

A Serendipity of Mavericks
*The Ratio Club and the British Experience of
Cybernetics from 1949 to 1959*



Colin Williams
Mansfield College
University of Oxford

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“There is much which we must leave, whether we like it or not, to the un-“scientific,” narrative method of the professional historian”.

Norbert Wiener¹

“Cybernetics is a term that means all things to some men and nothing to many”.

W. G. Walter²

¹ N. Wiener, *Cybernetics: or Control and Communication in the Animal and the Machine*, 1st edn., (Herman et Cie, Paris; Wiley & Sons, New York; MIT Technology Press, Boston; 1948), p. 191. [Thanks Norbert!].

² W. G. Walter, “Studies on Activity of the Brain”, in H. von Foerster, M. Mead, H. L. Teuber (eds.), *Cybernetics: Circular Causal and Feedback Mechanisms in Biological and Social Systems: Transactions of the Tenth Conference, April 22, 23, and 24, 1953, Princeton N. J.*, in C. Pias (ed.), *Cybernetics: The Macy Conferences 1946-1953: The Complete Transactions*, (Diaphanes, Zurich, 2016), p. 689.

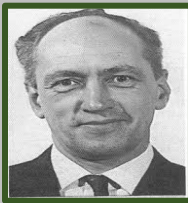
The Ratio Club



Ross Ashby
1903-1972



Horace Barlow
1921-2020



John Bates
1918-1993



George Dawson
1912-1983



Thomas Gold
1920-2004



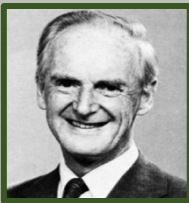
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1916-2009



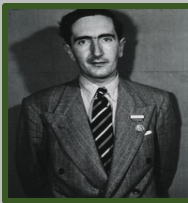
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Victor Little
1920-1976



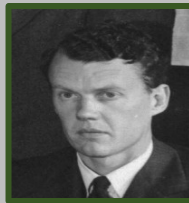
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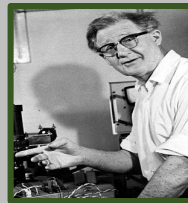
Turner McLardy
1916-1988



Patrick Merton
1920-2000



John Pringle
1912-1982



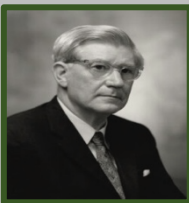
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1901-1980



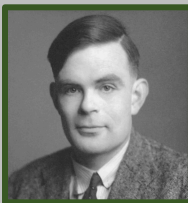
Harold Shipton
1920-2007



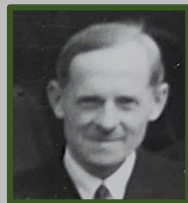
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1903-1960



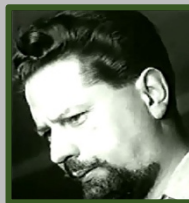
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1904-1983



Alan Turing
1912-1954



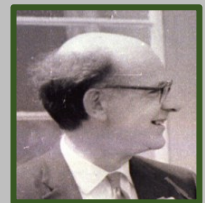
Albert Uttley
1906-1985



Grey Walter
1910-1977



John Westcott
1920-2014

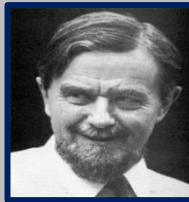


Philip Woodward
1919-2018

The Fellow Travellers



Giles Brindley
1926-



Colin Cherry
1914-1979



Dennis Gabor
1900-1979



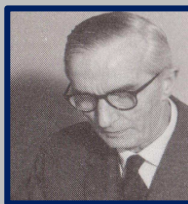
Arthur Porter
1910-2010



Wlodek Sluckin
1919-1985



Chris. Strachey
1916-1975



Arnold Tustin
1899-1994



J. Z. Young
1907-1997

The Other Cyberneticians



Alex Andrew
1924(?) - 2013



Stafford Beer
1926-2002



Frank George
1921-1997



Gordon Pask
1928-1996

Dedication

To Fiona, Angus and Eden.
Thank you. For everything.

Acknowledgements

First and foremost, my heartfelt thanks go to Rob Iliffe for his unstinting support and skilful guidance. I could not have hoped for a better steersman. Deep thanks are also due to my fellow Prometheans. I have been more of a ghost at the feast than I would have liked during the production of this thesis, but I have nevertheless been sustained by your good humour and sharp minds. Chris Histed has been a constant source of fellowship and gentle wisdom. My discussions with Dermot Turing have never failed to yield both his considerable erudition, and my considerable gratitude for his companionship. Archivists are the unsung heroes of historical research, and I have incurred debts to too many of them to name individually. Nevertheless, I am particularly grateful to the staff at the Wellcome Collection Library in London, the BBC Written Archives Centre at Caversham, the Special Collections and Archives at Liverpool John Moores University, and the Science Museum National Collections Centre at Wroughton. My thanks also to Rhodri Hayward for his encouragement, and to Jonathan Swinton for his support. My final note of thanks is to Phil Husbands. Not only did his pioneering work set me on this path, but he also graciously provided me with a trove of otherwise inaccessible, yet vital, primary material.

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Acronyms and Abbreviations

AACRG:	Anti-Aircraft Command Research Group
ACE:	Automatic Computing Engine (NPL)
ACS:	American Cybernetics Society
ADRDE:	Air Defence Research Development Establishment
AORG:	Army Operational Research Group
APRU:	Applied Psychology Research Unit (Cambridge University)
ARL:	Admiralty Research Laboratoires (Teddington)
ARPA:	Advanced Research Projects Agency (US DoD)
ARPANET:	Advanced Research Projects Agency Network (US DoD)
ASC:	American Society for Cybernetics
AScW:	Association of Scientific Workers
ASRE:	Admiralty Signals and Radar Establishment
ATA:	Air Transport Auxiliary
BBC/OPI:	BBC Online Programme Index
BBC/WAC:	BBC Written Archives Centre (Caversham)
BMJ:	British Medical Journal
BNI:	Burden Neurological Institute (Bristol)
BoT:	Board of Trade
BTH:	British Thomson-Houston
CHM:	Computer History Museum (Mountain View, CA)
CME:	Control Mechanisms and Electronics (NPL Division)
CRT:	Cathode Ray Tube
DERA:	Defence Evaluation and Research Agency
DEUCE:	Digital Electronic Universal Computing Engine (English Electric)
DoD:	Department of Defence (USA)
DSIR:	Department of Scientific and Industrial Research
EDSAC:	Electronic Delay Storage Automatic Calculator (Cambridge University)
EDVAC:	Electronic Discrete Variable Automatic Computer (Pennsylvania University)
EEG:	Electroencephalograph
EMS:	Emergency Medical Service
ENIAC:	Electronic Numerical Integrator and Computer
EPS:	Experimental Psychology Society
FPRC:	Flying Personnel Research Committee (RAF)
FRS:	Fellow of the Royal Society
GCCS:	Government Code and Cipher School (historically GC&CS)
GCHQ:	Government Communications Headquarters
GEC:	General Electric Company
GOFAI:	Good Old Fashioned AI
GP:	General Practitioner
HRG:	Human Research Group
IAS:	Institute of Advanced Study (Princeton)
IBM:	International Business Machines
ICA:	Institute of Contemporary Arts (London)
IEE:	Institution of Electrical Engineers
IPC:	International Publishing Corporation
KCL:	King's College London
LJMU:	Liverpool John Moores University
LSE:	London School of Economics
Metrovick:	Metropolitan Vickers
MIT:	Massachusetts Institute of Technology
MoAP:	Ministry of Aircraft Production
MoS:	Ministry of Supply

MPRC: Military Personnel Research Committee (Army)
 MRC: Medical Research Council
 NAHC: National Archive for the History of Computing (Manchester University)
 NCO: Non Commissioned Officer
 NDRC: National Defense Research Committee
 NPL: National Physical Laboratory (Teddington)
 NRDC: National Research Development Corporation
 NWP: Norbert Wiener Papers (MIT)
 ODNB: Oxford Dictionary of National Biography
 O&M: HM Treasury Organization and Methods Section
 OR: Operational Research
 OSRD: Office for Scientific Research and Development
 PAYE: Pay as You Earn
 PoW: Prisoner of War
 PR: Personnel Research
 RAE: Royal Aircraft Establishment
 RAMC: Royal Army Medical Corps
 RCA: Radio Corporation of America
 RMPA: Royal Medico Psychological Association
 RNPRC: Royal Naval Personnel Research Committee
 RRDE: Radar Research and Development Establishment (Malvern)
 RRE: Radar Research Establishment / Royal Radar Establishment
 RSCF: Research Scientists' Christian Fellowship
 SCS: Scientific Civil Service
 SIGMA: Science in General Management
 SMG: Science Museum Group
 STC: Standard Telephone and Cables
 TLS: Times Literary Supplement
 TRE: Telecommunications Research Establishment (Malvern)
 TREAC: TRE Automatic Computer
 TUC: Trades Union Congress
 UCL: University College London
 V&A: Victoria and Albert Museum
 WAAF: Women's Auxiliary Airforce
 WOSC: World Organisation of Systems and Cybernetics

Short Abstract

This archivally rich and methodologically innovative thesis presents a history of a crucial, yet little known, episode in post-war British history. On 22 October 1948, Norbert Wiener, a venerable yet idiosyncratic American mathematician, published *Cybernetics: or Control and Communication in the Animal and the Machine*. Confounding all expectations, the book became an instant success, and it spawned an international intellectual and cultural movement that laid the epistemological and ontological foundations for the Information Age.

Yet, despite its significance, cybernetics has all but vanished from the historical gaze. And, although Britain was one of the first, and most important, venues for the staging of the early experience of cybernetics outside America, this also has previously been neglected by historians.

Here, I examine the initial manifestations of the cybernetics movement in post-war Britain in the period from the end of the Second World War to the staging of the Mechanisation of Thought Processes Symposium at the National Physical Laboratory (NPL) in Teddington in 1958. Hitherto, such historiography of British cybernetics as there is, has concentrated on the Ratio Club; an informal cybernetics discussion group convened in the immediate aftermath of the publication of Wiener's book. However, whilst the Ratio Club was the most visible manifestation of British cybernetics, and whilst it contained known characters such as Alan Turing, it was neither the totality of British cybernetics nor its most significant dimension.

I set the Ratio Club in the context of the wider British cybernetics experience, and locate this experience as whole in the yet wider post-war British context. I evaluate the historical significance of British cybernetics, domestically and internationally, with regard to its intersections with early computing, information theory, the philosophy of mind and artificial intelligence. I conclude that this exposition of the importance of British cybernetics changes our understanding of post-war British history.

Long Abstract

This thesis presents a history of a little known and yet highly significant episode in the intellectual life of post-war Britain. In October 1948, Norbert Wiener, a professor of mathematics at MIT, published *Cybernetics: or Control and Communication in the Animal and Machine*. Despite its difficult mathematics, the book became a bestseller. Wiener was propelled to international celebrity and *Cybernetics* sparked the emergence of a global intellectual, scientific, and cultural movement. Britain briskly emerged as the first, and most important, site of the cybernetics movement beyond America. In September 1949, John Bates, a junior neurologist at the National Hospital for Nervous Diseases in London, convened some kindred spirits to discuss the ideas in *Cybernetics*. From this gathering of brilliant and eclectic minds came the Ratio Club. Seven of its twenty-one members were elected to fellowship of the Royal Society, including Alan Turing. The Ratio Club met regularly until 1955, and it sustained a notional existence until a terminal 1958 reunion during the NPL symposium on Mechanisation of Thought Processes. The Ratio Club was a vital part of the story of cybernetics in post-war Britain, but not the totality. Here, I locate the Ratio Club within the wider British experience of early cybernetics.

Cybernetics in Britain was historically important. It became inscribed in the development of computing and AI; and, it was at the centre of an eruption of a Cartesian version of the contest between mechanism and vitalism where it fuelled developments in the philosophy of mind. Cybernetics also populated both sides of an emergent discursive conflict between anxiety and optimism around mechanisation and computerised automation. Additionally, it propelled both the development of information theory in Britain, and stimulated the application of this theory to genetics, biology, and economics. More widely, cybernetics in

Britain was instrumental in the formation of systems theory. British cyberneticians also laid some of the foundations for the global spread of the cybernetics movement, and some of them became protagonists in the Cold War. Beyond my chronology, British cybernetics would later surface in both the episteme of the sixties counter culture, and the techno dystopic tropes of seventies popular culture.

Despite its historical significance, cybernetics has suffered from an historiographical silence. Such work as exists is, understandably, largely devoted to cybernetics in America and to Norbert Wiener. Much of this work has been done by Steve Heims, Ronald Kline, and Flo Conway and Jim Siegelman, who have all produced foundational studies. Whilst the historiography of cybernetics in America is limited, that on cybernetics in Britain is sparse. Andrew Pickering's 2010 work *The Cybernetic Brain* is the only book length treatment of cybernetics in Britain. However, Pickering's aim was less the production of history, and more the delivery of ideologically interventionist sociology. Pickering had little to say about the Ratio Club, or indeed the wider British experience of cybernetics.

The Ratio Club surfaced as the subject of a chapter in John Clark's unpublished 2002 PhD thesis. It then received an excellent introductory treatment in a seminal 2008 paper by Philip Husbands and Owen Holland, who also produced a paper on the interactions between cybernetics in Britain and America. Rhodri Hayward has written two papers on the post-war intersections between cybernetics and psychiatry in Britain which have drawn in the Ratio Club. This work has signposted important questions and directions, many of which I address in this thesis. Valuable as this work is, the history of the British experience of cybernetics is rich and significant enough to warrant a treatment beyond the confines of a handful of scholarly papers.

My thesis presents both the first substantive work of historical scholarship on the cybernetics movement in post-war Britain, and the first extended examination of the history of the Ratio Club. The absence of prior historiography about cybernetics in Britain does not signify an absence of historical significance, and I argue that the recovery of cybernetics to the historians' gaze necessitates the reappraisal of those other histories within which cybernetics is imbricated; including the histories of computing, AI, and Alan Turing. The proximate precedent is the effect of the release of knowledge about codebreaking at Bletchley Park. Here, I show the instrumentality of cybernetics in the formation of both the post-war popular and scientific episteme, and the national imaginary in Britain. Much of the history of science, technology, and philosophy in Britain in the second half of the twentieth century will remain partial for as long as the history of cybernetics is omitted. To borrow Conway and Siegelman's characterisation, cybernetics was the epistemological dark matter of the second half of the twentieth century.

This thesis interrogates the interrelationships between the life, times, and characters of the protagonists of British cybernetics, the wider experience of cybernetics in Britain, and the still wider post-war British context. I use this to explore both the sense in which cybernetics was inserted into the British context, and the sense in which the British context was infused into cybernetics. I argue that, ultimately, whilst cybernetics in Britain was historically important, there were few discernibly British aspects to this overall experience.

The Ratio Club itself was an informal dining and drinking club which eschewed academic normativities and existed in the liminal space between its members' professional and personal lives. It also nestled in the psychological spaces nurtured by the experiences of

Cambridge and the war common to its core membership. Like many of the protagonists of British cybernetics, most of the Ratio Club's members had been deeply immersed in the war-time development of the scientific and technological epistemologies and ontologies that had prefigured the central ideas and themes of *Cybernetics*.

Regarding the wider experience of cybernetics in Britain, I argue that although this did have a unique local character distinct from the American form, this was less about the imprint of historic British national cultural and intellectual practices into cybernetics, and more because of the reflexive relationships between the episteme of cybernetics and the specifics of the generative dynamics of the British post-war context. The mediations, trajectories, and outcomes of the wider cybernetics movement in Britain were products of a nation grappling with bankruptcy, reconstruction, and the end of an empire; whilst also being eclipsed by a new superpower, mortally imperilled by a new foe, and grappling with the moral jeopardies of total war. The Cold War was inscribed in the history of cybernetics in Britain, just as cybernetics infused the Cold War.

Methodologically, my hybrid approach stemmed from expedience, not from a firm ideological commitment to any particular method or theory. Broadly, it was constructivist. This was a unique opportunity to undertake the sociological explication of the production of new scientific knowledge during an episode when the scientists themselves were self-consciously creating their own new science, and their own new sociologies, beyond the academy. However, I have also recognised that the original appeal of cybernetics was its offer of a scientifically realist theory to explicate the lived war-time experiences of scientists who had encountered, and created, new socio-technical systems of manifest and novel

complexity. I have also considered the possibility that their judgement might have been right.

This archivally rich thesis integrates elements of biography, prosopography, intellectual history, and the history of ideas. Throughout, I have aimed at a narrative in which the externalist and internalist strands of the history of cybernetics are tightly interwoven. Alongside extensive use of conventional archival sources, I have made considerable use of cultural artefacts such as BBC broadcasts and novels, as well as works of popular science, and events such as the Festival of Britain. I have also deployed the records of a series of academic conferences and events related to cybernetics as primary sources, as well as a selection of the published works of the cyberneticians and other protagonists themselves.

The extended introduction contains an account of the origin and nature of the original form of cybernetics in America. This is not misplaced in a history of cybernetics in Britain. It is necessary on two counts. Firstly, cybernetics itself has become obscure to the point of invisibility. Secondly, cybernetics was an historically mutable episteme. Therefore, to examine the nature of the post-war British experience of cybernetics, it is essential to establish a view of the nature of that which was to be experienced, and, insofar as volition permits, to excise presentism and anachronism from this frame.

In Britain and America alike, the waging of mechanised total war amidst the complexities of mature industrial societies fostered the conditions for cybernetics to emerge. Especially, its ideas about the systemic communicative and control equivalences between humans and machines, and the particular equivalences between electronic digital computers and biological brains. Therefore, the first chapter of this thesis considers the British

manifestations of these conditions from the perspective of the interdisciplinarity of war-time scientific and technological research and development. Foregrounding the appearance of the technological and scientific constructions that presaged cybernetics, it also explores how immersion in the sociologies and practices around these constructions established networks and experiences that shaped the Ratio Club and British cybernetics overall. Although what I have characterised as proto-cybernetics coalesced around the development of radar and servomechanisms, and amidst the conduct of Operational and Personal Research, it also encompassed physicalist military psychiatry, mathematised cryptanalysis and weaponised information. The influence of the Cambridge experimental psychologist Kenneth Craik is emphasised here, alongside the effect of proto-cybernetics on both American pre-cybernetics and Wiener's authorship of *Cybernetics*.

The second chapter examines the proto-cyberneticist experiences of the protagonists of British cybernetics up to around 1948. It separates them into three groups. First, the Ratio Club, which whilst a coherent formation, was devoted to cybernetics more in name than in nature. Then, the Fellow Travellers, a constituency of scientists, mathematicians and engineers whom *Cybernetics* directly influenced without creating cyberneticians. Lastly, the Other Cyberneticians, who were all intellectually and professionally transformed by *Cybernetics*, and who all nurtured stronger cyberneticist commitments than most Ratio Club members. Of these Other Cyberneticians, Stafford Beer and Gordon Pask are historiographically known, whilst Frank George and Alex Andrew are new sightings. Of the Fellow Travellers, the cyberneticist intersectionality of Colin Cherry, Dennis Gabor, Christopher Strachey and J. Z. Young has largely been ignored, and Arnold Tustin's cyberneticist imbrications have only been noted in passing. Only Husbands and Holland have previously associated Giles Brindley with British cybernetics. Wladek Sluckin is a

new discovery. As, more significantly, is Arthur Porter, who features here despite his early emigration to Canada.

Chapter three examines both the constitution and conduct of the Ratio Club, and its members, up to 1958, and the general post-war context for the wider British cybernetics experience. This was an American techno-science of communications and systems that disavowed distinctions between organic and inorganic mechanisms, especially those involving cognition. It was inevitably implicated in the British post-imperial declinist anxieties spurred by the bankruptcy of victory, and in the anti-Americanism driven by the deepening transatlantic divide between prosperity and precarity. An early British public discursive clash around the professional and epistemological ownership of electronic digital computers also inexorably incriminated cybernetics. As did an equally public British battle for humanity's soul waged against electronic brains in the aftermath of Nazi robot war. Simultaneously therefore, British cybernetics was performatively Otherised in the nascent scientisation of computing, and vilified in a Cartesian computational controversy prominently staged by the BBC. The sensationalist exoticism of cybernetics also eased its scientific banishment and epistemological infamy, and its disreputability was further inscribed in its marginalisation across seven British events about computers and information theory, and strikingly exemplified in its expulsion from scientific orthodoxy at the NPL.

The fourth chapter explores the transmissive mechanics, cultural vectors and epistemological venues for the wider mediations of British cybernetics, with particular emphasis on the importance of the BBC and Penguin's *Science News* in propagating cyberneticist knowledge. Seminally, the BBC both popularised the Cartesian computational controversy, and foregrounded its belligerent intersectionality with cybernetics. This

activated both Alan Turing's unflinching public philosophical interventionism, and the strident evangelical scientific apologia of his fellow Ratio Club member Donald MacKay. By the mid-fifties, the fictive and philosophical spectre of soulless mechanistic simulacra usurping humans concretised in a socio-economic clash between technocratically imperative automation on one side, and a conservative alliance tacitly struck between capital, labour and state to preserve the shibboleth of full employment on the other. Although it was Othered by respectable science, spurned by the state, and repudiated by humanism, nevertheless the sublimated post-war discursive dissemination of cybernetics eventually surfaced across British sixties counterculture and then lodged in the catastrophist dystopic socio-technical imaginary of seventies popular culture. In parallel, early British cyberneticians interacted with their overseas counterparts, especially at domestic computer and information theory conferences and European cybernetics symposia, where they liminally transferred knowledge constructed within the British cybernetics experience beyond Britain.

Whilst this thesis has broken new methodological, historical and historiographical ground, it has only glimpsed at the richness and depth of the British cybernetics experience, and merely glanced at the significance of this experience to the wider history of cybernetics. As a start, it suffices. However, this vital dimension of the history of our contemporary socio-technics demands considerably greater attention than offered by my preliminary reconnaissance. *Cybernetics* was the wellspring of the epistemologies and ontologies that are currently metamorphosing the nature of human societies, the nature of human beings, and the nature of being human. Much has been made about Peter Galison's argument that *Cybernetics* was spawned by the dehumanising war-time militarisation of techno-science, and that cybernetics itself is perforce a dehumanised and dehumanising epistemology.

Generally, this argument strikes a lazy resonance with those who foreground Lewis Mumford's fear about the misuse of technology, yet forget his optimism about the power of the human spirit to master it. Theirs is a humanism implacably implicating technology in alienation and subjugation.

The British dimensions of cybernetics played a crucial and formative role in its creation and in its onward constructions. And, they were implicated in the birth of AI at the Dartmouth summer school in 1956; in vital yet hitherto unexplored ways. If we are to exercise intelligent agency in shaping a future shared amongst all of Wiener's children, whether animal or machine, it is imperative that we understand our past. Although Galison's politicised argument framed a highly selective reading of *Cybernetics* and its authorial hinterland, nevertheless it voiced an abiding historical tension within cybernetics itself. As the post-war British experience shows, *ab ovo*, *Cybernetics* enthralled those seeking a manifesto for techno-scientific transcendence, and terrified those for whom it conjured soulless robots. As Wiener recognised, the determination of either outcome is ours. We cannot abjure responsibility for our socio-technics by claiming either an ineluctable epistemological immanence, or by pleading submission to technological determinism. Catastrophe or civilization: we must choose.

