experts was dramatically reduced.

7.4 Conclusion

This chapter has drawn on interviewee accounts to show how organisational change and commercialisation affected the physical environments and career paths around which scientists' working lives were structured. In turn these processes of change were described by some interviewees as having a long-term impact on the development of specialist expertise in the transformed research organisations.

The reactions that interviewees expressed in how these changes affected them personally, both in terms of career prospects and how they felt about the ways in which they were able to carry out their work, varied from stories of loss to those of success. What emerges from the audio material is the complexity of experience among this group of interviewees, often reflecting their role in the GRE hierarchy and the varying career trajectories that occurred following organisational change. These included accounts of resignations, redundancy and relocation, along with examples of new routes for progression through management in contrast to narrowing opportunities to follow a technical career path. There were interviewees who resisted a painful re-examination of their experiences of being made redundant, while others who acknowledged they had benefited from generous redundancy packages. There were interviewees from DERA who as QinetiQ employees regretted the breakdown in relationships with former colleagues who went to Dstl, while those who went to Dstl spoke of how they went from being members of a prestigious organisation to one that was for a time unrecognised by the scientific community.

The more positive assessments of change are expressed by interviewees who benefited from the opportunities for career progression that came from the new management structures. For example, Ian Linsdell and Steve Rooks enjoyed accelerated rates of promotion that were not feasible in the more pedestrian processes of advancement in the civil service, what Mike Westby had described as 'a lot of treacle in the system' (see page 103). As Wendy Westby observed (see page 210) prospects for career advancement widened for those who were willing to move into management, with the role of project manager being promoted as a professional aspiration. Interviewee observations about the increasingly ad hoc nature of the promotion system came from those who had embraced

the security and clarity of the civil service structures. The inference is that individuals needed to become proactive, agile networkers to be successful, such as in Wendy Westby's story in Chapter 6 of building up her own customer base (see page 193).

The idea that there were winners and losers in this process of change is encapsulated in Steve Rooks' story about how in the rationalisation process he could only promise career development to limited numbers of his team (see page 200). While collaborative arrangements with industry stimulated fresh approaches to research with the launch of funding streams for dual use technologies, there is a regret expressed by many interviewees regarding the changing nature of research activities. These are articulated most powerfully by interviewees who had talked about the attraction of a 'researchy-type' job in a GRE and whose careers were defined by the development of expertise as technical leads. These included observations from Susan James, Mike Westby, Paul Cannon and Anthony Bravery. However frequent references to constraints on freedom across the collection of interviews show that values which had been taken for granted as part of the institutional culture in an GRE changed fundamentally. The transition to the delivery of tightly defined contracts represented a loss of freedom and excitement in the research that had defined working as a scientific civil servant in a GRE.

Commercialisation therefore limited these elements of working life that GRE scientists felt were intrinsic to their ability to operate as professional scientists. Some interviewees, for example Anthony Bravery, who had expressed their pride in publishing in academic journals spoke about how the delivery of contracts diminished opportunities to display their scientific rigour and excellence. The ethos of the organisations moved away from the encouragement and celebration of academic progress and scientific method, instead the emphasis was placed on limiting research activities to those that directly responded to customer needs.

As routes for advancement flowed more through the management roles, the development of technical specialists ebbed, leaving the impression that specialists were becoming less valued. The needs of the organisation shifted towards generalists as pressure on managers to deliver contracts affected their recruitment strategies, veering towards a preference for graduates who could be easily transferred between projects rather than those with a particular specialism. Some interviewees acknowledged that there was a risk that senior

technical experts could be regarded as an expensive overhead rather than a resource. Rather than being recognised as the embodiment of specialist expertise who made an individual contribution to the research programme, scientists felt they came to be valued according to how many hours they booked to timesheets, eroding those feelings of specialness associated with being a professional scientist. Those interviewees who were more inclined towards research activities—for example Susan James—particularly commented on how the need to pay close attention to the delivery of contracts and utilisation rates removed scientists' prospects for background research or 'thinking' time. For those scientists whose work was no longer able to attract customer support, the demise of their area of expertise could have a particularly cruel effect on their self-esteem, as demonstrated in the story provided by John Chisholm (see page 224).

These developments combined to create a culture in which the prestige of a specialist career through the cultivation of an 'idiosyncratic' research expertise was diminished. The most damning assessments of the diminishing cultivation of deep expertise come from Mike Westby and Susan James who are still employed in these research organisations, thereby witnessing the long-term consequences of organisational change.

Commercialisation therefore had multiple effects on the expertise that was embodied in GREs. Rationalisation and redundancies reduced the number of experts, project management led to the recruitment of generalists rather than specialists, lack of commercial viability forced some areas of research to close, leading to further redundancies, while the need to focus on customer contracts left little capacity for managers to cultivate succeeding generations of experts. Processes of culture change were activated that profoundly altered scientific civil servants' working lives in GREs.

8. Conclusion

This project is the first to explore the working lives of scientific civil servants who worked in UK government research establishments (GREs) during 1970-2005. It has focused on using oral history interviews with former government scientists to understand how scientists' working lives changed as a result of the civil service reforms that were implemented during the 1980s and 1990s. By foregrounding individuals' experiences of working in a GRE, this thesis provides a portrayal of the shared values and career expectations held by scientific civil servants which contributed to the GRE workplace culture. It also provides the first investigation into how that culture was then profoundly affected by commercialisation and privatisation. The findings resulting from this historical study suggest that these processes had wider repercussions for relationships between government and science, demonstrating that 'the history of the state's experts needs telling.'[1]

In mapping GREs' journey from state to private control, Chapter 2 has set out how these organisations fitted into the complicated landscape of public sector science, where government money for scientific research was disbursed through multiple channels across a spectrum of scientific research activities. It has shown that organisational change in GREs in the 1980s and 1990s was not so much about changing the way government science was organised and managed, but part of the general programme of public sector reform set in motion by the Conservatives under Margaret Thatcher and John Major and carried through by the Labour party under Tony Blair. The processes involved in civil service reform, such as fragmentation, reduction and commercialisation, contributed to the eventual privatisation of some GREs. However the final stage in the journey from state to private is remembered by interviewees more as an inevitable consequence of the success of commercial operations rather than the earlier ideological programme for civil service efficiency.

Chapter 2 has built on Agar's examination of Conservative science policy under Thatcher by clarifying that organisational changes in the GREs during the 1980s were driven by a

---

[1] Edgerton, *Warfare State*, p. 109.

separate strand of policy-making applied to the civil service.[2] While Turner and Gieryn have shown that scientists repeatedly argue for and expect special status, along with the right to be treated differently by government, in the case of public sector reform they were treated the same as the rest of the civil service.[3] The application of NPM made no special allowances for GREs or the scientists within them.[4]

Chapter 3 has shown the influences that led interviewees to become scientists and their motivations for joining the scientific civil service. Working in a GRE offered the attraction of a 'researchy-type' job cushioned within the security of the civil service framework, the promise of an interesting career with the excitement that came from 'playing' with science. Career advancement was not tied to the ability of the individual scientist to secure funds from the customer in government or the pressure to move between institutional settings to gain promotion. While opportunities for management training were on offer, what interviewees remember more were the options for development as scientists through educational opportunities and feeling unconstrained in their identities as professional scientists. These elements created an environment whereby exceptional scientists could spend the whole of their working life working in one field, enjoying the freedom to pursue research that allowed them to develop deep expertise.

Chapter 4 detailed the variety and inconsistencies in the activities and processes that defined government scientists' working days. State-of-the-art technical equipment was housed in shabby buildings, extensive freedoms to carry out research were entwined with cumbersome internal management processes, the working day could be filled with excitement or unfold lethargically. Chapter 4 has also made visible how GREs and the scientists employed in them operated as valued components in both the machinery of government and dynamic web of connections that underpinned systems of innovation in the UK. Interviewees speak of the GREs as 'bridging a gap' between academia and industry, and their accounts of working life show that GRE scientists were occupied on a fluid spectrum of programmes that ranged across what is labelled 'pure science' and 'applied R&D' to testing and evaluation activities.

---

[2] Agar, *Science Policy under Thatcher.*
[3] Turner, 'Public Science in Britain, 1880–1919'; Gieryn, 'Boundary-Work and the Demarcation of Science from Non-Science'.
[4] Boden et al., *Scrutinising Science.*

Together Chapters 3 and 4 showed how the career structures of the civil service and funding arrangements of GREs encouraged the cultivation of specialist expertise and promoted professional notions of autonomy among scientific civil servants. Interviewees remember exerting influence over the direction of research programmes and enjoying freedom in how they carried out their work. This examination of scientists' daily working lives has allowed an assessment in Chapter 5 of what it meant to work as a civil servant in a GRE. The interviews have revealed how the frameworks and values of the civil service and professional science combined and reinforced each other to create a workplace ethos specific to GREs. Camaraderie among colleagues and institutional support for further education was a fundamental part of working life. Scientists were nurtured and valued as embodying objective, specialist knowledge which was then directed through public service towards societal and strategic goals rather than monetary gain.

This portrayal of the culture within GREs builds on Shapin's work in evaluating the norms and values of scientists who worked in institutional settings beyond academia.[5] It has shown that scientists working in GREs exhibited similar expectations and perceptions of a professional career in science as those who worked in academia. They valued the ability to operate autonomously, to publish in peer-reviewed journals and to share knowledge with colleagues in the wider scientific community. While interviewees acknowledged that there were aspects of the civil service bureaucracy which needed reform, they relished the freedom they experienced in the working environment. By demonstrating these shared values, this thesis contends that there is a misleading tendency among historians of science to associate the values of professional science with the institutional setting of academia.

Chapter 6 has set out interviewees' experiences of the changing processes and practices that were introduced in GREs as a result of civil service reforms. These individual reflections add a historical perspective to earlier studies which looked at the implementation of NPM in GREs as a current, ongoing process.[6] The nuanced reactions from interviewees to organisational change reveal that the NPM reforms reconfigured

---

[5] Shapin, *The Scientific Life*.
[6] Boden et al., 'Men in White Coats'.

understandings of responsibility and autonomy both at organisational and individual levels, and interviewees' assessments of change often reflected their roles in the organisation and subsequent career outcomes. For project participants who moved into the new managerial roles, commercialisation meant being liberated from the constraints of the civil service management structures but also taking on increased responsibilities and stress. They benefitted from the opportunities for accelerated career progression facilitated by the new management frameworks. Some interviewees thrived on the broadening expectations to win new customers or work with different collaborators.

However, in the main, the enforced adjustment to commercial practices was not welcomed by their staff. Interviewee commentary illuminates how commercialisation introduced an alien set of tensions and pressures into the workplace. Scientists' notions of autonomy in the management of the research diminished as responsibility for the timely delivery of customer contracts passed to the project managers. The working day became more defined and managed as customer requirements were firmly delineated into projects, and project management rather than a technical path became a clearer route for career advancement. The constraints of accounting for time replaced the sense of freedom they had enjoyed in their daily work so that professional value to the organisation became linked to hours booked to projects rather than for individual skills. Transfer into the private sector, with the need to chase business opportunities, meant that scientists found themselves operating in a competitive way, both internally and with their former industrial partners, upsetting the established web of connections that were understood to facilitate the transfer of knowledge. While Shapin has shown how managers and scientists in industrial R&D laboratories accepted from the outset a working environment in which professional values were balanced against the demands of the corporate world, the changing expectations arising from privatisation required GRE scientists to adapt to an environment that they had deliberately avoided as a career choice.

Chapter 7 continued to explore what interviewees said about the impact of organisational change on the frameworks and values that determined the trajectory and content of scientists' working lives in a GRE. The range and diversity of their responses, both positive and negative, conveyed how the shifting parameters of the physical working environment, career prospects, working relationships and everyday research activities were experienced differently depending on the individual. However the prevailing

conclusion was that the collective ethos of government scientists and their enculturated ways of working could not be accommodated in the new organisational model. The individual experiences reveal telling instances whereby a commercial rationale impeded the continued development and provision of certain scientific expertise. Scientific civil servants embodied deep, specialist knowledge that was cultivated to meet government's needs, what Mukerji described as an 'elite reserve labor force' in her study of state-funded scientists in the USA.[7] However the foundations of the scientific civil service which had allowed for this—its career structures, funding arrangements and educational opportunities—were replaced by a customer focus which did not incorporate the same incentive to nurture specialists. Increasingly business group managers saw they could make better use of team members with a more generalist, flexible set of skills than those with highly specialist knowledge.

Interviewees spoke about the varied and often problematic impact of organisational change on scientists' values, allowing for an assessment in Chapter 7 of how the process of culture change unfolded in GREs. The status of individuals with specialist skills diminished as research programmes were more tightly geared towards the parameters of customer requirements. Working to contract meant that scientists no longer felt they could address their work according to the values which had defined their identities as professional scientists working in GREs. Competition erected obstacles in the familiar pathways of knowledge exchange with peers in academia and industry, while those scientists who became private sector employees could no longer enjoy the sense of pride that they had felt in working for the public good. However, the notable absence of reference to any union protest suggests that by that latter stages of organisational change scientists had accepted the inevitability of these processes.

The interviews record the complexity of scientists' experiences during this period of organisational change. There are stories of the challenges and opportunities for managers, yet one of the more consistent themes to emerge from the interviews is that of loss on the part of the working scientists. The loss of freedom in how they could carry out research, the loss of a sense of fun and camaraderie as they went about their work, the loss of treasured scientific facilities that underpinned their specialist work, the loss of prestige

---

[7] Mukerji, *A Fragile Power*, p. 6.

associated with the GRE institutional heritage, and ultimately the loss of deep expertise and institutional memory. These combine to suggest that through commercialisation, GRE scientists lost a central aspect of their scientific and personal identities, the feeling of being recognised as part of something special.

The use of oral history methodology has been key in understanding the everyday working lives of scientific civil servants and in assessing the multi-faceted dimensions and implications of organisational change in GREs. By recording interviews with scientists who experienced these changes, I gained access to perspectives that are not expressed in government records or corporate literature. These lived experiences have so far been overlooked by other scholars who prefer to focus their research on how policy was formulated, the technicalities of scientific research or the activities of scientists in more visible institutional settings. While acknowledging that only one version of GRE history has been articulated through the experiences of this group of interviewees, and that reflections from a different set of participants would have led to a different interpretation of this history, oral history interviewing has opened a door through which it has become possible to begin exploring the overlooked world of GREs and the scientists who worked in them. Through their deposit in the British Library Sound Archive, these interviews offer future researchers the opportunity to continue working on our understanding of working life in GREs and the processes that culminated in privatisation.

The interviews reflect the diversity of scientists' lived experiences rather than presenting a definitive account, yet there is sufficient consistency in their recounted experiences to indicate a broader experience of change. The repeated use of certain words by interviewees has revealed common experiences that indicate the issues and values that were remembered as being significant. Interviewees' references to 'freedom' indicate how feelings of autonomy were fundamental to their understandings of working as scientific civil servants. Working under state control allowed them to carry out what they labelled 'true' research whereas in the private sector this ability disappeared. Similarly the use of the word 'professional' or 'professionalism' signposted the values that contributed to scientists' attitudes to their work. Common memories of 'camaraderie' and 'pressures' signalled how the atmosphere in the workplace became less relaxed with the new organisational structures. The context of the use of the word 'individual', whether in official documents or in the interviews, shows the changing expectations of the individual

scientist from their employer. At an organisational level, new management practices and the creation of smaller business units placed greater responsibility for performance on the individual, particularly through performance monitoring via time booked to projects. Perceptions of an individual's value to the organisation that had previously been embodied in the name of the 'Individual Merit Promotion' scheme shifted from someone who had the freedom to apply their specialist knowledge to research to someone who contributed hours to project spreadsheets.

This thesis adds the experiences of individual government scientists to the academic literature, demonstrating the potential of oral history to inform historians of science of the personal dimensions of working worlds of science. The stories of government scientists that worked through this period of organisational change have until now been absent from the historiographies of twentieth-century British government and twentieth-century British science. The analysis of interviewee descriptions of their careers has made visible the position that GREs and the scientists who worked in them occupied in the British civil service and in the national landscape of scientific research. The portrayal of the workplace culture in GREs contributes to the existing sociological literature on the sites and culture of knowledge production. Its presentation of the attitudes and values embodied in GRE scientists and managers before the introduction of NPM brings an additional perspective to discussions about professional science and whether scientists' values are influenced by their institutional settings.

Interviewees' descriptions have also brought new insights into the individual experience of bureaucratic reform. While the content and track record of these reforms have received extensive attention in the public administration literature, there are few accounts of how individual public sector employees experienced these transformative processes or how they were implemented in GREs.[8] By evaluating how NPM effected culture change in the GREs through its impact on the conduct of science and scientific civil servants' professional values, this thesis serves as a case study of the culture change associated with the public sector reform programme. However it remains unclear the extent to which culture change was articulated as a specific goal of civil service reform. A future study

---

[8] O'Connell Davidson, *Privatization and Employment Relations*; Strangleman, *Work Identity at the End of the Line?*.

might ask whether the architects of bureaucratic reform programmes set out to change the established ethos of their public servants, and if so, how did they expect to do this? There is also potential to clarify the extent to which neoliberal ideas and Conservative policies for science in the 1980s influenced the decision-making processes that led to the privatisation of GREs in the late 1990s.

There are recognised limitations in the project's scope. The first is in the number of interviewees, determined by the timescale of the project and the practical capacity for interviewing by a sole researcher. A larger cohort of interviewees would have offered more varied details of working life in GREs which may have led to more nuanced findings. The onset of the Covid-19 pandemic at the beginning of the writing-up stage has left some lines of inquiry unaddressed. For example, I have been unable to look at primary sources for evidence of ministerial decision-making in the 1980s and 1990s over the future of GREs, nor have I been able to fully investigate union activity in the GREs during the privatisation process. The interview material does not suffice for a robust analysis of the outcome of commercialisation and privatisation in achieving Conservative goals for efficiency and stimulating the contribution of innovation systems to economic gain.

The thesis is concerned with understanding the consequences of decisions taken by government on the individuals who worked in GREs, yet by seeking out those individual experiences other questions begin to emerge about the impact of those decisions for government itself. The oral history interviews exposed how the processes of rationalisation, staff reductions and privatisation resulting from the bureaucratic reform agenda dispersed and reduced the cohort of scientific civil servants. Further archival research is needed to establish whether Ministers discussed the effect these processes would have on the collective knowledge that had accumulated in GREs during the twentieth century and on government's continued access to this expertise. A study such as this would contribute historic context to the recent efforts from the central government

unit responsible for science to increase the number of scientists and engineers in the civil service.[9]

Conservative science policy sought to transfer more responsibility for 'near market' R&D to private industry. However the expectation that industry would fill the gap was not realised, with some areas of research proving too risky for a commercial organisation to continue. This study has shown that one consequence of commercialisation was the demise of areas of research that were not commercially viable. Only with time did it become apparent which areas of research would suffer from market failure by not attracting customer demand, their survival dependent on sustained state support. History therefore shows today's policymakers that some areas of research will wither and die if they are not underwritten by the state.

The privatisation of GREs was seen by one Conservative adviser as 'the logical conclusion' to the practice of customer-contractor relationships between Whitehall and scientists.[10] However the customer-contractor model works on the assumption that government departments have intelligent customer status. Accounts from some interviewees indicate that during the period of this study intelligent customer status in part derived from the circulation of scientific civil servants between the GREs and Whitehall. Senior civil servants in government departments were increasingly commissioning research from arm's length or private organisations, yet the commercialisation and privatisation of GREs meant that at the same time the pool of experts in GREs which advised on their commissioning and procurement activities was dwindling. Understanding how governments achieve intelligent customer status, both historically and currently, is an area of research that merits focused attention. One particular aspect of such a study would be to assess whether scientists who are employed as civil servants are more useful in fulfilling this need than those working in academia or industry.

---

[9] Go-Science, *The Future of the Civil Service: Making the Most of Scientists and Engineers in Government* (2013); Go-Science, *Realising Our Ambition through Science: A Review of Government Science Capability* (2019); Go-Science, *GSE Profession Strategy* (2021).
[10] 'George Guise to Margaret Thatcher, 10 March 1987', quoted in Agar, *Science Policy under Thatcher*, p. 89.