Introduction

The Birth of Cybernetics

‘Cybernetics’ was publicly birthed on 12 September 1948 in a *Washington Post* report on an impending National Instrument Conference in Philadelphia. The foregathering mavens were eagerly awaiting the intellectual revolution portended by the idiosyncratic MIT mathematics professor Norbert Wiener. Although not yet fully formed, nevertheless they, and Wiener, foresaw his new science transforming the way humans thought about thinking.³ Then, on 22 October 1948, Wiener published *Cybernetics: or Control and Communication in the Animal and the Machine*.⁴ His book took America by storm. Within a year, wherever Americans read books *Cybernetics* was ubiquitous, and ‘cybernetics’ was officially inscribed in the formal lexica of American English.⁵

Wiener met Enrique Freymann, director of the venerably impecunious Parisian publisher Herman et Cie, in summer 1947 en-route to a mathematics conference in Nancy. By December, the manuscript of the book that Wiener had agreed to write over a cup of cocoa was in Freymann’s hands.⁶ Wiener’s text was carelessly proofread and unindexed, and his prose was freighted with both advanced mathematics and eclectic scholarly allusions. The book itself was sloppily typeset and cheaply printed. Even its title was a bewildering neologism. Wiener named his new science by anglicising *kubernētēs*, or *kybernetes*, itself a

³ J. L. Springer, “Electron Magic Still in Infancy: Tube Might Even Aid Learning”, *Washington Post*, 12 Sept. 1948, p. M17.

⁴ N. Wiener, *Cybernetics: or Control and Communication in the Animal and the Machine*, 1st edn., (Herman et Cie, Paris; Wiley & Sons, New York; MIT Technology Press, Boston; 1948). Hereinafter, unless otherwise specified, all references are to this edition.

⁵ I. W. Russell, “Among the New Words”, *American Speech*, Vol. 24, No. 4, Dec. 1949, p. 305.

⁶ Letter, Freymann to Wiener, 21 Jan. 1948, MIT/NWP/Box 5, Fldr. 80, <https://dome.mit.edu/handle/1721.3/193686>, [10 March 2024].

Latinate form of the Greek κυβερνήτης.⁷ Alongside invoking the Classical etymology of steering a ship, or polity, through iterative adjustments, Wiener also claimed inheritance of Maxwell's mathematical analysis of Watt's automatic steam engine governor. *Cybernetics* did not seem destined for commercial success. Both author and publisher considered it intellectually worthy yet commercially futile, much like the work of the Bourbaki collective which Freymann also published.

Yet, *Cybernetics* became a runaway American bestseller. Herman et Cie's initial run, number 1053 in its prestigious Actualités Scientifiques et Industrielles series, was supplemented by an American offset edition which was reprinted a further four times between October 1948 and April 1949.⁸ In January 1949, *Business Week* ranked the popularity of *Cybernetics* alongside the Kinsey Report.⁹ That February, the *New York Times* reported the delighted bafflement amongst Manhattan's book sellers caused by *Cybernetics*, again drawing comparison with Kinsey.¹⁰ *Cybernetics* was selling as well as sex, and by February 1948, 7,000 copies were in circulation. In 1949, *Cybernetics* was republished in Britain, and MIT reported royalties on overall sales of 15,000.¹¹ By 1956, French science writer Pierre de Latil claimed sales of 21,000.¹² By December 1959, Wiener's arcane book

⁷ Wiener, *Cybernetics*, p. 19.

⁸ F. Conway, J. Siegelman, *Dark Hero of the Information Age: In Search of Norbert Wiener the Father of Cybernetics*, (Basic Books, New York, 2006), p. 182.

⁹ "Machines That Think", *Business Week*, Iss. 1016, 19 Feb. 1949, p.40.

¹⁰ H. Gilroy, "Salesmen as Critics", *New York Times*, 13 Feb. 1949, p. BR5.

¹¹ Letter, Brooks to Wiener, 19 Dec. 1949, MIT/NWP/Box 7, Fldr. 108, <https://hdl.handle.net/1721.3/200285>, [6 Jan. 2024].

¹² P. de Latil, Y. M. Golla (trans.), *Thinking by Machine: A Study of Cybernetics*, (Houghton Mifflin, Boston, 1956), p. 12.

had sold 33,000 copies.¹³ Wiener became an instant American celebrity, and the civil rights activist James Baldwin later recalled that a “cybernetics craze” had swept America.¹⁴

The intellectual explosion sparked by Wiener’s idiosyncratic book radiated across post-war America. Within weeks of its publication, consumers of America’s mass circulation and middlebrow journalism were encountering *Cybernetics* in the pages of their newspapers and magazines. Readers of the *New York Times* learnt both that cybernetics portended a scientific revolution comparable with relativity or quantum mechanics, and that Wiener’s assertion of mechanistic commonality between electronic computers and human neurophysiology resolved the ancient dichotomy between free-will and determinism.¹⁵ *Newsweek* also noted Wiener’s claim of equivalence between brains and computers, albeit with greater discomfiture than the *Times*.¹⁶ Closing 1948, *Time* reflected that the multitudes of Wiener’s American readers were simultaneously thrilled and petrified by his prophesised Second Industrial Revolution where computers would replace the minds of managers as steam engines had once replaced the muscles of menials.¹⁷ *Seventeen* promised its teenage readers a future where computers replaced teachers, piloted aircraft, and wrote their homework.¹⁸ Bridging between popular and professional constituencies, *Scientific American* predicted that Wiener’s claim of electronic and biological cognitive equivalence would incite intense scientific and public controversy.¹⁹

¹³ R. R. Kline, *The Cybernetics Moment: Or Why We Call Our Age the Information Age*, (Johns Hopkins University Press, Baltimore, 2015), p. 83.

¹⁴ J. Baldwin, *No Name in the Street*, (Michael Joseph, London, 1972), p. 52.

¹⁵ W. L. Laurence, “Cybernetics, a New Science, Seeks the Common Elements in Human and Mechanical Brains”, *New York Times*, 19 Dec. 1948, p. E. 9.

¹⁶ “The Brain is a Machine”, *Newsweek*, Vol. 32, Iss. 21, 15 Nov. 1948, p. 89.

¹⁷ “Science: In Man’s Image”, *Time*, 27 Dec. 1948, p. 45.

¹⁸ D. B. Hertz, “Cybernetics”, *Seventeen*, Vol. 8, Iss. 10, Oct. 1949, pp. 114-115, 130, 132.

¹⁹ N. Wiener, “Cybernetics”, *Scientific American*, Vol. 179, No. 5, Nov. 1948, pp. 14-19.

Cybernetics permeated American universities with equal rapidity, and conspicuous consumption was required of staff and students alike. Congratulating Wiener on his success, Cornell mathematician Will Feller told him that it seemed as though everyone on campus had a copy.²⁰ Wiener's then friend and colleague, the neurophysiologist Warren McCulloch, joked that both his purchased copies were immediately pilfered.²¹ Illinois mathematician Joseph Doob was both astonished at the proliferation of *Cybernetics*, and sceptical about its actual readership.²² He suspected that ownership was more performative than studious. For some academics, such as the mathematician John Vanderslice, *Cybernetics* was alluringly transgressive; he found its unclassifiable radicalism exciting.²³ Instantly, *Cybernetics* became both a scholarly shibboleth and a cultural icon; terrifying some, mesmerising others.

The academic appeal of *Cybernetics* spread beyond the followers of faculty fashion. On a conservative count, by December 1949, *Cybernetics* was formally reviewed or cited at least forty times across a spectrum of American scholarly journals spanning mathematics, philosophy, sociology, linguistics, semantics, politics, psychology, history and economics. Whilst a minority balked at Wiener's scientific iconoclasm, the overwhelming majority of his academic peers heaped praise upon his bold venture. Even though psychologist Alphonse Chapanis denounced cybernetics as sensationalist and populist pseudo-science, he was aware of his own awkward heterodoxy.²⁴ However, although most American reviewers

²⁰ Letter, Feller to Wiener, 18 Nov. 1948, MIT/NWP/Box 6, Fldr. 86, <https://hdl.handle.net/1721.3/200263>, [19 Nov. 2023].

²¹ Letter, McCulloch to Wiener, 9 Dec. 1948, MIT/NWP/Box 6, Fldr. 87, <https://hdl.handle.net/1721.3/200264>, [19 Nov. 2023].

²² Letter, Doob to Wiener, 9 Dec. 1948, MIT/NWP/Box 6, Fldr. 87, <https://hdl.handle.net/1721.3/200264>, 19 Nov. 2023].

²³ J. L. Vanderslice, *Mathematics Magazine*, Vol. 23, No. 2, Nov./Dec. 1949, pp. 98-100.

²⁴ A. Chapanis, *Quarterly Review of Biology*, Vol. 24, No. 3, Sept. 1949, p. 266.

of *Cybernetics* thought that its scientific significance matched its popularity, few went as far as the renowned physicist Léon Brillouin who proclaimed that Wiener had discovered the secret of life itself.²⁵ Notably, Brillouin wrote his review whilst he was transitioning from teaching at Harvard to directing electronic education at IBM.

Wiener's academic peers frequently focussed on his claims about computational cognitive equivalence between neurology and electronics, and on his prediction of a new Industrial Revolution predicated on mechanised thinking. Rather than fearing computerised dehumanisation, America's post-war professional thinkers generally welcomed the prospect of cybernetic automation and the leisured consumerist prosperity they believed it would bring. For them, *Cybernetics*' scientific credibility was bolstered by its mathematised interdisciplinarity, and by its insistence upon a physicalist explanation of human nature. Wiener's amalgam of mathematics, neurology, electronics and engineering synthesised a scientifically realist explanation of humanity which eschewed psychoanalytic subjectivity, observational behaviourism, biological taxonomizing and philosophical metaphysics. Not only would Wiener's mathematically specifiable minds, whether biological or electronic, conjure material cornucopia; but they would also banish ideology and totalitarianism, and ward off atomic annihilation. Post-war American minds were eager to believe that mathematics could ameliorate the propensity to chaos and irrationality which had embroiled the world in its second calamitous conflagration within decades.

The belief that *Cybernetics* sundered social science from intuition and bound it to mathematical rigour was vigorously expressed by the psychologist Anatol Rapoport and the

²⁵ L. Brillouin, "Life, Thermodynamics, and Cybernetics", *American Scientist*, Vol. 37, No. 4, Oct. 1949, pp. 554-68.

biologist Alfonso Shimbel. They declared that *Cybernetics* delivered the capability for the scientific engineering of humanity foretold by the founder of general semantics, Alfred Korzybski.²⁶ Whilst he eschewed their messianic tone, nevertheless, Harvard mathematician Joseph Walsh paired *Cybernetics* with von Neumann and Morgenstern's *Theory of Games*, arguing that they each expressed the essential axioms of a new physics of human nature.²⁷ Morgenstern agreed. He thought that cybernetics furnished the theoretical basis for the computerised analysis of human economic behaviour.²⁸ This academic reception drew on the deeper historical American sense that human behaviour was scientifically manipulable. So, where Frederick Taylor had once suggested that industrial labour was as easily engineered as the machines it serviced, now Wiener theorised that both human mentality and societal mechanics were similarly malleable.²⁹ However, the enthusiasm for Wiener's ideas also reflected a specific post-war American intellectual appetite for a new kind of science to serve a newly energised imperative to enact social engineering at home and abroad.

Just as it had militarised techno-science during the Second World War, the strengthening American military-industrial complex now sought fresh epistemological weapons with which to wage a burgeoning new global conflict. The Cold War was an existential combat of a different kind. Whilst America's power ultimately depended on its vast military and overwhelming economy, the Cold War was fought as much across the intellectual and cultural spheres as through the direct clash of arms; albeit under the cloud of atomic

²⁶ A. Rapoport, A. Shimbel, "Mathematical Biophysics, Cybernetics and General Semantics", *ETC: A Review of General Semantics*, Vol. 6, No. 3, Spring 1949, p. 147.

²⁷ J. L. Walsh, "Another Contribution to the Rapidly Growing Literature of Mathematics and Human Behaviour", *Scientific American*, Vol. 181, No. 2, Aug. 1949, p.56. J. von Neumann, O. Morgenstern, *Theory of Games and Economic Behaviour*, (Princeton University Press, Princeton, 1944).

²⁸ W. Leontief, "Input-Output Analysis and Its Use in Peace and War Economics: Recent Developments in the Study of Interindustrial Relations", *American Economic Review: Papers and Proceedings of the Sixty-first Annual Meeting of the American Economic Association*, Vol. 39, No. 3, May 1949, p. 240.

²⁹ F. W. Taylor, *The Principles of Scientific Management*, (Harper & Brothers, New York, 1911).

Armageddon. Apart from nuclear supremacy, the primary battle was for civilizational legitimacy. Although Pax Americana possessed much of the same imperial character as the Pax Britannica it replaced, it was vital that America's influence appeared to be exercised through consent not coercion. As the historian of science Steve Heims argued, cybernetics joined a praxical Cold War transformation of American social science which was rooted in the totalising global conflict from which America had emerged as the supreme victor.³⁰ This war had both spurred interest in novel scientific techniques for manufacturing and manipulating human behaviour at societal scale, and elevated social scientists to new levels of prestige. As the Cold War unfolded, many of them shunned a return to their pre-war academic theorising and became instead epistemological belligerents, practising social engineering in the service of the military-industrial complex.

Cybernetics emerged within a nation that was confronting both the impossibility of a return to its pre-war isolationism, and the unavoidability of becoming a neo-imperialist superpower. It nourished a domestic appetite for a homegrown positivist science of American power, prosperity and ideologically evangelical democracy; an appetite which craved a geometry of systems, a physics of humanity, and a calculus of society. Notably, in October 1946, Wiener and McCulloch presented their nascent cyberneticist ideas to the sociologists Talcott Parsons and Robert Merton, and the anthropologist Clyde Kluckhohn, at the Teleological Mechanisms conference, specially convened by the New York Science Academy at the Macy Foundation's behest.³¹ The cybernetics craze gripped a transforming

³⁰ S. J. Heims, *The Cybernetics Group*, (MIT Press, Cambridge, 1991).

³¹ L. K. Frank, N. Wiener, G. E. Hutchinson, W. K. Livingston, W. S. McCulloch, "Teleological Mechanisms", *Annals of the New York Academy of Sciences*, Vol. 50, Art. 4, Oct. 13 1948, pp. 187-278, [Teleological Mechanisms Conference, New York Academy of Sciences, 21-22 Oct. 1946]. P. Paidipaty, "'Tortoises All the Way Down': Geertz, Cybernetics and 'Culture' at the End of the Cold War", *Anthropological Theory*, Vol. 20, Iss. 1, 2020, pp. 97-129, 111-12.

nation just as it prepared to exert its economic, cultural and military power to re-engineer the world in its own new image; an image which *Cybernetics* itself helped fashion.

For Wiener's compatriots, the electronic digital computer was a prime mover of this new, rationalist, American might. Economically, computers would drive American capitalism to abundant automated wealth creation. Psychologically, computers furnished observable models of mind, idealisations of mental normativity, and testbeds for physiological psychiatric interventions. Sociologically, computers promised the triumph of logic, free from ideological, pathological, psychotic, emotional or genetic contamination. Politically, they suggested mind control. Militarily, they augured impregnable defences, unassailable strategy, and clinically detached push-button warfare. The American embrace of electronic digital computers and the cybernetics explosion were interwoven with America's post-war ascent to geo-political superpower. *Cybernetics* promised America a scientific means of re-making itself, and the world around it, into a computer controlled technocracy.

The Intellectual Contents of Cybernetics

Cybernetics literally defied categorisation. In December 1949, the Director of the Dewey Decimal Classification office at the Library of Congress wrote to Wiener, pleading with him to decide whether his book was about mathematics, psychology or electronic computers.³² Neither she, nor her staff, could subsume *Cybernetics* within their requirement for taxonomical submission to a singular bibliographic classification. Their dilemma reflected authorial intent. Wiener believed that disciplinary demarcations existed to perpetuate academic fiefdoms, not to advance scientific knowledge. He aimed to both inhabit the

³² Letter, Potter to Wiener, 2 Dec. 1949, MIT/NWP/Box 7, Fldr. 108, <https://hdl.handle.net/1721.3/200285>, [19 Nov. 2023].

unclaimed epistemological territory that lay beyond the borders of orthodox science, and to erase the borders themselves.³³ By design, cybernetics was both trans, and anti, disciplinary; made inherently amorphous precisely to resist containment within the segregation of knowledge that Wiener despised. As Andrew Pickering said, cybernetics became a nomad science; equally denied and denying both the stabilising sustenance of academic instantiation and the sanctuary of institutional acceptance.³⁴ Consequently, the history of cybernetics became characterised by its continual self-adaptation and survival through sublimation.

In its primordial Wienerian form, the epistemological core of cybernetics was the assertion of a fundamental mathematical commonality between electronic digital computers and human neurophysiology, especially that within the brain. This isomorphism was predicated on Wiener's statistical theory of information which, although identical to Claude Shannon's contemporaneous idea, was, as they agreed, formulated independently.³⁵ *Cybernetics* declared a unity between the 'all-or-nothing' switching of biological synapses, and the 'on-or-off' gating of vacuum tubes. Their common 'either-or' character equivalenced a binary digit. For Wiener, computers were electronic analogues of human brains. Both were binary mechanical systems operating on physical manifestations of information, and although existing electronic and biological computers differed in their states of complexity, they were operationally and mathematically identical. Therefore, the rules governing the biological computation of binary information were as specifiable as those used to instruct a computer. Because cognition was computational, computers could think. Thus, they materialised an

³³ Wiener, *Cybernetics*, pp. 2-3.

³⁴ A. Pickering, *The Cybernetic Brain: Sketches of Another Future*, (Chicago University Press, Chicago, 2010), p. 11.

³⁵ C. E. Shannon, "A Mathematical Theory of Communication", *Bell System Technical Journal*, Vol. 27, Iss. 3, July 1948, pp. 379-423; Vol. 27, Iss. 4, Oct. 1948, pp. 623-56. C. E. Shannon, W. Weaver, *The Mathematical Theory of Communication*, (Illinois University Press, Urbana, 1949). Letter, Shannon to Wiener, 13 Oct. 1948, MIT/NWP/Box 6, Fldr. 85, <https://hdl.handle.net/1721.3/200262>, [6 Jan. 2924].

electronic analogue of the neuronal materiality of mind which, as an observable externality, circumvented its reflexive inability to apprehend its own internality. Thought was logically unable to comprehend itself. Cognition, using its own cognitive mechanics to cognate about cognition, cannot observe the operation of the cognitive mechanics cognating cognition. However, it could contemplate the operation of a machine constructed in its own image.³⁶

Wiener believed that the electronic digital computer expressed the same intellectual imperative to mechanise mathematics that had driven Pascal to invent his calculator. He also believed that his discovery of the informational isomorphism between organic and electronic computation could extend Leibniz's *calculus ratiocinator* from theory into practice. Just as Pascal's machine operationalised the rules of arithmetic, so the electronic computer could operationalise Leibniz's rules of reasoning. For Wiener, mathematics was the idealised symbolic representation of the logic of thought processes, therefore any mechanism capable of automatically enacting this logic was capable of thought, regardless of whether it was electronic or biological. So, as brains and computers were programmable logic machines, and as the idea of mind was merely a way of describing the operation of these machines, then an electronic computer was a *machina ratiocinatrix*; an embodiment of the *calculus ratiocinator*, powered by electricity not calories. Wiener also claimed that his *machina ratiocinatrix* realised the universal computing machine proposed by Turing in 1936. Following Turing's argument that a machine could compute whatever was computable, Wiener claimed that the logical processing capabilities of electronic computers were at least equivalent to those of their creators. Although he did not express it directly, Wiener clearly believed that whatever humans could think, computers could compute.³⁷

³⁶ Wiener, *Cybernetics*, pp. 22-3, 26, 139, 141, 147.

³⁷ *ibid.*, p. 20, 147, 149, 153.

Wiener's computationalist mind was mechanistic, but not reductively materialist. For him, mind was neither an immanence within, nor an emanation from, matter. Nor was thought a substantive secretion of either biological or electronic circuits. Rather, mind denoted a stateful property of machines in motion. It was the operation of the computer, not merely its mechanical structure, which imbued it with mind-like attributes. The isomorphism between brains and computers existed because each used the same binary architecture to process rules, enact instructions and store information. Although the continuous operation of the organic human computer exceeded the existing capabilities of a discrete single run of a contemporary electronic computer, this limitation was merely contingent on the current state of technology and would soon be surpassed. Wiener's operationalism deprecated Cartesian dualism, regardless of whether the *machina ratiocinatrix* was organic or electronic. Neither thought nor mind possessed either ontological or epistemological separability from the behavioural manifestations of corporeal mechanics. The resemblance between Wiener's assertion of operationalist cognition and Gilbert Ryle's philosophical repudiation of the Cartesian duality as a category error is striking. As was their timing. Ryle published *The Concept of Mind* the year after Wiener published *Cybernetics*.³⁸

Wiener's assault on vitalism did not rest with defenestrating Descartes. Brillouin was right to discern that Wiener sought the secret of life itself. Wiener's conception of life arose from his information theory. Unlike Shannon's specification of a probabilistic architectural primitive for digital telecommunications systems, Wienerian information was an indivisible universal property, fully equivalent to matter and energy. Just as mind denoted the active

³⁸ *ibid.*, p. 143, 147, 153, 155, 171.

mechanics of neuronal materiality, so life denoted the capacity of self-adaptive systems to store, process and communicate information. Informationally driven feedback and homeostasis defined life, but they were not exclusively biological. Life was an emergent behavioural property of any sufficiently complex system, regardless of its material composition. In Wiener's positivist hylozoism, information was not merely the resolution of abstract statistical uncertainty, but rather it cohered the constitutive elements of systems together, whatever their form. Viewed cybernetically, systems coalesced as probabilistically patterned contingent negations of uncertainty. Whereas classical physics expressed entropy thermo-dynamically and constructed living beings as energy converters, for cybernetics life was anti-entropic because it sustained material or operational coherence informationally, not because it microcosmically resisted the heat death of the universe. Organisms were information processing machines, not heat engines, and they need not be organic. Information was ontologically transcendent, and its anti-entropic property obtained across physical and relational systems of all kinds, including humans and their societies.³⁹

During the war Wiener investigated the mathematics of automating the predictive self-aiming of anti-aircraft guns. This prompted a realisation that, in the case of both the guns and their targets, the agency of their biological operators was constrained by the nature and goals of the systems they inhabited. Human behaviour became merely another set of variables in the equations specifying systemic operation.⁴⁰ Wiener also realised that whilst human cognition and perception lacked sufficient accuracy and speed to anticipate the behaviour of increasingly sophisticated aircraft; these neurological faculties could be bettered by machines. Even before the advent of electronic digital computation, electro

³⁹ *ibid.*, pp. 18-19, 27, 33, 47-8, 54, 71-3, 79, 132, 135, 187.

⁴⁰ *ibid.*, pp. 12-13.

mechanical automation had outstripped neurology.⁴¹ The mathematical representability of neurological agency in manufactured systems controlled by feedback and information drew Wiener's attention to the naturalistic manifestation of equivalent mechanical characteristics in biological systems. He drew an illustrative corollary between radar guided, computer controlled and servomechanically actuated self-aiming anti-aircraft fire; and the human self-adjustive, sensorial and cognitive mechanisms deployed in picking up a pencil.⁴²

Fusing Wiener's ideas about agentic equivalence, systemic fungibility, computational isomorphism, and informationally anti-entropic life, *Cybernetics* did more than merely propose indistinguishability between machines of meat and metal; it spawned an entirely new synthetic being. Wiener's cyberneticist automata coupled electronic digital computers with thermometers, photo-electric-cells, radar, microphones, and hydrogen-ion-potential recorders to equivalence brains and the primary senses. Electrical circuits operated as nerves, and handled communications with the strain and pressure gauges replicating proprioception and kinaesthesia. Similarly, motors and solenoids mirrored the skeletal effects of antagonistic muscles, whilst neurons and thermionic valves shared a common relationship with the circulatory systems that energised them.⁴³

Like humans, Wiener's creatures stored information for future retrieval, and they combined such memories with subsequent inputs so as to modify their behaviour according to these later experiences.⁴⁴ In Wiener's view biological memory arose operationally from contingent synapsial permeability thresholds that were conditioned by the temporal and

⁴¹ *ibid.*, p. 75

⁴² *ibid.*, p. 14, 116, 127.