Using oral history in this project has expanded our understanding of the impact of these reforms across the public sector, showing how the exploration of individual experiences can shed light on broader processes of change. In the specific settings of GREs, the processes that drove forward organisational change—rationalisations, rebranding and privatisations—have largely eradicated the GRE as a site of knowledge production from the current national landscape of scientific research. These processes have also adversely affected the preservation and availability of GRE institutional records. This lack of visibility means that the history of GREs and the history of the scientists who worked in them has been obscured. This thesis brings the lost working worlds of GREs back into view, and in so doing contributes to an understanding of what their demise meant to the scientific civil servants who worked in them and to the governments that they were established to serve.

Appendix 1. Government research establishments (GREs), c. 1976

Ministry of Agriculture, Fisheries and Food

- Agricultural Development and Advisory Service:
  - Cattle Breeding Centre, Reading, Berkshire.
  - Central Veterinary Laboratory, Weybridge, Surrey.
  - Lasswade Veterinary Laboratory, Midlothian.
  - Pest Infestation Control Laboratory, Slough, Buckinghamshire.
  - Plant Pathology Laboratory, Harpenden, Hertfordshire.
  - Veterinary Investigation Service, Surbiton, Surrey and 24 regional centres.
- Fisheries Research:
  - Fish Cultivation Unit, Port Erin, Isle of Man.
  - Fish Diseases Laboratory, Weymouth, Dorset.
  - Salmon and Freshwater Fisheries Laboratory, London.
  - Sea Fisheries Research Laboratory, Lowestoft, Suffolk,
  - Shellfish Laboratories, Burnham on Crouch, Essex.
  - Sea Fisheries Radiobiological Laboratory, Lowestoft, Suffolk.
  - Fisheries Experiment Station, Conwy.
  - Torry Research Station, Aberdeen and Hull.
- Food Science Laboratories, London.
- Royal Botanic Gardens, Kew.

Department of Agriculture and Fisheries for Scotland

- Agricultural Scientific Services, Edinburgh
- Freshwater Fisheries Laboratory, Perthshire.
- Marine Laboratory, Aberdeen.
- Royal Botanic Garden, Edinburgh.

Ministry of Defence

- Admiralty Compass Observatory, Slough, Buckinghamshire.
- Admiralty Engineering Laboratory, West Drayton, Middlesex.
- Admiralty Experiment Works, Haslar, Hampshire.
- Admiralty Marine Engineering Establishment, Haslar, Hampshire.

- Admiralty Materials Laboratory, Holton Heath, Dorset.

- Admiralty Oil Laboratory, Cobham, Surrey.

- Admiralty Research Laboratory, Teddington, Surrey.

- Admiralty Surface Weapons Establishment, Portsmouth, Hampshire.

- Admiralty Underwater Weapons Establishment, Portland, Dorset.

- Aeroplane and Armament Experimental Establishment, Boscombe Down, Wiltshire.

- Atomic Weapons Research Establishment, Aldermaston, Berkshire.

- Chemical Defence Establishment, Porton Down, Wiltshire.

- Explosives Research and Development Establishment, Waltham Abbey, Essex.

- Meteorological Office, Bracknell, Berkshire.

- Microbiological Research Establishment, Porton Down, Wiltshire.

- Military Vehicles and Engineering Establishment, Chertsey, Surrey.

- National Gas Turbine Establishment, Pyestock, Hampshire.

- Naval Construction Research Establishment, Dunfermline, Fifeshire.

- Royal Aircraft Establishment, Farnborough, Hampshire.

- Royal Armament Research and Development Establishment, Fort Halstead, Kent.

- Royal Navy Physiological Laboratory, Alverstoke, Hampshire.

- Royal Radar Establishment, Malvern, Worcestershire.

- Services Electronics Research Laboratory, Baldock, Hertfordshire.

- Signals Research and Development Establishment, Christchurch, Dorset.

(These defence research establishments had been consolidated into 12 by 1980).

Department of Energy

- United Kingdom Atomic Energy Research Establishment, Harwell, Oxfordshire.

Department of the Environment

- Building Research Establishment, Watford, Hertfordshire.

- Princes Risborough Laboratory, Aylesbury, Buckinghamshire.

- Fire Research Station, Borehamwood, Hertfordshire.

- Hydraulics Research Station, Wallingford, Oxfordshire.

- Transport and Road Research Laboratory, Crowthorne, Berkshire.

Home Office

- Forensic Science Laboratories, Aldermaston, Berkshire.

Department of Industry

- Computer Aided Design Centre, Cambridge.
- Laboratory of the Government Chemist, London.
- National Engineering Laboratory, East Kilbride, Glasgow.
- Birniehill Institute, East Kilbride, Glasgow.
- National Physical Laboratory, Teddington, Middlesex.
- Warren Spring Laboratory, Stevenage, Hertfordshire.

Ministry of Overseas Development

- Centre for Overseas Pest Research, London
- Directorate of Overseas Surveys, Surbiton, Surrey.
- Land Resources Division, Surbiton, Surrey.
- Tropical Products Institute, London.

Source: British Council, *Government Organisation of Science and Technology in Britain*, (London: British Council, 1976), pp. 22–42.

Appendix 2. Organisational changes in GREs, 1970–2005

Slides taken from 'Government research establishments: organisational change from 1970: mapping the routes to privatisation', presentation by Emmeline Ledgerwood at the British Society for the History of Science annual conference, July 2017.
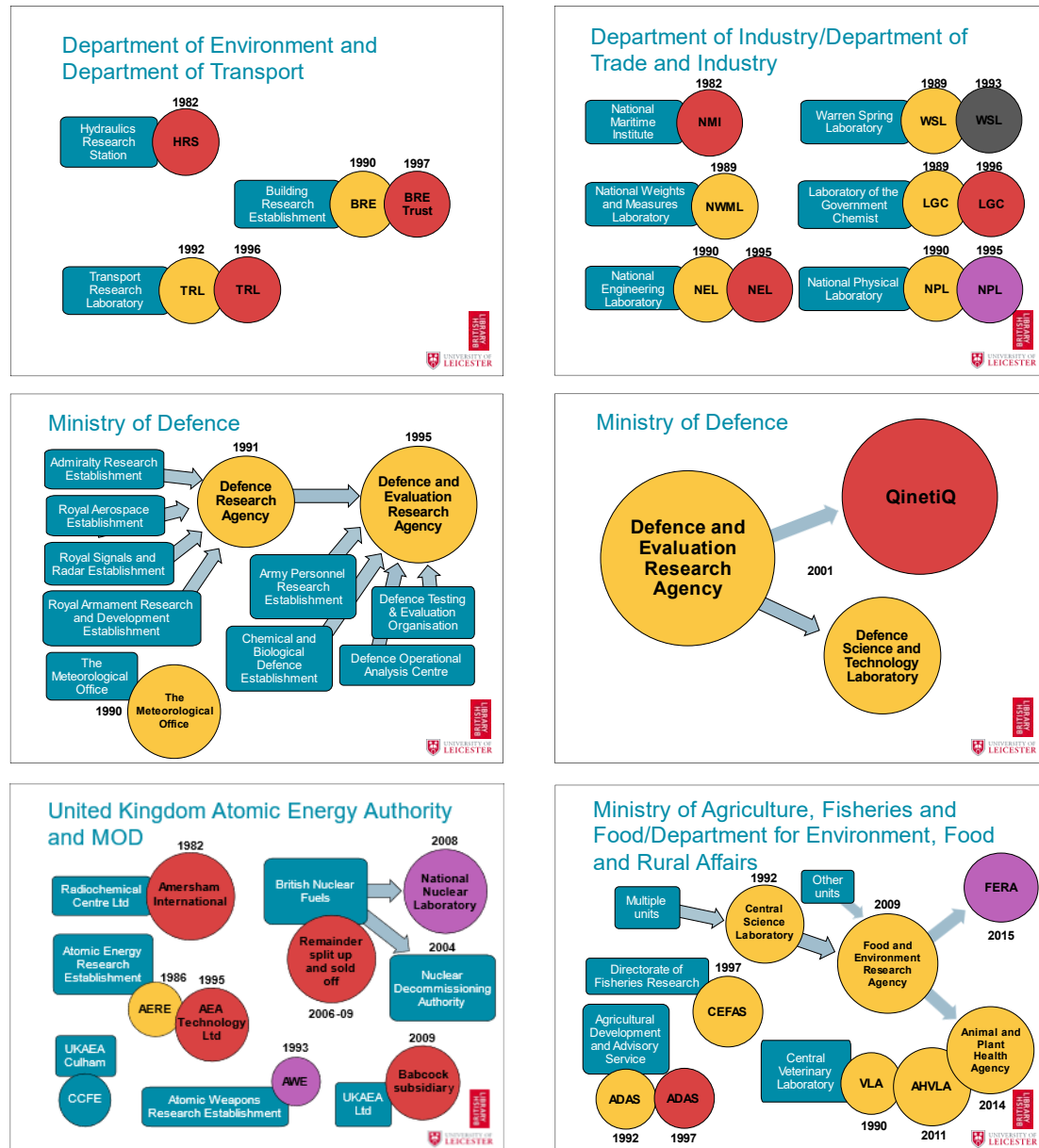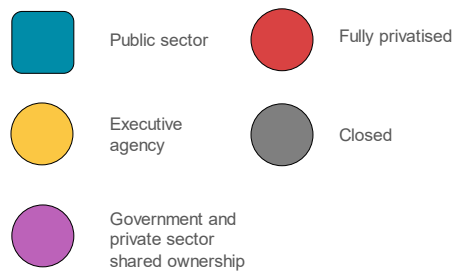
Appendix 3. Project participation paperwork

BRITISH LIBRARY

UNIVERSITY OF LEICESTER

Address 1
Address 2
Address 3

Name
Address 1
Address 2

Date

Dear X,

Oral history project: Privatisation of Government Science

I am writing to invite you to participate in a research project that is investigating how privatisation policies of the 1980s and 1990s affected government research establishments and the scientists who worked in them. The working title of the project is 'Re-evaluating the 1980s and 1990s through Life Histories: Politics, Privatisation and the Culture of Government Research'.

I am a collaborative PhD student with the University of Leicester and the British Library. Through this research project I aim to broaden our understanding of how privatisation impacted these establishments and the people who worked there. So far, little academic research has been published about how the organisational and cultural changes associated with privatisation were implemented, nor about how staff were affected individually. By conducting life story interviews with 20 scientists who experienced these changes I aim to record personal reflections that are not documented in the official records.

Your background of working as a XXXX at XXXX during this period means that your experiences are particularly relevant to the project. I would very much like to include your story in my research if you are willing to participate. Participation involves being interviewed by myself to record your life story, usually in your own home or in another location of your choice. This would include a discussion of your childhood, education, professional career, personal interests and family life. The areas of enquiry around your working life would include working as a scientist for the civil service, working relationships within the research establishment, relationships between scientists and Whitehall, political activities, commercial contracting, reactions to public sector reform and the changing nature of scientific work.

With your permission the project's findings would be incorporated into my PhD thesis. Similarly, your agreement would be sought over the future use of the completed audio recordings with the intention to deposit them in the British Library Sound Archive. Deposited recordings will complement the British Library's existing collection of interviews with scientists *An Oral History of British Science* (http://www.bl.uk/historyofscience). Your involvement in the project, which is being carried out in accordance with the University of Leicester's Code of Research Ethics, would be entirely voluntary and you would be entitled to withdraw at any time.

I would be happy to discuss this with you in more detail. Perhaps I can telephone you in the next week or so to discuss this in more detail?

I look forward to hearing from you.

With best wishes,

Emmeline Ledgerwood

INFORMATION SHEET
Oral History Project: Privatisation of Government Science
A collaborative PhD project funded by the Arts and Humanities Research Council
Researcher: Emmeline Ledgerwood, the University of Leicester and the British Library

The conduct of scientific research in the UK underwent a fundamental shift during the latter part of the twentieth century when many research activities that had originated in the public domain were transferred to the private sector. The aim of this project is to use life story interviews with scientists who worked in government research establishments to assess the impact of privatisation policies on their working lives and the nature of scientific research. The context of these changes will be informed through shorter interviews with senior civil servants, politicians and government advisers.

The project's working title is *Re-evaluating the 1980s and 1990s through Life Histories: Politics, Privatisation and the Culture of Government Research*. Little academic research has been published about how the organisational and cultural changes associated with privatisation were implemented in these establishments, nor about how staff were affected individually. By interviewing people who experienced these changes, the researcher aims to collect personal reflections on privatisation that are not documented in the official records. These findings will add to a broader understanding of the long-term outcomes of these policies.

The project covers both civil and defence research—the Building Research Establishment and the Royal Aircraft Establishment and its various successors have been selected as case studies. The areas of enquiry include: working as a scientist for the civil service, working relationships within research establishments, relationships between scientists and Whitehall, scientists' membership of political parties and trade unions, the introduction and expansion of commercial contracting, public sector reform, reactions towards organisational change and changes in ownership, and the changing nature of scientific work such as publication, collaboration and public engagement.

The recordings will be used as primary source material in the writing of the researcher's PhD thesis, and the findings will also be used in academic conference presentations or articles written for academic journals. The project is part of the work of the National Life Stories team at the British Library and the intention is for the completed audio recordings to be deposited in the British Library Sound Archive as a resource for other researchers. Deposited interviews will complement the existing collection of interviews with British scientists, *An Oral History of British Science*.

Before any recorded interviews begin, interviewees are asked to sign a Participation Agreement. This form asks for confirmation that the interviewee understands the nature of the project, how personal data will be managed and stored and how the recorded interview will be used in the writing of the researcher's thesis. Interviewees are at liberty to decide whether they want the material to be used only for the purposes of this specific research project, or whether they are happy for it to be deposited in the British Library Sound Archive where it will be preserved as a permanent public reference resource. If interviewees are happy for the material to be transferred to the British Library, they will be asked to complete a separate Recording Agreement form which determines how any information recorded is stored and used.

Involvement in the research is entirely voluntary and interviewees are entitled to withdraw from participation at any time by contacting the researcher. It is very important that interviewees are aware of the conditions of the project, which is being carried out in accordance with the University of Leicester's Code of Research Ethics (https://www2.le.ac.uk/institution/ethics/code). If you have any questions, and would like to discuss participating in the project, please contact Emmeline Ledgerwood at emme.ledgerwood@bl.uk.

The deposit of your oral history recording at the British Library

This leaflet explains:

o How your recording or interview will become part of the British Library's collections

o The forms we will ask you to complete to ensure we can provide public access to them in accordance with your wishes

o How people use recordings at the British Library

The British Library is the national library of the United Kingdom and one of the world's greatest research libraries. It provides world class information services to the academic, business, research and scientific communities and offers unparalleled access to the world's largest and most comprehensive research collection. The Library's collection has developed over 250 years and exceeds 150 million separate items representing every age of written civilisation, among which the oral history recordings are considered vital to the Library's intention to preserve the nation's memory.

As a statutory charity, the British Library is most grateful for contributions, such as yours, to help to build, improve and enhance its collections. These collections are cared for by a team of professionals: their priorities are to select, preserve, research and provide access to them.

Your oral history recording will become part of the national collection cared for by the British Library. The audio recording itself will be archived in the Library's Digital Library System (the British Library's system for securing digital content for the long term), and research access will be provided to generations of students, academics, family historians, journalists, writers and many others for years to come.

1

The British Library's Sound Archive

The Sound Archive holds over 3 million sound recordings. They come from all over the world and cover the entire range of recorded sound from music, drama and literature, to oral history and wildlife sounds. The Sound & Moving Image Catalogue, http://sami.bl.uk, is updated daily. It is one of the largest catalogues of its kind anywhere in the world, covering both published and unpublished recordings. Visit the Sound Archive section on the British Library website for more information: www.bl.uk/soundarchive.

The Oral History collections

Oral history is a powerful means of collecting and preserving the unique memories and life experiences of people whose stories might otherwise have been lost. Few historians, researchers, teachers and students can now afford to neglect the insights that oral sources provide. Our mission is to capture as many voices as possible from across Britain. The BL's oral history collection is one of the largest in the world and covers a huge range of topics encompassing diverse voices, from artists to steelworkers, doctors to postmen, Holocaust survivors to authors. Visit the oral history section on the British Library website for more information: www.bl.uk/oralhistory.

Many oral history interview projects are led by National Life Stories, an independent charitable trust based in the oral history section. Visit www.bl.uk/nls for more details.

Oral History
The British Library
96 Euston Road
London
NW1 2DB
020 7412 7404 / oralhistory@bl.uk

ORAL HISTORY PARTICIPATION AGREEMENT
Project: Privatisation of Government Science

The purpose of this form is to explain how the recorded interview which you agree to undertake with us as part of this project is archived at the British Library. When you sign this form you are agreeing to take part in the interview and allowing us to store and make use of your personal data now and in the future in order to administer and archive your interview.

After your interview we will ask you to complete an Oral History Recording Agreement to sign-off the terms under which your interview will be accessible at the British Library and through the British Library's online services.

Oral history at the British Library

The British Library is the national library of the United Kingdom and one of the world's greatest research libraries. It provides world-class information services to the academic, business, research and scientific communities and offers unparalleled access to the world's largest and most comprehensive research collection. The Library's collection has developed over 250 years and exceeds 150 million separate items representing every age of written civilisation, among which the oral history recordings are considered vital to the Library's intention to preserve the nation's memory.

The BL's oral history collection is one of the largest in the world and covers a huge range of topics encompassing diverse voices, from artists to steelworkers, doctors to postmen, Holocaust survivors to authors. The oral history section on the British Library's website has more information: www.bl.uk/oralhistory.

The collection which you are contributing to

You have been invited to take part in the **Privatisation of Government Science** oral history project which forms the basis of a collaboarative PhD research project between the University of Leicester and the British Library. The research is being conducted by Emmeline Ledgerwood, and the working title of the project is 'Re-evaluating the 1980s and 1990s through Life Histories: Politics, Privatisation and the Culture of Government Research'. This research complements the ongoing project run by the British Library *An Oral History of British Science* (http://www.bl.uk/historyofscience).

Your personal data

New data protection legislation (the General Data Protection Regulation [GDPR] which came into effect on 25 May 2018, and its implementing legislation, the Data Protection Act 2018) has changed the way in which we inform you about how your personal data is stored and processed, and how you can get access to it. For information about how the Library will use your personal data you can review our Privacy Policy at www.bl.uk/aboutus/terms/privacy/. Information contained within the interview itself will be processed in accordance with our Collection Materials transparency notice at www.bl.uk/aboutus/terms/privacy/Collection%20Materials/.

The Oral History Section at the BL also follows the Oral History Society's best practice guidance on data protection (www.ohs.org.uk/advice/data-protection/).

1

Oral History
The British Library
96 Euston Road
London
NW1 2DB
020 7412 7404 / oralhistory@bl.uk

What we will do with your personal data

The data contained within this form will be held securely and not shared with anyone, unless the Library is obligated to do so for legal purposes, such as evidencing ownership or demonstrating a valid Agreement. The information contained within the interview itself will be made available (subject to your agreement) through the Library to researchers, academics and other members of the public who access oral history content. We will keep this data in perpetuity, so as to preserve the oral history of the United Kingdom and inform the research of future generations.

You can request partial or complete closure of your interview to public access using the Oral History Recording Agreement which you will complete <u>after</u> your interview has been completed. You can request a copy of the personal data we hold about you at any time.

Your agreement to take part

This Agreement is made between **The British Library Board, 96 Euston Road, London, NW1 2DB ("the Library")** and you **("the Interviewee", "I")**:

Your name: ....

Your address: ....

Date: ....

Declaration

I have read and understood the **Privatisation of Government Science** project information sheet. I hereby agree to take part in an interview for the British Library and am fully aware that the intention is to make the content of this interview publicly available, subject to any closure or other restrictions that I might request when the interview has been completed.

By or on behalf of the Interviewee:

Signed: ....

Name in block capitals: ....Date: ....

Office use only:		
Full name:	Acc.no.:	Series title:

2

LIBRARY BRITISH

ORAL HISTORY RECORDING AGREEMENT
Project: Privatisation of Government Science

Recordings of oral histories are integral to the British Library's intention to preserve the nation's memory. Your recorded interview will become part of the national collection cared for by the British Library, where it will be preserved as a permanent public reference resource for use in research, publication, education, lectures, broadcasting and the internet. The purpose of this Agreement is to ensure that your contribution is added to the collections of the British Library in strict accordance with your wishes.