⁴³ *ibid.*, pp. 53-54.

⁴⁴ *ibid.*, pp. 22, 171-2.

physiological contiguity of afferent informational stimulus. Computationally, this could be replicated by manipulating the contingent variability in the summative excitation trigger of vacuum tubes. Therefore, Wienerian automata could be reflexively trained, not merely programmed.⁴⁵ Equally, like bio-forms, Wiener's children were environmentally coupled through self-adaptive circular feedback mechanisms that connected sensors, processors and actuators to sustain the dynamic equilibria of homeostasis. Regardless of whether their matter was metal or meat, the essence of Wiener's machines was information.⁴⁶

Wiener's denunciation of vitalism went deeper still. His automata were just as capable of phenomenological subjectivity as their human makers. Wiener expressed Locke's associative theory of ideas cybernetically as the computational construction of perceptual universals from informational gestalts generated by neurologically processed sense data.⁴⁷ Therefore, as sensorily equipped digital computers processed their electronic equivalent of visceral sense data informationally, so they were also capable of experiencing perception and ideation.⁴⁸ Moreover, given that subjective human temporality expressed the informational latency of synapsial processes, and given that information delay systems in electronic computers replicated these biological circuits, then Wienerian automata could experience the internality of Bergsonian time.⁴⁹ As cyberneticist automata manifestly lacked metaphysical life force, so Wiener sublatively nullified the dialectical antagonism between mechanism and vitalism.⁵⁰ *Cybernetics* vitiated both Descartes and God.⁵¹

⁴⁵ *ibid.*, p. 146, 153.

⁴⁶ *ibid.*, pp. 36-7, 54-5.

⁴⁷ *ibid.*, p. 156.

⁴⁸ *ibid.*, pp. 156-67.

⁴⁹ *ibid.*, p. 143.

⁵⁰ *ibid.*, pp. 49, 51, 54-6.

⁵¹ *ibid.*, pp. 52-3.

Weiner foresaw his environmentally agentic computational entities unleashing a societal transformation greater even than the rise of industrial capitalism. Whereas the First Industrial Revolution had embodied thermodynamics and Newtonian physics in mechanical replacements of muscles and bones, the forthcoming socio-economic tumult would embody information and cybernetics in electronic surrogates for human perception and cognition.⁵² As Weiner saw, the war had accelerated and amplified the imperative to automate and augment the informational processes required to control the increasingly sophisticated machines upon which society was existentially dependant. Even as he wrote *Cybernetics*, it was evident both that humans were the limiting factor in the speed and power of electronic computation, and that these new computers were as essential to the technologies of peace as self-regulating machines and radar had been to the prosecution of war.⁵³ For all that self-aiming missiles and self-steering ships were the wonder of the moment, they were as nothing compared to the fully automated cybernetic factories to come.⁵⁴

Whilst Wiener revelled in the techno-scientific triumph of his new cyberneticist life-forms, he was also terrified by the prospect of their misuse. His automata forced upon humanity the choice between enslaving machines or being enslaved by them.⁵⁵ *Cybernetics* contained one of the earliest evocations of the Erewhonian's putative fictive fate as a warning against the rise of thinking machines and their revolt against their makers.⁵⁶ Less prosaically, Wiener warned the president of the United Automobile Workers Union about the

⁵² *ibid.*, pp. 36-9.

⁵³ *ibid.*, p. 139.

⁵⁴ *ibid.*, p. 36, 55.

⁵⁵ *ibid.*, pp. 36-7.

⁵⁶ S. Butler, *Erewhon: or, Over the Range*, (Trübner, London, 1872).

catastrophic unemployment which the inevitable automation of motorcar manufacturing would inflict on Detroit.⁵⁷ Wiener's dread of the devastating consequences of the mass unemployment that cyberneticist automation presaged drew on his deep antipathy to unrestrained free-market capitalism. He hoped that cybernetics heralded an age of material plenty and leisured freedom. He feared that it would endow the unscrupulous elite with even greater command over both the means of economic production, and the information and communication systems through which society as a whole was ultimately controlled.⁵⁸

Historiographical Hinterland

Cybernetics became one of the most important texts of the twentieth century, instantly igniting an eponymous international intellectual and cultural movement, and laying deep epistemological and ontological foundations for our contemporary socio-technics. The history of cybernetics is deeply inscribed in the histories of computing, information and communications technology, the Internet, AI, machine learning, artificial life and robotics. William Gibson perhaps understood more than he realised when he prophesied “cyberspace”.⁵⁹ He certainly recognised his debt to Wiener.⁶⁰ From the outset, the free flowing epistemological fluidity of cybernetics carried it deeply into the narrative cores of science fiction, from where it permeated into the minds of generations of scientists whose professional knowledge constructions bore its unmistakable imprimatur. More than nominatively, fictively, or virtually; *Cybernetics* begat cyber.

⁵⁷ Letter, Wiener to Reuther, 13 Aug. 1949, MIT/NWP/Box 7, Folder 102, <https://hdl.handle.net/1721.3/200279>, [6 Jan. 2024].

⁵⁸ Wiener, *Cybernetics*, pp. 37-9, 48-50, 55, 186-9.

⁵⁹ W. Gibson, “Burning Chrome”, *Omni*, July 1982, 72-7.

⁶⁰ W. Gibson interviewed by D. Solomon, “Back From the Future: Questions For William Gibson”, *New York Times Magazine*, 19 Aug. 2007, <https://www.nytimes.com/2007/08/19/magazine/19wwln-q4-t.html>, [25 May 2023].

However, despite its vital importance to the technologies constituting the modern phenomenon bearing its name, cybernetics has largely vanished from the historical and scientific gaze. *Cybernetics* is absent from university reading lists in any discipline, and even the word itself is lexically obsolete. The historiographical lacuna around *Cybernetics* and cybernetics is particularly conspicuous in histories of the systems it helped constitute. One may read many standard texts on the history of computing and yet emerge with little sense of the significance of cybernetics. This silence is echoed in the conduct of our contemporary discourse around the societal deployments of computationally based technologies. Even expert debates about AI carry little sense of the connection between its current form and its future possibilities. Still less do they recognise the significance of the historical contingencies from which it emerged. The ahistoricism of both current AI research and the discourse around its societal potential is concerning for several reasons.

Firstly, for example, conversations about the role of explainability in ensuring the safe use of AI pivot around the fulcrum of algorithmic determinism. AI will be safe to deploy as an autonomous decision maker when we humans are confident that we will be able to recursively analyse the specificities of any given enactment of its linear decision making process. This conceit is predicated on the assumption that AI conforms to the algorithmic image in which it was crafted by John McCarthy at the Dartmouth Summer Research Project in 1956. However, as I show in this thesis, McCarthy invented AI as a covert renunciation of cybernetics. Therefore, inasmuch as cybernetics and AI constitute incommensurable paradigms for machine or computational cognition, so too are our current presumptions about safety through explainability inoperable when decoupled from their deterministic predicate. The indeterminate behaviours of sensorily equipped, self-adaptive, self-

determining, self-locomoting, feedback regulated and environmentally situated Wienerian automata are irreducible to McCarthy's disembodied mathematical exercise in pre-scripted linear cause and effect.

Secondly, and relatedly, much of the current excitement (and concern) about what we must still call AI stems from the deployment of approaches that are demonstrably closer to cybernetics than to McCarthy's invention. Thus, the essence of the approach that has yielded the current wave of generative AI is an implementation of the ideas about neural networks that were proposed by Walter Pitts and Warren McCulloch in 1943, and which became one of the epistemological foundations for Wiener's *Cybernetics*.⁶¹ Indeed, knowingly or otherwise, many of the alternatives to conventional AI, including connectionism and embodied AI, ultimately derive from cybernetics. Much time, resource and frustration may yet be spared if contemporary AI researchers were to permit themselves to become better acquainted with the history of their field.

Thirdly, impressive though the achievements of generative pre-trained transformer implementations of neural networks are, they have only employed a fraction of the potential of the approach first outlined by the cyberneticians of the mid-twentieth century. For all that Frank Rosenblatt's construction of the Mark 1 Perceptron was vilified by followers of John McCarthy, nevertheless his implementation of the ideas in Pitts and McCulloch's 1943 paper

⁶¹ W. S. McCulloch, W. Pitts, "A Logical Calculus of the Ideas Immanent In Nervous Activity", *Bull. Mathematical Biophysics*, Vol. 5, Dec. 1943, pp. 115-33.

remains impressive today.⁶² One can only speculate about the future cognitive capacity of sensorily equipped Wienerian automata that embody neuromorphic computing.

Finally, the history of cybernetics contains a trove of prior art which may yet yield both new pathways for research, and the necessary intellectual equipment which we will require in order to prepare ourselves for the possible futures that these pathways may lead us to. Uncovering this history is a necessary, but by no means sufficient, condition for the extraction of whatever epistemological treasure that Wiener and his fellow cybernetics may have bequeathed us.

Like the computers upon which they are based, the current forms of AI appear to have emerged as positivist expressions of deterministic techno-scientific imminences. Therefore, statements about the capabilities and limitations of non-human cognition are couched in correspondingly absolutist terms. Within the normative contemporary techno-scientific computational discourse, these statements express not merely a falsifiable hypothesis about the capacity of current systems, but rather an expression of an inviolable scientific law. Yet, historically, these technologies were contingent constructions formed within a dynamic transatlantic context which was shaped by intellectual currents carrying cybernetics within their ebb and flow. In this thesis, I argue both that the current forms of computing and AI are products of historical contingency rather than immutable expressions of techno-scientific determinism, and that the possible futures for these technologies derive from their historical imbrications with cybernetics. Despite its later invisibility, *Cybernetics* matters.

⁶² Although the perceptron controversy is discussed later in this thesis, it remains a largely obscure historical episode which is only slightly better known of amongst AI researchers than amongst historians of science. The main work on the history of the controversy is: M. Olazaran, "A Sociological Study of the Official History of the Perceptrons Controversy", *Social Studies of Science*, Vol. 26, Iss. 3, Aug. 1996, pp. 611-59.

This thesis helps recover this lost history through an archivally rich and deeply contextualised examination of the early, post-war, British encounters with cybernetics, itself a largely overlooked dimension of a neglected subject. The most obvious manifestation of cybernetics in Britain was the Ratio Club, an informal London based dinner, drinking and cybernetics discussion group. It was convened in September 1949 by John Bates, a young neurologist working at the National Hospital for Nervous Diseases in London, to coalesce a small group of like-minded scientists, mathematicians and engineers with a shared interest in Wiener's ideas. Whilst the Ratio Club was an important venue for British cybernetics, it was neither the totality, nor the most significant dimension, of the overall British experience of Wiener's creation. This thesis sets the Ratio Club in its wider post-war British societal context and explores how, within this context and beyond the Ratio Club's operation, cybernetics was implicated in constructing a broad range of discursive and techno-scientific practices, including around computers and computing, information theory, economic automation, philosophy of mind, and artificial intelligence.

Geoff Bowker's 1993 paper, "How to Be Universal: Some Cybernetic Strategies, 1943-70", contained tantalising and important early glimpses of several British cyberneticians and members of the Ratio Club; albeit, without any sense of either their social proximities in and around the club, or their distinct location within British -rather than American- cybernetics.⁶³ Nevertheless, Bowker was perhaps the first to identify F. H. George as an important cybernetician and one of the first to identify the epistemological unity across the work of the

⁶³ G. Bowker, "How to Be Universal: Some Cybernetic Strategies, 1943-70", *Social Studies of Science*, Vol. 23, No. 1, Feb. 1993, pp. 107-27. Bowker cited: Gordon Pask, p. 110; F. H. George, p. 112; Ross Ashby, p. 115; Albert Uttley, p. 116; Donald MacKay, p. 121; Stafford Beer, p. 125 fn. 27 (albeit in passing); and Grey Walter's unattributed cybernetic robot tortoises Elmer and Elsie, p. 113.

others he cited. However, Bowker's purpose was not to contribute to the historiography of cybernetics; indeed, his treatment of the cyberneticians he referenced was ahistorical in that it was devoid of either chronology or context. Rather, Bowker's paper thematically excavated and analysed the discursive, rhetorical and material mechanisms deployed by cyberneticians to validate and promote the foundational Wienerian claim that cybernetics constituted a new and 'universal' science which could traverse, if not transcend, conventional disciplinary demarcations. Consequently, Bowker's paper projected the tacit assumption that all of those historical actors whose work he cited were fully and equally committed to this universalising epistemological project. Whilst this assumption held broadly true for some of those whom Bowker referenced; more generally, and as I show in this thesis, such commitments were far from universal amongst those with agency in the British experience of cybernetics, including some of those Bowker selected to make his case.⁶⁴

Empirically, therefore, Bowker's paper had limited bearing on the directions followed in this thesis. Above all, there was scant manifestation of the universalising Wienerian scientific imperative in the post-war British experience of cybernetics. The epistemological and discursive 'imperialism' that Bowker ascribed to cybernetics generally, actually characterised its American enactments far more so than it did its British emergences; for deeply contextualised reasons which I explain and explore throughout this thesis.⁶⁵ Thus, in

⁶⁴ Of Bowker's British exemplars, Pask and George could be considered as both fully fledged cyberneticians, and adherents to Wiener's universalising mission; Pask considerably more so than George in the latter sense. Ashby, whilst an avowed cybernetician, was more concerned with developing abstract models and theories for self-adaptive systems, and had less interest in how these might be deployed in any trans-disciplinary sense. Uttley and MacKay both deployed cybernetics in their work, but neither sought to promote its disciplinary universality. Beer was mentioned by Bowker but not cited, and Walter's tortoises were mentioned without attribution to their maker.

⁶⁵ Bowker, "How to Be Universal", p. 121.

post-war America, Wiener's adherents were propelled across the intellectual and cultural mainstream by the cybernetics explosion; whereas, in Britain, cybernetics and cyberneticians inhabited the epistemological and institutional margins and liminalities of scientific practice. Therefore, the rhetorical devices identified by Bowker as the means of cybernetics' scientific colonisation were less vigorously deployed in Britain than Bowker's citations of British cyberneticians might have suggested; and, when they were, it was typically as a means of mediating and internalising cybernetics within an existing discipline, rather than in pursuit of an expansionist strategy of disciplinary subsummation. Although, all of this said, Bowker did highlight the sense that cybernetics was rooted in the war-time imperative to develop fusions of machines and humans that could compensate for the amplifying deficiencies of human control and communicative agency in advancingly complex weapons systems.⁶⁶ This identification of the origins of cybernetics by Bowker had a particularly strong resonance with my identification of the emergence of British proto-cybernetics amidst the novel and complexifying epistemologies and ontologies summonsed by mechanised total war.

Whilst Bowker's argument had more empirical salience to the actuality of the American experience of cybernetics than to the manifestations of Wiener's ideas in Britain; nevertheless, there were significant thematic connections between Bowker's discursive study and my historical analysis. The strongest and most productive of which was Bowker's discussion of the ways in which cybernetics sought to erase the imbricated binary dualities between machines and humans, and brains and computers; and, his evocation of the sense of existential jeopardy that these erasures might be felt to pose to humanity amidst the fragility of a fractured post-war humanism.⁶⁷ In Britain especially, the immediate post-war

⁶⁶ *ibid.*, pp. 109-10.

⁶⁷ *ibid.*, p. 112.

period was a time of acutely sensitised humanist sensibilities, in which the suggestion that humans were machines had the power to spur both dread and revulsion; particularly inasmuch as such mechanist reductionism would repudiate the vitalist exceptionalism of the human mind. Similarly, the concomitant idea that humanity might be subjugated, if not destroyed, by machines of its own making that were wrought in its own image was a humanist anathema. In post-war Britain, cybernetics portended just these terrors. As Bowker said, even Wiener recognised the potential corollary between his work and the Erewhonians' forestalled fate.⁶⁸

Although he illustrated his argument with textual evidence that was often distant in time and space from the post-war British cybernetics experience; nevertheless, Bowker captured several of the important ways in which cybernetics provoked resistance and spurred fear amongst the British contemporaries of Pask, George and Ashby. Thus, Bowker wrote of the hostile Soviet reaction to the roboticizing and dehumanising alienation pregnant within the cyberneticist assertion of equivalence between humans and machines.⁶⁹ He also highlighted the way in which cybernetics resurrected and re-populated the belief in the mortal danger posed to humanity if it transgressed God's law and created a new technological form of being in its own image; albeit that, as he also noted, the prospect of exercising a godlike power to create a new life-form was relished by some cyberneticians as much as it was feared by humanists and theists alike.⁷⁰ And, Bowker also described the capacity of cybernetics to invoke the terrifying potential for human minds to be programmed as though they were computers; if, indeed, the cyberneticist conflation of mind and body, and its assertion of the

⁶⁸ *ibid.*, p. 111.

⁶⁹ *ibid.*, p. 111.

⁷⁰ *ibid.*, pp. 111-13.

equivalence between brains and electronic circuits, were both true.⁷¹ Manifestations of all of these themes were operable across the post-war British cybernetics experience.

Although British cyberneticians themselves made limited use of the universalising rhetorical strategies discussed by Bowker, forms of some of them were deployed by British advocates of economic automation; amongst whom *Cybernetics* was canonized as a foundation text. These automation campaigners eagerly harnessed the imperative of what Bowker called the cyberneticist “historical conjecture” around the magnifying complexity of mind-like machines on one hand, and the intensifying informational conveyances between such machines and humans on the other. However, rather than claiming this conjunction in the name of a “Cybernetics ... Moment” wherein a previously occluded set of universal scientific truths about the nature of the human condition were revealed, these technocrats assimilated cybernetics within their own Automation Moment.⁷² They also deployed the discursive mechanisms of appropriation and transference, described by Bowker as the enactments of “legitimacy exchange” and “discontinuous transmission”, within cybernetics itself.⁷³ However, whereas cyberneticians used these strategies to claim the legitimacy of mathematics and biology, or to deploy esoteric yet vacuous terminology to validate their cyberneticist arguments, the automation technocrats used the same strategies to appropriate and transfer the authority and language of cybernetics into the discursive practices of economic production.

⁷¹ *ibid.*, pp. 110-11.

⁷² *ibid.*, p. 117.

⁷³ *ibid.*, p. 116.

Like many of their American scientific cybernetician counterparts, the British automation evangelists often couched their exhortations in existential terms. Just as cybernetics could prevent nuclear Armageddon through rational informational control of the feedback mechanisms that governed society, so too could automation stave off Malthusian collapse or economic domination by a hostile (Soviet) power.⁷⁴ Equally, many of the British opponents of automation delivered their critique of mind-machines supplanting economic human agency in the same discursive terms as those that were used to contest the cyberneticist subversion of humanism more generally. Cyberneticist automation would either denature humanity into a state of indolent stupor or vassalage to machine intelligence, or deliver it into an economic golden age. Either way, it, and its machines, encompassed society totally.

Accordingly, in defence of their economic equivalent of what Bowker has called the “techno-determinist underpinning” of cybernetics’ claim to epistemic universality, the British automation technocrats also deployed their sociological version of an obligatory passage point; to borrow the concept (as Bowker did) from actor-network theory.⁷⁵ In their instantiation of the obligatory passage point, automation itself was the only means through which Britain could flourish and prosper. And they, its technocratic elite, were the only ones who could mediate the incommensurability between the dynamic feedback regulated modalities of the self-adaptive cyberneticist systems of the future, and the now dangerously redundant linear modalities that constituted the legacy of industrialisation. Prosperity depended on cyberneticist automation which only they could deliver, and cyberneticist automation was a positivist imperative which could not fail but to deliver an enriched

⁷⁴ *ibid.*, p. 113.

⁷⁵ *ibid.*, pp. 122-23.

society. The focussed deployments of cybernetics by the British automation apostles are discussed in the section on The Spectre of Automation in chapter four of this thesis.

Overall however, and notwithstanding its thematic intersections with the actuality of the post-war British cybernetics experience, Bowker's work also exemplified the ways in which dislocated historical material is commonly deployed as an ahistorical adjunct to scholarly expositions of the philosophical dimensions or socio-political deployments of cybernetics.

Insofar as there is historiography of cybernetics, it has dealt predominantly with its American paternity and origins. Wiener was a pivotal figure in the contemporary American mathematical and scientific milieu, and his authorship of the seminal and eponymous text for the cybernetics movement gestated during a deep immersion in an elite American intellectual circle comprising, amongst others, John von Neumann, Claude Shannon and Margaret Mead. Likewise, much of this limited canon has been produced by scholars whose primary disciplinary commitments lay outside history. The origins of cybernetics and the authorship of *Cybernetics* were imbricated with the histories of computing and AI. Cybernetics exercised, and exercises, an easy attraction for those already interested in the nature and future capabilities of the technologies in which it was historically implicated. This was especially the case for those whose professional practices centred around the manifestations of the technologies shaped by an ostensibly American episteme. Within an American frame, cybernetics, computing and artificial intelligence look American.

This American narration of an American history beatified Wiener amidst Newton and Einstein. Just as they proclaimed eureka for gravity and relativity, so Wiener was the Archimedes of cybernetics. For his fellow mathematician Pesi Masani, Wiener was an

American Leibniz and his polymathy was second only to Charles Sanders Peirce.⁷⁶ Masani's hagiographical biography portrayed an epochal genius whose singular mind changed the world. Flo Conway and Jim Siegelman chose a journalistic depiction of a flawed yet heroic visionary. An enigma riven with paradox and self-doubt. A psyche scarred by merciless paternal hothousing. A scientist driven to prophesize against the existential perils of his own science. And, a rationalist compelled to mysticism by inner torment. However, despite the value of both books, any heroization of singular genius belies the contextual contingencies within which all minds are embodied.

Romanticism notwithstanding, Conway and Siegelman's insight that cybernetics became the epistemological dark matter of the Information Age because of its historiographical invisibility was as fruitful as it was acute.⁷⁷ Just as the theoretical presence of dark matter accounts for gravitational effects that are inexplicable in the Standard Model of physics; it is now similarly evident that cybernetics exercised an epistemological gravitational force on the contingent formations of AI, computing and the theory of mind that are difficult to explain adequately with recourse to just their standard histories.⁷⁸ Although the deficiencies in these standard histories only became fully identifiable as such with the recovery of cybernetics from its historical occlusion; nevertheless, the sense of their presence was one of the principal factors that impelled me to undertake the research that has produced this thesis. There was something about the conventional histories of AI and computing especially that made them unsatisfactory to my mind. Once the epistemological attractions

⁷⁶ P. R. Masani, *Vita Mathematica: Norbert Wiener, 1894-1964* (Birkhäuser Verlag, Basel, 1990), p. 15.

⁷⁷ Conway, Siegelman, *Dark Hero*, p. xv.

⁷⁸ Here at least, historians now have the explanatory advantage over physicists; we have the evidence for this epistemological equivalent of their postulated particle.

and revulsions of cybernetics are factored in to the analytical historical equation, the origins and nature of the contingent shapes it helped form make considerably more sense.

Following the path to the origins of the Information Age, Ronald Kline wove the histories of cybernetics and information theory into a post-war techno-utopian reformulation of manifest destiny where a rejuvenated American civilization boldly advanced the new electronic frontiers of computation and communication.⁷⁹ Kline rightly emphasised Wiener's heterodox misgivings about the potentially dire socio-economic consequences of the misuse of cybernetics, and his steadfast denial of the ineluctability of socio-technical progress. Notably, Wiener's apprehensions about the abuse of science resonated more in Britain than America. Like other Americans writing about the 'cybernetics moment', Kline's focus was domestic. However, Kline's treatment of American information theory usefully drew him to parallel developments in Britain. As he highlighted, there was considerable sociological and intellectual intersectionality, and friction, between the British and American practices, alongside considerable overlap between cybernetics and information theory in both countries. Kline's discussion of these collisions and complementarities in the staging of three London information theory symposia in 1950, 1952 and 1955 was especially apposite. And, his treatment of Dennis Gabor and Colin Cherry, two early British information theorists, and of Donald MacKay a protagonist in British cybernetics, was atypical for American cybernetics historiography; he even mentioned the Ratio Club. Nevertheless, British cybernetics remained adjunctive to America.