This Agreement is made between **The British Library Board, 96 Euston Road, London, NW1 2DB** ("the Library") and you ("the interviewee", "I"):

Your name: ....

Your address: ....

in regard to the recorded interview/s which took place on:

Date: ....

Declaration: I, the Interviewee, confirm that I agreed to take part in the recording and hereby assign to the Library all copyright in my contribution for use in all and any media. I understand that this will not affect my moral right to be identified as the 'performer' in accordance with the Copyright, Design and Patents Act 1988.

If you do not wish to assign your copyright to the Library, or you wish to limit public access to your contribution for a period of years, please state these conditions here:

....

This Agreement will be governed by and construed in accordance with English law and the jurisdiction of the English courts.

Both parties shall, by signing below, indicate acceptance of the Agreement.

By or on behalf of the Interviewee:

Signed: .... **Date:** ....

Name (block capitals) : ....

On behalf of The British Library Board:

Signed: .... **Date:** ....

Name (block capitals) : ....

Office use only:		
Full name:	Acc.no.:	Series title:

Appendix 4. Interviewees

Portraits, audio clips and brief biographical details.

**Portraits by Bill Knight.
Links to audio clips.**

Brief details of scientists' education and careers in GREs and successor organisations.

🎧 ▶️ https://vimeo.com/589370193 [Password: C1802]

C1802/01 Roger Courtney
Born in Barnehurst, Kent, 1946.
Secondary education in Greenwich, London.
Natural Sciences degree from Cambridge University, 1967.
MSc from Bristol University, 1969.
Joined BRE in 1969.
Operational Research degree from Brunel University, 1973.
Worked on secondment Whitehall, 1977–1986.
Deputy Director then Director of BRE, 1986–1990.
Chief Executive, BRE Executive Agency, 1990–1997.
Deputy Chairman, Building Research Establishment Ltd, 1997-1999.
Left BRE in 1999.

C1802/02 Dr David Dunford
Born in Dorchester, Dorset, 1959.
Secondary education in Salisbury, Wiltshire.
Joined RAE in 1975.
Materials Science and Engineering degree from University of Bath, 1983.
PhD from Imperial College, 1994.
Technical Director and Business Leader, Aerospace Technical Group, QinetiQ, 1999–2009.
Director, Aerospace Technology Programmes, QinetiQ, 2009.
Left QinetiQ in 2009.

🎧▶ https://vimeo.com/589356825 [Password: C1802]

C1802/03 Dr Vic Crisp
Born in Norwich, Norfolk, 1943.
Secondary education in Norwich.
Physics degree from Imperial College, 1965.
PhD from the University of East Anglia, 1970.
Joined BRE 1973.
Director of both Environment & Energy Group and Energy Efficiency Group, 1991–1997.
Worked on secondment to Carbon Trust.
Left BRE in 2003.

🎧▶ https://vimeo.com/589372630 [Password: C1802]

C1802/04 Dr Martin Wyatt
Born in Aylesbury, Bucks, 1950.
Secondary education in Aylesbury, Bucks.
Structural Engineering degree from Nottingham University, 1971.
PhD from Nottingham University, 1974.
Private sector engineering practices, 1974–1994.
Joined BRE 1994 as Director of Cardington Laboratory.
Chief Executive, BRE Group, 1997–2011.
Chairman, BRE Group, 2012–2014.
Left BRE in 2014.

https://vimeo.com/589378506 [Password: C1802]

C1802/05 Pam Turner
Born in Woking, 1949.
Secondary education in Woking, Surrey.
Library Association qualifications, Ealing Technical College, 1971.
Joined Central Unit for Scientific Photography as a librarian, 1971.
Joined RAE as a librarian, 1973.
Left QinetiQ in 2009.

https://vimeo.com/589384992 [Password: C1802]

C1802/06 Carol Atkinson
Born in Isleworth, Middlesex, 1959.
Secondary education in Gravesend, Kent.
Chemistry degree from Oxford University, 1981.
GEC Hirst Research Centre, 1981–1990.
Joined BRE in 1990.
Chief Executive, BRE Global Ltd, 1998–2012.
Left BRE in 2012.

https://vimeo.com/589389242 [Password: C1802]

C1802/07 Dr Chris Peel
Born in Shipley, Yorkshire, 1946.
Secondary education in Folkestone, Kent.
Physical Metallurgy degree from Birmingham University, 1967.
Joined RAE in 1967.
PhD from Southampton University, 1978.
Chief Materials Scientist, Structural Materials Centre, DERA, 1996.
Director of Technology, Futures Systems Technologies, QinetiQ, 2004.
Technical Director, Future Systems Technologies, QinetiQ, 2005.
Technical Director, Air Division, QinetiQ, 2005.
Left QinetiQ in 2006.

https://vimeo.com/589398764 [Password: C1802]

C1802/08 Susan James
Born in Wilton, Wiltshire, 1960.
Secondary education in Fleet,
Hampshire.
Joined RAE in 1979.
HNC in Applied Physics,
Farnborough College of
Technology, 1979–1982.
MSc in Environmental
Acoustics, South Bank
Polytechnic, 1986.
Technical Leader, Human
Acoustics Team,
DERA/QinetiQ, 1996–present,
Still employed at QinetiQ.

https://vimeo.com/589334806 [Password: C1802]

C1802/09 Phil Catling
Born on Isle of Wight, 1955.
Secondary education overseas.
Joined RAE in 1973.
Applied Science degree from
Royal Military College of
Science, Shrivenham, 1979.
Resource manager/Business
Group/Development Manager,
1995–2008.
New Business Manager,
Healthcare, 2008–2010.
Left QinetiQ in 2010.

https://vimeo.com/589455534 [Password: C1802]

C1802/10 Chris Scivyer
Born in St. Alban's,
Hertfordshire, 1957.
Secondary education in St.
Alban's, Hertfordshire.
HNC from Hertfordshire
College of Building, 1978.
Joined BRE in 1978.
Thirty years focusing on R&D
for radon reduction measures.
Retired from BRE in 2017.

🎧▶ https://vimeo.com/589419808 [Password: C1802]

C1802/11 Dr Steve Rooks
Born 1966, Caerleon, Wales.
Secondary education in
Caerleon, Wales.
Materials Science and
Technology degree from
Swansea University, 1988.
PhD from Swansea University,
1991.
Joined DRA in 1992. On
Farnborough site from 1993.
Head of Dstl Strategy, 2013–
2015/2021–present.
Capability Leader, Defence and
Security Analysis Division,
2015–2020.
Still employed at Dstl.

🎧▶ https://vimeo.com/589427345 [Password: C1802]
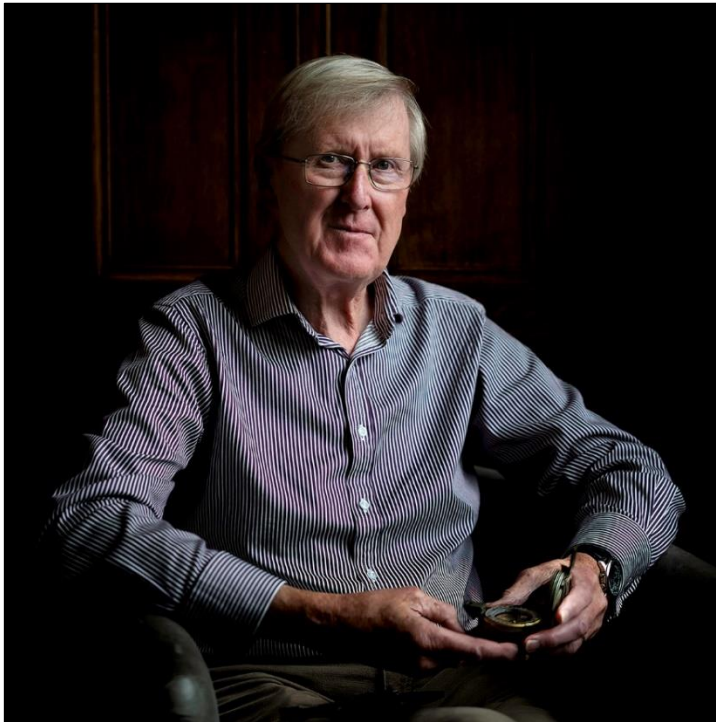
C1802/12 Alan Gray
Born in Coltishall, Norfolk, 1949.
Secondary education in Maidstone, Kent.
Natural Sciences degree from Cambridge University, 1972.
Joined Royal Artillery, 1972.
Technical Staff Course, Royal College of Military Science, Shrivenham, 1981.
Staff Officer (Weapons) at RSRE, 1983–1986.
Joined DRA as an HSO, 1995.
Physics and Mathematics degree from the Open University, 1996.
Left Dstl in 2009.

🎧▶ https://vimeo.com/589454469 [Password: C1802]

C1802/13 Dr Sarah Herbert (Bishop)
Born in Woking, Surrey, 1946.
Secondary education in Folkestone, Kent.
Physics degree from Victoria University of Manchester, 1967.
PhD from Victoria University of Manchester, 1970.
Joined RAE in 1971.
Section Leader in Composite Structures, 1990–1996.
Technology Group Customer, MOD, 1996–2000.
Assistant Director, Aerospace & Defence Unit, DTI, 2000–2005.
Retired 2009.

🎧▶ https://vimeo.com/589464037 [Password: C1802]
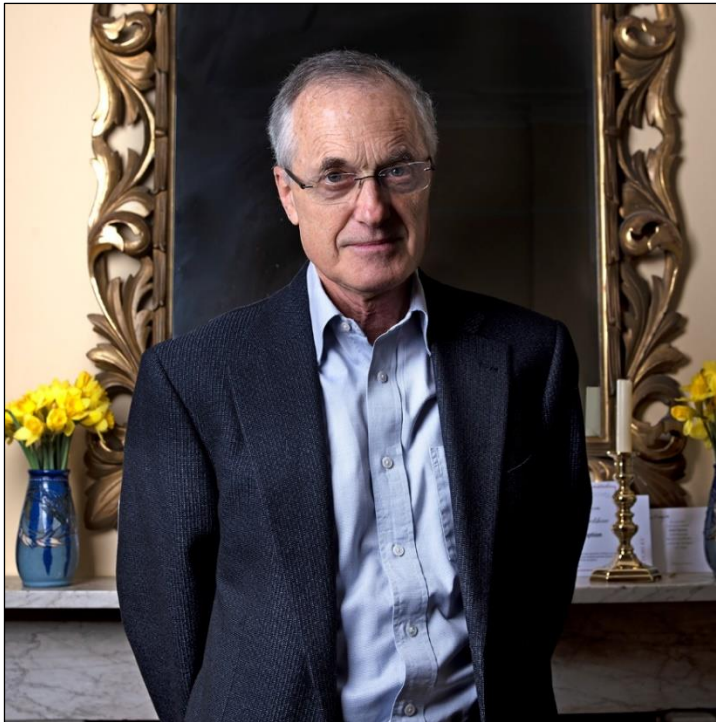
C1802/14 Sir Andrew Cahn
Born in Harwell, Oxfordshire, 1951.
Head of Research Policy, MAFF, 1988–1992.
Principal Private Secretary to William Waldegrave, Chancellor of the Duchy of Lancaster, 1992–1995.

https://vimeo.com/589466243 [Password: C1802]

C1802/15 Mike Westby
Born in Nottingham, 1967.
Secondary education in Nottingham.
Aeronautical Engineering degree from Southampton University, 1988.
Joined RAE in 1988.
Technical and project management roles in weapons systems R&D.
Project management and lead technical reviewer at Dstl.
Principal Adviser for Systems Effectiveness in Platform Systems Division, 2016–present.
Still employed at Dstl.

https://vimeo.com/589356656 [Password: C1802]

C1802/16 Wendy Westby
Born in Bournemouth, Dorset, 1968.
Secondary education in Brighton, Sussex.
Degree in Chemistry from Southampton University, 1990.
Joined RAE in 1990.
Analytical chemist supporting materials science research and fuels and lubricants centre, 1990–2009.
Left QinetiQ in 2009.

https://vimeo.com/589467428 [Password: C1802]

C1802/17 Shirley Jenkins
Born in London, 1935.
Secondary education in Dartford, Kent.
Joined RAE in 1954.
Applied Physics Diploma of Technology from Northampton Polytechnic, 1960.
Flight test observer measuring transmission of solar radiation.
Worked on programmes developing the use of infrared in defence countermeasures.
Retired from Dstl in 2005.

https://vimeo.com/589469378 [Password: C1802]

C1802/18 Dr Anthony Bravery
Born on Isle of Wight, 1941.
Secondary education in Sandown, Isle of Wight.
Botany and Zoology degree from Southampton University 1965.
Joined FPRL in 1965.
PhD from Imperial College, 1973.
Head of Timber Division, BRE, 1989–1997.
Director, Centre for Timber Technology and Construction (CTTC), BRE, 1997–2002.
Technical director roles, BRE 2004–2011.
Retired from BRE in 2011.

🎧▶ https://vimeo.com/589473396 [Password: C1802]

C1802/19 Dr Paul Cannon
Born in Enfield, Middlesex, 1953.
Secondary education in Enfield, Middlesex.
Physics and Electronics degrees from Southampton University, 1975 and 1976.
PhD from Southampton University, 1981.
Joined RAE in 1981.
Individual Merit, 1993.
Founder and leader of Radio Science and Propagation Group, DRA/DERA (Malvern), 1993–2000.
QinetiQ Senior Fellow, 2002.
Chief Scientist, Communications Division, QinetiQ, 2004–2008.
Left QinetiQ in 2013.

🎧▶ https://vimeo.com/589288988 [Password: C1802]

C1802/20 Ian Linsdell
Born in Dartford, Kent, 1956.
Secondary education in
Dartford, Kent.
Joined MOD in 1974.
Executive Accountancy
qualification, Royal Army Pay
Corps Training Centre, Worthy
Down, 1975.
RARDE representative on DRA
commercial accounting team, c.
1990.
Operations Director, Aerospace
Division, 2004–2011.
Left QinetiQ in 2011.

https://vimeo.com/589474818 [Password: C1802]

**C1802/21 Dr Robyn
Thorogood**
Born in Bradford-on-Avon,
Wiltshire, 1941.
Secondary education in
Ilfracombe, Devon.
Student Apprentice and HND at
North Gloucestershire Technical
College, Cheltenham, 1960.
Joined BRE, 1960–62.
A levels at Willesden Technical
College, 1961.
Civil Engineering degree from
Nottingham University, 1965.
Site engineer, John Laing
Construction, 1965–66.
BRE, 1969–73.
PhD from University of
Nottingham, 1969.
Advisor and co-ordinator of
scientific research programmes,
DOE, 1981–93.
Head of Construction
Innovation and Research
Management DOE, 1993–1997.
Left civil service in 1997.

https://vimeo.com/589479780 [Password: C1802]

C1802/22 Lord Peter Levene
Born in Pinner, London, 1941.
Chief of Defence Procurement, MOD, 1985-91.
Adviser to Prime Minister on Efficiency and Effectiveness, 1992–1997.

https://vimeo.com/589483425 [Password: C1802]

C1802/23 Sir John Chisholm
Born in India, 1946.
Secondary education in Worth, West Sussex.
Mechanical Sciences degree from Cambridge University, 1968.
Chief executive, DRA/DERA/QinetiQ, 1991–2005.

https://vimeo.com/589484472 [Password: C1802]

Appendix 5. Interview question schedule

Childhood/family

- Name, date and place of birth.
- Earliest memories.
- Family:
    - Parents, grandparents, siblings.
    - What was your relationship like with your parents?
    - What ambitions did your parents have for you?
    - Family leisure activities and holidays; childhood past-times, toys.
- Awareness of financial status, social class?
- Political outlook, party or union membership, membership of community groups.
- Religion.
- Media: books, newspapers, radio, TV, libraries.
- Childhood home and neighbourhood; household technologies, household chores.
- The outdoors.
- First memories of science or engineering.
- Modes of transport.
- Part-time jobs.

Education

- Description of primary and secondary schools.
- Subjects; teaching of science, talking about science with friends.
- Exposure to theatre, museums, literature, music, sport.
- What did you enjoy about school?
- Attainment and positions of responsibility.
- Curriculum.
- Influences: famous people, teachers or relatives, books, cultural or scientific items.
- Ambitions for further education.
- Relationships: eg. girlfriends/boyfriends, socialising.

Early adulthood

- Summer jobs.
- Higher education/apprenticeship:
    - Choice of subject.
    - Practical sessions: description of labs, technicians, facilities, materials, experiments.
    - Balance of theory and practical.
- Postgraduate study: funding, supervisor, content, methods, instruments.
- Women/men ratio.
- Political awareness; what were the issues of the day?
- Membership of clubs or societies, voluntary organisations, political party.

Career

- Why become a research scientist? Did you consider any alternatives?
- Experience of working in industry?
- Civil service:
    o Why the civil service? Other options?
    o Recruitment/applications.
    o Notions of public service: what does being a civil servant mean to you?
    o Were you conscious of having to give good value to the taxpayer?
    o Diversity in the workplace.
    o Civil service as an employer.
- Government research establishments (GREs):
    o What was the attraction of working at a GRE?
    o Were you familiar with the extent of government-funded research when you joined?
    o In your view, what was the aim of the GRE? What was its purpose?
    o Comparison of focus compared to academia, industrial R&D, research council institutes.
    o Status of GRE in international scientific community.
    o The quality of science at the GRE.
    o GRE culture: university/campus atmosphere.
    o Was there a different culture from GRE to GRE?
    o Comparison with culture of working in different scientific environments.
    o Status/role/identity of GRE? Did GRE consider itself superior? Did GRE lose some of its identity with organisational change?
    o GRE as repository of data: did you use the GRE library?
    o Institutional way of thinking and GRE culture; was it easily challenged?
    o Importance of institutional history?
    o GRE internal organisation:
        ▪ Description of section, division etc.
        ▪ Loyalty to organisation and team vs personal ambition.
        ▪ How did teams interact within the GRE? Working in silos? Danger of duplication?
        ▪ Research priorities over time: areas of focus, budgets, funding streams.
- Scientific civil service:
    o Career development.
    o Was there a clear technical career path?
    o Grades and hierarchy.
    o Promotion and appraisal system.
    o Secondments.
    o Terms of employment: new contract on privatisation?
    o Threat of redundancy.
    o Whitehall:
        ▪ Chief scientists in Whitehall, and in armed services.
        ▪ Relationships with desk officers in Whitehall.
        ▪ Were you a member of any advisory committees?
        ▪ Contact with Ministers and senior civil servants?
        ▪ What did you understand government attitudes to scientific research to be at that time?

Working life

- Personal perspective:
    - Ambition/goals: what did you hope to achieve in your career?
    - Memorable moments?
    - What motivated you?
    - Discussion of values and descriptions of science: basic, fundamental, strategic etc.
    - Your ideal way of doing science, funding of science?
    - How do you approach research? What makes research progress satisfactorily?
    - Were you aware of changes in science policy during your career?
    - Trade union membership.
    - Membership of local community.
- What do scientists do all day?
    - Programme of work – who made the decisions?
    - Opportunities to contribute, reporting structures.
    - Further education while employed.
    - Description of major research projects.
    - Description of workplace: labs, test facilities, offices, site.
    - Exciting moments, discoveries.
    - Managing scientific research in a GRE.
    - Coping with failures as part of working life?
    - Did you work on theoretical/experimental/applied research?
    - Experiments.
    - Equipment: variety, how to purchase, training.
    - Running tests.
    - Report writing.
    - Training:
        - Shrivenham.
        - Courses for career development.
    - Memorable work trips: international, to other institutes, tests and trials.
    - Conferences, publishing papers, networking.
    - Use of computers.
    - Daily tasks.
    - Taking responsibility; were civil servants reluctant to do so?
    - Networks:
        - Extramural contractors and level of co-working; different mindsets between civil servants and private sector; comparison with other research labs; contracts and patents officers in GREs.
        - Links with UK defence attachés or scientific counsellors in embassies.
        - Links with peers in academia, industry, other GREs, international.
    - Research budgets and finance:
        - Who set and controlled budgets?
    - Customers:
        - Government departments, industry etc.
        - Idea of the intelligent customer – what does it mean to you?
- Membership of professional bodies.