⁷⁹ R. R. Kline, *The Cybernetics Moment: Or Why We Call Our Age the Information Age*, (Johns Hopkins University Press, Baltimore, 2015).

Steve Heims' work predated Kline's, and although they each took a different path, they both arrived at similar destinations. Heims' dual biography of Wiener and von Neumann explored how these rivalrous friends came to follow widely diverging intellectual and professional paths.⁸⁰ For Heims, the wedge of separation was the atom bomb. Unlike Wiener, von Neumann joined the Manhattan Project and subsequently pledged his mathematical genius to prosecuting the Cold War. Wiener's war-work was limited to one small research project on automating predictive anti-aircraft fire and, repelled by the nuclear bombing of Japan, after 1945 he repudiated all military research. In 1947 he attracted considerable publicity, and the FBI's official gaze, with a letter to the *Atlantic* denouncing the weaponization of science.⁸¹ For Heims, the bifurcation of the two mathematicians was a morality fable, illustrating the ethical jeopardy and choice confronting all scientists. Whilst Heims had no business with British cybernetics, his illumination of Wiener's motives for *Cybernetics*' authorship and publication foregrounded the nature of the book's appeal for some British readers. Wiener wanted *Cybernetics* to equip scientifically and sociologically responsible minds with the authority to contest the profiteers and powermongers whose exploitation of the power of war-time science he so feared.

Heims continued to investigate cybernetics with his history of a landmark sequence of conferences organised by the Josiah Macy Foundation from 1946 to 1953.⁸² Although the philanthropic foundation sponsored many scientific gatherings, these became *the* Macy conferences. Heims' chronicle of the seminal intellectual sociology for cybernetics

⁸⁰ S. J. Heims, *John von Neumann and Norbert Wiener: From Mathematics to the Technologies of Life and Death*, (MIT Press, Cambridge, 1980).

⁸¹ N. Wiener, "A Scientist Rebels", *Atlantic*, Jan. 1947, p. 46.

⁸² S. J. Heims, *The Cybernetics Group*, (MIT Press, Cambridge, 1991). Paperback published as, *Constructing a Social Science for Postwar America: The Cybernetics Group, 1946-195*, (MIT Press, Cambridge, 1991).

necessarily occupied an American frame. He merely listed the guest Macy attendances by British scientists Ross Ashby, Donald MacKay, Turner McLardy, Grey Walter and J. Z. Young, all of whom were involved in British cybernetics. Nevertheless, like his exploration of Wiener's intellectual motives, Heims' account of foundational American cybernetics is useful here. As he highlighted, the scientific constructions of the Macy conferences were constitutively co-located with the materialisation of post-war American geo-political hegemony. During the war, the totality of the human condition was weaponised, and American social scientists and psychologists were militarised as alacritously as physicists. In the ensuing Cold War, the military-industrial complex continued to deploy social, behavioural and mind sciences in pursuit of Pax Americana.⁸³ Even for those unconcerned with prosecuting Cold War belligerence, the scientisation of humanity surpassed ideology as a rational response to the world's madness. Cybernetics was a mathematical American behavioural science, encompassing machines, minds, humans and societies. The emergence of the United States as a post-war superpower afforded cybernetics a unique and favourable domestic intellectual and cultural context; unlike in Britain.

Jon Agar's illuminating construction of the British state as an information processing machine, metaphorically and literally, was ultimately adjacent rather than integral to my analysis.⁸⁴ Agar examined the development of new electronic, mechanical and sociological information processing technologies during the war, and their synthesis into new socio-technical systems framing new human-machine interactions. His connection of these developments to the emergence of Operational Research (OR) usefully signposted the

⁸³ D. Dickson, "How the CIA Backed Research on Mind Control", *Nature*, Vol. 278, No. 5701, March 1979, p. 200

⁸⁴ J. Agar, *The Government Machine: A Revolutionary History of the Computer*, (MIT Press, Cambridge, 2003).

techno-scientific and socio-technical constructions of British military research as precursors to the post-war British experience of cybernetics. However, although valiant, the post-war efforts of the Treasury Organization and Methods (O&M) section to drive computerisation of the informational machinery of government were often equally strenuously resisted. By the end of the fifties, there were only seven commercially sourced computers either installed or ordered across government.⁸⁵

Tacitly, Agar's account highlighted that the Treasury O&M formation was the only substantive post-war Whitehall residuum of OR. The mandarins of the New Jerusalem spurned both computerisation and scientific managerialism, and Agar ultimately failed to detect materialisations of cybernetics within the government machine because cybernetics failed to materialise. Whatever the fortunes of the various technocratic expert movements stalking Whitehall's corridors of peacetime power, British cyberneticians were not amongst them. Nor did cybernetics inhabit the official government mind as a source of scientific solutions to the problems of their various post-war 'working worlds'; as Agar has elsewhere characterised the relationship between scientific practices and contexts.⁸⁶ Conspicuously, British cybernetics received more American than British government funding.

Thomas Rid's attempt to recover cybernetics from historical invisibility and his account of its formative influence on twenty-first century technics successfully recognised Wiener's epistemic instrumentality without heroizing him. This reflected Rid's wider purpose of de-mythologising the seductive fable of a technologically deterministic cybernetic golden age. Rid shared neither Heims' epistemic nor biographical sympathies. And, atypically, Rid was

⁸⁵ Excluding those nested deep within the cryptological bastions of the secret state.

⁸⁶ J. Agar, *Science in the Twentieth Century and Beyond*, (Polity, Cambridge, 2012).

a product of European rather than American academic training. However, whilst tracking the militarised arc of cybernetics from the Second World War to the Cold War, via excursions into the counterculture and the surveillance state, Rid nevertheless described an exclusively American trajectory. He made cursory mention of Stafford Beer and passing mention of Grey Walter, both pivotal figures in British cybernetics. His treatment of Ross Ashby, another vitally important British cybernetician, was more developed but nevertheless, like Beer and Walter, Ashby signified only insofar as he was briefly drawn into American cybernetics. Rid's recovery of a lost history failed to find British cybernetics.⁸⁷

The Americentrism of the existing scholarship about cybernetics carries the tacit narrative impression that this historiography merely reflects an American essentialism to cybernetics itself. It is true that *Cybernetics* was authorially American, and it remains the case that cybernetics coalesced into intellectual coherence in America. However, whilst a grasp of its American incubation is conceptually and historically vital, cybernetics was not an exclusively American episteme. As this thesis shows, the emergence of *Cybernetics* and cybernetics was shaped by a transatlantic intellectual cross-fertilisation which, even during the war, was facilitated by fruitful social interactions between British and American boffins. Before 1945, some British minds had already directly encountered some of the intellectual precursors to *Cybernetics*. As soon as the war ended, these interactions intensified, giving a powerful additional and direct impetus to Wiener's authorship of *Cybernetics*, and further preparing the ground for the emergences of some of the dimensions of British cybernetics.

⁸⁷ T. Rid, *Rise of the Machines: The Lost History of Cybernetics*, (Scribe, London, 2016).

During the war the Ratio Club's founder, John Bates, worked closely with Kenneth Craik, a brilliant young philosopher turned experimental psychologist whose pioneering research led directly to the immediate post-war formation of ergonomics. Before his untimely death in 1945, Craik was a pivotal figure in the Cambridge psychological laboratory of Frederic Bartlett, who led the Medical Research Council's Applied Psychology Research Unit. Through his war-work, Craik formatively influenced Bates, and several other would-be members of the Ratio Club, to the extent that they almost named the group after him.

Craik was a centrally important figure in preparing the social and epistemological ground for both the formation of the Ratio Club, and the wider British cybernetics experience. He operated at the nexus of the scientific practices driven by the totalising nature of existential conflict. These practices, and the nature of the conflict they served, centred on the development of increasingly complex weapons systems, and on the advancing use of mechanistic replacements of human agency within them. Craik personified and exemplified what I generalise as British proto-cybernetics; by which I mean the emergence of militarised epistemologies and ontologies that prefigured the central ideas in *Cybernetics* regarding the mechanistic nature of cognition, and the systemic fungibility of human and machine agency.

Craik was not entirely historically lost. His 1943 book, *The Nature of Explanation*, describing thinking as the construction of neurophysiological representations of the relation structures of real phenomenon, influenced several later American cyberneticians, notably Wiener's colleague and chair of the Macy cybernetics conferences, neurophysiologist Warren McCulloch.⁸⁸ This was first detected by Heims, who also noted, briefly, that Craik

⁸⁸ K. J. W. Craik, *The Nature of Explanation*, (CUP, Cambridge, 1943).

influenced others in Britain.⁸⁹ The interrelations between Craik's thought and cybernetics, and his influence on McCulloch, were subsequently investigated by the psychologist Alan Collins.⁹⁰ However, Collins' deployed Craik to exemplify the historical dynamics of scientific reputation construction and therefore he undertook an exercise in science studies rather than a history of cybernetics. Writing between Heims and Collins, the philosopher of science Roberto Cordeschi gave a rich account of Craik's ideas about the physicality of mental processes, drawing out some of the connections between Craik's proto-cybernetics and Wiener's pre-cybernetics.⁹¹ Particularly, the commonality between their efforts to automate control of complex systems and systemically mechanise human control agency. However, although noting the recognition Craik received from Ratio Club member Grey Walter, Cordeschi's intellectual history focussed on cybernetics' epistemological antecedents and successors, not its post-war British manifestations.

Historiographical glimpses of the Ratio Club's existence began to surface in the late seventies. In 1979, Pamela McCorduck, a personal friend of the AI pioneer John McCarthy, wrote a journalistic early history of AI in which the Ratio Club was mentioned.⁹² McCorduck's book was based on her own first-hand knowledge, and on interviews she conducted with many of the protagonists of her story; including the Ratio Club members Jack Good and Donald MacKay. Also in 1979, James Fleck conducted an interview with Ratio Club member Albert Uttley at Sussex University whilst researching his PhD. This

⁸⁹ Heims, *Cybernetics Group*, pp. 42-3, 204, 257-8.

⁹⁰ A. F. Collins, "An Asymmetric Relationship: The Spirit of Kenneth Craik and the Work of Warren McCulloch", *Interdisciplinary Science Reviews*, Vol. 37, Iss. 3, Sept. 2012, pp. 254-68. A. F. Collins, "The Reputation of Kenneth James William Craik", *History of Psychology*, Vol. 16, Iss. 2, May 2013, pp. 93-111.

⁹¹ R. Cordeschi, *The Discovery of the Artificial: Behaviour, Mind and Machines Before and Beyond Cybernetics*, (Springer, Dordrecht, 2002), pp. 137-52.

⁹² P. McCorduck, *Machines Who Think: A Personal Inquiry into the History and Prospects of Artificial Intelligence*, 1st edn., (Freeman, New York, 1979), pp 59, 68, 78-79, 80, 81.

interview was referenced in Fleck's 1982 paper "Development and Establishment in Artificial Intelligence", which also mentioned the Ratio Club and cited McCorduck's 1979 book.⁹³ However, in each of these early sightings the Ratio Club was little more than incidental detail, and neither have been conspicuously referenced in the subsequent historiography. Although, alongside his acknowledgement of the Ratio Club members John Bates, Jack Good and John Pringle as primary sources of information about Alan Turing, Andrew Hodges also thanked James Fleck for his assistance during the production of Hodges' pivotal 1983 biography.⁹⁴

Hodges' account of Turing's life and work contains what was probably the first archivally based historiographical treatment of the Ratio Club, and an equally ground-breaking discussion of the relationships between Turing, cybernetics, and his cyberneticist contemporaries.⁹⁵ Hodges highlighted both the meeting at the NPL between Wiener and Turing in 1947, and the esteem that Wiener had for what he regarded as Turing's grasp of his cyberneticist ideas; as Hodges rightly said, Wiener considered Turing to be a fellow cybernetician.⁹⁶ Hodges also located the Ratio Club as a site of emergence for cybernetics in Britain, and he drew out the social and intellectual intersections that derived from Turing's membership. In particular, Hodges' emphasised Turing's Ratio Club connections with Donald MacKay and Albert Uttley, who were both interested in mechanical enactments of intelligence; and those with Grey Walter and Ross Ashby, who were each interested in

⁹³ J. Fleck, "Development and Establishment in Artificial Intelligence", in N. Elias, H. Martins, R. Whitley (eds.), *Scientific Establishments and Hierarchies: Sociology of the Sciences: A Yearbook, Vol. 6*, (Springer, Dordrecht, 1982), p. 182, 213 fn. 41.

⁹⁴ A. Hodges, *Alan Turing: The Enigma*, (Vintage, London, 2012), p. 538.

⁹⁵ In fact, Hodges used the papers as they were then held by John Bates as his primary source of information about the Ratio Club before this material was passed to the Wellcome Collection after Bates' death in 1993. Hodges, *Turing*, p. 562 fn. 7.25.

⁹⁶ *ibid.*, p. 403. The 1947 meeting between Wiener and Turing, which occurred just before Wiener decided to write *Cybernetics*, is discussed in the section on Minds Across the Atlantic in chapter one of this thesis.

mechanical simulacra of neurological systems.⁹⁷ Although Turing's cyberneticist connections well known to his peers, Hodges was one of the first modern scholars to recover the sense of the congruity between Turing's ideas about computational cognition and cybernetics. Hodges was also perspicacious in his identification of the Ratio Club as a surrogate for the intellectual excitement and sociologically transgressive thrill exemplified by the Sunday Soviets that were held to stimulate radar research at the Telecommunications Research Establishment (TRE); a point discussed later in this thesis.⁹⁸

However, for all that Hodges was the first to develop an extended account of the historical connections between Turing, cybernetics and the Ratio Club, his treatment of this crucial episode in the history of both Turing's thinking, and cybernetics, was limited in two important respects.

Firstly, Hodges had a profound disquiet about the epistemological contents and scientific validity of cybernetics itself. As he himself acknowledged, readers should look elsewhere for a more "sympathetic" exposition of Wiener's ideas.⁹⁹ For Hodges, despite its populist appeal, *Cybernetics* was both "incoherent" and "unreadable"; whilst Wiener himself was a pompous and humourless scientific 'empire-builder' with a proclivity to pontificate spurious predictions based on flimsy thinking.¹⁰⁰ Thus, for Hodges, whilst Turing was unquestionably

⁹⁷ *ibid.*, pp. 411-12.

⁹⁸ *ibid.*, p. 112. Several Ratio Club members worked on war-time radar research and would conceivably have attended the Sunday Soviets. Many would have experienced something of the same exhilaration elsewhere amidst the exceptionally imperative conditions of militarised scientific and technological research and development. Turing himself was the lead signatory on the now famous letter which he and his Bletchley colleagues sent directly to Winston Churchill to warn of the dire consequences which would befall if they continued to be denied the allocation of an essential increment in personnel. Undoubtedly, the letter writers would have learnt that Churchill had issued an "ACTION THIS DAY" edict in response to a missive that would have been unforgivably insubordinate under any other circumstances. *Ibid.*, 218-21.

⁹⁹ Specifically, Hodges directed readers to Steve Heims' work. *Ibid.*, p. 561 fn. 7.11.

¹⁰⁰ *ibid.*, 403-4.

ranked alongside Claude Shannon in the vanguard of information and communication theory; nevertheless, the idea that Turing's obvious connections with Wiener and cybernetics might render him a cybernetician was an accusation that compelled a refutation, rather than an insight that warranted analytical reflection. Consequently, Turing's sound and rigorous thinking opposed Wiener's whimsies, just as Turing's elegant English "wit" mocked the American's unsmiling self-importance.¹⁰¹ Moreover, whilst there were superficial commonalities between Wiener and Turing's ideas and interests, in reality Turing's was the superior intellect, and his substantive conception of computational cognition was considerably more sophisticated than Wiener's "feeble" cyberneticist analogies between synapses and thermionic valves.¹⁰² In Hodges' view, Turing's 1950 paper on "Computing Machinery and Intelligence" was, at least in part, a direct admonition of Wiener's tedious prose and spurious superficiality.¹⁰³ The towering strength of Hodges' magisterial account of Turing's vital and vast significance is that he was not a neutral observer of his subject's life and mind. However, in the matter of Turing's cyberneticist intersectionality, Hodges' otherwise essential partiality obscured far more than it revealed.

The second limitation to Hodges' account of Turing's encounters with cybernetics was principally a consequence of the nature of his project, rather than of his desire to reclaim his subject from *damnatio memoriae*.¹⁰⁴ Hodges' task was the production of a scientific biography, not the authorship of a wider historical survey of the times and circumstances inhabited by his subject. Moreover, Hodges was writing at a time when the historiography

¹⁰¹ *ibid.*, p. 403.

¹⁰² *ibid.*, pp. 403, 404-5.

¹⁰³ *Ibid.*, pp. 417-18.

¹⁰⁴ Hodges wrote of Turing as the "Trotsky of the computer revolution", and of his 'unpersoning' having started at the NPL as early as 1950. *Ibid.*, pp. 407-8.

of cybernetics was scant, and knowledge of the Ratio Club was held by only a few individuals and communicated largely by word of mouth. Additionally, in the early eighties, such historiography of British computing as there was, had largely been written by computer scientists such as Simon Lavington and Martin Campbell-Kelly, and was focused on internalist accounts of the technology itself.¹⁰⁵

Consequently, whilst Hodges drew attention to Turing's membership of the Ratio Club, this was by way of incidental detail, rather than as part of a substantive treatment of either the Ratio Club itself, or Turing's membership of it.¹⁰⁶ Much the same can be said of Hodges' identification of Turing's correspondence with the cybernetics inspired biologist J. Z. Young, which is used to draw attention to Turing's mathematical theory of morphogenesis, rather than to highlight his cyberneticist imbrications.¹⁰⁷ And, equally, whilst Hodges reported both Lord Louis Mountbatten's incendiary 1946 speech about ENIAC, and Sir Geoffrey Jefferson's correspondingly inflammatory 1949 Lister Oration on "The Mind of Mechanical Man", neither were located within the broader enactments of the British Cartesian computational controversy which is discussed extensively in this thesis, particularly in the section on The Matter of the Mind in chapter three.¹⁰⁸

Similarly, I also encompass both the 1949 Manchester University Seminar on The Mind and the Computing Machine, and the publication of Gilbert Ryle's *The Concept of Mind* in the

¹⁰⁵ Simon Lavington's books *A History of Manchester Computers*, (NCC Publications, Manchester, 1975) and *Early British Computers: The Story of Vintage Computers and the People Who Built Them*, (Manchester University Press, Manchester, 1980) exemplified the literature about historical British computing available to Hodges at the time he was writing his biography of Turing.

¹⁰⁶ Hodges, *Turing*, pp. 411-12, 466, 476, 512.

¹⁰⁷ *ibid.*, pp. 435-37.

¹⁰⁸ *ibid.*, pp. 347-48, 404-6.

same year, within the enactment of the Cartesian computational controversy. Whereas, for Hodges, these episodes were disconnected incidents whose significance was restricted to either an interesting philosophical reflection of Turing's ideas in the case of Ryle's book, or an illustration of the needless intellectual jeopardy that Turing's association with cybernetics exposed him to in the case of the Manchester seminar.¹⁰⁹

In all of these instances, Hodges' attention was directed inwards and towards the particular impacts that these events had on the life of his subject, rather than outwards and towards the wider question of the place of these events in the history of British public attitudes towards the emergence of electronic computation, and the possibility of its cognitive equivalence to biological (human) brains. The consideration of this wider question is a substantive theme of this thesis, as is the enactment of the Cartesian computational controversy with Turing as one of its principal protagonists.

Following Hodges' less than fulsome treatment of the Ratio Club and Turing's cyberneticist intersectionality, a somewhat clearer discernment of the post-war emergence of a distinct manifestation of cybernetics in Britain emerged in the work of British historian Rhodri Hayward in 2001. Like all the subsequent historiography about British cybernetics, Hayward's work contained important signposts which I have followed and developed. Hayward recognised Wiener's authorial synthesis, particularly his clarion expression of a new mechanistic conception of life and mind shaped by the systemic demands for non-human agency in the new complex ontologies of war. Hayward also foregrounded the parallel emergence of British proto-cybernetics, stressing its nucleation around Craik, and

¹⁰⁹ *ibid.*, pp. 414-15, 418.

noting its manifestation in the post-war formation of the Ratio Club. Nevertheless, since his focus was on the psychological mediations of cybernetics by Grey Walter and Ross Ashby, Ratio Club members who both practised as neurologists in the West Country after the war, the Club itself is mentioned only in passing. Thus, whilst he shed some light on aspects of the early history of British cybernetics, and acknowledged the Ratio Club's existence, there was much left to reveal.

One of Hayward's British cybernetics essays emphasised the materiality of the epistemological intersections between Craik, Walter and Ashby, wherein both neurologists crafted electro-mechanical models expressing Craik's mechanistic conception of mind.¹¹⁰ Ashby's Homeostat, constructed from surplus RAF bomb sights, replicated the feedback dynamics of homeostatic self-adaptive neurological equilibria. Walter's tortoise robots, also assembled from sold-off military stock, simulated the dynamic tropic properties of organic life. Hayward drew particular attention to the sense whereby a Craikian form of British cybernetics fused with a wider British philosophical shift away from abstract metaphysics and towards a new philosophy of mind. His brief discussion of the epistemological overlaps between British cybernetics and the seminal work of Oxford philosopher Gilbert Ryle spurred the investigation of the circumstances surrounding the authorship and publication of Ryle's *The Concept of Mind* conducted in this thesis.¹¹¹ In particular, it prompted my discovery of deeper connections between Alan Turing, cybernetics, and the development of mid-century British philosophy of mind than previously realised. In another essay, Hayward focussed entirely on Grey Walter and his tortoises, dealing more with the interwoven

¹¹⁰ R. Hayward, "'Our Friends Electric': Mechanical Models of Mind in post-war Britain", in G. Bunn, A. D. Lovie, G. Richards (eds.), *Psychology in Britain: Historical Essays and Personal Reflections*, (British Psychological Society, Leicester, 2001), pp. 290-308.

¹¹¹ G. Ryle, *The Concept of Mind*, (Hutchinson, London, 1949).

constructions of Walter's professional, personal and psychological lives than with British cybernetics.¹¹² Although narrowly farmed, Hayward's analysis adroitly demonstrated that the British scientific establishment used the Othering of cybernetics to Other Walter, and the Othering of Walter to Other cybernetics; a theme explored further in this thesis.

Walter's biological analogues, and their creator's buccaneering adventurism, had received earlier attention from the roboticist Owen Holland, whose 1996 essay both claimed Walter as the earliest pioneer of artificial life, and identified Craik's early influence on him.¹¹³ Holland's pioneering effort to recover Walter from scholarly obscurity and inscribe him in the honour roll of modern cognitive science marked him as one of the first writers about British cybernetics, albeit within a tight focus on behavioural and biological robotics. In a later essay, Holland made an early brief reference to the Ratio Club, and highlighted Bates' assertion of the emergence of proto-cyberneticist ideas amongst British military scientists during the war.¹¹⁴ Holland's third treatment of the subject stressed the direct but largely unrecognised influence of Walter on Rodney Brooks, a pioneering roboticist whose embodied behaviourist approach to synthetic cognition was closer to cybernetics than to conventional symbolic algorithmic AI. Here Holland also located Walter at the heart of British cybernetics, and explored the extension of Craik's influence further across the Ratio Club. Echoing Hayward's observation of Walter's professional Othering, Holland explained Walter's disreputability both in terms of his scandalous disregard for sexual and social normativity, and on the basis of his flamboyant publicity seeking scientific showiness. I

¹¹² R. Hayward, "The Tortoise and the Love-Machine: Grey Walter and the Politics of Electroencephalography", *Science in Context: Special Issue: Mindful Practices: On the Neurosciences in the Twentieth Century*, Vol. 14, Iss. 4, Winter, 2001, pp. 615-41.