- Working in a team:
    - How did the team operate? Reporting structure?
    - What were your bosses like?
    - Did you feel part of a team?
    - Did you feel your work was valued?
    - Social side, lunch and tea breaks.
    - Colleagues
        - Faith, social activities, politics, ethnicity/diversity.
        - Eccentrics, those that lived on site.
        - Influential, internationally recognised colleagues.
    - Visiting VIPs eg. foreign nationals, royalty, politicians.
    - Dress code: what did people wear to work?
    - Were there aspects of your role that required emotional input?

National and international politics

- Awareness of national/international politics?
- Impact on working life - Cold War era, Falklands War, Northern Ireland.
- Awareness of changes in science policy?
- Reviews or policies that affected working life?

Commercialisation/organisational change

- Management of research:
    - Who was in charge of implementing change? Input from Whitehall, consultants?
    - Scrutinies, reviews, feasibility studies – what did they entail?
    - Implementation of performance measurement.
    - Project management tools: timesheets etc. What was your personal experience of these?
    - Health and safety.
    - Implementing quality assurance eg. ISO 9001.
    - How did your daily working life change?
    - Funding streams: how did they change?
    - Market testing, purple money: preparing for executive agency status?
    - Concept of a customer:
        - Changes in customer base.
        - Identifying future customers and markets.
        - Customer focus.
    - Drawing up bids - learning how to do this successfully?
    - Competitors when bidding.
    - New accounting and financial systems.
    - Increasing expectations of accountability: how did that affect you?
    - Use of consultants to effect change?
    - What areas of research fell away due to lack of customers? Did you notice a loss of expertise within the organisation?
    - Loss of prestige, status for organisation and for staff?
- Staff/teams:
    - How did team structures change? New management roles?

- o Staffing levels.
  - o Attitudes to John Chisholm/Martin Wyatt/senior managers?
  - o Consultative process?
  - o Rationalisation: staff relocations, reducing staff numbers, reducing equipment and facilities.
  - o Changes in recruitment?
  - o Training for new accounting and project management systems?
  - o What was the expectation surrounding goal of efficiency?
  - o Union membership and activity.
  - o Atmosphere among staff: morale/mental health?
  - o Redundancies: were you ever at risk? Effects on remaining staff.
  - o Communications from management: how was change communicated?
  - o What changes did staff resist?
  - o Changes in use of physical space eg. different offices [Cody Technology Park], office design, laboratory provision.
- Innovation:
  - o Patenting in GREs.
  - o Becoming entrepreneurial.
  - o Changes in grading structures, appraisals, promotions with new organisational structures?
  - o Working in defence research: OSA and classified research?

Privatisation implementation

- What did this involve?
- New branding?
- New grades/levels/job titles?
- Transfer of pension?
- Share offers?
- Restructuring of teams/sections?
- Changes in union status after privatisation?
- Use of management consultants?
- Loss of experimental facilities/negotiating a future for facilities?
- DERA split: implementing the firewall between QinetiQ and Dstl?

Privatisation impact

- Changing terms and conditions of employment?
- New responsibilities for managers eg personnel management?
- Relocation and rationalisation eg Dstl to Portsmouth.
- Daily working patterns.
- Different managers brought in from outside.
- Administrative changes.
- Your personal attitude to privatisation/split; how does this compare to colleagues' experiences? Did you feel better off?
- Effects on working practices, relationships with colleagues?
- Did it increase internal competition?

- Pressure to innovate? How did new pressures compare between Dstl, QinetiQ and BRE?
- How did privatisation/split affect strategic programmes?
- Were there changes in approaches to scientific research?
- Casualties of privatisation/split? Knowledge exchange, ownership of intellectual ideas?
- Impact on autonomy in research?
- Mission drift? Lack of capital investment in national facilities? Succession planning?
- Ownership of land and buildings.
- Changes in staff recruitment, staff appraisals and promotions.
- Have you ever considered moving from QQ/Dstl/BRE to another sector?
- Reflections on individual achievements and career.
- Dstl**:**
  - How did Dstl differ to DERA?
  - Establishing an identity/brand?

Reflection

- Do you continue to have technical interests/research questions?
- Your assessment of the long-term impact of commercialisation and privatisation on scientific research.
- Your personal legacy.
- The oral history interview process.

Appendix 6. Example of an interview content summary

Carol Atkinson, interviewed by Emmeline Ledgerwood, Hemel Hempstead, 2018, BL C1802/06.

Track 1 [Session one: 10 July 2018] [Intermittent rustling when interviewee shifts position; intermittent background noise through open windows] Carol Atkinson [CA], born Isleworth 5 April 1959. Father engineer at National Physical Laboratory [NPL], then left for better pay at Mimic Diagrams and Electronics in Kent. Comments about moving to Kent. Mentions preferring to be outdoors and asking lots of questions as a child. Remarks about primary school. Comments about CA's mother. Story about mother lacking confidence intellectually, leaving school at 15. Parents met at NPL. Comments about father's career. Story about accompanying father to electronics factory and sitting with girls in wiring shop. [00:11:06] Mentions being born with spine problems and father assuming CA would need to support herself. Description of how the spine problems affected CA. Comments on having spine fused aged 21 and reasons why. Remarks about impact of having a physical disability. Story about job offer at Esso being withdrawn because of the surgery. Mentions enjoying post-graduate research job at Oxford University. Description of traction. [00:20:30] Further comments on father's factory. Remarks about CA's sister being very different and interested in fashion. Comments on family holidays and outings. Story about CA getting herself and her sister ready for school. Description of childhood games and activities. Mentions wanting to mix science and arts subjects at A level. Mentions being fearful of how CA would support herself after leaving home. [00:29:44] Comments about discussing science with her father. Mentions his involvement with renewable energy when working at John Brown. Describes father coming home with models of wind turbines and discussing them with CA. Story about mother once getting a job to pay for a fur coat. Comments on parents' attitude to politics. Mentions mother read the 'Express' and father the 'Daily Telegraph'. Mentions father persuading CA not to join Young Communists. Comments on CA's views on relations between people and the environment. Mentions family were not churchgoers and that CA became a Christian at university. Remarks about CA's mother belonging to Young Housewives and other voluntary organisations. Remarks about learning about business from her father. [00:38:58] Story about using grandmother's advice on making money as an example at the Building Research Establishment [BRE]. Comments about family finances. Comments on CA's holiday job in local pub. Comments on teachers at primary school. Mentions being interested in nature as a child. Comments about being bullied at middle school. Further remarks about secondary school and curriculum. Mentions wanting to play the piano as a child. Story about discovering her father played piano. Mentions going to the pub as a family on Sunday lunchtimes. Story about sports mistress at school. Comments on involvement in cricket club through father playing for the club. Remarks about lack of transport limiting involvement in after school clubs. Comments on speaking in public. [00:58:48]

Track 2 Story about father's mathematics aptitude and applying to university. Comments about father's sister who studied maths at Oxford and became a maths teacher. Comments about CA's application to Oxford and description of entrance exam. [microphone becomes dislodged]. Remarks about deciding on a chemistry degree. [00:09:31] Story about CA not wanting to go to Oxford. Reflection about impact of going to Oxford University. Description of experience of going to Oxford. Mentions most of her friends were studying Philosophy, Politics and Economics (PPE) or Law. Comments on becoming interested in politics at Oxford. Mentions belonging to Oxford Union and starting up a cricket society. Comments about loving cricket. Description of course commitments. Remarks about not being good at practicals. Comments about less consideration for health and safety when CA was doing practicals at school and university. Comments about staying on to work as a research assistant on photovoltaics in Professor John Goodenough's group which developed the lithium-ion battery. Mentions being aware of photovoltaics because of CA's father. Description of how CA joined that research group where she worked on using photovoltaics to generate hydrogen from sunlight. Remarks about environmental consequences of using rare metals for battery technology and in electric vehicles. Comments about responding as a scientist to government policies. Comments on activities of Department of Environment [DOE] and Energy Efficiency Office driving introduction of condensing boilers and energy efficient lighting. [00:31:03] Further comments about influence of German and other manufacturers on UK standards. Remarks about technical expertise in Whitehall and lobbying of civil servants such as through international conference invitations. Comments about CA's view that some research was undertaken to satisfy lobbyists. Story about rigid hierarchy at BRE. Remarks about bureaucracy and occasionally copying senior staff into CA's memos. [00:38:26] Further comments on relevance of degree to CA's career. Remarks about thinking about a career in marketing. Comments about provision of equipment in university labs. Remarks about university holidays. Mentions joining Oxford Union library committee because they wanted a scientist. Comments about activity at Union. Mentions how CA has been influenced by work of researcher [Suzanne Simard] who has studied how trees communicate using fungi. Comments on CA and political activity. [00:51:37] Comments on CA's belief in need for clean, alternative sources of energy. Description of Oxford Energy Group, including Phil Wiseman and Andrew Hamlet under Goodenough and CA's work in the group. Mentions CA discovered some of the first organic photovoltaics but never wrote it up. Description of getting electricity by shining light on a junction between a metal and a semiconductor. Mentions group were looking at a range of semiconductor materials and gave CA gallium arsenide to investigate. [00:58:24] Comments on interactions between scientists in the group. Description of coffee/tea breaks. Mentions PhD student Martin Dare Edwards [MDE] who helped CA with her research. Description about how CA approached the research. Remarks about testing whether organic substances produced a photo current. Comments on potential of organic semiconductors. [01:05:41]

Track 3 Comments about how research team managed its budget and members of the team. Further remarks about MDE. Remarks about other women scientists in the group. Comments on possibility of doing a PhD at that time. Story about CA working out

economics of producing photovoltaic devices and finding out more about industrial chemistry. Mentions conflict CA feels about industry's effect on the environment. [short break] Comments about looking for work after Oxford. Story about interview at GEC while in plaster after spine operation. [00:09:43] Comments about difficulties resulting from the operation. Story about GEC's attitude to CA's post-op requirements and other staff with disabilities. Reflection on impact of CA's disability on her career. Story about recent problems getting medical equipment replaced by NHS. [00:19:23] Further remarks about application process for GEC job. Mentions not thinking of applying to scientific civil service then. Comments about GEC HR secretary suggested CA join microelectronics photovoltaic team. Comments on organisation of research teams. Reflection on decrease in co-operation among colleagues as GEC wanted more transparency over expenditure. Description of CA's day book to record her activity at work. Description of CA research at GEC on double layer metals. Remarks that most of her colleagues were electronics engineers rather than chemists. Story about being teased for being female and for not having the right physics and electronics knowledge. Mentions being able to ask questions of people same age as CA's father. Comments about women at GEC, including boss Eileen Reid [ER] who was a good manager. Mentions gossip regarding ER's senior position and similar suggestions being worse in the civil service. Comments on relationships with other women at GEC. Story about men looking out for CA to make a mistake. [00:38:04]

Track 4 [Session two: 24 July 2018] [incorrect date on audio] Description of GEC Hirst building. Comments on use of labs and need to avoid cross-contamination. Comments on materials that CA used. Comments of patent infringement and reverse engineering. Mentions working on some Ministry of Defence [MOD] contracts. Description of how silicon and gallium arsenide were prepared for use in experiments. [00:09:43] Comments on lab equipment and efforts to produce devices at lower temperatures. Description of loading wafers manually into furnaces. Description of loose hierarchy of team at GEC. Mentions some GEC customers. Remarks about always working with other people and part of a team. As an example tells detailed story about how CA worked out a solution to a serious problem at GEC with voltage in thyristors used in communication devices. Mentions being awarded a technical prize a year later. [00:21:18] Comments on CA's approaches to a research problem. Comments on getting papers published while at GEC, including one on Schottky barrier diodes. Remarks about not being particularly interested in attending conferences, observing that colleagues would go to conferences to find new jobs. Remarks about getting a job offer from Hewlett Packard. Comments about collaborators, including with the Royals Signals and Radar Establishment [RSRE] at Malvern on developing plasma etching processes. Comments on exchanging visits with RSRE scientists. [00:30:14] Mentions not remembering that sharing of knowledge was restricted in that situation. Remarks about timesheets. Mentions at BRE was conscious of government attitudes to state funding of research, but not at GEC. Mentions disappointment at GEC that Lord Weinstock decided not to go into consumer electronics. Remarks about technical director at GEC Dr Mike Reece. Mentions 1400 people working at GEC Hirst when CA started, then numbers dropped. Comments about visiting GEC factories and enjoying working at Hirst. Mentions becoming anxious about losing her job

when staff cuts with merger of GEC, Siemens and Plessey. Remarks about effect of design issues with Nimrod aircraft led to changes in MOD contracts that changed from cost-plus. [00:40:17] Mentions not using terms such as 'Big Science'. Remarks about colleagues accepted jobs abroad. Mentions CA did not want to leave the UK. Comments about personal life and marriage while working at GEC. Comments about leaving GEC as CA was not prepared to move to a job in Marconi working on quality systems. Remarks about Marconi company culture. Mentions being asked to rethink after leaving GEC. Remarks about morale at GEC during cuts. Anecdote about building team spirit in GEC team and having to let team members know they were being made redundant. Description of how CA moved into different roles at GEC. [0:49:59] Description of using flowcharts, learnt from manager Eileen Reid. Mentions one process having 1600 stages in the flowchart. Comments on who was responsible for the whole process and influence of Edward Deming on Japanese businesses. Description of how scientists kept track of processes in ring-binder files which CA refers to as 'recipes'. Description of how CA started on a new project by going to the library or talking to people who had worked on previous project. Comments on importance of library as a resource. [00:58:39] Remarks about computing being a hindrance rather than a help in early days. Mentions typing pools. Further remarks about loss of BRE library and CA receiving updates from Hansard from librarian. Mentions librarian left BRE around privatisation. Description of why CA was successful in getting funding from government departments. Comments on becoming interested in politics. Remarks about getting advice from the librarian. [01:05:06]

Track 5 Comparison of importance of getting papers published in academia, industry and civil service. Remarks about pressure at BRE for publications and staff being invited to write for publications where articles were not checked as BRE seen as the authority. Detailed comments on mentors as an early career scientist and those who actively disapproved of CA because she was female and chemist. Comments on managing scientists and CA's style. Mentions brief daily team meetings. Remarks about why scientists were not always open. Comments on lack of management in civil service and size of redundancy packages. [00:11:31] Remarks about redundancies at BRE and management at GEC. Comments about CA deciding to leave GEC because she didn't want to work at Marconi Defence Systems. Remarks about union membership. Mentions CA was never a member and being uncomfortable with idea of unions. Comments on why CA applied to work at BRE and getting a job offer from Hewlett Packard. Remarks about CA being main income earner and moving to Hemel Hempstead. Mentions not being aware of different culture in the civil services. [00:20:10] Comments about different kinds of science at GEC and BRE. Description of interview for BRE. Story about going to BRE bar, the Reinforcing Bar, on day of interview. Story about fighting to get the same salary as at GEC. Comments on terms and conditions of working for civil service. Story about chatting to the cleaner. Mentions being restricted as to which grades CA could communicate with at BRE. Comments on hierarchy. Description of energy efficiency section. Mentions doing her own research into the limitations of the work commissioned by Energy Efficiency Office and effects on the environment. [00:30:50] Mentions BRE had taken CA on to do project management. Comments about

consequences of promoting energy efficiency measures. Comments about general programme of work at BRE. Mentions moving a year later into the materials group to work on testing and environmental labelling. Story about being token woman in that group. Comments about further move where hierarchy no longer limited CA. Comments about science done in the civil service and that BRE programme was divided between policy departments and spending departments. [00:40:12] Comments about CA contact with civil servants in the departments usually at the same grade level. Description of consulting Whitehall organograms to identify the right civil servants to approach. Description of some colleagues' lack of input during the working day. Mentions tea breaks or staff playing tennis while clocked in. Comments on civil servants working for the public good and need to work across departments. [00:49:40] Remarks about energy consumption and production, a secure and sustainable supply. Mentions introducing Sir David MacKay [DM] to the Department for Energy and Climate Change where he became chief scientific adviser. Comments on DM's contribution to the energy debate. Description of meeting DM through CA's role at BREEAM [BRE Environmental Assessment Method] for sustainability of buildings. Comments about BREEAM's attitude to nuclear power. Comments on need to base BREEAM's work on scientific evidence and doubts about energy efficiency. Remarks on BRE's potential to help solve problems after privatisation. Comments about potential of certification at BRE. [01:00:40]

Track 6 Description of BRE response to EU environmental labelling regulation and need to consider where and how products would be used. Comments about doing some research for UK Eco Labelling Board. Remarks about CA's advice to BRE about eco labelling. Story about submitting a report to DOE and description of labelling system developed for buildings. [00:10:20] Remarks about enjoying role as business development manager for Materials group. Comments on BRE becoming an executive agency. Comments on role of business development manager and having restrictions on how much business CA could generate. Remarks about BREEAM model. Comments about encouraging departmental staff to think about how to make money. Comments about being financially aware and making charitable donations. [00:20:04] Remarks about patenting. Mentions no drive for patenting at BRE. Story about Martin Wyatt's [MW] efforts to develop a clean air product from a collaborator's patent. Comments on attracting business to BRE and success of BREEAM certification sales. Remarks about BRE's advisory service which could include site visits. Mentions not being attracted to working in Whitehall. Comments about colleagues who did. [00:29:55] Comments on grades. Remark on structure of civil service not being compatible with science. Story about working out that a problem in production of devices was due to the person working on the night shift. Comments on restructuring of BRE post-privatisation and encouragement of cross-discipline working. Remarks on matrix management theory. Comments about performance appraisal. [00:40:46] Comments on introduction of performance-related targets. Comments on scientists' attitudes to growing expectation to bring in business. Description of CA training initiative in commercial essentials. [00:47:22]

Track 7 [Session three: 22 August 2018] Remarks about providing financial training as team members were financially naïve. Comments about having to price up project on first day at GEC. Story about GEC accountant explaining charge out rates to CA. Remarks about roles after environmental labelling and being a business development manager. Mentions belief that BRE would be better run in private sector. Comments about how BRECSU was funded and run. Mentions conflict between scientists and non-scientists about the validity of some BRECSU [Building Research Energy Conservation Support Unit] proposals. [00:09:54] Remarks about moving to heritage team within materials group. Mentions boss writing on appraisal that physical disabilities would affect CA's career at BRE. Comments on CA's strategy as a business development manager which civil servants found refreshing. Description of asking library staff to compile regular news report for CA from construction press plus questions in Hansard. Remarks about travel allowances. Mentions anxiety among colleagues about organisational changes. Remarks about Futures Group which was then closed once privatisation bids were in preparation. Mentions announcement being a shock to staff. Remarks about Prior Options review. Mentions being in adjoining office to MW. [00:20:17] Comments about discussions in Futures Group and CA suggestion for certification business. Comments on establishing the certification business. Mentions belonging to a group looking at recycled aggregates. Description of first step of getting standards for certification bodies and writing a quality manual and gradual recruitment of experts. Mentions difficult process working with UKAS (UK Accreditation Service) to be licensed. Story about problematic accreditation scheme for construction industry. [00:31:53] Mentions period of father's death and breakdown of CA's marriage. Comments about being responsible for bringing facilities together into central location. Mentions a lot of facilities were associated with research to inform development construction product standards. Comments about facilities brought over from Loss Prevention Council. Remarks about staff having emotional attachment to facilities. Comments about rival bids and pension implications. Remarks about pension deficit. [00:40:13] Comments about preferring not to have government as main customer. Description of the work for which government was invited bids. Remarks about scientists at BRE and nature of BRE work. Comments on government giving building regulation work to other contractors. [00:50:54] Comments on Grenfell Tower fire. Remarks about how building regulations are set out and consequence of privatisation of building control. Mentions issue with eco labelling of fridges and freezers. Comments on good and bad science and science that influences life safety and property safety. [01:02:50]

Track 8 Description on CA's view of how to do good science and to make it open. Story about Robert Millikan going unchallenged about a mistake he made. Remarks about scientists being upset after privatisation. Comments on efforts to promote culture change, including financial training and introduction to risk management. Comments about needing to improve health and safety after privatisation. [00:11:01] Remarks about MW wanting recruits with some commercial experience. Remarks about some redundancies. Comments about working hard to generate business and good diversity of skills in CA's

teams. Remarks about people moving offices. Mentions improvements in management after privatisation. Remarks about attitudes in civil service to keeping account of working day. Mentions staff survey about BRE conducted pre-privatisation. Anecdote about BRE being known locally as a holiday camp. Comments about changes MW made. [00:20:53] Comments about reasons why some work fell away such as building regulations and promotion of energy efficiency. Remarks about no longer bidding for government business because MW asked CA to focus on health and safety, the facilities, setting up BRE certification. Comments about women at BRE. Mentions efforts to recruit and encourage women at BRE. Mentions not being aware at the time that CA was first woman to reach a certain level at BRE. [00:29:57] Remarks about rationalisation of site improving working practices. Comments on benefits of open plan offices to individual offices. Mentions having a major row with MW over loss of library. Comments on role of library staff in connecting staff with each other and as information scientists. Mentions BRE did not keep up all database subscriptions after privatisation. Remarks about retaining library of timber products. Mentions library of stone samples from UK quarries. Remarks about MW ideas to broaden BRE work beyond construction industry. [00:41:11] Comments on MW trying to make money out of BRE intellectual property. Story about reverse engineering a Hewlett Packard product at GEC. Remarks on qualities sought in new recruits. Comments about BRE Ventures and proposal for an air cleaning product. Remarks about process of being interviewed for an oral history project. [00:50:53]

Bibliography

PRIMARY SOURCES

<u>Archival material</u>

British Library, London

An Oral History of British Science, BL C1379:

Desmond King-Hele, interviewed by Paul Merchant, Farnham, 2010, BL C1379/13.

John Charnley, interviewed by Thomas Lean, Camberley, 2010, BL C1379/30.

John Houghton, interviewed by Paul Merchant, Aberdovey, 2007, BL C1379/45.

Julia Slingo, interviewed by Paul Merchant, various locations, 2011–2012, BL
    C1379/61.

Cyril Hilsum, interviewed by Thomas Lean, Middlesex, 2012, BL C1379/69.

Jenny Constant, interviewed by Thomas Lean, Powick, 2013, BL C1379/98.

Privatisation of UK Government Science: Life Story Interviews, BL C1802:

Roger Courtney, interviewed by Emmeline Ledgerwood, Watford, 2018, BL
    C1802/01.

David Dunford, interviewed by Emmeline Ledgerwood, Farnborough, 2018, BL
    C1802/02.

Vic Crisp, interviewed by Emmeline Ledgerwood, London, 2018, BL C1802/03.

Martin Wyatt, interviewed by Emmeline Ledgerwood, Watford, 2018, BL C1802/04.

Pam Turner, interviewed by Emmeline Ledgerwood, Fleet, 2018, BL C1802/05.

Carol Atkinson, interviewed by Emmeline Ledgerwood, Hemel Hempstead, 2018,
    BL C1802/06.

Chris Peel, interviewed by Emmeline Ledgerwood, Fleet, 2018, BL C1802/07.

Susan James, interviewed by Emmeline Ledgerwood, Church Crookham, 2018, BL
    C1802/08.

Phil Catling, interviewed by Emmeline Ledgerwood, Farnborough, 2018, BL
    C1802/09.

Chris Scivyer, interviewed by Emmeline Ledgerwood, Frogmore, 2018, BL
    C1802/10.

Steve Rooks, interviewed by Emmeline Ledgerwood, Meonstoke, 2018–19, BL
    C1802/11.

Alan Gray, interviewed by Emmeline Ledgerwood, Malvern, 2019, BL C1802/12.

Sarah Herbert, interviewed by Emmeline Ledgerwood, St. Mary's Bay, 2019, BL C1802/13.

Andrew Cahn, interviewed by Emmeline Ledgerwood, London, 2019, BL C1802/14.

Mike Westby, interviewed by Emmeline Ledgerwood, Hedge End, 2019, BL C1802/15.

Wendy Westby, interviewed by Emmeline Ledgerwood, Hedge End, 2019, BL C1802/16.

Shirley Jenkins, interviewed by Emmeline Ledgerwood, Farnham, 2019, BL C1802/17.

Anthony Bravery, interviewed by Emmeline Ledgerwood, Longwick, 2019, BL C1802/18.

Paul Cannon, interviewed by Emmeline Ledgerwood, Colwall, 2019, BL C1802/19.

Ian Linsdell, interviewed by Emmeline Ledgerwood, Titchfield, 2019, BL C1802/20.

Robyn Thorogood, interviewed by Emmeline Ledgerwood, Haddenham, 2019, BL C1802/21.

Peter Levene, interviewed by Emmeline Ledgerwood, London, 2019, BL C1802/22.

John Chisholm, interviewed by Emmeline Ledgerwood, Rickmansworth, 2019, BL C1802/23.

Radio and television programmes

'Fulton Report on the Civil Service', 28 June 1968, BBC Archive.

'Government and the Civil Service', BBC Radio 3, 16 October 1976.

'A will of steel', BBC 1, 30 September 1980.

'Politics of Thinkings', BBC Radio 4, 20 May 1984.

'A Bloody Union Jack on Top of It', BBC Radio 4, 6 May 1988 and 13 May 1988.

'Whitehall and the Boffins', BBC Radio 4, 18 September 1997 and 25 September 1997.

The National Archives, Kew

AT 66/189   Building Research Establishment privatisation: working papers regarding the privatisation of BRE and possible Management Board bid, 1996–7.

AT 67/681   The role of the Building Research Establishment – presentation to the Construction Division research assessment panel, July

1992 by R. G. Courtney, 1992.

AT 82/209	Increasing the role of the private sector in research: assessment of progress made in the Department of the Environment, 1982–83.
CAB 130/1117	Official Steering Group on Government Strategy: meetings 1–5, papers 1–21, 1979.
CAB 130/1305	Ministerial Group on Research and Development Priorities Across Government: meetings 1–4, papers 1–20, 1985.
CAB134/5100	Ministerial Steering Committee on Economic Strategy: Sub-Committee on Science and Technology: meetings 1–3, papers 1–13, 1987.
DEFE 68/1165	Controller R&D Establishments Research (CER) Winter Conference: 1980/81/82/83/84/85.
DEFE 72/213	Reviews of work of Space Department, Royal Aircraft Establishment (RAE), 1977–1981.
DEFE 75	Defence Evaluation and Research Agency (DERA) and its immediate predecessors: Reports and Files 1991–2001.
DSIR 72/144	National Physical Laboratory Local Joint Industrial Committee (LJIC): agendas, minutes and constitution, 1975–1988.
PREM 19/680	Civil Service: Long term management and manpower policy; open structure review; response to Select Committee report on efficiency and effectiveness in Civil Service; Management Information System for Ministers (MINIS); part 10, 1982.
PREM 19/149	Civil Service. Long-term management and manpower policy: efficiency of central government; Civil Service manpower; Sir Derek Rayner's recommendations for reforms; part 3, 1980.
PREM 19/772	Government Machinery: Review of supporting services in Research and development and allied scientific establishments, 1981–2.
T 644/75	Financial Management and the 'Next Steps' Programme: Defence Research Agency, 1988–89.

Farnborough Air Sciences Trust, Farnborough

Ministry of Technology Telephone Directory (1969).

Ministry of Defence Telephone Directory (1976).

Letter from Donald Spiers, Controller Establishments Research and Nuclear Programmes, to Establishments staff, 16 March 1989.

RAE Telephone Directory (1990).

Letter from Nigel Hughes, Chief Executive (Designate) to all DRA staff, 10 January 1991.

DRA – A New Era in Defence Research (1991).

Countdown Bulletin (1989–1990).

DRA Bulletin (1990–1992).

DRA Telephone Directory (1993–1994).

DRA News (1992–1995).

DERA News (1995–2001).

BRE Archives, Garston, Watford

BRE News (1972–1984).

BRE News of Construction Research (1984–1998).

BRE Annual Reports (1989–96).

Innovation Policy Research Associates, *Analysis of Private and Public Sector Funding of Research and Development in the Construction Sector* (1992).

BRE View (1995–1996).

Correspondence and minutes of meetings between BRE staff, civil servants and union representatives regarding redundancy agreements, transfer of pension arrangements and union status on privatisation (1996).

Press cuttings relating to privatisation of BRE (1995–1997).

Agreement on the Pay and Grading Arrangements and Related Matters for Staff in the Building Research Establishment (1996).

PA Consulting Group, *A Review of Privatisation Options for the Building Research Establishment: Final Report* (1996).

Building Research Establishment Privatisation Options Study, Advisory Group View (1996).

Documents concerning proposals to establish a National Construction Centre, 1996.

Pannell Kerr Forster, *Limited Scope Review of the Building Research Establishment on behalf of Price Waterhouse* (1996).

Documents relating to the BRE Management Bid (1996–1997).

BRE, *Vulnerable BRE Technical Capabilities of National Importance*, n.d.

BRE Business Plan, n.d.

Science Policy Research Unit, *Developing a Construction Futures Capability –
Scoping Study* (1997).

Constructing the Future (1998–2011).

Personal collections

Phil Catling personal collection

Satirical poem about the scientific officer grades by an anonymous member of RAE
staff, n.d.

John Chisholm personal collection

Defence Research Agency budgets (1993–1994).

Defence Research Agency, *Corporate Plan*, *1992–97*.

Defence Research Agency, *Corporate Plan*, *1993–98*.

Defence Research Agency, *Corporate Plan*, *1994–99*.

Defence Research Agency, *Corporate Plan*, *1995–2000*.

Defence Research Agency, *DRA Marketing Strategy*, *1995–2000*.

DSTA: Defence Science and Technology Agency, *Corporate Plan 1995–2000.*

DERA Framework Document (1995).

Defence Evaluation and Research Agency, *Business Plan 1995–1996.*

Defence Evaluation and Research Agency, *Business Plan 1996–1997.*

Defence Evaluation and Research Agency, *Business Plan 1998–1999.*

Defence Evaluation and Research Agency, *Business Plan 1999–2000.*

Defence Evaluation and Research Agency, *Corporate Plan 1996–2001.*

Defence Evaluation and Research Agency, *Corporate Plan 1997–2002.*

Defence Evaluation and Research Agency, *Corporate Plan 1998–2003.*

Roger Courtney personal collection

Chilver, Henry and Peter Harrop, *Review of the Building Research Establishment and
Customer Arrangements* (1986).

*Building Research Agency: An Executive Agency of the Department of the
Environment* (1990).

Building Research Establishment, *Financial Statement 1995–1996*.

Department of the Environment, *Information Memorandum on the Building Research Establishment* (1996).

3i plc, *BRE Interim report* (1997).

Parliamentary Office of Science and Technology, *Science and Technology Agencies* (1993).

Institution of Professionals, Managers and Specialists, submission to House of Commons Select Committee on Science and Technology Inquiry into Prior Options Review (1996).

David Dunford personal collection

Letter of appointment as an Assistant Scientific Officer.

Ministry of Defence, *RAE* (London: HMSO, 1980).

Susan James personal collection

'A Good Job with Prospects: Specialist Civil Servants', BBC Schools TV (c. 1983).

Graham Rood personal collection

Ministry of Defence*, Management in Research and Development Training Course* (1979).

Official publications and parliamentary papers

Advisory Board for the Research Councils, *A Study of Commissioned Research* (London: HMSO, 1983).

Advisory Board for the Research Councils, *Report of the Working Party on the Private Sector Funding of Scientific Research* (London: HMSO, 1986).

Advisory Board for the Research Councils, *A Strategy for the Science Base* (London: HMSO, 1987).

Advisory Council for Applied Research and Development, *Exploitable Areas of Science* (London: HMSO, 1986).

Advisory Council for Applied Research and Development and Advisory Board for the Research Councils, *The Science Base and Industry,* Cm 34 (London: HMSO, 1986).

Advisory Council on Science and Technology, *Defence R & D: A National Resource* (London: HMSO, 1989).

Baker, John, *Creating Knowledge Creating Wealth: Realising the Economic Potential of Public Sector Research Establishments: a Report to the Minister for Science and the Financial Secretary to the Treasury* (1999).

Beard, Geoffrey C., *Government Finance and Accounts* (London: Management and Personnel Office, 1982).

Board of Trade, *Public Sector Research Establishments: Government Response to the Multi-Departmental Scrutiny of Public Sector Research Establishments,* Cm 2991 (London: HMSO, 1995).

Cabinet Office, *Government Research and Development: A Guide to Sources of Information* (London: HMSO, 1979).

——— *Review of Support Services in Research and Development and Allied Scientific Establishments* (London: Management and Personnel Office, 1982).

——— *Annual Review of Government Funded R&D* (1983–1993).

——— *R&D Assessment: A Guide for Customers and Managers of Research and Development* (London: HMSO, 1989).

——— *Career Management and Succession Planning* (London: HMSO, 1993).

——— *Modernising Government* (London: HMSO, 1999).

Civil Service Commission, *The Report of the Committee on the Civil Service*, Cmnd 3638 (London: HMSO, 1968).

——— *Scientists in the Civil Service* (London: HMSO, 1978).

Civil Service Department, *Government Organisation for Defence Procurement and Civil Aerospace*, Cmnd 4641 (London: HMSO, 1971).

——— *The Employment of Women in the Civil Service* (London: HMSO, 1971).

——— *Review of the Scientific Civil Service*, Cmnd 8032 (London: HMSO, 1980).

——— *Review of Personnel Work in the Civil Service* (London: HMSO, 1983).

Committee on Higher Education, *Higher Education*: *Report of the Committee Appointed by the Prime Minister under the Chairmanship of Lord Robbins, 1961–63*, Cmnd 2154 (London: HMSO, 1963).

Dainton, Frederick, *The Future of the Research Council System* (London: Council for Scientific Policy, 1971).

Defence Committee, *Ministry of Defence Reorganisation*, 15 October 1984, HC 584 1983–84.

——— *The Defence Evaluation and Research Agency*, 6 July 1998, HC 621 1997–1998.

Department of Trade and Industry, *DTI – the Department for Enterprise*, Cm 278 (London: HMSO, 1988).

——— *Science, Engineering and Technology Statistics 1999*, Cm 4409 (London: HMSO, 1999).

Education, Science and Arts Committee, *The Future of the Science Budget*, 9 July 1985, HC 46 1984–5.

Efficiency Unit, *Efficiency in the Civil Service*, Cmnd 8293 (London: HMSO, 1981).

——— *Making the Most of Next Steps: The Management of Ministers' Departments and their Executive Agencies* (London: HMSO, 1991).

——— *Multi-departmental Scrutiny of Public Sector Research Establishments* (London: HMSO, 1994).

Go-Science, *The Future of the Civil Service: Making the Most of Scientists and Engineers in Government* (2013).

——— *Realising Our Ambition through Science: A Review of Government Science Capability* (2019).

——— *GSE Profession Strategy* (2021).

HM Treasury, *The Scientific Civil Service. Reorganisation and Recruitment during the Reconstruction Period*, Cmd 6679 (London: HMSO, 1945).

——— *Executive Agencies: a Guide to Setting Targets and Measuring Performance* (London: HMSO, 1992).

Jenkins, Kate, Karen Caines and Andrew Jackson, *Improving Management in Government: the Next Steps* (London: HMSO, 1988).

Levene, Peter, and W. D. P. Stewart, *Review of Allocation, Management and Use of Government Expenditure on Science and Technology* (London: HMSO, 1993).

Lord Privy Seal, *A Framework for Government Research and Development*, Cmnd 4814 (London: HMSO, 1971).

——— *Framework for Government Research and Development,* Cmnd 5046 (London: HMSO, 1972).

——— *Review of the 'Framework for Government Research and Development' (Cmnd. 5046),* Cmnd 7499 (London: HMSO, 1979).

Lord Rothschild, *The Organisation and Management of Government R. and D.* (London: HMSO, 1971).

Management and Personnel Office, *Civil Service Management Development in the 1980s* (London: HMSO, 1983).

———— *Review of Personnel Work in the Civil Service* (London: HMSO, 1983).

———— *Careers and Career Management in the Scientific Civil Service: A Guide for Science Group Staff* (London: HMSO, 1983).

———— *Scrutiny of the Means of Identifying and Developing Internal Talent: Central Report and Action Plan* (London: HMSO, 1985).

Megaw, J., *Inquiry into Civil Service Pay: Report of an Inquiry into the Principles and the System by which the Remuneration of the Non-Industrial Civil Service should be Determined*, Cmnd 8590 (London: HMSO, 1982).

Minister for the Civil Service, *The Reorganisation of Central Government*, Cmnd 4506 (London: HMSO, 1970).

Ministry of Defence, *Defence: Outline of Future Policy*, Cmnd 124 (London: HMSO, 1957).

———— *Steering Group on Research and Development Establishments*: *Consultative Document* (London: HMSO, 1980).

———— *Defence Science 1983* (London: HMSO, 1982).

———— *Royal Aircraft Establishment* (London: HMSO, c. 1984).

———— *The Central Organisation for Defence*, Cmnd 9315 (London: HMSO, 1984).

———— *Statement on the Defence Estimates 1984*, Cmnd 9227 (London: HMSO, May 1984).

———— *Front Line First: The Defence Costs Study* (London: HMSO, 1994).

Ministry of Defence and the National Archives, *MOD Records Appraisal Report 2020*.

Ministry of Technology, *Industrial Research and Development in Government Laboratories: A New Organization for the Seventies* (London: HMSO, 1970).

National Audit Office, *The Rayner Scrutiny Programmes, 1979 to 1983* (London: HMSO, 1986).

———— *Ministry of Defence: Management of Work at Research Establishments* (London: HMSO, 1986).

———— *The New Management Strategy in the Ministry of Defence* (London: HMSO, 1994).

———— *The Financial Management Initiative* (London: HMSO, 1986).

———— *Delivering the Commercialisation of Public Sector Science* (London: HMSO, 2002).

———— *Reaping the Rewards of Agricultural Research* (London: HMSO, 2003).

———— *The Privatisation of QinetiQ* (London: HMSO, 2007).

Office of the Minister for Science, *Report of the Committee on the Management and Control of Research and Development* (London: HMSO, 1961).

Office of the Prime Minister, *Science and Government: Government observations on the First Report of the House of Lords Select Committee on Science and Technology*, Cmnd 8591 (London: HMSO, 1982).

———— *Financial Management in Government Departments*, Cmnd 9058 (London: HMSO, 1983).

———— *Civil Research and Development: Government Response to the First Report of the House of Lords Select Committee on Science and Technology*, Cm 185 (London: HMSO, 1987).

———— *Realising Our Potential: A Strategy for Science, Engineering and Technology,* Cm 2550 (London: HMSO, 1993).

Parliamentary Office of Science and Technology, *Public Sector Research Establishments* (1994).

———— *Research Institutes and "Prior Options"* (1996).

Public Administration Committee, *From Citizen's Charter to Public Service Guarantees: Entitlements to Public Services*, 15 July 2008, HC 411 2007–08.

Public Accounts Committee, *The Privatisation of QinetiQ*, 12 May 2007, HC 151 2007–08.

———— *Specialist Skills in the Civil Service*, 7 December 2020, HC 686 2019–21.

Science and Technology Committee (Commons), *Defence Research*, 27 March 1969, HC 213 1968–69.

———— *Industry and Scientific Research*, 24 March 1976, HC 23–i–xx 1975–76.

Science and Technology Committee (Lords), *Science and Government*, 12 November 1981, HL 20–I & 20–II 1981–82.

———— *Civil Research and Development*, 26 November 1986, HL 20–I, 20–II & 20–III 1986–87.

———— *Defence Research Agency*, 7 July 1994, HL 24–I & 24–II 1993–1994.

———— *Efficiency Unit Scrutiny of Public Sector Research Establishments*, 29 November 1994, HL 5–I & 5–II 1994–1995.

The *Science and Technology Act* 1965.

Treasury and Civil Service Committee, *Civil Service Manpower Reductions*, 22 July 1980, HC 712–I 1979–1980.

——— *Civil Service Pay,* 8 November 1982, HC 19–i 1982–83.

Trend, Sir Burke, *Committee of Enquiry into the Organisation of Civil Science,* Cmnd 2171 (London: HMSO, 1963).