¹¹³ O. Holland, "Grey Walter: The Pioneer of Real Artificial Life", in C. G. Langton, K. Shimohara (eds.), *Artificial Life V: Proceedings of the Fifth International Workshop on the Synthesis and Simulation of Living Systems*, (MIT Press, Cambridge, 1996), pp. 33-41.

¹¹⁴ O. Holland, "The First Biologically Inspired Robots", *Robotica*, Vol. 21, Iss. 4, Aug. 2003, pp. 351-63.

have followed their direction in connecting Walter's celebrity with the denigration of cybernetics as a pseudo-science by the guardians of British scientific respectability.¹¹⁵

Following closely on from Hayward, Andrew Pickering's essay "Cybernetics and the Mangle" also focused on the material practices of British cybernetics, specifically those of Ross Ashby, Stafford Beer and Gordon Pask.¹¹⁶ Whilst part of Pickering's purpose was to correct the historiographical imbalance towards American pioneers such as Wiener and McCulloch, his main interest in British cybernetics was as an historical case study in science studies. Pickering characterised cybernetics generally, and British cybernetics particularly, as a shift away from science as a discursive mode of representation, and towards science as a constructionally performative act. For Pickering, cybernetics was a science of ontology more than epistemology, and of deed more than discourse. Hence his subjects; Ashby, Beer and Pask all built physical manifestations of Wiener's ideas. Like Holland and Hayward, Pickering was drawn to the gadgeteering physicality of British cybernetics.

Pickering's illumination of British cyberneticist practices came with a deceptively narrow focus. Cybernetics in Britain encompassed far more than his three subjects and their artefacts. Nevertheless, his enjoyment of the exotic allure of cybernetics, and the correspondingly idiosyncratic characters of many of its British practitioners, are easily shared, and he did glance at important elements of its wider history beyond his subjects. Specifically, his mention of the eruption of post-war interest in overlapping ideas about the

¹¹⁵ O. Holland, "Exploration and High Adventure: The Legacy of Grey Walter", *Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences (Theme Issue: Biologically Inspired Robotics)*, Vol. 361, No. 1811, 15 Oct. 2003, pp. 2085-121.

¹¹⁶ A. Pickering, "Cybernetics and the Mangle: Ashby Beer and Pask", *Social Studies of Science*, Vol. 23, Iss. 3, June 2002, pp. 413-37.

mind, brain, electronic computers and information theory alerted me to what further research revealed to be a major theme of early British cybernetics. Likewise, his glimpse of the manifest epistemological divergence between symbolic AI and cybernetics spurred my examination of the history of this schism. As I explore in this thesis, symbolic AI was crafted by John McCarthy as a conscious, yet covert, refutation of cybernetics.

Nearly a decade later, Pickering germinated the seeds in his initial cybernetics essay into his seminal book, *The Cybernetic Brain: Sketches of Another Future*; the first, and hitherto the only, book length history of British cybernetics.¹¹⁷ As before, this was an undertaking in historical science studies. However, whereas Pickering's essay had only hinted at his ideological inclinations, the book was an overtly activist sociological intervention in the historiography. His purpose was to set cybernetics against the concealing representationalism of a modern science that alienated its practitioners from the reality which their episteme simultaneously obfuscated, constructed and described. Pickering saw cybernetics as a performative ontological counter to the constrictive enframing of contemporary socio-technics within the hegemonic practices of reductive classical science. In place of which, he sought a new, revealing, cyberneticist modernity. His avowedly Heideggerian motive was to overthrow the deterministic positivism that characterised orthodox contemporary narratives concerning the nature of human being. For Pickering, the material practices of British cybernetics declared a science where the dynamic, creative, indeterminate uncertainties of the world were revealed and embraced rather than concealed and feared. With legitimising historicism, a new 'non-modern' ontological science based on these practices could empower both a new world and a new way of being in it.

¹¹⁷A. Pickering, *The Cybernetic Brain: Sketches of Another Future*, (Chicago University Press, Chicago, 2010), p. 6.

Pickering's *Cybernetic Brain* approached the history of British cybernetics through a sectionalised and sequential examination of the practices of six of its principal protagonists. To begin with, the neurologists and Ratio Club members, Grey Walter and Ross Ashby occupied chapters three and four, whilst the anthropologist Gregory Bateson and the psychiatrist R. D. Laing shared chapter five. Pickering grouped his examination of the work of these four actors into a section of his book that explored the relationships between cybernetics on one hand, and neurology and psychiatry on the other. Here, one of Pickering's central concerns was to support his pivotal argument that post-war British cybernetics was characterised by a preoccupation with the science of neurological and mental adaptivity which was, in turn, rooted in psychiatry.¹¹⁸ The second section of the *Cybernetic Brain* was inhabited by the cyberneticians Stafford Beer and Gordon Pask who populated chapters six and seven respectively. This extended Pickering's treatment of British cybernetics past the boundaries of brain and mind science, and into the richly varied cyberneticist practices enacted by both of these polymathic, if not picaresque, characters; neither of whom had any substantive professional or intellectual commitments towards neurology or psychiatry. The unity across these subjects was established by the performative commonality of their cyberneticist commitments, and by their shared fascination with exploring and revealing the behavioural complexity of systems of all kinds.¹¹⁹

In Pickering's view, all of his subjects deployed cybernetics as a way of invoking a paradigmatic state of mind that was intended to equip an observer to experience the actuality of a system; unlike conventional science which situated systems as knowledge containers

¹¹⁸ Pickering, *Cybernetic Brain*, pp. 5-9, 384-85, 386.

¹¹⁹ *ibid.*, p. 181.

which could be excavated to produce positivist representations enframèd within the discourse of modernity.¹²⁰ Thus, building upon his foundational conception of post-war British cybernetics as mind science, Pickering's broader concern was to depict this historical intellectual phenomenon as an epistemological scaffold that was used by his actors to construct ontological and performative practices which themselves constituted a new modality of scientific enquiry and knowledge construction. Pickering's concern was with the material and performative actions that were undertaken by his actors with cybernetics as their epistemological stage. Centrally, for Pickering, post-war British cybernetics was a form of scientific "ontological theatre"; in which, his various practitioners choregraphed, fabricated and observed material and behavioural systemic "dances of agency" as a way of experiencing and embracing the unknowable complexities that were the way of the world's working in a realm beyond the representational idiom of classical science.¹²¹ Historical cybernetics was, for Pickering, a science of doing more than knowing, and an epistemology of experience more than representation. Consequently, in Pickering's analysis, for those of its post-war British initiate whom he selected for examination, cybernetics was as much an alternative way of living as it was an intellectual disciplinary modality.¹²²

Whilst Pickering's book was structured around a series of empirical case studies of each of his subjects, his interests were not principally biographical. Neither were they directly concerned with the intellectual history of cybernetics of which these actors were a part. Nor were the various cyberneticist performances and enactments of his protagonists located in their wider historical contexts; there was scant sense of the Britain inhabited by Pickering's

¹²⁰ *ibid.*, pp. 18-22, 24-25, 27, 28-30, 31-32.

¹²¹ *ibid.*, pp. 20-22.

¹²² *ibid.*, p. 9.

British cyberneticians in his *Cybernetic Brain*. Pickering was less concerned with what his British cyberneticians thought or with the times in which they lived, and more interested in what they did with Wiener's ideas. Nevertheless, the *Cybernetic Brain* assembled a rich trove of empirical treasure about Pickering's protagonists; much of which was gathered from people who knew them personally, and from his own investigations of archives and other primary sources. Although Pickering's primary purpose in writing *Cybernetic Brain* was to harness history to his contemporary political project, the textual and narrative core of his book contains an extensive repository of information about the life and work of his subjects which was as vital to the construction of my own research into our shared subject as it will be to subsequent students. Moreover, Pickering's indication of war-time OR and the imbricated work of the British experimental psychologist, Kenneth Craik, as antecedents to British cybernetics contributed to both the direction of my research, and the structure of my argument in this thesis.

However, ultimately, and notwithstanding the breadth and depth of the historical knowledge he assembled, Pickering's intention in the authorship of the *Cybernetic Brain* was not to create a work of historiography. Rather, his concerns were the conduct of an exercise in science studies, and the production of an epistemologically activist contribution to his political project of remaking both our contemporary socio-technics, and the wider shape of our society itself. Hence, his subtitle; *Sketches of Another Future*. Pickering's fascination with cybernetics first surfaced in his 2002 paper on "Cybernetics and the Mangle" which deployed post-war British cybernetics as an empirical case study for the theoretical approach to science studies which he had proposed in his 1995 book, *The Mangle of Practice*.¹²³ Here,

¹²³ A. Pickering, *The Mangle of Practice: Time, Agency, and Science*, (University of Chicago Press, Chicago, 1995).

Pickering had recast scientific knowledge production as a performative “dance of agency” in which human, non-human and conceptual actors were temporally compressed together in synthetic cultural, social, intellectual and material forms by the eponymous mangle of the enactments of scientific practice itself.¹²⁴ In “Cybernetics and the Mangle”, Pickering sought to both recover the largely lost memory of the British cyberneticians Ross Ashby, Stafford Beer and Gordon Pask, and to explore the ways in which this historical manifestation of cybernetics might validate his theory of scientific knowledge production as a performative emergence from the complex interplay between things, ideas and people when they became jointly constituted as scientific practice. He also professed his sense that cybernetics carried a theoretical and philosophical “pregnancy”, which, when brought to term, would yield not merely an historical exemplification of a theoretical approach to science studies, but also a new way of performing science itself.¹²⁵

It was this pregnancy that birthed the *Cybernetic Brain*; where, from the outset, Pickering’s desire to harness historical cybernetics to his political purpose of constructing new contemporary models of scientific and social practice was manifest.¹²⁶ However, Pickering’s desire was not to entirely deconstruct or supplant the enframing modernity predicated on the representationalism of classical science. As he observed, the positivism of the physical sciences, and their technological instantiations, were crucial foundations for the operation of modern society and without them civilization would collapse. In his example, without physics and electrical engineering, there would be no power stations.¹²⁷ However, it was Pickering’s intent to both fracture the ‘monotheistic’ hegemony of positivist modernity, and

¹²⁴ *ibid.*, p. 102.

¹²⁵ Pickering, “Cybernetics and the Mangle”, pp. 413-14.

¹²⁶ Pickering, *Cybernetic Brain*, p. 9, 15, 33.

¹²⁷ *ibid.*, pp. 394-95.

to inculcate an intellectual and cultural receptivity to the nonmodern, or perhaps postmodern, epistemological and ontological alternatives promised by a contemporary resurrection of post-war British cybernetics.¹²⁸ This receptivity would then result in new and cyberneticist approaches in fields as diverse as the design of the physical fabric of life, the creation of art, the exercise of social and political power, university curricula, knowledge of the self, and the practice of spirituality.¹²⁹ Ultimately, therefore, Pickering's central purpose in writing the *Cybernetic Brain* was political not historiographical. His desire was to uncover and unleash the democratising power of cybernetics in order to change the world.¹³⁰

Consequently, for all of its narrative wealth and textured depiction of the actualities of some elements of British cybernetics, the *Cybernetic Brain* did little to explore the contexts and contingencies amongst and through which the post-war British experience of cybernetics emerged and was enacted. The partial identification of its roots in psychiatry and OR were indicated rather than explored. Thus, the *Cybernetic Brain* contributed more to our knowledge than our understanding of this vital, yet neglected, episode of modern British history. By design, Pickering's pathway through the past led to his political present. I made a different choice. Whilst Pickering's historical excursion was a fruitful source of information and inspiration for this thesis, he and I travelled in different directions. My choice was to look beyond the biographically internalised examination of the individual protagonists of British cybernetics, and instead to deploy a prosopographic examination of the contingencies of their lived experiences within a wider analysis of the ways in which Wiener's ideas became part of the broader epistemological fabric of post-war Britain. My

¹²⁸ *ibid.*, p. 33

¹²⁹ *ibid.* Chapter 8, "Sketches of Another Future", pp. 380-402.

¹³⁰ *ibid.*, p. 328, 391, 393.

purpose was to situate the ‘dance of agency’ of these actors on the wider stage of post-war Britain, rather than to bear authorial witness to their unwitting historical affirmation of the contemporary utility of cybernetics to the construction of new modalities of being modern. Although, like Pickering, I too feel the attraction of the transgressive and enigmatic epistemic spell cast by Wiener nearly eighty years ago.¹³¹

As Pickering recognised, even his book length treatment of British cybernetics covered only a fraction of its rich history. Whilst necessarily highlighting the Ratio Club as an important venue of British cybernetics, he unavoidably trammelled its treatment within his epistemologically activist narrative confines. Moreover, empirically, his narrative was tightly bound to Walter, Ashby, Bateson, Laing, Beer and Pask, and to their exemplification of Pickering’s arguments about the ‘non-modern’ practices and ontologies of British cybernetics. Biographically, sociologically and intellectually, swathes of the British cybernetics experience remained untouched. Chronologically, Pickering landed briefly in the forties and fifties, then accelerated rapidly into the sixties. His politically activist purpose of recovering and reconstructing cybernetics as a modern counter cultural science naturally drew his gaze deeper into the second half of the twentieth century. However, whilst this thesis opens with the war and closes with the 1958 NPL Mechanisation of Thought Processes symposium, and although it explores some of the territory Pickering merely signposted, there remains vast terrain for future expeditions.

In his book, Pickering argued that British cybernetics was constitutively socially unstable and institutionally liminal. As he put it, dining clubs cannot stabilise or replicate scientific

¹³¹ Pickering, *Cybernetic Brain*, p. 7. Pickering, “Cybernetics and the Mangle”, p. 413.

knowledge through doctoral training.¹³² Thus, British cybernetics was both epistemologically ‘protean’ and sociologically ‘nomadic’.¹³³ Alongside emphasising the Ratio Club’s informality as an extra-institutional venue for British cybernetics, Pickering highlighted three international cybernetics conferences in Namur, Belgium, in 1956, 1958 and 1961, as illustrations of the same point. This prompted my search for other, similar, informal British venues in the immediate post-war period which uncovered a series of domestic conferences and academic events that had a formative influence on the British cybernetics experience. Unexpectedly, from these there emerged equally formative collisions between British cybernetics on the one hand, and British computing and information theory on the other.

For Pickering, British cybernetics pivoted around the ontological primacy of the biological brain. It was, essentially, an emergence of brain science. Although Pickering’s observation centred on Ashby and Walter, it held for other Ratio Club members, many of whom were also neurologists or psychologists. However, even within the Ratio Club, the practice of brain science did not entirely account for the interest in cybernetics, not even amongst the brain scientists, nor did it wholly typify the kinds of cybernetics they practiced. Several Ratio Club members were more interested in the mathematics of information theory than in the neuro-physiological mechanics of adaptive behaviour. Moreover, although commitments to neurology and psychology featured across the wider British experience of cybernetics, they were neither universal nor dominant. Beyond the Ratio Club at least as many were drawn to Wiener’s ideas through the theory and application of servomechanisms or economic automation, as through neurology. Nevertheless, the cyberneticist proposition

¹³² Pickering, *Cybernetic Brain*, p. 59.

¹³³ *ibid.*, p. 8, 11.

that thought could be mechanised and machines could think spread widely across the British cybernetics experience, becoming a nexus of hope for some and fear for others. It was one thing to hear of computers slavishly automating arithmetic through electronic switches emulating synapses, but it was another matter entirely to suggest that computers had minds.

Further unpacking of Pickering's emphasis on the associations between British cybernetics, neurology and psychiatry led me to reconsider the relationships between Alan Turing's ideas about the materiality of mind and computational cognition, and his hitherto overlooked intersections with cybernetics, including his Ratio Club membership. As a result, I unveiled a profound public philosophical contest about the nature of mind which I characterise as the British mid-century Cartesian computational controversy. This epistemological eruption openly implicated cybernetics in a zero-sum fight for the nature of humanity. As they reeled from the war's moral and material consequences, British audiences heard venerable intellectuals and eminent scientists resurrect Descartes' ancient ghost across the full spectrum of the BBC's airwaves. In a remarkable popular intellectualisation of public service broadcasting, the BBC cast the question of the human mind deeply into its listeners' minds. Whilst much of this output entered the high-brows of the Third Programme's elite targets, the mass listenership of the Home Service and the Light Programme were not neglected. There can be few other episodes where a national broadcaster has played such a direct and vital role in staging such a consequential philosophical struggle.

In this freighted discursive conflict between mechanism and vitalism, energetically sustained by the BBC, the champions of human cognitive exceptionalism cast cybernetics as a pseudo-science and banished it to the exile of romantic fiction. Fatefully, for British cybernetics, the vitalist position was bolstered by the fledgling institutional computing elite at Cambridge

and Manchester universities who seized the opportunity to assert their nascent epistemological power as the arbiters of approved knowledge about these new machines. Computers were scientific instruments, not philosophical toys. The mundanity of computation could be automated, but the mathematical minds of their human masters were irreplaceable. These minds resented the intrusion of metaphysics into the instrumentalised empiricism of mechanised mathematics, just as they shunned Turing for publicly advocating the science-fiction of thinking machines. Post-war public sentiment chimed with human exceptionalism and reductive computational mechanism, more than with cybernetics. Amidst an austere British victory against the Nazi war machine, the distinction between human minds and mechanical brains was more than an abstract philosophical nicety.

Whilst none of this featured in Pickering's analysis, nevertheless it validated his general sense that British cybernetics withered intellectually and institutionally in liminal post-war marginality before emerging, seemingly spontaneously, as the exotic science of sixties counterculture. Pickering's goal of rehabilitating cybernetics, whilst preserving its allure as a bizarre and enigmatic science was well served. However, his concentration on the later countercultural manifestations of cybernetics, and his casting of cybernetics as an exoticized scientific Other, glossed the deeper explanation of how and why cybernetics failed to establish itself as a post-war official science. The Ratio Club's informality, the amateurism of some of its member's practices, and colourful characters like Walter, Pask and Beer, whilst necessary, are insufficient to explain why cybernetics was repudiated by respectable science, ignored by the state and derided by common sensical public opinion. Unseen by Pickering, this clash between transgressive exoticism and post-war conservatism was staged against a backdrop of precipitous British decline and an accompanying sense of techno-scientific anxiety. Hence, Big Brother's dominion over Airstrip One.

For British cybernetics, liminality was not invisibility. In the immediate post-war period, cybernetics, and its ontological artefacts, were highly visible across British public and professional intellectual life. *Cybernetics* did not explode into British culture as in America, but it nevertheless landed with force. Not only was cybernetics expressly implicated in a public existential philosophical struggle for the nature of humanity, but visitors to the Festival of Britain also saw Walter's avowedly cybernetic tortoise robots enact uncannily life-like performances, just as cinema goers watched them in BBC and Pathé newsreels. Notwithstanding its contemporary excision from orthodoxy and its historiographical absence, cybernetics was powerfully present in the post-war British public mind. Extending the compass of British cybernetics beyond the Ratio Club revealed that cybernetics fell into obscurity because of, not despite, its public enactments. Enervated British sensibilities needed a culturally palliative post-conflict humanism more than a promise of prodigious mind-machines. The popular cultural visibility of cybernetics made it an easy target for humanist Othering. Ironically, the social and intellectual insularity which characterised the Ratio Club's operation rendered it constitutively incapable of even attempting to counter the banishment of cybernetics into disreputability.

Whilst the Ratio Club contributed to its own historical invisibility, and whilst it did not subsume British cybernetics, it was nevertheless vital to the British experience of Wiener's ideas. This was recognised in David Clark's PhD thesis about the role of the NPL's Autonomics Division in the post-war scientisation of British computing.¹³⁴ Clark framed cybernetics as a paradigmatic alternative to the logical positivism assimilated by the

¹³⁴ D. J. Clark, Chapter 3, "Ratio", *Enclosing the Field: From 'Mechanisation of Thought Processes' to 'Autonomics'*, PhD thesis, Warwick University, 2002, pp. 63-102.

ontologies and practices of electronic digital computation, and he positioned its neuro-materialism as a predicate for an alternative biological architecture for mechanistic computation. For Clark, the Ratio Club was a potential venue for the construction of this now lost cyberneticist computational model. Closer scrutiny has belied this view. Nevertheless, Clark's foregrounding of the wider British tensions between computing and cybernetics heightening the significance of the Cartesian computational controversy, and his discussion of Craik's theory about the biological physicality of ideation drew the epistemological commonalities between Craik and Wiener into sharper focus. As Clark also noted, Craik shared his war-time encounters with electronics and servomechanisms with several future Ratio Club members, some of whom he knew, and these experiences fostered a collective familiarity with the mechanistic substitution of human cognitive and perceptual agency in complex systems which is a substantive theme of this thesis.

Following Clark, Owen Holland and Philip Husbands produced the first, and hitherto only, substantive scholarly treatment of the Ratio Club itself. Their frequently cited book chapter was rehearsed at the 2006 London Cybernetics Society conference and reprised for further publication in 2011.¹³⁵ They aimed to recover the Ratio Club from historical obscurity and rebut the prevailing narrative that cybernetics was an exclusively American construction. As they observed, the Ratio Club conveyed an outstanding group of early career academics and clinicians into an encounter with cybernetics which propelled many of them to professional renown. Of the seven who became Royal Society fellows, six were elected

¹³⁵ P. Husbands, O. Holland, "The Ratio Club: A Hub of British Cybernetics", in P. Husbands, O. Holland, M. Wheeler (eds.), *The Mechanical Mind in History*, (MIT Press, Cambridge, 2008), pp. 91-148. O. Holland, P. Husbands, "The Origins of British Cybernetics: The Ratio Club", in M. Smith, B. Scott (eds.), *Kybernetes: Selected Papers from Conferences of the Cybernetics Society*, Vol. 40, Iss. 1/2, 2011, pp. 110-23.

after joining the Ratio Club.¹³⁶ Strikingly, in Husbands and Holland's view, four Ratio Club members were also credible candidates for Nobel laureateship.¹³⁷ Undoubtedly, the Ratio Club profoundly affected many of its members, and it was evidently an important venue for the fruitful mediation of cybernetics into their professional and disciplinary practices. In a second paper, Holland and Husbands examined the sustained social and intellectual interactions between Warren McCulloch and British cyberneticians, including Turing's prior influence on McCulloch's ideas about neural nets, and Craik's posthumous influence on McCulloch. This made useful, yet brief, mention of cybernetics beyond the Ratio Club.¹³⁸

Husbands and Holland aimed to establish the Ratio Club both as an important British intellectual formation, and as a manifestation of cybernetics imbued with distinctively British characteristics. However, they were limited to a single book chapter. Therefore, whilst they alluded to the wider manifestations of cybernetics in Britain, and mentioned in passing the 1955 London Information Theory and 1958 NPL Mechanisation of Thought symposia, their account could not explore the broader landscape of the British cybernetics experience any further. As they acknowledged, the history of the Ratio Club and its members was larger than their narrative confines. Even without its wider contextual location, the Ratio Club easily filled their entire frame, historically and textually. This was a necessary constraint for a history of cybernetics wherein the significances of its British dimension were newly recognised. However, when the Ratio Club is resituated as one aspect of the British experiences of Wiener's ideas amidst several others, a position I adopt in this thesis, a different picture of both British and American cybernetics emerges.

¹³⁶ Barlow, 1968; Gold, 1964; Merton, 1979; Pringle, 1954; Rushton, 1948, Turing, 1951; Westcott, 1983.

¹³⁷ Barlow, Rushton, Gold, Walter.

¹³⁸ P. Husbands, O. Holland, "Warren McCulloch and the British Cyberneticians", *Interdisciplinary Science Reviews*, Vol. 37, Iss. 3, Sept. 2012, pp. 237-53.

For all its significance, the Ratio Club constituted a small element of post-war cyberneticist activity in Britain. Many more gravitated to *Cybernetics* than joined the Ratio Club, and often with a stronger intellectual affinity than many Ratio Club members. The Ratio Club was assimilative not transmissive. Rather than promoting cybernetics professionally or publicly, it actively constrained its membership and influence. This contrasts with the epistemologically interventionist British social relations of science movement led by zoologist Solly Zuckerman, whose early advocacy of cybernetics also went unremarked by the Ratio Club. Zuckerman's initial enthusiasm for cybernetics was manifest in his contribution to a series of talks under the title *The Physical Basis of Mind* which were broadcast on the BBC Third Programme in May and June 1949. Zuckerman's talk on "Self-Organisation", the third in the series, was aired at 22:10 on 19 May.¹³⁹ Although it did not feature in the contemporaneous reproduction of the talks in the *Listener*, Zuckerman's lecture was included in the book form publication of the series in 1950.¹⁴⁰ Here, Zuckerman explicitly endorsed Ashby's theories about the brain as an organ of adaptivity; and, equally explicitly, he credited Wiener with the authorship of the new science that promised humans the ability to create electronic machines that might replicate the learning and remembering capacities of biological brains.¹⁴¹ In the remainder of the written version of his talk, Zuckerman heralded the concept of feed-back as the core of this new science, and drew the explicit analogy between the operation of switches in electronic computers and synapsial

¹³⁹ Table 20: BBC Broadcasts: Cybernetics, Information Theory, Automation, 1946-59.

¹⁴⁰ S. Zuckerman, "The Mechanism of Thought: The Mind and the Calculating Machine", in P. Laslett (ed.), *The Physical Basis of Mind: A Series of Broadcast Talks by Sir Charles Sherrington, E. D. Adrian, W. E. Le Gros Clark, S. Zuckerman, E. T. O. Slater, W. Russell Brain, Wilder Penfield, Viscount Samuel, A. J. Ayer, Gilbert Ryle*, (Blackwell, Oxford, 1950), pp. 25-35.

¹⁴¹ Laslett, *Physical Basis of Mind*, pp. 30-31.

activation.¹⁴² He concluded with a prediction that the construction of sensorily equipped, self-organising and self-operating electronic computers would contribute to the comprehension of the operation of the human mind.¹⁴³ Whilst Zuckerman's early keenness for cybernetics had dimmed somewhat by the time he came to review the publication of J. Z. Young's overtly cyberneticist Reith lectures in 1951, it had not abated entirely and he still countenanced the prospect that the new science might stimulate the experimentation that would unlock the secrets of the brain's workings.¹⁴⁴

Cybernetics entered British public and institutional intellectual life more through the activity of those outside the Ratio Club than because of the agency of the Club itself. When Ratio Club members performed as public intellectuals with cyberneticist commitments, they acted personally and independently of their Club membership, and only a very few ever did so. Moreover, whilst the Ratio Club nucleated around brain science, this biological characterisation was not replicated across the wider British cybernetics experience. The Ratio Club was a hub of British cybernetics only inasmuch as its members absorbed cybernetics individually and insofar as it absorbed a few overt cyberneticians; and it was the preeminent British cyberneticist formation by virtue of its singularity alone. Whilst cybernetics in Britain extended far beyond the Ratio Club, its presence was diffused and atomised. Ironically, it was this dispersal which enabled cybernetics to propagate through sublimation and emerge across the surface of the sixties counterculture.

¹⁴² *ibid.*, pp. 31-33.

¹⁴³ *ibid.*, pp. 33-34.

¹⁴⁴ S. Zuckerman, "Brains and Machines", *Nature*, Vol. 168, No. 4287, Dec. 1951, pp. 1095-96 [review of J. Z. Young, *Doubt and Certainty in Science: A Biologist's Reflections on the Brain: The B.B.C. Reith Lectures 1950*, (Clarendon Press, Oxford, 1951)].

Husbands and Holland's expedient omission of the wider British cybernetics experience was offset by their discussion of the prior war-time imbrications between future Ratio Club members and the proto-cybernetic techno-scientific practices and constructions of militarised research. Drawn by Bates' claim that many British scientists had cyberneticist thoughts before *Cybernetics*, Husbands and Holland discussed how war-time techno-science foregrounded ideas about the mechanistic equivalence between humans and artefacts in control, perceptual, information processing and computational systems. They emphasised the involvement of many Ratio Club biologists in the electronics of radar research, and gestured towards the possible war-time transatlantic flow of Wiener's mathematics into biologically infused British radar research. Although Husbands and Holland did not discuss servomechanisms as a manifestation of proto-cybernetics explicitly, they did highlight the British development of ideas about feedback control in electro-mechanical systems, and the burgeoning sense that feedback was common across biological and engineered systems. They also hinted at a strong pre-*Cybernetics* transatlantic cross-fertilisation. Following these indicators surfaced a hitherto unseen picture of parallel, independent, and interconnected epistemological emergences in Britain and America, and a formative British influence on Wiener in the immediate authorial hinterland for *Cybernetics*. My research also highlighted previously obscured, yet consequential, British influences on the broader subsequent history of cybernetics, and on the imbricated histories of computing and AI.

This thesis is unique in the historiography of cybernetics. Although other historians have examined the primary American emergences of cybernetics, this is the first book length discussion of both the Ratio Club and of the British cybernetic activities that took place beyond its influence. By exploring early British cybernetics, I do more than address historiographical lacunae, or recover a worthy historical curiosity. *Cybernetics* exercised a

profound historical influence on both the shape of our contemporary socio-technics, and on the possible forms of our future ways of being: corporeal, cognitive as well as social.

Cybernetics laid the deep foundations of the Information Age. In 1958, the inventors of the idea of what we now call IT proposed the creation of a new type of “information technology” that would permit the “systematic manipulation of information in individuals, groups, or machines” in order to augment, or even replace, human industrial and commercial managerial activity. They explicitly identified cybernetics as one of the sources of their ideas.¹⁴⁵ Whilst Wiener and Shannon had independently formulated the same mathematical conception of information in 1948, Wiener’s deployment of the new theory to the understanding and control of the behaviours of self-adaptive and feedback regulated systems lent itself to applications across systems of all kinds; as Wiener had intended. Moreover, as the early example of the invention of the idea of information technology shows, Wiener’s ideas about trans-systemic informational isomorphism, and the consequent possibility of informational communication and control between different types of systems (organic and inorganic alike), were being understood and applied within his lifetime.

Wiener and cybernetics also exercised a formative influence on Bob Taylor and J. C. R. Licklider, who were both pivotal in the creation of ARPANET; the US Department of Defence (DoD) computer network which became the technical core of the Internet.¹⁴⁶ In 1965, Taylor succeeded Licklider as the head of the Information Processing Techniques Office at the DoD Advanced Research Projects Agency (ARPA) where, building on work

¹⁴⁵ H. J. Leavitt, T. L. Whisler, “Management in the 1980’s”, *Harvard Business Review*, Vol. 36, Iss. 6, Nov./Dec. 1958, pp. 42.

¹⁴⁶ J. Hauben, *Norbert Wiener, J.C.R. Licklider and the Global Communications Network*, Columbia University, 3 Dec. 1996, <https://www.columbia.edu/~jrh29/licklider/lick-wiener.html>, [12 July 2024].

instigated by Licklider and drawing on his own knowledge of cybernetics, he initiated the project that led to ARPANET. From 1950 to 1957, Licklider had been at MIT where he had gravitated to Wiener's circle and cybernetics. In 1968, Taylor and Licklider co-authored "The Computer as a Communication Device", in which they proposed the use of networked computers as a platform for what we would today call video conferencing, social networking and voice enabled computer assistants.¹⁴⁷ Wiener's ideas about the possibility of systemic and symbiotic informational relationships between humans and electronic computers were carried into the architectural core of the Internet as we inhabit it today.

Wieners ideas also equipped the neurophysiologist Manfred Clynes and the psychologist Nathan Kline with the means of conceiving the cybernetic organism, or cyborg.¹⁴⁸ For some, the cyborg is fancifully fictive. For others, including those wielding the vast resources of Silicon Valley, cyborgism is the necessary transhuman state our species must attain to survive the Singularity. Amongst these powerful techno-transhumanists there are those who foresee a future where immortal cyborgs transcend Earthly limits and ascend to cosmic eternity. Some have built entire companies to realise their vision. Whatever one's views on the desirability of a cyborg future, it looks certain that the epistemological and ontological artefacts spawned by cybernetics will destabilise, if not deconstruct entirely, our normative and oppositional distinctions between the binary categories of human and machine; as Donna Haraway foresaw.¹⁴⁹ If the Anthropocene can be broadly conceived of as an epoch of

¹⁴⁷ J. C. R. Licklider, R. W. Taylor, "The Computer as a Communication Device", *Science and Technology*, April 1968, reprinted in R. W. Taylor (ed.), *In Memoriam: J. C. R. Licklider: 1915-1990*, 7 Aug. 1990, (Digital Systems Research Centre, Palo Alto, CA.), https://bitsavers.org/pdf/dec/tech_reports/SRC-RR-61.pdf, [12 July 2024].

¹⁴⁸ N. S. Kline, M. Clynes, "Drugs, Space, and Cybernetics: Evolution to Cyborgs", *Psychophysiological Aspects of Space Flight*, Brooks Air Force Base, Texas, 1960, (Columbia University Press, New York, 1961).

¹⁴⁹ D. Haraway, "A Manifesto for Cyborgs: Science, Technology, and Socialist Feminism for the 1980s", *Socialist Review* 80, Vol. 15, No. 2, 1985, pp. 65-107.

consequential and irreversible human impacts on a planetary scale, and if the capacity of humans to exercise this magnitude of effect is predicated on our computational technology, then the emergence of ever more powerful tools for the manipulation and communication of information will have far-reaching consequences. Moreover, if, as the cyborg portends, our corporeal and cognitive mechanisms are as malleable as the information from which they are constituted, then their technologized reconstitution and augmentation will also have profound implications for the nature and scale of the effects that our remade beings will have on the Earth. The Internet of Things may yet co-exist with the Internet of Cyborgs. As our century unfolds, cybernetics will transform both humans and humanity. Knowing its history is essential.

Structure and Argument

The outer chronological and thematic edges of this narrative are sharper than the inner ones. Although glimpsing the sixties counterculture and the techno-dystopic cultural narratives of the seventies, I conclude with the 1958 NPL Mechanisation of Thought Processes Symposium. Firstly, this reflects historical actuality. The surfacing of cybernetics across culture, art, and radical politics in the sixties and seventies produced a profoundly different set of experiences to those emerging when cybernetics first collided and elided with professional science, public sentiment, establishment conservatism, and highbrow philosophy in the fifties. Secondly, the 1958 event was a landmark in the history of cybernetics. Thirdly, the Ratio Club's final gathering occurred in the margins of the symposium. Contrastingly, the inner boundaries blur chronologically across the Second World War, and thematically across the Atlantic. Although less precise, this is equally expedient. British cybernetics is inexplicable without exploring the manifestations of proto-cybernetics in the epistemologies, ontologies and sociologies of British military techno-

scientific research. Similarly, whilst this thesis discusses British cybernetics, it accounts for the inception and intellectual contents of *Cybernetics* because without its American hinterland British cybernetics appeared arbitrary and free-floating. To contextualise the British experience of cybernetics, it is necessary to historicise the experiential subject.

My research questions were set by the subject itself, and by the paucity of its scholarship. Whilst Husbands and Holland concentrated on the Ratio Club, and Pickering included only two cyberneticians operating beyond it, there were sufficient clues to warrant wider investigation. Nevertheless, vanishingly little was known about British cybernetics more generally. Consequently, nothing was known about the relative position of the Ratio Club within the broader British cybernetics experience. Therefore, my primary task was two-fold. Firstly, to explore the nature, scope and significance of the British cybernetics experience overall. How did it arise? Who inhabited it, how did they come to do so, and how did they interact? What were the sites and venues for this experience? What impacts did cybernetics in Britain have? And, although this was not a comparative analysis, how did this experience relate transatlantically? Did British cybernetics feedback to America, and could a distinctive ‘Britishness’ be discerned in the British mediations of *Cybernetics*? Secondly, to evaluate the relative position of the Ratio Club within this bigger picture. Where, how and why did the Ratio Club fit into British cybernetics? These were broad, if not foundational, questions. It is rare, and exhilarating, to encounter a field as unmapped as British cybernetics.

The past never speaks for itself. Historians speak for it and thereby re-make it in their own image. Assertions of objectivity merely camouflage the subjectivity they deny. Historians’ subjectivities are manifested in their, ultimately subjective, theory choices, and all one can do is declare these subjectivities as honestly as reflexively possible. My theoretical

inclinations are towards constructivism in the sense that the evident realist capabilities of positivist science do not, in themselves, account for either the construction or authorisation of scientific knowledge. Sometimes realism and sociology coincide, but there is no necessary causality at work. Cybernetics easily accommodates such a constructivist approach. Not only was it an entirely synthetic science, but it was also crafted to reconcile a crisis of scientific incommensurability manufactured by Wiener himself. In all but Latourian name, Wiener authored *Cybernetics* to deliberately impel a paradigm shift. Moreover, both the embrace and the denial of cybernetics' scientific validity were rooted in sociology more than in realism. Wiener's central claims were, at best, hypothetical. Accepting his imaginative extrapolations from the early assertions of correspondences between electronic and neurological systems required a shift of intellectual register which easily resembled a leap of faith. Whilst cybernetics asserted a realist account of its systemic ontologies, this realism emanated from the observers not the observed. Similarly, *Cybernetics* was repudiated by those who balked at it philosophically, theologically or professionally, not because of any provable positivistic deficiency. *Cybernetics* explained the world to those predisposed to see the world in its image. Especially in relation to the materiality of mind and the vanquishing of vitalism.

Alongside extensive use of conventional archives, I have deployed evidence from two atypical primary sources. Firstly, the proceedings of a sequence of academic and professional conferences about computers, information theory and cybernetics. Secondly, information from a plethora of BBC broadcasts regarding the same subjects, and extending into philosophy of mind and automation. Concerning the former, I excavated both the delegate records as sources of prosopographic and sociological data, and the published proceedings as evidential sources for intellectual history. Regarding the latter, I drew

programme broadcast information into a composite depiction of cultural production, and interrogated some programme content to unpack this overall picture. In both cases, significant data are tabulated in the Annex. This data source is intended to be comprehensive, if not exhaustive, and it includes, names, nationalities and institutional affiliations of conferees, and titles, speakers and transmission data for BBC programmes. Historians make surprisingly little use of these types of sources. Occasionally, individual conferences are mentioned in isolation, or BBC broadcasts feature as singular moments. However, there is little previous aggregation of such information to establish patterns, explore connections, or discern wider associations between people or ideas.

A rare exception was Allan Jones' partial identification of BBC output about computers, cybernetics and theories of mind.¹⁵⁰ Prompted by Jones' work, and by sporadic references in the historiography of British computing and Turing's biographies to some of the events examined here, I ventured speculatively further towards these sources. This excursion was also partly prompted by the sociological liminality of cybernetics itself. These conferences and broadcasts emerged as vital, and hitherto overlooked, extra-institutional venues for the staging of British cybernetics. It was, for instance, through the lens of the BBC broadcasts that the magnitude of the British Cartesian computational controversy became visible. To view the performance, it was first necessary to see the stage. Alongside uncovering this vital episode in British intellectual history, this thesis is also the first identification of a pattern of intersecting British events about computing and information theory as central sites for the sociological construction of this new knowledge. And the first to highlight international

¹⁵⁰ A. Jones, "Five 1951 BBC Broadcasts on Automatic Calculating Machines", *IEEE Annals of the History of Computing*, Vol. 26, Iss. 2, 2004, pp. 3-15. A. Jones, "Brains, Tortoises and Octopuses: Post-War Interpretations of Mechanical Intelligence on the BBC", *Information & Culture*, Vol. 51, Iss. 1, 2016, pp. 81-101.

delegations at these British events, and British delegations overseas. However, whilst these conferences and broadcasts were vital to the British cybernetics experience, there was no sense that they constituted a central core from which its wider manifestations radiated. Rather than spreading by linear transmission from the inside out, British cybernetics propagated rhizomatically. I have only touched on the utility of these sources. Further work would enrich the histories of British and European computing and information theory, and open new perspectives on British public attitudes towards science and technology.

More conventionally, my general method was chronological. In particular, I have sought to capture and correlate the sequencing of these conferences and broadcasts, and to relate this temporality to the dynamic and contingent dimensions of experiential knowledge production. However, whilst the protagonists of British cybernetics inhabited time, not themes, nevertheless I have identified several common threads which unified many of their experiences. With few exceptions, they were deeply immersed in the intellectual and sociological heartlands of proto-cybernetics. Similarly, most of them were young and striving to re-establish career trajectories that had been dislocated by war. Uniformly, none of my principal characters hailed from disciplines within either the humanities or the social sciences. Although I have focussed on the experiences and identities of key individuals, I have also accounted for their activities in the context of their disciplinary, professional, institutional or national affiliations. And my use of a widely drawn prosopographical approach has extended my focus beyond the small cluster of characters who typically populate the historiography. I have combined this treatment of the shared practices and experiences of the protagonists of British cybernetics with an examination of its epistemological content conducted through a merger of history of ideas and intellectual history techniques. I have aimed to both individuate and embody the intellects that

constituted the British cybernetics experience, and to reflexively situate them within it; with the sparing and (hopefully) judicious assistance of cultural theory and discourse analysis

In this thesis, the British experience of cybernetics is concretised through personification. Its narrative is shouldered by the biographies of its protagonists, and accounts of their intersections with its venues, sociologies and epistemologies. Whilst this approach was spurred by the Ratio Club's emergence as a sociologically and biographically discrete entity, it should not be taken to diminish the overall sense of British cybernetics as a nebulous phenomenon. Although the Ratio Club was a forum that brought together some of the most influential figures in British cybernetics, my thesis assembles a much wider cast of historical actors inhabiting other dimensions of British cybernetics. Even so, I do not claim that they constituted the totality of the broader British experience of cybernetics, and neither is this thesis an exhaustive account of the ways in which even these actors inhabited this experience. For several of them, inside the Ratio Club as well as outside, such an account warrants a book length treatment of its own. Whilst the Ratio Club was self-typifying, self-descriptive and self-contained, I have divided those beyond it into two authorially imposed categories; the Fellow Travellers and the Other Cyberneticians. The former inhabited the intellectual and social landscapes of British cybernetics whilst the latter became avowed cyberneticians.

Cybernetics has many stories, some better told than others. The post-war European encounter with Wiener's ideas was not an exclusively anglophone phenomenon. Although initially banished as a bourgeois science under Stalin, cybernetics was set on the path to

becoming an official Soviet science by Khrushchev's 1956 secret speech.¹⁵¹ Meanwhile, in France, *Cybernetics* precipitated the formation of the Cercle d'Etudes Cybernétiques in 1950.¹⁵² Notwithstanding the richness of these parallel stories, my subject is British cybernetics. This nominative determination signifies both the historiographical distinction from the scholarly preoccupation with America, and an historical concern with exploring the distinctive nature of this separate, yet inseparably related, experience of cybernetics. Yet, all of the history I discuss occurred in England. Largely in the South, and mostly in London. However, while the delegations from universities in Scotland and Wales to events in England about computers and information theory were fractional, the designation of this subject as the British experience of cybernetics stands. For its protagonists, the question of this distinction did not exist. They inhabited Britain as the British inhabited the World, and imposing modern sensibilities on these historical subjects would distort their sense of their lived experiences. Notably, *Cybernetics* was often cast as American extravagance in pointed contrast to explicitly British sobriety. Thus, where American and British historical versions of terms co-exist, this thesis adopts the British nomenclature. So, Operational Research is used instead of Operations Research, and cybernetician is preferred to cyberneticist.

Chapter one charts the emergence of British proto-cybernetics. Like Clark, Husbands and Holland, I was taken by Bates' notorious claim that there were many British scientists with ideas similar to Wiener's before *Cybernetics*. In this thesis, I test Bates' belief in detail and uncover a picture of a richer prior episteme than even he imagined. Like American pre-cybernetics, British proto-cybernetics arose amidst the militarisation of science, and within

¹⁵¹ S. Gerovitch, *From Newspeak to Cyberspeak: A History of Soviet Cybernetics*, (MIT, Cambridge, 2004).

¹⁵² R. Vallée, "Correspondence: The 'Cercle d'Etudes Cybernétiques'", *Systems Research*, Vol. 7, Iss. 3, Sept. 1990, pp. 135-212.

constructions of increasingly complex weaponised ontologies. Yet, cybernetics derived not from the dehumanising brutality of war, but rather from the systemic sophistication necessitated by its totalising and mechanised character. The impetus was mechanical substitution of human perceptual and cognitive agency in controlling and operating novel ontologies, and this commonality of war-time context accounted for the parallel transatlantic epistemological development. There were also stronger intellectual transmissions from America to Britain during the war, especially of Wiener's ideas, and stronger post-war British influences on Wiener's authorship of *Cybernetics* than has hitherto been recognised.

Chapter two interweaves the biographies of my protagonists into the fabric of British proto-cybernetics. Partly, this empiricises the ways in which they became agentic in the British cybernetics experience. Partly, it clads this agency in their individuated personhood. The visibility of my subjects varies considerably. Turing is now world-famous. Strachey is occasionally mentioned in histories of British computing. Some Ratio Club members still enjoy continuing, albeit narrow and fading, scientific prestige. Hick, for instance, has an eponymous law, and Barlow and Gabor's work remains current. Others, including Young, Wescott, Gold and MacKay, whilst professionally prominent in life, have waned posthumously. Woodward and Uttley, although renowned amongst contemporary government scientists, were obscure outside this occluded community. Beyond the Ratio Club, Sluckin and Tustin enjoyed contemporary recognition for their cyberneticist literary excursions, but have since become historically invisible. Likewise Cherry, despite his popularity as a public scientist in the seventies. Ashby, Beer and Walter are acclaimed, but only by specialist scholars and cyberneticians, and not even the cyberneticist *cognoscenti* take sufficient note of George and Andrew's significance. This is the first serious historiographical recognition of George and Andrew, and the first identification of George's

important role as a seventies scientific populariser. Porter was hitherto invisible, and Young's cybernetics encounter went unremarked. Amidst Turing's celebrity, his scholars and biographers have woefully downplayed his cyberneticist connections.¹⁵³ Overall, this is the first collective casting of these actors on the British post-war cybernetics stage.

Chapter three locates the Ratio Club within its domestic context. The Britain encountering *Cybernetics* was a nation unexpectedly impoverished by victory, and a metropole bewildered by imperial disintegration. British anti-Americanism flourished as a mighty ally, steadfast in combat, became precipitously capricious in peace. Many Ratio Club members had blossomed in the irregular intellectual meritocracy of militarised research. Yet, the transgressions legitimised by war became impermissible in peace. As Bates' group gathered, many of them chafed under both a resurgent scientific sociological stratification, and the burgeoning deprecation of *Cybernetics* by the intellectual establishment. There was scant tolerance for domestic intellectual impudence or American scientific iconoclasm in their re-normalising hierarchical post-war professions. Respectable antipathy to *Cybernetics* also emerged in the Cartesian computational controversy; a struggle over the nature of human mind, and the capacity of electronics to emulate it. This thesis provides the first broad treatment of the conduct and scale of this high-stakes public philosophical contest which condemned cybernetics for portending dehumanising roboticization, and inscribed a deep

¹⁵³ With the notable exception of Dermot Turing.

foundational schism between it and British computing.¹⁵⁴ The Othering of cybernetics by respectable science was also propagated in the staging of the British events about computers and information theory attended by various Ratio Club members. Amidst professional conservatism and public controversy the Ratio Club offered sanctuary not activism.