Trosa, Sylvia, *Next Steps: Moving On* (London: HMSO, 1994).

Walport, Mark, *A Review of MOD's Science & Technology Capability* (2015).

Hansard

HC Deb 18 January 1971 vol 809 c502.

HC Deb 26 April 1971 vol 816 cc163–94.

HC Deb 11 June 1979 vol 968 c68W.

HC Deb 9 July 1979 vol 970 cc223–34.

HC Deb 7 February 1989 vol 146 cc861–902.

HC Deb 22 November 1994 vol 250 cc90–96.

HC Deb 21 November 1995 vol 267 c93W.

HC Deb 4 June 1996 vol 278 cc346–54W.

HL Deb 15 February 1982 vol 427 cc371–414.

Institutional publications

British Council, *Governmental Organisation of Science and Technology in Britain* (London: British Council, 1976).

Institution of Professionals, Managers and Specialists, *Science in Crisis: A Trade Union Response* (Institution of Professionals, Managers and Specialists, 1991)**.**

Library Association Standing Committee on Official Publications, *R&D and OPs: Proceedings of a One Day Seminar on Sources of Publications on & resulting from Officially Funded Research and Development* (London: Library Association Information Services Group, 1993).

OECD, *Frascati Manual*: *Guidelines for collecting and reporting data on research experimental development*, 6th edn (Paris: OECD, 2015).

Newspaper and magazine articles

Arthur, Charles, 'If it ain't broke, sell it', *The Independent*, 4 November 1996, p. 20.

Cross, Michael, 'Government Labs in Sale of the Century', *New Scientist*, 9 April 1981, pp. 72–72.

'Government research laboratories are due to be privatised but will all of them survive?', *The Engineer*, no. 7151 (1993), p. 27.

Hibbert, Lee, 'Britain's Best-Kept Secret', *Professional Engineering*, 15, no. 18 (2002), pp. 34–35.

Humphreys, Colin and John Mulvey, 'The State of British Science', *Nature*, 13 June 1991, p. 513.

Mills, John, 'The Government Laboratory,' *Strand Magazine*, 21, no. 125 (1901), pp. 561–71.

Motluk, Alison, 'Scrutiny 2: The Nightmare Returns', *New Scientist*, 7 October 1995, p. 7.

'QinetiQ: Boffins in the Money', *The Economist*, 24 November 2007, p. 36.

Sherwood, Martin, 'Scientists in Government', *New Scientist*, 29 November 1973, pp. 618–620.

Taylor, Ian, 'Yes, it hurts. Yes, it works', *The Independent,* 3 February 1997, p. 20.

'The Diploma in Technology', *Nature*, 2 March 1963, p. 848.

SECONDARY SOURCES

Printed books and articles

Abrams, Lynn, *Oral History Theory*, 2nd edn (London: Routledge, 2016).

Abromeit, Heidrun, 'British Privatisation Policy', *Parliamentary Affairs*, 41, no. 1 (1988), pp. 68–85.

Agar, Jon, *Science and Spectacle: The Work of Jodrell Bank in Post-War British Culture* (Amsterdam: Harwood Academic, 1998).

——— *The Government Machine* (Cambridge, Mass: MIT Press, 2003).

——— 'Thatcher, Scientist', *Notes and Records of the Royal Society*, 65, no. 3 (2011), pp. 215–32.

——— *Science in the Twentieth Century and Beyond* (Cambridge: Polity, 2012).

——— *Science Policy Under Thatcher* (London: UCL Press, 2019).

——— 'What Is Science for? The Lighthill Report on Artificial Intelligence Reinterpreted', *The British Journal for the History of Science*, 53, no. 3 (2020), pp. 289–310.

Agar, Jon and Brian Balmer, 'British Scientists and the Cold War: The Defence Research Policy Committee and Information Networks, 1947-1963', *Historical Studies in the Physical and Biological Sciences,* 28, no. 2 (1998), pp. 209–52.

Arnold, Lorna, *Atomic Energy in Britain: 1939–1975*, 4th edn (Harwell: UKAEA, 1979).

Ashworth, William, *The State in Business* (Basingstoke: Macmillan, 1991).

Badawy, M. K., *Developing Managerial Skills in Engineers and Scientists: Succeeding as a Technical Manager* (London: Van Nostrand Reinhold, 1982).

Bailyn, Lotte, 'Autonomy in the Industrial R&D Lab', *Human Resource Management*, 24, no. 2 (1985), pp. 129–46.

Ball, Stuart, and A. Seldon, *The Heath Government 1970–74: A Reappraisal* (London: Routledge, 2014).

Balmer, Brian, *Britain and Biological Warfare: Expert Advice and Science Policy, 1930–1965* (Basingstoke: Palgrave, 2001).

Barker, Anthony and B. Guy Peters (eds), *The Politics of Expert Advice: Creating, Using and Manipulating Scientific Knowledge for Public Policy* (Edinburgh: Edinburgh University Press, 1992).

Barnes, Barry, and David Edge (eds), *Science in Context* (Milton Keynes: Open University Press, 1982).

Baskaran, Angathevar, and Rebecca Boden, 'Prometheus Bound: Accounting and the Creation of the New Science Paradigm', *International Studies of Management & Organization*, 37, no. 1 (2007), pp. 9–26.

Beattie, Anthony, 'Experience of Commissioning Research and Development', in R. Hay (ed.), *Science in Government: The Rise of the Intelligent Customer* (Scottish Agricultural Science Agency, 1994), pp. 15–20.

Bell, Michael, 'Leaving Portsoken—Defence Procurement in the 1980s and 1990s', *The RUSI Journal*, 145, no. 4 (2000), pp. 30–36.

Berridge, Virginia, 'Why Policy Needs History (and Historians)', *Health Economics, Policy and Law*, 13, nos. 3–4 (2018), pp. 369–381.

Blackstone, Tessa and William Plowden, *Inside the Think Tank: Advising the Cabinet 1971–1983* (London: William Heinemann, 1988).

Blume, Stuart S. and Elizabeth Chennells, 'Professional Civil Servants: A Study in the Sociology of Public Administration', *Public Administration,* 53, no. 2 (1975), pp. 111–31.

Boden, Rebecca et al., 'Men in White Coats ... Men in Grey Suits: New Public Management and the Funding of Scientific Research in the UK', *Journal of Auditing, According and Accountability*, 11, no. 3, (1998), pp. 267–91.

Boden, Rebecca et al., 'Administrative Reform of United Kingdom Government Research Establishments: Case Studies of New Organisational Forms', in Deborah Cox, Philip Gummett and Katharine Barker (eds), *Government Laboratories: Transition and Transformation* (Amsterdam: IOS Press, 2001), pp. 77–96.

Boden, Rebecca et al., *Scrutinising Science: The Changing UK Government of Science* (Basingstoke: Palgrave Macmillan, 2004).

Bornat, Joanna, 'Oral History', in Clive Seale et al. (eds), *Qualitative Research Practice* (London: SAGE Publications, 2004), pp. 34–47.

Bovens, Mark, Robert E. Goodin and Thomas Schillemans (eds), *The Oxford Handbook of Public Accountability* (Oxford: Oxford University Press, 2014).

Box, Steven, and Stephen Cotgrove, 'Scientific Identity, Occupational Selection, and Role Strain', *The British Journal of Sociology*, 17, no. 1 (1966), pp. 20–28.

Broadbent, Ewen, *The Military and Government: From Macmillan to Heseltine* (Basingstoke: Macmillan, 1988).

Brooke, Stephen, 'Living in "New Times": Historicizing 1980s Britain', *History Compass* 12, no. 1 (2014), pp. 20–32.

Brown, L., and A. Valk, *Living with Jim Crow: African American Women and Memories of the Segregated South* (New York: Palgrave Macmillan, 2010).

Bryson, Ann and Seán McConville, *The Routledge Guide to Interviewing: Oral History, Social Enquiry and Investigation* (London: Routledge, 2014).

Bud, Robert, '"Applied Science": A Phrase in Search of a Meaning', *Isis*, 103, no. 3 (2012), pp. 537–545.

Bud, Robert and Philip Gummett (eds), *Cold War, Hot Science: Applied Research in Britain's Defence Laboratories, 1945–1990* (Amsterdam: Harwood Academic, 1999).

Bullard, Edward, 'What Makes a Good Research Establishment?', in John Cockcroft (ed.), *The Organization of Research Establishments* (Cambridge, Cambridge University Press, 1965), pp. 262–272.

Bush, V., *Science, the Endless Frontier. A Report to the President by Vannevar Bush* (Washington: Office of Scientific Research and Development, 1945).

Calvert, Jane, 'What's Special about Basic Research?', *Science, Technology, & Human Values*, 31, no. 2 (2006), pp. 199–220.

Cardwell, D. S. L., *Organisation of Science in England* (London: Heinemann Educational Publishers, 1959).

Carter, G. B., *Porton Down: 75 Years of Chemical and Biological Research* (London: HMSO, 1992).

Castellani, Lorenzo, *The Rise of Managerial Bureaucracy: Reforming the British Civil Service* (Basingstoke: Palgrave Macmillan, 2018).

Chapman, Richard A., 'Change in the Civil Service', *Public Administration*, 72, no. 4 (1994), pp. 599–610.

Charlesworth, Max, *Life among the Scientists: An Anthropological Study of an Australian Scientific Community* (Oxford: Oxford University Press, 1989).

Chisholm, John, 'Pushing at the boundaries: the management of change in the Defence Evaluation and Research Agency', speech to Public Finance Foundation (July 1996).

Clarke, John and Janet Newman, *The Managerial State: Power, Politics and Ideology in the Remaking of Social Welfare* (London: SAGE Publications, 1997).

Clarke, Peter, 'The Rise and Fall of Thatcherism', *Historical Research*, 72, no. 179 (1999), pp. 301–22.

Clarke, Richard, 'Mintech in Retrospect—II', *Omega*, 1, no. 2 (1973).

Clarke, Sabine, 'Pure Science with a Practical Aim: The Meanings of Fundamental Research in Britain, circa 1916–1950', *Isis*, 101, no. 2 (2010), pp. 285–311.

——— *Science at the End of Empire* (Manchester: Manchester University Press, 2018).

Clarke, Thomas, 'The Political Economy of the UK Privatization Programme: A Blueprint for Other Countries?', in Thomas Clarke and Christos Pitelis (eds), *The Political Economy of Privatization* (London: Routledge, 1993), pp. 205–233.

Clarke, Thomas and Christos Pitelis (eds), *The Political Economy of Privatization* (London: Routledge, 1993).

Clegg, Stewart R., 'The End of Bureaucracy?', in Thomas Diefenbach and Rune Todnem (eds), *Reinventing Hierarchy and Bureaucracy—From the Bureau to Network Organizations* (Bingley: Emerald Group Publishing, 2012), pp. 59–84.

Cobain, Ian, *The History Thieves* (London: Portobello Books, 2016).

Cockcroft, John (ed.), *The Organization of Research Establishments* (Cambridge: Cambridge University Press, 1965).

Cockett, Richard, *Thinking the Unthinkable: Think-Tanks and the Economic Counter-Revolution 1931–1983* (London: HarperCollins, 1994).

Cohen, Laurie, Joanne Duberley and Pete Smith, 'Losing the Faith: Public Sector Work and the Erosion of Career Calling', *Work, Employment and Society*, 33, no. 2 (2019), pp. 326–35.

Cohen, Laurie, Joanne Duberley and John McAuley, 'The Purpose and Process of Science: Contrasting Understandings in UK Research Establishments', *R&D Management*, 29, no. 3 (1999), pp. 233–46.

Cohen, Laurie, John McAuley and Joanne Duberley, 'Continuity in Discontinuity: Changing Discourses of Science in a Market Economy', *Science, Technology, & Human Values*, 26, no. 2 (2001), pp. 145–66.

Collins, Harry, *Tacit and Explicit Knowledge* (Chicago: University of Chicago Press, 2010).

Collins, Peter, *The Royal Society and the Promotion of Science since 1960* (Cambridge: Cambridge University Press, 2015).

Coopey, R., Matthew Uttley and Graham Spinardi (eds), *Defence Science and Technology: Adjusting to Change* (Reading: Harwood Academic, 1993).

Courtney, Roger, 'Building Research Establishment Past, Present and Future', *Building Research & Information*, 25, no. 5 (1997), pp. 285–91.

Cox, Deborah, Philip Gummett and Katharine Barker (eds), *Government Laboratories: Transition and Transformation* (Amsterdam: IOS Press, 2001).

Crow, M. and B. Bozeman, *Limited by Design: R&D Laboratories in the US National Innovation System* (New York: Columbia University Press, 1998).

Cruz-Castro, Laura and Luis Sanz-Menéndez, 'Autonomy and Authority in Public Research Organisations: Structure and Funding Factors', *Minerva*, 56, no. 2 (2018), pp. 135–60.

Cruz-Castro, Laura, Luis Sanz-Menéndez and Catalina Martínez, 'Research Centers in Transition: Patterns of Convergence and Diversity', *The Journal of Technology Transfer*, 37, no. 1 (2012), pp. 18–42.

Cunningham, Catherine M., and Robin Nicholson, 'Central Government Organisation and Policy Making for British Science and Technology since 1982', in Robin

Nicholson, Catherine M. Cunningham and Philip Gummett (eds), *Science and Technology in the United Kingdom* (Harlow: Longman, 1991), pp. 27–43.

Cunningham, Paul (ed.), *Science and Technology in the United Kingdom*, 2nd edn (London: Cartermill, 1998).

Dalyell, Tam, *A Science Policy for Britain* (London: Longman, 1983).

Dasgupta, Partha and Paul A. David, 'Towards a New Economics of Science', *Research Policy*, 23, no. 4 (1994), pp. 487–521.

de Chadarevian, Soraya, 'The Future Historian: Reflections on the Archives of Contemporary Sciences', *Studies in History and Philosophy of Biological and Biomedical Sciences*, 55 (2016), pp. 54–60.

Diefenbach, Thomas and Rune Todnem (eds), *Reinventing Hierarchy and Bureaucracy—From the Bureau to Network Organizations* (Bingley: Emerald Group Publishing, 2012).

Dillman, David L., 'The Thatcher Agenda, the Civil Service, and "Total Efficiency"', in Ali Farazmand (ed.), *Handbook of Bureaucracy*, 1st edn (New York: Routledge, 1994), pp. 241–52.

——— 'Enduring Values in the British Civil Service', *Administration & Society,* 39, no. 7 (2007), pp. 883–900.

Doel, Ronald E., 'Oral History of American Science: A Forty-Year Review', *History of Science*, 41, no. 4 (2003), pp. 349–378.

Doel, Ronald E. and Thomas Söderqvist (eds), *The Historiography of Contemporary Science, Technology and Medicine: Writing Recent Science* (Abingdon: Routledge, 2006).

Driscoll, Amanda, and Jonathan Morris. 'Stepping Out: Rhetorical Devices and Culture Change Management in the UK Civil Service', *Public Administration*, 79, no. 4 (2001), pp. 803–24.

Dunleavy, P., and C. Hood, 'From Old Public Administration to New Public Management', *Public Money & Management*, 14, no. 3 (1994), pp. 9–16.

Dunsire, Andrew, Keith Hartley and David Parker, 'Organizational Status and Performance: Summary of the Findings', *Public Administration*, 69, no. 1 (1991) pp. 21–40.

Edgerton, David, *Science, Technology, and the British Industrial 'Decline', 1870-1970* (Cambridge: Cambridge University Press, 1996).

——— 'The "White Heat" Revisited: The British Government and Technology in the 1960s', *Twentieth Century British History*, 7, no. 1 (1996), pp. 53–82.

——— 'The Prophet Militant and Industrial: The Peculiarities of Correlli Barnett', *Twentieth Century British History*, 2, no. 3 (1991), pp. 360–79.

——— *Warfare State: Britain, 1920–1970* (Cambridge: Cambridge University Press, 2006).

——— 'Time, Money, and History', *Isis*, 103, no. 2 (2012), pp. 316–27.

——— *The Rise and Fall of the British Nation: A Twentieth-Century History* (London: Allen Lane, 2018).

Edgerton, David, and Kirsty Hughes, 'The Poverty of Science: A Critical Analysis of Scientific and Industrial Policy under Mrs Thatcher', *Public Administration*, 67, no. 4 (1989), pp. 419–33.

Ellis, Vaughan, and Phil Taylor, '"You Don't Know What You've Got till It's Gone": Re-Contextualising the Origins, Development and Impact of the Call Centre', *New Technology, Work and Employment*, 21, no. 2 (2006), pp. 107–22.

Etzkowitz, H., and L. Leydesdorff, 'The Dynamics of Innovation: from National Systems and 'Mode 2' to a Triple Helix of University-Industry-Government Relations', *Research Policy*, 29, no. 2 (2000), pp. 109–123.

Epstein, Katherine C., *Torpedo: Inventing the Military-Industrial Complex in the United States and Great Britain* (Cambridge, Mass.: Harvard University Press, 2014).

Fairbrother, Peter, *Politics and the State as Employer* (London: Mansell, 1994).

Falconer, Peter K., and Kathleen McLaughlin, 'Public-Private Partnerships and the "New Labour" Government in Britain', in Stephen P. Osborne (ed.), *Public-Private Partnerships: Theory and Practice in International Perspective* (London: Routledge, 2000).

Farnham, David, and Sylvia Horton, *Managing the New Public Services*, 2nd edn (Basingstoke: Macmillan, 1996).

Ferlie, Ewan et al., *The New Public Management in Action* (Oxford: Oxford University Press, 1996), pp. 165–94.

Flanagan, Kieron and Michael Keenan, 'Trends in UK Science Policy', in Paul Cunningham (ed.), *Science and Technology in the United Kingdom*, 2nd edn (London: Cartermill, 1998), pp. 565–97.

Flink, Tim and David Kaldewey, 'The Language of Science Policy in the Twenty-First Century: What Comes after Basic and Applied Research?', in David Kaldewey and Désirée Schauz (eds), *Basic and Applied Research*: *The Language of Science Policy in the Twentieth Century* (New York: Berghahn Books, 2018), pp. 251–84.

Focus: Applied Science', *Isis* 103, no. 3 (2012), pp. 515–563.

Foreman-Peck, J., and R. Millward, *Public and Private Ownership of British Industry, 1820–1990* (Oxford: Clarendon Press, 1994).

Freund, Alexander, 'Toward an Ethics of Silence? Negotiating Off-the-Record Events and Identity in Oral History', in Rob Perks and Alistair Thomson (eds), *Oral History Reader*, 3rd edn (London: Routledge, 2016), pp. 273–286.

Frisch, Michael H., *A Shared Authority: Essays on the Craft and Meaning of Oral and Public History* (Albany, NY: State University of New York Press, 1990).

——— 'Three Dimensions and More: Oral History Beyond the Paradoxes of Method', in S. N. Hesse-Biber and P. Leavy (eds), *Handbook of Emergent Methods* (New York: Guilford Press, 2008), pp. 221–238.

Fry, Geoffrey K., 'The British Career Civil Service under Challenge', *Political Studies*, 34, no. 4 (1986), pp. 533–55.

Gamble, Andrew, 'Privatization, Thatcherism, and the British State', *Journal of Law and Society*, 16, no. 1 (1988), pp. 1–20.

——— 'The Thatcher Myth', *British Politics*, 10, no. 1 (2015), pp. 3–15.

Garrett, John, *Managing the Civil Service* (London: Heinemann, 1980).

Georghiou, Luke, 'The United Kingdom National System of Research, Technology and Innovation', in P. Larédo and P. Mustar (eds), *Research and Innovation Policies in the New Global Economy: An International Comparative Analysis* (Cheltenham: Edward Elgar, 2001), pp. 253–98.

Gibbons, Michael, 'Science's New Social Contract with Society', *Nature*, 402 (2 December 1999), pp. C81–84.

Gibbons, Michael, and Philip Gummett, 'Recent Changes in the Administration of Government Research and Development in Britain', *Public Administration*, 54, no. 3 (1976), pp. 247–66.

Gibbons, Michael, Philip Gummett and Bhalchandra Udgaonkar (eds), *Science and Technology Policy in the 1980s and Beyond* (London: Longman, 1984).