Chapter four navigates the wider enactments of British cybernetics. Whilst denied both academic and government institutional establishment, cybernetics nevertheless spread broadly across post-war British intellectual life. The Cartesian computational controversy propelled cybernetics, and Turing, to the forefront of a philosophical tumult inextricably interlaced with post-war anxieties about the fragility of humanity which the BBC was particularly active in popularising. Auntie's enthusiastic coverage of existential philosophy spread beyond the tiny elite audience for the newly established Third Programme and reached the mass listenership of the Light Programme and the Home Service. Alongside belligerence in the battle for the nature of mind, and computing, cybernetics was similarly implicated in an equally dramatic mid-century anxiety about economic automation. This

¹⁵⁴ In 2022 Bernardo Gonçalves published a paper drawing attention to the importance of the Cartesian contest between Turing on one side, and Douglas Hartree, Michael Polanyi and Geoffrey Jefferson on the other. This summarised his 2021 PhD thesis. Gonçalves' main concern was to construct a proximate historical context for his revisionist exegesis of Turing's 1950 paper and his reframing of the origins, nature and purpose of Turing's imitation game. Alongside his recognition of the Cartesian computational controversy, Gonçalves also noted Turing's intersections with Wiener, and Jefferson's explicit attack on cybernetics. However, Gonçalves' focus was on historicizing the context for the philosophical contents of Turing's theory of mind, rather than exploring the context itself. Nevertheless, this is the only other work that I am aware of which has recognised the presence and significance of the British Cartesian computational controversy. Likewise, in personal correspondence, Gonçalves has confirmed that, to the best of his knowledge, he and I are alone in detecting this important historical episode. We each arrived at our now shared realisation independently. B. Gonçalves, *Machines Will Think: Structure and Interpretation of Alan Turing's Imitation Game*, (PhD thesis, University of São Paulo, 2021). B. Gonçalves, "Can Machines Think? The Controversy That Led to the Turing Test", *AI & Society*, Vol 38, Iss. 6, 2023, pp. 2499-2509, <https://doi.org/10.1007/s00146-021-01318-6>, [24 March 2024]. Gonçalves then extended his treatment of the British Cartesian computational controversy with a discussion of the direct dispute between Turing and Hartree over the question of computational cognition. This paper was published after the substantive draft of this thesis was written. B. Gonçalves, "Lady Lovelace's Objection: The Turing-Hartree Disputes Over the Meaning of Digital Computers, 1946-1951", *IEEE Annals of the History of Computing*, Jan.-March 2024, Vol. 46, Iss. 1, pp. 6-18, [10.1109/MAHC.2023.3326607](https://doi.org/10.1109/MAHC.2023.3326607), [11 July 2024].

conflict also cast cybernetics as either redemptively rationalist, or dangerously dehumanising. Although generally unnamed, nevertheless cybernetics permeated this freighted discourse around machines replacing human minds in wealth creation. Because there was more to British cybernetics than the Ratio Club, and more to its members than their membership, this chapter also examines the agency of all my protagonists across this wider canvass. Finally, because British cybernetics was not exclusively British, I explore the international intersectionality of British cybernetics, uncovering the hitherto unexplored part played by British cyberneticians in the birth of AI at Dartmouth in 1956.

The Annex to this thesis contains a comprehensive collection and tabularisation of prosopographical data about the protagonists of the British cybernetics experience, the conferences and events they attended, and the BBC output they encountered. It is, to the best of my knowledge, the first time that this information had ever been captured and presented in this way. In particular, it is the first time that the attendance records and agendas of a series of seminal British conferences about computing and information theory have been interrogated and analysed as primary historical sources in their own right.

Chapter One: British Proto-Cybernetics

Scientists Go to War

The British state consumed vast amounts of energy and treasure in the systematic militarisation and weaponization of science and technology during the Second World War, with decisive effect. In this ‘scientists war’, the Boffins cloistered in their backrooms were heroized as unlikely yet endearingly idiosyncratic architects of victory. In peace, for a time, they became the New Jerusalem’s rationalist prophets. Whilst the decentralised nature of British war-time research obviates quantification of its cost, the inputs and outputs were eloquent. The expanding compass of personal income tax necessitated the introduction of PAYE deductions in 1944, and radar, jet engines, and split atoms resulted. Less visibly, great advances occurred in electronics, medicine, plastics, and nutrition.

After the events of September 1938, the British government began compiling a list of those senior technocrats, scientists and administrators who were more likely to be useful in military research than in combat. Unlike in the Great War, valuable brains would not be squandered in slaughter. By October, the Royal Society had inscribed 6,484 names, some 90% of Britain’s credentialed scientists, in the Central Scientific Register.¹⁵⁵ When war came, those listed quickly answered the call. Naturally, the Royal Society’s elite nominees were immediately appointed to senior grades in the enlarged Scientific Civil Service. However, important though they were, it was the subsequent intake that characterised the unprecedented nature of British war-time scientific research and technological development.

¹⁵⁵ “Beryl Power”, www.civilservant.org.uk/women-beryl_power.html, [6 Dec. 2021].

War-time science and technology became leviathan. In January 1940, the Ministry of Supply (MoS) register classified 1,967 employees as professional scientists and technicians, and 4,763 as junior technical staff. By October 1941, the MoS professional research cohort alone grew to 7,002; already a marked uplift to the initial Royal Society count of 6,484. At the Ministry of Aircraft Production (MoAP), the 1940 figures were 1,447 in the higher division and 1,450 in the lower. By 1945, the MoS figures had risen to some 7,575 in the senior echelon and 19,692 in the subordinate class, and the MoAP's to 4,643 and 4,113 respectively. Combining both ministries and both classifications, by 1945 there were 36,023 scientists and technicians in service compared to 9,627 in 1940.¹⁵⁶ Whilst the MoS oversaw most military research, these figures still understate the numbers in scientific service.

The response to the voracious intellectual appetites of total warfare arose spontaneously from British university students who alacritously volunteered their cerebral services in vast numbers. This mass-militarisation of academia occurred without compulsion or overt state intervention, and with the fulsome support of the university authorities. Although exempt from conscription, students could complete a full degree in six terms on the tacit proviso of direct entry into military service, and these short war degrees became commonplace.¹⁵⁷ There was also little incentive for students to linger. Most of the remaining senior research staff were directed to support the war, and any other research atrophied. *De-facto*, British universities became factories for the accelerated production of a civilian scientific militia.

¹⁵⁶ J. D. Scott, R. Hughes, *The Administration of War Production: History of the Second World War, United Kingdom Civil Series, War Production Series*, (HMSO, London, 1955), pp. 518-19.

¹⁵⁷ "The University of Glasgow Story: The University During the Second World War", www.universitystory.gla.ac.uk/ww2-background/, [13 Feb. 2023]. "Downing College in the Second World War", www.dow.cam.ac.uk/about/downing-college-archive/archives-college-history/downing-college-second-world-war, [13 Feb. 2023].

Upon leaving their lecture theatres, these young soldier-scientists entered a world of unprecedented fluidity. The Second World War was a sociological solvent, temporarily subverting and transforming normative behaviours and practices, especially those around gender and class. Women became soldiers and labourers, and flew unarmed, yet liveried, combat aircraft from factories to operational airfields. Sergeants became pilots, and officers were no longer exclusively Gentlemen. War did not obliterate sociological stratification, and structures of power and privilege rapidly reformed after 1945, often aggressively. Nevertheless, the exigencies of an existential imperative created an exceptional sociological moment wherein the prosecution of total war displaced conformance to pre-war precepts about how Britain, and the British, should be. Boffins experienced this exceptionalism just as much as those drafted into uniforms, factories, farms, aircraft, or the officer's mess.

In 1939, age required deference from youth, as did men from women, upper classes from lower, and senior personnel from subordinates. War changed this. From 1940 onwards, the ranks of the Scientific Civil Service swelled with a massive influx of clever and confident youths who were energised by a deep sense of mission and empowered by their voluntarism. Upon entering their new domain, these inexperienced youngsters were typically accorded their proper place at the bottom of the pecking order. Previously, this would have invoked strictly enforced hierarchies of protocol and behaviour. If one started on the lowest rungs, there one remained, at least for the allotted time. Now however, ability supplanted seniority and success circumvented propriety. As many discovered, promotion could arrive vertiginously. Civilian scientists were even granted temporary military commissions, replete with the insignia and privileges of their often senior rank.

A. P. Rowe's Superintendency of the TRE exemplified the transformative practices of a goal-driven intellectually muscular meritocracy experienced by an entire generation of fledgling technocrats. The TRE's focus was radar, a subject so new that it had neither a stable language, nor a theoretical base (beyond classical physics), nor an established body of knowledge. It was also secret, vital for survival, and it was being made up as it went along. Its military operators could not articulate their requirements within the existing protocols for equipment specification, and few of its researchers had any experience of military operations or equipment acquisition procedures. Even fewer military personnel knew enough science. Nobody knew enough about radar's operational scope. Secrecy closed the normal channels of scientific communication and commercial negotiation. Even had it not, nobody would have understood anybody else. So, Rowe convened weekly colloquia, known contemporaneously as the Sunday Soviets.¹⁵⁸

Soviets were for the weekend. On Sundays, everyone involved in the development, production, and use of radar speculated and argued, informally and without an agenda. Although war blurred class distinctions, they were not erased. Whilst ability enjoyed unprecedented authority, nevertheless consciousness of rank persisted in both Military and Civil Services. Remarkably therefore, Rowe's Soviets practiced discursive equality. The most senior military officers, civil servants and academics debated with the most junior, including factory supervisors and laboratory assistants. It is forgivable to suggest that decisions taken by the Soviet on Sunday were enacted in Whitehall on Monday. The imbricated ironies of equalitarian meetings of hierarchically stratified sociological constituencies, nominatively honouring Bolshevism, held on the Christian Sabbath, in the

¹⁵⁸ J. G. Crowther, R. Whiddington, *Science at War*, (DSIR/HMSO, London, 1947), pp. 84-89.

metropole of a capitalist empire, to prosecute scientific warfare against fascism, are delicious. Unsurprisingly, Britain's only state sanctioned Soviet perished with peace. However, some future Ratio Club members probably attended TRE's Sunday Soviets.

At TRE, as elsewhere, researchers were deployed to meet operational need, regardless of their disciplinarity. Of the 6,484 scientists inscribed in the Royal Society's Central Scientific Register by October 1938, I have calculated that around 51% were physical scientists, 38% were life scientists, 8% were mathematicians, and 2% were psychiatrists.¹⁵⁹ The war then triggered a collapse in demand for humanities degrees, and an upsurge of graduations in physics and medicine.¹⁶⁰ However, although war summonsed more physicists than ever before, radar's insatiable appetite demanded more brains even than this. Consequently, scientists from other disciplines, especially biology, worked alongside physicists in previously unimaginable ways. Biologists became immersed not only in the generalities of physics, but also in the emerging specificities of electronics, and in new forms of human machine symbiosis. From the outset, the development of radar fused meat and metal.

As well as impelling interdisciplinarity, war-time research necessitated new enactments of scientific praxis. War science was teleological and purposeful, and much of the militarised new scientific knowledge was exotic and experimental, with no clear or stable distinction between what would otherwise have been segregated as pure or applied science. War immersed these young epistemological nomads in scientific practices which compelled a conceptual and methodological synthesis of categories of scientific knowledge, just as much

¹⁵⁹ "The Royal Society and the Central Register", *Notes and Records of the Royal Society of London*, Vol. 2, No. 2, Nov. 1939, pp. 176-78.

¹⁶⁰ Lord Hankey, "Science in the War", *Sunday Times*, 13 Dec. 1942, p. 4.

as they ordered the embodiment of science in military machinery. This scientific generation acquired intellectual maturity through conjuring corporeal forms and concrete applications from even the most esoteric speculations. In their hands, the fabric of reality was seemingly as pliable as their minds could make it. Not uncommonly, the experience of the novel praxis of war-time science inculcated an abiding receptivity to intellectual heterodoxy. Particularly to any new knowledge fusing theory and practice as technology, or that with direct applicability to improving the human condition. For some of those imbued with such receptivity, *Cybernetics* would appeal to this new sense of their worldly praxical agency.

The Madness of War

Defeating fascism saved civilization, but at incalculable cost. The birthplaces of the Renaissance and the Enlightenment were savaged by a war waged against barbarism, just as Hiroshima and Nagasaki were incinerated in the name of peace. Although the victors could claim the mantle of righteousness, their gaze fell uncomfortably on the ruins razed by their just war, whilst the evidence of Nazi genocide further seared their souls. Decades of strife, revolution, chaos, and poverty culminated in a total war where the power of Western civilization wrought unparalleled devastation. Science, the bedrock of European civilizational ascendancy, confronted humanity with self-annihilation. In Britain especially, an ambiguous victory brought both peace and a sense of moral jeopardy. Particularly amidst the boffins whose brains had spawned the technologies of death. Their pervasive post-war sense that this power must avert future destruction and usher redemptive reconstruction was heightened because the call to militarise science had come most vociferously from scientists themselves. Just as the war had rendered the applications of science explosively visible, it had also materialised the performative enactment of societal interventionism by activist

scientists. Whilst Hitler's defeat was a moral imperative, peace now compelled a rededication of science to its civilizing mission.

In 1940, Penguin published *Science in War*, which rapidly sold over 20,000 copies.¹⁶¹ Its anonymous authors were members of the Tots and Quots scientific dining club convened by zoologist Solly Zuckerman. There was considerable overlap between the memberships of the Tots and Quots, and the interwar social relations of science movement championed by Patrick Blackett and J. D. Bernal.¹⁶² Both groups proclaimed the moral duty of scientists to undertake societal activism and prevent the misuse of science. *Science in War* directed this duty to opposing fascism, demanding that scientists should be mobilised to research, not squandered under arms. Whilst its exhortation was heeded by scientists and the state alike, nevertheless, as early as 1941, J. G. Crowther, a Tots and Quots member and communist stalwart of the social relations of science movement, pointedly reminded scientists of their civilizational duty.¹⁶³ In 1947, Penguin followed *Science in War* with *Science and the Nation* which extolled the virtues of science and planning in restoring rationality and forging peace.¹⁶⁴ *Science and the Nation* was credited to the Association of Scientific Workers (AScW), which after re-constituting as a trade union in 1941, had rapidly acquired 84 branches, 6,000 members and left-wing politics.¹⁶⁵ In 1949, Butterfield's ironically whiggish *The Origins of Modern Science* responded to the general imperative, affirming the scientific revolution as the genesis of Western civilisation.¹⁶⁶ Unsurprisingly, many young

¹⁶¹ *Science in War*, (Penguin Special, London, 1940). S. Zuckerman, *From Apes to Warlords: An Autobiography 1904-46*, (Collins, London, 1988), p. 399.

¹⁶² J. D. Bernal, *The Social Function of Science*, (Routledge, London, 1939).

¹⁶³ J. G. Crowther, *The Social Relations of Science*, (Macmillan, London, 1941).

¹⁶⁴ *Science and the Nation*, (Pelican, London, 1947).

¹⁶⁵ "The Association of Scientific Workers", *Nature*, Vol. 149, No. 3785, 16 May 1942, p. 550.

¹⁶⁶ H. Butterfield, *The Origins of Modern Science: 1300-1800*, (Bell, London, 1949).

left-leaning scientists saw themselves as the architects of the New Jerusalem. Some found cybernetics.

After the madness of war, peace ushered a deep consensus that rationality must prevail, and that science must restore balance to the World. Science must cure, not cause, the World's insanity. Whilst this imperative was acutely felt across the scientific community generally, it pressed particularly powerfully on those who had treated the minds and brains traumatised by war. The core membership of the Ratio Club was mainly comprised of neurologists and psychiatrists, and although some were drafted into radar research, several of the clinicians spent the war treating military psychiatric and neurological casualties. The insanity of war was a collective societal experience, and like all of their soldier-scientist comrades, all of the future Ratio Club members were acutely sensitised to the ambivalent power of science. However, for those Ratio Club members who had attempted to mend the madness of war medically, the imperative to use science in the service of sanity was literal. In their terms, they had witnessed a lunacy in war which they sought to vanquish in peace.

Like the Great War, the Second World War spurred a dramatic increase in the numbers of psychiatric, psychological, and neurological casualties. However, in 1939, neither the public nor clinicians generally thought well of mind medicine. According to Eliot Slater, psychiatrist and Ratio Club member, the pre-war Royal Medico-Psychological Association (RMPA) did little more than shelter the medical superintendents of the despised asylums from the well-earned scorn of the medical profession, whilst psychotherapy had abandoned science for Freudian cant. Slater ruefully acknowledged that even his medicalised

psychiatry was denigrated by his fellow doctors.¹⁶⁷ In common usage, psychology meant endlessly expensive psychotherapy, and psychiatry meant the asylum; the rich got the couch, the poor were warehoused. Unsurprisingly, at the start of the war many military doctors saw mental illness as merely medicalised cowardice. Stigmatised shell shock cast a long shadow.

Nevertheless, British military psychiatric medicine expanded significantly during the war. Especially in the Army, where psychiatry experienced both a substantial increase in scale and a marked attitudinal shift.¹⁶⁸ Whilst the RAF retained the condemnatory label of Lack of Moral Fibre (LMF) as a putative deterrent, the Army avoided it, favouring Instead the administrative categorisations of Not Yet Diagnosed Nervous or Battle Exhaustion.¹⁶⁹ These neutral labels avoided the automatic removal from combat triggered by an LMF designation, and helped to counter stigmatisation by stilling the shame of madness or cowardice. Patients considering themselves unwell were more treatable than those believing themselves corrupted. This restorative psychiatry was pragmatism, not compassion. Speedy restoration to combat trumped moral outrage that mental illness was euphemised character failure. The supply of fighting fit humans was constrained by a relatively small population, and the extensive mechanisation of the British military was, in part, an expedient driven by this perennial paucity of personnel. However, this compensation itself increased the reliance on trained, skilled operators. Soldiers were expensive and valuable. It was vital to avoid costly and time-consuming medical repatriations or, worse, medical discharges.

¹⁶⁷ E. T. O. Slater, "Autobiographical Sketch", in J. Shields, I. I. Gottesman (eds.), *Man, Mind, and Heredity: Selected Papers of Eliot Slater on Psychiatry and Genetics*, (Johns Hopkins, Baltimore, 1971), p. 17.

¹⁶⁸ R. H. Ahrenfeldt, *Psychiatry in the British Army in the Second World War*, (Routledge, London, 1958).

¹⁶⁹ D. Ellin, "A 'Lack of Moral Fibre' in Royal Air Force Bomber Command and Popular Culture", *Brit. J. Military History*, Vol. 6, Iss. 3, Nov. 2020, pp. 42-65.

Because injuries to minds and brains compromised combat capability just as much as damaged bodies did, the Army developed an extensive practice of forward psychiatric treatment where casualties were received as close to combat as practical, then treated and returned to fight as rapidly as possible.¹⁷⁰ The value of the forward psychiatric treatment system was confirmed during the early stages of the Allied invasion of Europe when its organisation faltered under the initially rapid advances from the Normandy beaches. In June 1944, 85% of psychiatric casualties were being repatriated, many to South London's Sutton Emergency Hospital. As psychiatric casualties accounted for around 10% of the overall tally, this was unsustainable. By July, forward treatment had improved, and 45% of psychiatric casualties were now being returned to combat.¹⁷¹ The success of Army psychiatry eased the hostility of many Medical Officers, and the officer corps generally, to the idea of curative mind medicine, and the post-war credibility of psychology, psychiatry, and brain science generally was bolstered by the treatment of mental illness during the war.

The Army privileged somatic speed and favoured brisk pharmacological interventions and induced coma over leisurely psychotherapy. As well as accelerating the restoration of military capability, this expedient also facilitated a post-war reversal of pre-war norms within psychiatry itself. From the nineteenth century onwards, professional and public opinion discriminated between disordered nerves and broken minds. Neurotics were unwell and received treatment. Psychotics were mad and were incarcerated. Wealth camouflaged lunacy as neurosis and purchased interminable couch sessions, often with no discernible

¹⁷⁰ A. S. MacNalty, F. Mellor (eds.), *Medical Services in War: The Principal Medical Lessons of the Second World War: Based on the Official Medical Histories of United Kingdom, Canada, Australia, New Zealand and India*, (HMSO, London, 1968).

¹⁷¹ M. Harrison, *Medicine and Victory: British Military Medicine in the Second World War*, (OUP, Oxford, 2004), pp. 251-52.

improvement. However, it was better than the madhouse, and there was scant alternative. Somatic theories of neurosis did exist, alongside some Heroic physical treatments, including malaria induced pyrotherapy to attack the paralytic dementia of late-stage syphilis for instance. However, such therapies were neither reputable nor safe.

After the war, the status of somatic psychiatric medicine improved considerably. During the war, the Army had maintained the distinction between neurosis and psychosis. As restorative combat medicine, Army psychiatry dealt exclusively with neurosis. Even in war, it remained the case that diagnosed psychotics were automatically incarcerated. Therefore, the Army applied its physical methods to treat illness not madness. Nevertheless, the lesson was clear. Psychiatry could be practiced physiologically and scientifically, and become respectably medicalised. This war-time physicalisation of psychiatry stimulated a post-war upsurge of psycho-pharmacology and psycho-surgery, which in turn nourished the energised scientific, philosophical, and public discourse about the nature of mind and its relationship with the brain and body that permeated the Cartesian computational controversy.

Inevitably, war foregrounded questions around the relationships between neurosis, the patient's nature, and their environment. Evidently, environment and malfunction were linked. Combat produced legions of military psychiatric casualties who would otherwise have lived ostensibly normal lives. For many Army psychiatrists, war neuroses were extreme manifestations of natural stress reactions that had been amplified by the violent abnormality of prolonged mortal danger. Yet, only a minority of soldiers suffered breakdowns and most remained at least functionally adapted, even to the extremis of war. Manifestly, some were less resilient than others. Generally, Army psychiatrists deployed variants of pre-existing disposition theory to explain their patient's neurosis; some people

were simply less adaptive. However, the origin of this innate adaptability was unresolved. Was it nature or nurture? Did adaptive failure arise from deep childhood trauma, or breeding? Was adaptability physiological or psychological? What was the difference, if any, between physiology and psychology? For psychiatrists and neurologists, the experiences of war emphasised the relationships between the nature of a mind, and its ability to equip its owner with the capacity to adapt their behaviour in response to varying environmental conditions. Whilst their job was to mend soldiers, not ponder eternal verities, nevertheless, for many of these practitioners war posed questions about the adaptive mechanics of complex neurological systems, especially those within humans. For some, *Cybernetics* answered.

More generally, the post-war imperative to explain the madness of Nazi Germany and rationalise the insanity of Hitler's war turned upon another expression of the distinction between nature and nurture. Either there was an innate Teutonic character which predisposed Germans to Nazism, or psychopaths had twisted millions of minds with propaganda.¹⁷² If the former, how had fascism arisen elsewhere in Europe? If the latter, then human minds were dangerously susceptible to influence. If this was so, what did the ascent of Soviet power portend? Amidst the acute post-war interest in the nature of mind, collective and individual, there was fertile ground for anxieties about the exercise of mind control. Especially through the technological mechanisms of mass communication. For many, the most pressing questions were how had the Nazis managed to roboticize an entire nation; and, could it happen again? Many were ready to agree with Orwell that it could.

¹⁷² W. Brown, "The Inferiority Complex and the Paranoid Tendency: With a Brief Reference to Nazi Psychology", *Nature*, Vol. 156, No. 3957, 1 Sept. 1945, p. 261.