Gibbons, Michael, and Björn Wittrock, *Science as a Commodity: Threats to the Open Community of Scholars* (Harlow: Longman, 1985).

Gibbons, Michael, et al., *The New Production of Knowledge: the Dynamics of Science and Research in Contemporary Societies* (London: SAGE Publications, 1994).

Gibbs, Graham R., *Analyzing Qualitative Data* (London: SAGE Publications, 2018).

Giddings, P. J. (ed.), *Parliamentary Accountability: A Study of Parliament and Executive Agencies* (Basingstoke: Macmillan, 1995).

Gieryn, Thomas F., 'Boundary-Work and the Demarcation of Science from Non-Science: Strains and Interests in Professional Ideologies of Scientists', *American Sociological Review*, 48, no. 6 (1983), pp. 781–95.

Giffard, Hermione, 'Engine of Innovation: The Royal Aircraft Establishment, State Design and the Coming of the Gas Turbine Aero-Engine in Britain', *Contemporary British History*, 34, no. 2 (2020), pp. 165–78.

Gluckman, P. and J. Wilsdon, 'From Paradox to Principles: Where Next for Scientific Advice to Governments?', *Palgrave Communications*, 2, no. 16077 (2016).

Godin, Benoit, 'Research and Development: How the "D" got into R&D', *Science and Public Policy*, 33, no. 1 (2006), pp. 59–76.

Goldfarb, Brent, 'The Effect of Government Contracting on Academic Research: Does the Source of Funding Affect Scientific Output?', *Research Policy* 37, no. 1 (2008), pp. 41–58.

Gooday, Graeme, 'Placing or Replacing the Laboratory in the History of Science?', *Isis,* 99, no. 4 (2008), pp. 783–95.

Goodfield, June, *An Imagined World: A Story of Scientific Discovery* (University of Michigan Press, 1991).

Gourvish, T. R., *British Rail, 1974–97: From Integration to Privatisation* (Oxford: University Press, 2002).

Govoni, Paola and Zelda Alice Franceschi (eds.), *Writing about Lives in Science: (Auto)Biography, Gender, and Genre* (Goettingen: V & R Unipress, 2015).

Gowing, Margaret, *What's Science to History or History to Science?* (Oxford: Clarendon Press, 1975).

Green, Alix R., *History, Policy and Public Purpose: Historians and Historical Thinking in Government* (London: Palgrave Macmillan, 2016).

Greenwood, John, Robert Pyper and David Wilson, *New Public Administration in Britain*, 3rd edn (London: Routledge, 2003).

Guise, George, 'Margaret Thatcher's Influence on British Science', *Notes and Records of the Royal Society*, 68, no. 3 (2014), pp. 301–9.

———— *Inside the Tank: A Memoir of Four Years in Margaret Thatcher's Prime Minister's Policy Unit 1986–1990* (Epsom: Bretwalda Books, 2015).

Gummett, Philip, *Scientists in Whitehall* (Manchester: Manchester University Press, 1980).

Gummett, Philip, and Michael Gibbons, 'Government Research for Industry: Recent British Developments', *Research Policy*, 7, no. 3 (1978), pp. 268–90.

Gummett, Philip et al., 'The Changing Central Government of Science and Technology', in R. A. W. Rhodes (ed.), *Transforming British Government, Volume 2: Changing Roles and Relationships* (Basingstoke: Macmillan, 2000), pp. 237–88.

Hackman, J. Richard, and Ruth Wageman, 'Total Quality Management: Empirical, Conceptual, and Practical Issues', *Administrative Science Quarterly*, 40, no. 2 (1995), pp. 309–42.

Hammond, P. W., *Weighed in the Balance: A History of the Laboratory of the Government Chemist* (London: HMSO, 1992).

Hannah, Leslie, 'A Failed Experiment: The State Ownership of Industry', in Roderick Floud and Paul Johnson (eds), *The Cambridge Economic History of Modern Britain*, (Cambridge: Cambridge University Press, 2004), pp. 84–111.

Hartley, J. M., and E. M. Tansey, 'White Coats and No Trousers: Narrating the Experiences of Women Technicians in Medical Laboratories, 1930–90', *Notes and Records of the Royal Society*, 69, no. 1 (2015), pp. 25–36.

Hay, R. (ed.), *Science in Government: The Rise of the Intelligent Customer* (Scottish Agricultural Science Agency, 1994).

Haynes, Roslynn D., *From Faust to Strangelove: Representations of the Scientist in Western Literature* (Baltimore: Johns Hopkins University Press, 1994).

Heclo, Hugh and Aaron B. Wildavsky, *The Private Government of Public Money: Community and Policy inside British Politics,* 2nd edn (London: Macmillan, 1981).

Helm, Dieter, *Energy, the State, and the Market*: *British Energy Policy since 1979* (Oxford: Oxford University Press, 2003).

Hennessy, P., *Whitehall* (London: Secker & Warburg, 1989).

Heseltine, Michael, *Where There's a Will,* 2nd edn (London: Arrow Books, 1990).

Hesse-Biber, S. N., and P. Leavy (eds), *Handbook of Emergent Methods* (New York: Guilford Press, 2008).

Hicks, Marie, *Programmed Inequality: How Britain Discarded Women Technologists and Lost Its Edge in Computing* (Cambridge, Mass.: MIT Press, 2017).

Hoddeson, Lillian, 'The Conflicts of Memories and Documents: Dilemmas and Pragmatics of Oral History', in Ronald E. Doel and Thomas Söderqvist (eds), *The Historiography of Contemporary Science, Technology and Medicine: Writing Recent Science* (Abingdon: Routledge, 2006), pp. 187–200.

Hood, Christopher, 'Public Administration and Public Policy: Intellectual Challenges for the 1990s', *Australian Journal of Public Administration*, 48, no. 4 (1989) pp. 346–58.

——— 'A Public Management for All Seasons?', *Public Administration*, 69, no. 1 (1991), pp. 3–19.

Horrocks, Sally, 'A Promising Pioneer Profession? Women in Industrial Chemistry in Inter-War Britain', *The British Journal for the History of Science*, 33, no. 3 (2000), pp. 351–67.

——— 'The Use of the Life Story in An Oral History of British Science', *NLS Review and Accounts 2015/2016* (London: British Library, 2016).

——— 'The Women Who Cracked Science's Glass Ceiling', *Nature*, 575, no. 7781 (6 November 2019), pp. 243–46.

Horrocks, Sally, and Thomas Lean, *The Electricity Supply Industry: Scoping Study for Proposed National Life Stories Project* (2011).

——— 'Doing It for Britain: Science and Service in Oral History with Government Scientists', in Don Leggett and Charlotte Sleigh (eds), *Scientific Governance in Britain, 1914–79* (Manchester: Manchester University Press, 2016), pp. 161–78.

Horton, Sylvia, 'The Civil Service', in Sylvia Horton and David Farnham (eds), *Managing People in the Public Services* (Farnham: Macmillan Business, 1996), pp. 93–148.

Hoskyns, John, *Just in Time: Inside the Thatcher Revolution* (London: Aurum, 2000).

Howell, David, *A New Style of Government: A Conservative View of the Tasks of Administrative, Financial and Parliamentary Reform Facing an Incoming Government* (London: Conservative Political Centre, 1970).

Ince, Martin, *The Politics of British Science* (Brighton: Wheatsheaf, 1986).

Irwin, Alan, 'STS Perspectives on Scientific Governance', in E. Hackett et al. (eds), *The Handbook of Science and Technology Studies* (Boston: MIT Press, 2008), pp. 583–607.

Irwin, Alan, and Brian Wynne, *Misunderstanding Science?: The Public Reconstruction of Science and Technology* (Cambridge: University Press, 1996).

James, Andrew D., 'Organisational Change and Innovation System Dynamics: The Reform of the UK Government Defence Research Establishments', *The Journal of Technology Transfer*, 34, no. 5 (2009), pp. 505–23.

James, Andrew D., Deborah Cox and John Rigby, 'Testing the Boundaries of Public Private Partnership: The Privatisation of the UK Defence Evaluation and Research Agency', *Science and Public Policy*, 32, no. 2 (2005), pp. 155–161.

Jasanoff, Sheila, *The Fifth Branch: Science Advisers as Policymakers* (Cambridge, Mass: Harvard University Press, 1994).

Jasanoff, Sheila et al. (eds), *Handbook of Science and Technology Studies* (Thousand Oaks: SAGE Publications, 2001).

Jenkins, Kate, *Politicians and Public Services: Implementing Change in a Clash of Cultures* (Cheltenham: Edward Elgar, 2008).

Joseph, Keith, *Reversing the Trend: A Critical Reappraisal of Conservative Economic and Social Policies: Seven Speeches* (Chichester: Rose, 1975).

Kay, J. A., C. P. Mayer and David Thompson, *Privatisation and Regulation: The UK Experience* (Oxford: Clarendon, 1986).

Kenna, Steve, 'Globalized New Public Management and Its Impact on Scientific Research Activity in New Zealand', *Asia Pacific Business Review* 7, no. 1 (2000), pp. 151–70.

Knorr-Cetina, Karin, 'Laboratory Studies: The Cultural Approach to the Study of Science' in Sheila Jasanoff et al. (eds), *Handbook of Science and Technology Studies* (Thousand Oaks: SAGE Publications, 2001), pp. 140–66.

Kogan, Maurice, and Mary Henkel, *Government and Research: The Rothschild Experiment in a Government Department* (London: Heinemann Educational, 1983).

Kohler, Robert E., 'Lab History: Reflections', *Isis*, 99, no. 4 (2008), pp. 761–68.

Kornhauser, W., *Scientists in Industry* (Berkeley: University of California Press, 1963).

Krige, John (ed.), *How Knowledge Moves: Writing the Transnational History of Science and Technology* (Chicago: The University of Chicago Press, 2019).

Kuhn, Thomas, *The Structure of Scientific Revolutions* (Chicago: University of Chicago Press, 1962).

Kunda, Gideon, *Engineering Culture: Control and Commitment in a High-Tech Corporation* (Philadelphia: Temple University Press, 2006).

Kuznick, Peter J., *Beyond the Laboratory: Scientists as Political Activists in 1930s America* (Chicago: University of Chicago Press, 1987).

Lægreid, Per, 'Accountability and New Public Management', in Mark Bovens, Robert E. Goodin and Thomas Schillemans (eds), *The Oxford Handbook of Public Accountability* (Oxford: Oxford University Press, 2014), pp. 324–38.

Larédo, Philippe, and Philippe Mustar, 'Public Sector Research: A Growing Role in Innovation Systems', *Minerva*, 42, no. 1 (2004), pp. 11–27.

Latour, Bruno, *Science in Action: How to Follow Scientists and Engineers through Society* (Cambridge, Mass: Harvard University Press, 1997).

Latour, Bruno, and Steve Woolgar, *Laboratory Life: The Construction of Scientific Facts*, 2nd edn (Princeton, NJ: Princeton University Press, 1986).

Lave, Rebecca, Philip Mirowski and Samuel Randalls, 'Introduction: STS and Neoliberal Science', *Social Studies of Science,* 40, no. 5 (2010), pp. 659–75.

Law, John, and Madeleine Akrich, 'On Customers and Costs: A Story from Public Sector Science', in Michael Power (ed.), *Accounting and Science: Natural Inquiry and Commercial Reason* (Cambridge: Cambridge University Press, 1996), pp. 195–218.

Lawson, Nigel, *The View from No. 11: Memoirs of a Tory Radical* (London: Corgi, 1993).

Lea, F. M., *Science and Building. A History of the Building Research Station* (London, 1971).

Lean, Thomas, 'The Life Electric: Oral History and Composure in the Electricity Supply Industry', *Oral History*, 46, no. 1 (2018), pp. 55–66.

Leggett, Don, *Shaping the Royal Navy: Technology, Authority and Naval Architecture, c.1830–1906* (Manchester: Manchester University Press, 2015).

Leggett, Don, and Charlotte Sleigh (eds), *Scientific Governance in Britain, 1914–79* (Manchester: Manchester University Press, 2016).

Lepore, Jill, 'Historians Who Love Too Much: Reflections on Microhistory and Biography', *The Journal of American History*, 88, no. 1 (2001), pp. 129–44.

Leslie, Stuart W., *The Cold War and American Science: The Military-Industrial-Academic Complex at MIT and Stanford* (New York: Columbia University Press, 1993).

Levene, Peter, *Send for Levene* (London: Nine Elms Books, 2018).

Liberman, Dvora, 'Interpreting Inconsistencies and Finding Meaning in Crown Court Clerks' Life-Story Narratives', *Oral History*, 48, no. 2 (2020), pp. 80–89.

Lighthill, M. J., 'The Royal Aircraft Establishment', in John Cockcroft (ed.), *The Organization of Research Establishments* (Cambridge, Cambridge University Press, 1965).

Lightman, B. (ed.), *A Companion to the History of Science* (Chichester: John Wiley and Sons, 2016).

Linde, C., *Life Stories: the Creation of Coherence* (New York: Oxford University Press, 1993).

Lowe, Rodney, *The Official History of the British Civil Service: Reforming the Civil Service, Volume I: The Fulton Years, 1966–81* (London: Routledge, 2011).

——— 'Review: Of Mice and Men: Constructing an Administrative History of Twentieth-Century Britain', *Twentieth Century British History*, 16, no. 1 (2005), pp. 103–15.

Lowe, Rodney, and Hugh Pemberton, *The Official History of the British Civil Service: Reforming the Civil Service, Volume II: The Thatcher and Major Revolutions, 1982–97* (London: Routledge, 2020).

Lucier, Paul, 'Commercial Science', in B. Lightman (ed.), *A Companion to the History of Science* (Chichester: John Wiley and Sons, 2016), pp. 268–281.

Lummis, Trevor, 'Structure and Validity in Oral Evidence', in Rob Perks and Alistair Thomson (eds), *The Oral History Reader*, 1st edn (London: Routledge, 1998), pp. 273–83.

Lynn, Laurence E. Jr., *Public Management: Old and New* (London: Routledge, 2006).

MacKenzie, Donald, and Graham Spinardi, 'The Technological Impact of a Defence Research Establishment', in R. Coopey, Matthew Uttley and Graham Spinardi (eds), *Defence Science and Technology: Adjusting to Change* (Reading: Harwood Academic, 1993).

MacLeod, Roy (ed.), *Government and Expertise: Specialists, Administrators and Professionals, 1860–1919* (Cambridge: Cambridge University Press, 1988).

MacLeod, Roy, and Kay MacLeod, 'The Contradictions of Professionalism: Scientists, Trade Unionism and the First World War', *Social Studies of Science*, 9, no. 1 (1979), pp. 1–32.

Major, John, *John Major: The Autobiography*, 1st edn (New York: HarperCollins, 1999).

Mallon, Mary, Joanne Duberley and Laurie Cohen. 'Careers in Public Sector Science: Orientations and Implications', *R&D Management*, 35, no. 4 (2005), pp. 395–407.

Mandler, Peter, *The Crisis of the Meritocracy: Britain's Transition to Mass Education since the Second World War* (Oxford: Oxford University Press, 2020).

Marsh, David, 'Privatisation under Mrs. Thatcher: A Review of the Literature', *Public Administration*, 69, no. 4 (1991), pp. 459–480.

Massey, H., and M. O. Robbins, *History of British Space Science* (Cambridge: Cambridge University Press, 1986).

Mazzucato, Mariana, *The Entrepreneurial State: Debunking Public vs. Private Sector Myths*, 2nd edn (London: Anthem Press, 2013).

McGrath, Patrick J., *Scientists, Business, and the State, 1890–1960* (Chapel Hill, NC: University of North Carolina Press, 2002).

McCrensky, Edward, 'Scientists in the British Civil Service', *Science*, 124, no. 3222 (1956), pp. 567–71.

McDowell, Linda, *Working Lives: Gender, Migration and Employment in Britain, 1945–2007* (Chichester: John Wiley & Sons, 2013).

Merchant, Paul, 'Scientists' Childhoods', *Oral History*, 41, no. 1 (2013), pp. 63–72.

——— 'What Oral Historians and Historians of Science Can Learn from Each Other', *British Journal for the History of Science*, 52, no. 4 (2019), pp. 673–88.

Merton, Robert K., *The Sociology of Science: Theoretical and Empirical Investigations* (London: University of Chicago Press, 1973).

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

Mirowski, P., and R. van Horn, 'The Contract Research Organization and the Commercialization of Scientific Research', *Social Studies of Science*, 35, no. 4 (2005), pp. 503–48

Mody, Cyrus C. M., 'The Professional Scientist', in B. Lightman (ed.), *A Companion to the History of Science* (Chichester: John Wiley and Sons, 2016). pp. 164–177.

Molas-Gallart, Jordi, 'Government Defence Research Establishments: The Uncertain Outcome of Institutional Change', *Defence and Peace Economics* 12, no. 5 (2001), pp. 417–37.

Molas-Gallart, Jordi, and Tom Sinclair, 'From Technology Generation to Technology Transfer: The Concept and Reality of the "Dual-Use Technology Centres"', *Technovation*, 19, no. 11 (1999), pp. 661–71.

Moore, Charles, *Margaret Thatcher: the Authorized Biography. Vols I, II and III* (London: Allen Lane, 2013, 2015 and 2019).

Morrell, J. B., 'Professionalisation', in R. C. Olby (ed.), *Companion to the History of Modern Science* (London: Routledge, 1990), pp. 980–989.

Mortimer, J. E., and Valerie Ellis, *A Professional Union: The Evolution of the Institution of Professional Civil Servants* (London: Allen and Unwin, 1980).

Mottram, Richard, 'The Reform of Government: The Place of Market Testing', *The RUSI Journal*, 139, no. 2 (1994), pp. 1–6.

Mukerji, Chandra, *A Fragile Power: Scientists and the State* (Princeton, NJ: Princeton University Press, 1989).

Mulkay, J., 'Norms and Ideology in Science', *Social Science Information*, 15 (1970), pp. 637–56.

Nahum, Andrew, 'The Royal Aircraft Establishment from 1945 to Concorde', in Robert Bud and Philip Gummett (eds), *Cold War, Hot Science: Applied Research in Britain's Defence Laboratories, 1945-1990* (Amsterdam: Harwood Academic, 1999), pp. 29–58.

Nicholson, Robin, Catherine M. Cunningham and Philip Gummett (eds), *Science and Technology in the United Kingdom* (Harlow: Longman, 1991).

O'Connell Davidson, Julia, *Privatization and Employment Relations: The Case of the Water Industry* (London: Mansell Publishing, 1993).

Olby, R. C. (ed.), *Companion to the History of Modern Science* (London: Routledge, 1990).

Parker, David, *The Official History of Privatisation Vol. 1: The Formative Years 1970–1987* (London, 2009).

——— *The Official History of Privatisation, Vol. 2: Popular Capitalism, 1987–97* (London, 2012).

Parker, Miles, 'The Rothschild Report (1971) and the Purpose of Government-Funded R&D—a Personal Account', *Palgrave Communications*, 2, no. 16053 (2016).

Pendleton, Andrew, and Jonathon Winterton (eds), *Public Enterprise in Transition: Industrial Relations in State and Privatized Corporations* (London: Routledge, 1993).

Perks, Rob, '"Corporations Are People Too!": Business and Corporate Oral History in Britain', *Oral History*, 38, no. 1 (2010), pp. 36–54.

Perks, Rob, and Alistair Thomson (eds), *The Oral History Reader*, 1st edn (London: Routledge, 1998) and 3rd edn (London: Routledge, 2016).

Pestre, Dominique, 'Thirty Years of Science Studies: Knowledge, Society and the Political', *History and Technology*, 20, no. 4 (2004), pp. 351–69.

Pickstone, John, *Ways of Knowing* (Manchester: Manchester University Press, 2000).

Pinch, Trevor, 'The Culture of Scientists and Disciplinary Rhetoric', *European Journal of Education*, 25, no. 3 (1990), pp. 295–304.

Plant, Helen, 'Women Scientists in British Industry: Technical Library and Information Workers, c.1918–1960', *Women's History Review*, 14, no. 2 (2005), pp. 301–21.

Pollitt, Christopher, and Geert Bouckaert, *Public Management Reform: A Comparative Analysis* 2nd edn (Oxford: Oxford University Press, 2000).

Poole, J. B., and K. Andrews (eds), *The Government of Science in Britain* (London: Weidenfeld and Nicolson, 1972).

Portelli, Alessandro, 'Oral History as Genre', in P. Thompson and M. Chamberlain (eds), *Narrative and Genre* (London, 1998), pp. 23–45.

——— *They Say in Harlan County: An Oral History* (New York: Oxford University Press, 2011).

Powell, Christopher, and Arthur Butler, *Parliamentary and Scientific Committee: The First Forty Years 1939–79* (London: Croom Helm, 1980).

Power, Michael (ed.), *Accounting and Science: Natural Inquiry and Commercial Reason* (Cambridge: Cambridge University Press, 1996).

Prandy, Kenneth, *Professional Employees* (London: Faber and Faber, 1965).

Priestley, Clive, speaking at 'The Civil Service Reforms of the 1980s: The Genesis and Initial Implementation of *Next Steps*', seminar held 17 November 2006, Centre for Contemporary British History, 2007.

Profitt, T. H., 'Great Britain', in F. F. Ridley (ed.), *Specialists and Generalists: A Comparative Study of the Professional Civil Servant at Home and Abroad* (London: George Allen & Unwin, 1968), pp. 13–56.

Putley, E H., 'The History of the RSRE', *Physics in Technology*, 16, no. 1 (1985), pp. 13–18.

Raelin, Joseph A., 'The Basis for the Professional's Resistance to Managerial Control', *Human Resource Management*, 24, no. 2 (1985), pp. 147–175.

Randle, Keith, 'The White-Coated Worker: Professional Autonomy in a Period of Change', *Work, Employment and Society*, 10, no. 4 (1996), pp. 737–53.

Rassam, Clive, *Second Culture: British Science in the 1990s* (London: Aurum Press, 1993).

Ravetz, J. R., *Scientific Knowledge and Its Social Problems* (Oxford: Clarendon Press, 1971).

Rayner, Derek, 'Making Room for Managers in Whitehall', *Management Services in Government*, 28, no. 2 (1973), pp. 62–63.

Read, Nicholas, 'The "Near Market" Concept Applied to UK Agricultural Research', *Science and Public Policy*, 16, no. 4 (1989), pp. 233–38.

Rhodes, R. A. W. (ed.), *Transforming British Government, Volume 2: Changing Roles and Relationships* (Basingstoke: Macmillan, 2000).

Ridley, F. F. (ed.), *Specialists and Generalists: A Comparative Study of the Professional Civil Servant at Home and Abroad*, (London: George Allen & Unwin, 1968).

——— 'Career Service: A Comparative Perspective on Civil Service Promotion', *Public Administration*, 61, no. 2 (1983), pp. 179–196.

Rifkind, Malcolm, 'Front Line First', *RUSI Journal*, 139, no. 6 (1994), pp. 1–6.

Ritchie, Donald A. (ed.), *The Oxford Handbook of Oral History* (New York: Oxford University Press, 2011).

——— 'Top down/Bottom up: Using Oral History to Re-Examine Government Institutions', *Oral History* 42, no. 1 (2014), pp. 47–58.

Robinson, Samuel A., *Ocean Science and the British Cold War State* (London: Palgrave Macmillan, 2018).

Robinson, Stephen, 'Government Management of Defence Research since the Second World War', in Robert Bud and Philip Gummett (eds), *Cold War, Hot Science: Applied Research in Britain's Defence Laboratories, 1945–1990* (Amsterdam: Harwood Academic, 1999), pp. 393–415.

Robson, Keith, 'Connecting Science to the Economic: Accounting Calculation and the Visibility of Research and Development', *Science in Context*, 7, no. 3 (1994), pp. 497–514.

Roller, Katja, 'Towards the "Oral" in Oral History: Using Historical Narratives in Linguistics', *Oral History*, 43, no. 1 (2015), pp. 73–84.

Rood, Graham, 'The Royal Aircraft Establishment, Farnborough', *Journal of Aeronautical History,* 10, (2020), pp. 53–113.

Rose, Hilary, and Steven Rose, *Science and Society* (London: Allen Lane, 1969).

Rose, Kenneth, 'Rothschild, (Nathaniel Mayer) Victor, third Baron Rothschild (1910–1990), Zoologist and Public Servant', *Oxford Dictionary of National Biography* (Oxford: Oxford University Press, 2004).

Rothblatt, Sheldon, 'The Notion of an Open Scientific Community in Historical Perspective', in Michael Gibbons and Björn Wittrock (eds), *Science as a Commodity: Threats to the Open Community of Scholars* (Harlow: Longman, 1985), pp. 21–75.

Saint-Martin, Denis, *Building the New Managerialist State: Consultants and the Politics of Public Sector Reform in Comparative Perspective* (Oxford: Oxford University Press, 2000).

Saks, Mike, 'Defining a Profession: The Role of Knowledge and Expertise', *Professions and Professionalism*, 2, no. 1 (2012), pp. 1–10.

Salomon, Jean-Jacques, 'Science Policy Studies and the Development of Science Policy', in Derek de Solla Price and Ina Rösing (eds), *Science, Technology and Society: A Cross-Disciplinary Perspective* (London: SAGE Publications, 1977), pp. 43–70.

Sanderson, Michael, *The Universities and British Industry, 1850–1970* (London: Routledge and Kegan Paul, 1972).

Savage, Gail, *The Social Construction of Expertise: The English Civil Service and its Influence, 1919–1939* (Pittsburgh: University of Pittsburgh Press, 1996).

Seale, Clive, et al. (eds), *Qualitative Research Practice* (London: SAGE Publications, 2004).

Shapin, Steven, *The Scientific Life: A Moral History of a Late Modern Vocation* (Chicago: University of Chicago Press, 2008).

——— 'Invisible Science', *The Hedgehog Review*, 18, no. 3 (2016), pp. 34–46.

Sheftel, Anna, and Stacey Zembrzycki (eds), *Oral History off the Record: Toward an Ethnography of Practice* (New York: Palgrave Macmillan, 2013).

Shopes, Linda, 'Editing Oral History for Publication', in Rob Perks and Alistair Thomson (eds), *The Oral History Reader*, 3rd edn (London: Routledge, 2016), pp. 490–509.

Shute, Nevil, *No Highway* (London: Vintage Classics, 2009). First edition 1948.

Simpson, Barbara, 'After the Reforms: How Have Public Science Research Organisations Changed?', *R&D Management*, 34, no. 3 (2004), pp. 253–66.

Sismondo, Sergio, *An Introduction to Science and Technology Studies* (Oxford: Blackwell, 2003).

Small, Bruce, and Mary Mallon, 'Science, Society, Ethics, and Trust: Scientists' Reflections on the Commercialization and Democratization of Science', *International Studies of Management & Organization*, 37, no. 1 (2007), pp. 103–24.

Smith, Melissa, 'Architects of Armageddon: The Home Office Scientific Advisers' Branch and Civil Defence in Britain, 1945–68', *The British Journal for the History of Science* 43, no. 2 (2010), pp. 149–80.

Smith, Jack, 'From R&D to Strategic Knowledge Management: Transitions and Challenges for National Laboratories', *R&D Management*, 30, no. 4 (2000), pp. 305–11.

Snow, C. P., *The New Men* (London: Macmillan, 1954).

Spinardi, Graham, 'Defence Technology Enterprises: A Case Study in Technology Transfer', *Science and Public Policy*, 19, no. 4 (1992), pp. 198–206.

——— 'Industrial Exploitation of Carbon Fibre in the UK, USA and Japan', *Technology Analysis & Strategic Management*, 14, no. 4 (2002) pp. 381–398.

Spufford, Francis, *Backroom Boys: The Secret Return of the British Boffin* (London: Faber and Faber, 2004).

Söderqvist, Thomas (ed.), *The Historiography of Contemporary Science and Technology* (Amsterdam: Harwood Academic Press, 1997).

Starr, J. R., 'Civil Service Careers', *Physics Bulletin*, 31, no. 8 (1980), pp. 264–264.

Stedman Jones, Daniel, *Masters of the Universe: Hayek, Friedman, and the Birth of Neoliberal Politics* (Princeton, NJ: Princeton University Press, 2014).

Stewart, Mary, 'Exploring Family Reactions to Life Story Recordings', *Oral History* 41, no. 1 (2013), pp. 51–62.

Strangleman, Tim, *Work Identity at the End of the Line?: Privatisation and Culture Change in the UK Rail Industry* (Basingstoke: Palgrave Macmillan, 2004).

Summerfield, Penny, 'Culture and Composure: Creating Narratives of the Gendered Self in Oral History Interviews', *Cultural and Social History*, 1, no. 1 (2004), pp. 65–93.

Sutcliffe-Braithwaite, Florence, *Class, Politics, and the Decline of Deference in England, 1968–2000* (Oxford: Oxford University Press, 2018).

Tarter, C. Bruce, *The American Lab: An Insider's History of the Lawrence Livermore National Laboratory* (Baltimore: Johns Hopkins University Press, 2018).

Thain, Colin, and Maurice Wright, *The Treasury and Whitehall; the Planning Control of Public Expenditure 1976–93* (Oxford: Oxford University Press, 1995).

Thatcher, Margaret, *The Path to Power* (London: HarperCollins, 1995).

——— *The Downing Street Years* (London: HarperCollins, 1995).

Theakston, Kevin, *The Civil Service since 1945* (Oxford: Blackwell, 1995).

——— *Leadership in Whitehall* (Basingstoke: Macmillan, 1999).

Thirtle, Colin, Paolo Palladino and Jenifer Piesse, 'On the Organisation of Agricultural Research in the United Kingdom, 1945–1994: A Quantitative Description and Appraisal of Recent Reforms', *Research Policy*, 26, nos. 4–5 (1997), pp. 557–76.

Thompson, P., *The Voice of the Past*: *Oral History*, 2nd edn (Oxford: Oxford University Press, 1988).

Thompson, P., and M. Chamberlain (eds), *Narrative and Genre* (London: Routledge, 1998).

Thomson, Alistair, *Anzac Memories: Living with the Legend* (Oxford: Oxford University Press, 1994).

——— 'Four Paradigm Transformations in Oral History', *Oral History Review*, 34, no. 1 (2007), pp. 49–71.

——— 'Memory and Remembering in Oral History', in Donald A. Ritchie (ed.), *The Oxford Handbook of Oral History* (New York: Oxford University Press, 2011), pp. 77–95.

Tomlinson, Jim, 'A "Failed Experiment"? Public Ownership and the Narratives of Post-War Britain', *Labour History Review*, 73, no. 2 (2008), pp. 228–43.

Tonge, Jonathan, *The New Civil Service* (Tisbury: Baseline, 1999).

Tooth Murphy, Amy, 'Listening In, Listening Out: Intersubjectivity and the Impact of Insider and Outsider Status in Oral History Interviews', *Oral History*, 48, no. 1 (2020), pp. 35–55.

Traweek, Sharon, *Beamtimes and Lifetimes: The World of High Energy Physicists* (Cambridge, Mass: Harvard University Press, 1992).

Turner, Frank, 'Public Science in Britain, 1880–1919', *Isis*, 71, no. 4 (1980), pp. 589–608.

Turpin, Tim, and Adrian Deville, 'Occupational Roles and Expectations of Research Scientists and Research Managers in Scientific Research Institutions', *R&D Management*, 25, no. 2 (1995), pp. 141–57.

Twigge, Stephen, *The Early Development of Guided Weapons in the United Kingdom: 1940–1960* (Reading: Harwood Academic, 1993).

Uttley, Matthew, 'Contracting-out and Market-testing in the UK Defence Sector: Theory, Evidence and Issues', *Public Money & Management*, 13, no. 1 (1993), pp. 55–60.

Vandenabeele, Wouter, and Sylvia Horton, 'The Evolution of the British Public Service Ethos', in L. W. Huberts, Jeroen Maesschalck and Carole L. Jurkiewicz (eds), *Ethics and Integrity of Governance: Perspectives Across Frontiers* (Cheltenham: Edward Elgar Publishing, 2008), pp. 7–24.

Varcoe, Ian, *Organizing for Science in Britain: A Case Study* (London: Oxford University Press, 1974).

Vig, Norman J., *Science and Technology in British Politics* (Oxford: Pergamon Press, 1968).

Waldegrave, William, *A Different Kind of Weather: A Memoir* (London: Constable, 2015).

Waldron, Keith, 'Performance Assessment of Public Sector Scientists', *Public Money and Management*, 24, no. 1 (2004), pp. 57–62.

Walker, Percy B., *Early Aviation at Farnborough: The History of the Royal Aircraft Establishment, Vol. I* (London: Macdonald & Co., 1971).

Webster, A. J., 'Privatisation of Public Sector Research: The Case of a Plant Breeding Institute', *Science and Public Policy*, 16, no. 4 (1989), pp. 224–32.

Weiner, Charles, 'Oral History of Science: A Mushrooming Cloud?', *The Journal of American History,* 75, no. 2 (1988), pp. 548–59.

Wells, P., 'The Military Scientific Infrastructure and Regional Development', *Environment and Planning A: Economy and Space*, 19, no. 12 (1987), pp. 1631–58.

Whelan, R. C., 'Management of Scientific Institutions NPL 1995–98: The Transition from Agency to Government-Owned Contractor Operated (GOCO)', *R&D Management*, 30, no. 4 (2000), pp. 313–22.

Wilkie, Tom, *British Science and Politics since 1945* (Cambridge, Mass: Basil Blackwell, 1991).

Williams, Roger, 'Some Political Aspects of the Rothschild Affair', *Science Studies*, 3, no. 1 (1973), pp. 31–46.

——— 'UK Science and Technology: Policy, Controversy and Advice', *The Political Quarterly*, 59, no. 2 (1988), pp. 132–44.

Wilson, Harold, 'Labour's plan for science', speech delivered at Scarborough (1 October 1963).

Winetrobe, Barry, 'Next Steps and Parliamentary Scrutiny' in P. J. Giddings (ed.), *Parliamentary Accountability: A Study of Parliament and Executive Agencies* (Basingstoke: Macmillan, 1995), pp. 33–51.

Winslow, Michelle, and Graham Smith, 'Ethical Challenges in the Oral History of Medicine', in Donald A. Ritchie (ed.), *The Oxford Handbook of Oral History* (Oxford University Press, 2012), pp. 372–388.

Woodward, Nick, '"Managing" Cultural Change on Privatisation', in V. V. Ramanadham (ed.), *Privatisation in the UK* (London: Routledge, 1988), pp. 85–101.

Wootton, David, *The Invention of Science* (London: Allen Lane, 2016).

Young, Hugo, *One of Us* (London: Pan, 2013).

Young, Stephen, 'The Nature of Privatization in Britain 1979-1985', *West European Politics*, 9, no. 2 (1986), pp. 235–52.

Yow, Valerie, *Recording Oral History* (London: SAGE Publications, 1994).

——— '"Do I Like Them Too Much?": Effects of the Oral History Interview on the Interviewer and Vice-Versa', *The Oral History Review*, 24, no. 1 (1997), pp. 55–79.

Ziman, J. M., *Knowing Everything about Nothing: Specialization and Change in Scientific Careers* (Cambridge: Cambridge University Press, 1987).

Zuckerman, Harriet, 'The Sociology of Science', in N. J. Smelser, *The Handbook of Sociology* (London: SAGE Publications, 1988), pp. 511–74.

Theses

Beesley, Anne, 'Strategic Change in a Government Laboratory: The Case of the Building Research Establishment' (unpublished PhD thesis, University of Manchester, 2000).

Berry, Dominic, 'Genetics, Statistics, and Regulation at the National Institute of Agricultural Botany, 1919-1969' (unpublished PhD thesis, University of Leeds, 2014).

Boon, Rachel, ''Research is the Door to Tomorrow': the Post Office Engineering Research Station, Dollis Hill, 1933–1958' (unpublished PhD thesis, University of Manchester, 2020).

Butler, Stuart, 'National Prestige and In(ter)dependence: British Space Research Policy 1959-73' (unpublished PhD thesis, University of Manchester, 2016).

Keith, Stephen T., 'The Role of Government Research Establishments: a Study of the Concept of Public Patronage for Applied Research and Development' (unpublished PhD thesis, Aston University, 1982).

Oikonomou, Alexandros-Panagiotis, 'The Hidden Persuaders: Government Scientists and Defence in Post-War Britain' (unpublished PhD thesis, Imperial College, London, 2011).

Sirrs, Christopher, 'Health and Safety in the British Regulatory State, 1961-2001: The HSC, HSE and the Management of Occupational Risk' (unpublished PhD thesis, London School of Hygiene & Tropical Medicine, 2016).

Smith, Andrew John, 'The Process of Change in a Public-Private Partnership: Work and Culture. A Case Study of Durham National Savings and Investments' (unpublished PhD thesis, Durham University, 2006).

Born-digital material

Anderson, Robert, *University Fees in Historical Perspective,* 8 February 2016 <http://www.historyandpolicy.org/policy-papers/papers/university-fees-in-historical-perspective> [accessed 26 October 2020].

BRE Group, *Our History* <https://www.bregroup.com/about-us/our-history/> [accessed 29 May 2021].

British Academy, 'Lessons from the History of UK Science Policy', August 2019
    <https://www.thebritishacademy.ac.uk/sites/default/files/Lessons-History-UK-
    science-policy.pdf> [accessed 28 May 2020].

Chisholm, John, *The QinetiQ Question – A Public Scandal or a National Triumph?*
    (2011).

Dstl Secretariat, 'Dstl Departure from Fort Halstead and Loss of Energetic Materials
    Subject Matter Experts', 10 February 2015
    <https://assets.publishing.service.gov.uk/government/uploads/system/uploads/at
    tachment_data/file/403718/20150210.pdf> [accessed 30 April 2021].

European Commission Joint Research Centre, *Eurocodes: Building the Future*
    <https://eurocodes.jrc.ec.europa.eu/> [accessed 9 April 2020].

HM Treasury, *Supply Estimates: A Guidance Manual 2011*
    <https://assets.publishing.service.gov.uk/government/uploads/system/uploads/at
    tachment_data/file/220744/estimates_manual_july2011.pdf> [accessed 30 April
    2021].

Ledgerwood, Emmeline, *Experiences of Women in STEM: Working in the Scientific
    Civil Service*, 10 February 2021 <https://www.bl.uk/womens-
    rights/articles/women-in-stem> [accessed 1 April 2021].

Mandler, Peter, *RHS Presidential Address: 'Educating the Nation III: Social Mobility'*,
    27 November 2015 <https://royalhistsoc.org/rhs-presidential-address-by-peter-
    mandler-educating-the-nation-iii-social-mobility/> [accessed 4 November
    2020].

Ministry of Defence, *Science and Technology Strategy 2017*
    <https://www.gov.uk/government/publications/mod-science-and-technology-
    strategy-2017> [accessed 3 April 2019].

Ministry of Defence, *MOD Acronyms and Abbreviations*
    <https://assets.publishing.service.gov.uk/government/uploads/system/uploads/at
    tachment_data/file/227048/acronyms_and_abbreviations_dec08.pdf> [accessed
    2 July 2018].

Oral History Society, *Dealing with GDPR* <https://www.ohs.org.uk/gdpr-2/> [accessed
    1 June 2021].

Oral History Society, *Is Your Oral History Legal and Ethical?*
    <https://www.ohs.org.uk/legal-and-ethical-advice/> [accessed 1 June 2021].

Talbot, Colin, *From Public Administration to New Public Management: Who Killed The Study of Public Administration in the UK?*, 6 August 2020 <https://blogs.lse.ac.uk/politicsandpolicy/public-administration-uk/> [accessed 19 April 2021].

The National Archives, DEFE 75/1–55, *Defence Evaluation and Research Agency (DERA) and Its Immediate Predecessors: Reports and Files 1991-2001* <http://discovery.nationalarchives.gov.uk/details/r/C16166> [accessed 2 June 2021].

———— *Information Management Guidance: Dissolution and Privatisation of Public Bodies* <https://www.nationalarchives.gov.uk/documents/dissolution-and-privatisation-guidance-v1.pdf> [accessed 22 June 2017].

———— *Office of Public Service and Office of Public Service and Science* <https://discovery.nationalarchives.gov.uk/details/r/C704> [accessed 14 June 2021].