Information Goes to War

Like science, information was comprehensively weaponised during the Second World War. In 1939, the British government formed the Ministry of Information (MoI) to fortify civilian mental resilience through benign propaganda. With the expectation of mass casualties from aerial bombardment and in anticipation of rationing, maintaining domestic moral was critical. Institutionalisation of state propaganda during war was hardly novel. However, whereas the Great War's Propaganda Bureau was clandestine, the MoI was performatively self-declarative. It openly employed creatives, made its own uplifting films, and endorsed popular commercial feature films. Anyone reading an MoI poster knew that information was being used to influence their thoughts. What Hitler did for evil; Britain did for good. Nevertheless, this overt amalgam of propaganda and modern media foregrounded later concerns about information and technology being used to exercise malign control over minds and societies. The Ministry of Truth echoed the lived realities of Orwell's readers.

Like propaganda, the equally ancient art of cryptology was transformed by war. First Blitzkrieg, then global total war, demanded real-time coordination of vast numbers of fast moving machines and humans with encrypted radio signals. Laborious manuscript ciphers were inadequate. Enigma answered the imperatives of this war of mechanised mobility by itself mechanising and automating the encipherment and decipherment of military communications. In response Bletchley's codebreakers automated and mechanised cryptanalysis. First came Turing's Bombe which adapted the work of Polish mathematician Marian Rejewski to break Enigma; then Tommy Flower's Colossus which used Turing's ideas to perform cryptanalysis on the Lorenz cipher. Despite its later fame, operationally Colossus was dwarfed by the Bombes. By 1945, according to Turing's colleague, Hugh

Alexander, there were 152 three rotor Bombes across sites in Bletchley, Adstock, Gayhurst and Wavendon, and another 180 four rotor Bombes in Britain and America.¹⁷³

Whilst the Bombes were a major advance in cryptanalysis, without which the attack on Enigma would have been impracticable, by themselves they were insufficient to break the Kriegsmarine's particularly sophisticated implementation of the system which confronted the Bombes with excessive uncertainty, and the codebreakers with insufficient time. Cracking the naval Enigma required mathematical as well mechanical augmentation. Following the Polish mathematician, Jerzy Różycki, Turing and Jack Good developed the Banburismus method of narrowing the range of possibilities before making initial guesses about the rotor settings on an Enigma machine. Banburismus implemented a form of sequential conditional probability using the neglected work of the eighteenth-century mathematician Thomas Bayes. Using Bayes' theorem, Good and Turing inferred a probabilistic possibility range from limited information, rather than extrapolating predictive projections from a larger data set.¹⁷⁴ Banburismus introduced the Bletchley codebreakers to

¹⁷³ C. H. O'D. Alexander, *Cryptographic History of Work on the German Naval Enigma*, National Archives (HW25/1), www.ellsbury.com/gne/gne-000.htm, [11 Jan. 2022].

¹⁷⁴ The first hand evidence for Good and Turing's use of Bayes' theorem in the development of Banburismus, and elsewhere at Bletchley, came from two contemporary sources; Jack Good who worked directly alongside Turing, and Edward Simpson who led the team in Block B who were attacking the Japanese Naval cipher (JN 25). Intriguingly, Simpson knew nothing of the work of his Bletchley co-workers on the German Naval Enigma cipher at the time, and arrived at his use of Bayes' theorem independently of Good and Turing. Hodges' account of the development of Banburismus came largely from Good's recollections. I. J. Good, "Early Work on Computers at Bletchley", *Annals of the History of Computing*, Vol. 1, Iss. 1, Jan.-March 1979, pp. 38-48, [10.1109/MAHC.1979.10011](https://doi.org/10.1109/MAHC.1979.10011). I. J. Good, "Studies in the History of Probability and Statistics. XXXVII: A. M. Turing's Statistical Work in World War II", *Biometrika*, Vol. 66, No. 2, Aug. 1979, pp. 393-96, <https://doi.org/10.2307/2335677>. M. Rejewski, "How Polish Mathematicians Deciphered the Enigma", *Annals of the History of Computing*, Vol. 3, Iss. 3, July-Sept. 1981, pp. 213-34, [note by Good, pp. 232-34], [10.1109/MAHC.1981.10033](https://doi.org/10.1109/MAHC.1981.10033). E. Simpson, "A Life in Statistics: Edward Simpson: Bayes at Bletchley Park", *Significance*, Vol. 7, Iss. 2, June 2010, pp. 76-80 [p.79 for his contemporary ignorance of Good and Turing's work], <https://doi-org.ezproxy-prd.bodleian.ox.ac.uk/10.1111/j.1740-9713.2010.00424.x>. E. Simpson, "Banburismus Revisited: Depths and Bayes", Part VII: Mathematics, Chapter 38, B. J. Copeland, J. P. Bowen, M. Sprevak, R. Wilson, and others, *The Turing Guide*, (Oxford University Press, Oxford, 2017), pp. 415-26. Hodges, *Turing*, pp. 196-97, 549 fn. 4.20.

the idea that states of complexity were probabilistic emergences, rather than expressions of linear determinacy. After the war, for the Bletchley initiate, the statistical theory of information, and ideas about the stochastic nature of systems, would be easily accessible.

Bletchley witnessed another transformation to cryptanalysis which also prefigured the post-war emergence of information theory. In 1939, crosswords were used to establish the lexical dexterity of putative codebreakers who would then deploy venerated methods of textual and linguistic analysis to break ancient ciphers. The British Academy claims 84 Bletchley codebreakers with a humanities background.¹⁷⁵ However, with the mechanisation of encryption and decryption, and the development of new forms of statistical analysis to forcibly restore order to distorted signals, cryptanalysis became a branch of applied mathematics where discernment of semantic content was, to an extent, analytically separable from re-constitution of signal pattern. The coherence of messages as statistical patterns was as central to *Cybernetics* as to Shannon's parallel formulation of information theory. Conspicuously, Shannon derived his theory whilst working on ways to mechanise the mathematical distortion, and restoration, of order in digitised binary signals.

By mechanising and automating the mathematics of cryptanalysis, Bletchley itself became a vast sociological machine. It was an epistemological factory, applying Fordism and Taylorism to information (not objects) through cognitive production lines employing some

¹⁷⁵ "Humanities Scholars Who Worked in Military Intelligence in the Second World War", www.thebritishacademy.ac.uk/publishing/memoirs/humanities-scholars-who-worked-military-intelligence-second-world-war/, [11 Jan. 2022].

10,000 brains.¹⁷⁶ Bletchley demonstrated that the products of mind could be industrialised as effectively as those of matter. Information could be processed, processes could be systematised, and systems could be automated. Information could be manipulated by humans and machines interchangeably, and transmitted between them in dynamic symbiotic cognition. This was radically different to the entirely passive manuscript recording and retrieval systems extant in banking and insurance, although these too operated on industrial scales. It was also different to existing Hollerith punched card data processing systems. Although partially automated, they merely tabulated static data stores. They did not act to produce or transform the data itself. Neither did machines and humans interact creatively in the Hollerith system. Bletchley constituted a factory scale, automated, generative information processing system where humans and machines co-operated with functional equivalence. Existential purpose created a morphically agnostic sociological and informational teleological ontology which erased systemically arbitrary distinctions between organic and inorganic cognitive mechanisms. This resonated with *Cybernetics*.

Enigma confronted Bletchley's minds with machines enacting cognition better than humans, and its organic brains required mechanical augmentation to respond. Machine generated mathematical complexity was insoluble without machines. For the first time, humans

¹⁷⁶ The vast scale of the Bletchley operation is now common knowledge, as is the use of highly specialised labour working in shifts to perform repetitive tasks as part of the overall process of intelligence production. My conceptualisation of Bletchley in the way I describe it here was prompted by both the overall tone of Hodges' description of the codebreaking operation, and by his reference to "the Bletchley industry ... with ten thousand people ... at work on rolling secrets off the production line". See, Hodges, *Turing*, p. 270. My particular sense of Bletchley as a factory was developed over the course of many visits to the site, and affirmed by the contents of its exhibition presenting the war-time operation there as "The Intelligence Factory", which opened on 28 April 2022. See, "Bletchley Park: The Intelligence Factory", <https://bletchleypark.org.uk/event/the-intelligence-factory/>, [24 June 2024]; "Intelligence Factory Exhibition Sheds Light on Secret Bletchley Park Operation", *Guardian*, 22 April 2022, <https://www.theguardian.com/world/2022/apr/22/intelligence-factory-exhibition-sheds-light-on-secret-bletchley-park-operation>, [22 June 2024]. There are several references to the use of factory methods at Bletchley in C. Grey, *Decoding Organization: Bletchley Park, Codebreaking and Organisation Studies*, (Cambridge University Press, Cambridge, 2012), p. 188, 205, 215.

successfully outsourced mental activity to automatic information processing machines that exceeding the minds of their makers. Babbage's machines were never realised. Telegraphy and telephony operated mechanically, but only on the visceral output of cognition. However, Enigma, Colossus, and the Bombe materialised mechanical analogues of cognition itself. They demonstrated that the manipulation and production of information were not exclusively human. If information was expressed mathematically and systemically as a probabilistic function, and if the systemic mechanics of information processing were common to humans and machines, then not only could humans and machines exist symbiotically in automated information systems, but machines could also be functional analogues of biological brains. Furthermore, if mathematics was a symbolic thought language, and if doing mathematics was cognition, then as machines used mathematics to do mathematics, so machines could think. Moreover, whereas humans operated Enigma, Bletchley's machines were automatic. As Good later recalled, he and Turing discussed both thinking, and chess playing, machines at Bletchley.¹⁷⁷ Secrecy stilled tongues, but not minds. Good and Turing took Bletchley into their encounter with *Cybernetics*, and the Ratio Club.

Bletchley was not the only complex British socio-technical information processing system uniquely summonsed by war. There was also the outcome of the operationalisation of radar. In August 1938, RAF Fighter Command conducted a war game. Five new Chain Home radar stations were already active. Yet, confounding expectations, the exercise failed.¹⁷⁸ Britain was bombed and the Air Minister himself was a 'fatality' of the public debacle.¹⁷⁹ The technology itself worked. However, the RAF had not integrated radar into its social

¹⁷⁷ D. L. Banks, "A Conversation with I. J. Good", *Statistical Science*, Vol. 11, No. 1, Feb. 1996, pp. 10.

¹⁷⁸ "Britain's Greatest Air Manoeuvres ... Defence Tests in Mimic Air Warfare", *London Illustrated News*, 13 Aug. 1938, Vol. 193, No. 5182, p. 3, 5.

¹⁷⁹ "900 Battle Planes Over England", *Sunday Times*, 7 Aug. 1938, p. 13.

practices. Clearly, Britain's coastline was indefensible by a tiny air force attempting standing patrols, and images of Guernica were still raw. Radar was an existential imperative. The RAF responded to the 1938 disaster by unifying the disparate elements of air defence into a novel structure. Named after Air Chief Marshall Sir Hugh Dowding, head of RAF Fighter Command, the Dowding System merged the Chain Home radar stations, human observation posts, searchlights, barrage balloons, smokescreens, anti-aircraft guns, and fighter aircraft into an organismic entity. Information about incoming enemy aircraft was centrally processed at RAF Fighter Command HQ and filtered to subordinate regional Control Rooms, who then activated aircraft and guns and co-ordinated their local operations with radio. The system was networked through thousands of miles of new telephone lines which extended even to remote grass airfields. It was ready in time for the Battle of Britain.

The Dowding System was manifestly proto-cybernetic. When radar detected an environmental variation, human and machine processors acted on the electronic sense data to compute a systemic response. The processors then communicated their control signals to the actuating guns and pilots, which acted upon the environment, neutralising the disturbance and restoring homeostatic equilibrium. Radar was an information processing machine, electronically emulating and augmenting human sensorial capabilities. Pilots, radar operators and control room map plotters were mechanistic effectors, operating as levers, rods and gears. Electrons communicated computed information across telephone lines to these processors and effectors, as nerves carried processed signals from sense organs to brains, and control signals from brains to muscles and limbs. Overall, the Dowding System enacted a negative feedback loop which fused humans and machines into systemic symbiosis. Machines controlled humans, just as humans controlled machines; and information controlled them all. Like Bletchley, this vast, complex and novel socio-technical system

devised equally novel technologies and sociologies to process, represent and communicate its informational predicate. Both systems necessitated new technologies of mind as well as of matter. However, whereas Bletchley was linear and programmatic, the Dowding System was dynamically self-adaptive. Moreover, whilst Bletchley was deeply covert, the Battle of Britain was highly visible, and radar was publicly celebrated as early as 1945. The resonances with *Cybernetics* were easily struck.

Operational Research

Alongside the militarisation of science, war necessitated the scientisation of the military. Operational Research (OR) arose as a new form of scientific praxis directly from the development of the Dowding System. The epicentre of its emergence was Fighter Command HQ at RAF Bentley Priory. After the 1938 debacle, two small research teams were despatched from Bawdsey Research Station to integrate the new technology of radar into a new sociology of air defence. One, under E. C. Williams, integrated the Chain Home installations. The other, under G. A. Roberts, crafted the hierarchical control structures. As war broke, Bawdsey Station was hastily evacuated to Dundee. At the direct request of Dowding and his Senior Air Staff Officer, Commodore Keith Park, the detached teams remained at Bentley and became the Radar Research Section.¹⁸⁰ Notably, Roberts had a background in communications and electronics, and an ability to devise sociological applications of engineering control systems.¹⁸¹

¹⁸⁰ Air Ministry, *Air Publication 3368: The Origins and Development of Operational Research in the Royal Air Force*, (HMSO, London, 1963), pp. 8-9.

¹⁸¹ J. G. Crowther, R. Whiddington, *Science at War*, p. 92.

Although it acquired both nominative and organisational form during the war, OR was as definitionally elusive as cybernetics became, and its formative practices were correspondingly fluid.¹⁸² Nevertheless, its contemporaries quickly recognised OR's novel scientisation of war.¹⁸³ Ingenious war machines were, like propaganda and cryptology, ancient artifice. Weaponizing science was as old as science itself. However, with OR, the scientific method itself became a technique of war. OR's pioneering practitioners critically evaluated the empirical systems and behaviours through which weapons and humans were actually used. Against the mythic cultural grain of heroic leadership, OR promulgated evidentially based warfare; literally, science in action. Science spawning weapons was commonplace. Science supplanting the military's controlling minds was radical.

OR was predicated on observation. Researchers either gathered data directly from military operations, or harvested field data second hand. In extremis, experimentation sufficed. Canonically, OR deprecated intuition and promoted empiricism over prejudice. Methodologically, OR was behaviourist, empiricist and mathematical, with a predisposition to statistical analysis. For its practitioners, this positivism gave OR, and them, authority. They countered sentiment with logic and rationality, even amidst the madness of war. In his 1941 Admiralty committee report, *Scientists at the Operational Level*, Patrick Blackett, a leading OR pioneer, forcibly argued that the complexity of war now exceeded the capacity of the conventional military mind. Only science and mathematics could avert catastrophe. The rationality of probabilities was an especially pressing alternative to emotion.¹⁸⁴ Conflict

¹⁸² M. W. Kirby, *Operational Research in War and Peace: The British Experience from the 1930s to 1970*, (Imperial College, London, 2003), pp. 1-29.

¹⁸³ Crowther, Whiddington, *Science at War*, p. 91.

¹⁸⁴ P.M.S. Blackett, "Scientists at the Operational Level", 1941, in Air Ministry, *Air Publication 3368: The Origins and Development of Operational Research in the Royal Air Force*, (HMSO, London, 1963), Appendix 1.

with the military establishment was inevitable. When OR indicated that aircraft from Bomber Command should be transferred to Coastal Command to defend the convoys, Sir Arthur Harris, Bomber Command Commander in Chief, complained to Churchill, “are we fighting this war with weapons or slide rules?”; Churchill replied, “that’s a good idea; let’s try the slide rule for a change”.¹⁸⁵ Although such expertise was tolerated as an expedient of war, officialdom neither forgot nor forgave the transgressions of upstart scientists.

From its genesis in the RAF, OR proliferated rapidly across the British military, with Blackett as one of its prime movers. In 1940, Lt. Gen. Frederick Pile, Commander in Chief of Army Anti-Aircraft Command, recruited Blackett to devise improvements to the fire control systems of his anti-aircraft guns which were now within the Dowding System. Whilst Pile’s guns had some radar tracking capability, they still used analogue acoustic detectors. Blackett assembled an eclectic team which comprised: an Army officer; a surveyor; three physiologists; two mathematical physicists; two mathematicians; an astrophysicist and a classical physicist. Apocryphally, the group self-named and self-formalised through the unauthorised self-manufacture of a rubber stamp. ‘Blackett’s Circus’, as the Anti-Aircraft Command Research Group became known, toured anti-aircraft installations leaving improvements, fame and blustering Blimpish bureaucrats behind.

From 1941 to 1945, under the physicist, Lt. Col. B. F. J. Schonland, the Army instantiated sixteen Army OR Sections which dovetailed with the burgeoning complexities of increasingly mechanised and automated warfare.¹⁸⁶ After the Army, Blackett himself moved

¹⁸⁵ R. V. Jones, “Churchill and Science”, in R. Blake, W. R. Lewis (eds.), *Churchill: A Major New Assessment of His Life in Peace and War*, (Norton, New York, 1993), p. 437.

¹⁸⁶ Table 1: Army OR Sections, 1940-1945.

to the Navy, via RAF Coastal Command, becoming first the Admiralty's chief OR advisor, and then Director of Naval OR. He resumed his physics professorship at Manchester in 1945 and moved to Imperial in 1953. From 1949 to 1964 Blackett worked for the National Research Development Corporation (NRDC). During the war, Blackett had recruited Max Newman to Bletchley, and in September 1945 he brought Newman to Manchester as head of the mathematics department and Professor of Pure Mathematics. Whereupon, Newman established the Royal Society Computing Machine Laboratory with a grant of £35,000 secured with Blackett's enthusiastic support.¹⁸⁷ Newman brought Turing to Manchester.

OR also flourished across civil defence with J. D. Bernal and Solly Zuckerman as its leading proponents. They, and Blackett, joined the social relations of science movement, the Tots and Quots, and the AScW. In 1939, Bernal was appointed to the Ministry of Home Security's Research and Experiments Branch to investigate the effects of explosions on people and property.¹⁸⁸ Bernal recruited Zuckerman, a primate expert, and subsequently they both joined the staff of the Director of Combined Operations, Louis Mountbatten. From 1943 Zuckerman was the Allied Expeditionary Air Force's Scientific Advisor on Planning. Ultimately, Zuckerman, a one-time left-wing radical agitator for politically interventionist science, thrived in Whitehall. He became the Chief Scientific Advisor to the Ministry of Defence from 1960 to 1966, and the first Government Chief Scientific Advisor in 1964. Inasmuch as OR was constitutive of proto-cybernetics, then the constellation of Blackett, Bernal and Zuckerman offered at least the potential of senior scientific support for later emergences of cybernetics.

¹⁸⁷ J. Swinton, *Alan Turing's Manchester*, (Infang, Manchester, 2019), p. 41.

¹⁸⁸ Kirby, *Operational Research*, p. 126.

Overall, war-time scientific practices were characterised by a general disregard of academic convention and sociological normativity, and OR exemplified this heterodoxy in a particularly visible fashion; its Boffins were not cloistered in back rooms. Moreover, OR also performatively subverted the military lionization of heroic leadership; it was woven from the same transgressive threads as the Sunday Soviets. Differential experiences of OR, as object or subject, helped shape the post-war minds of scientists, technicians, mathematicians, civil and military servants, and their masters. For its adherents OR propelled the progressive authority of science beyond the academy, promising the sociological ascendancy of rationality over ideology. Equations, not slogans, summonsed the New Jerusalem. However, for others, the usurpation of establishment power by boffins was unnatural; an aberration imposed by a temporary existential imperative. Like women in military uniforms, it was to be endured with forbearance and rapidly reversed in peace. Moreover, amongst its naysayers, OR also foreshadowed post-war fears about future fusions of science and mathematics in technologies of social control. Nevertheless, for some, OR nurtured receptivity to Wiener's rationalisation of the human condition in *Cybernetics*.

In Service of the Machines

On Friday 8 July 1949, an informal group of twelve military officers, government researchers and academic scientists gathered in the headquarters of the Royal Navy Medical Department. Calling themselves the Human Research Group (HRG), they resolved to constitute substantively. They then inaugurated formally during a September 1949 meeting at the Medical Research Council (MRC) Climate and Working Efficiency Research Unit in the human anatomy department at Oxford University. The second HRG meeting, in January 1950, was hosted by Frederick Bartlett at the MRC Applied Psychology Research Unit (APRU) in Cambridge University's Psychological Laboratory, where Bartlett was

professorial head. The group announced itself in the *Lancet* on 1 April 1950.¹⁸⁹ By then, it had become the Ergonomics Research Society, with a nominative neologism commissioned from two classicists, Eric Warmington and Thomas Webster, who crafted an anglicised portmanteau of the Greek *έργο* (ergo), for work, and νόμος (nòmos) for the legal precepts regulating human social behaviour. This was the genesis of modern ergonomics.¹⁹⁰

The roots of ergonomics lay in the novel and complex ontologies of mechanised total war. In 1937, the Medical Director General of the RAF, Air Vice Marshall Victor Richardson had approached the MRC and suggested a new kind of medical research establishment. Richardson's early realisation that increasingly sophisticated aircraft required new ways of integrating machines and humans had led him to the view that a novel approach was required to develop the techniques that would better adapt meat to metal.¹⁹¹ By August 1939 the MRC had resolved to support similar research across the services. In January 1939, the RAF created the Flying Personnel Research Committee (FPRC).¹⁹² The Army followed with the formation of the Military Personnel Research Committee (MPRC) in 1941.¹⁹³ By 1942, the Admiralty had convened the Royal Naval Personnel Research Committee (RNPRC).¹⁹⁴ To begin with, the new committees focused on mitigating combat damage to frail human flesh; the greater fear during the Battle of Britain was paucity of pilots, not aircraft. Typically

¹⁸⁹ R. C. Browne, C. G. Roberts, O. G. Edholm, W. F. Floyd, H. D. Darcus, R. Conrad, W. E. Hick, G. M. Morant, H. Mound, K. F. H. Murrell, T. P. Randle, "Ergonomics Research Society", *Lancet*, 1 April 1950, Vol. 255, Iss. 6605, pp. 645-46; and *BMJ*, 29 April 1950, Vol. 1, No. 4660, p. 1009.

¹⁹⁰ O. G. Edholm, K. F. H. Murrell, "History of the Ergonomics Research Society", *Ergonomics*, No. 10, Sup. 1, 1967, pp. 72-109.

¹⁹¹ Privy Council Committee for Medical Research, *Medical Research in War: Report of the Medical Research Council for 1939-45: Cmd. 7335*, (HMSO, London, 1947), p. 20.

¹⁹² "Air Ministry and Ministry of Defence: Flying Personnel Research Committee: Reports and Papers", www.discovery.nationalarchives.gov.uk/details/r/C2112, [27 Jan. 2022].

¹⁹³ "Military Personnel Research Committee and Sub-committees, later Army Personnel Research Committee: Minutes and Papers", www.discovery.nationalarchives.gov.uk/details/r/C14552, [27 Jan. 2022].

¹⁹⁴ "Royal Naval Personnel Research Committee: Reports", www.discovery.nationalarchives.gov.uk/details/r/C2006, [27 Jan. 2022].

therefore, the MPRC's first concern was the development of body armour. However, although work on protecting humans in order to preserve combat effectiveness was sustained, nevertheless, the scope of these committees soon extended to encompass Richardson's original aim. They became venues for a second new war-time scientific praxis; that of personnel research (PR).

Richardson's concern that the complexity of the weapons systems required by mechanised total war would exceed the human faculty to operate them was prudent. Even by the late thirties, streamlined and metal skinned monoplane fighter aircraft could propel pilots beyond the limits of physiology. The Mk1a Supermarine Spitfire entered service in August 1938. It had a turning circle of 880 feet which was attainable at 300mph. However, doing so would have generated 7G of acceleration and humans normally lose consciousness at around 4G or 5G.¹⁹⁵ The first Spitfire's service ceiling was 34,400 feet. Yet, above 6,900 feet, blood-oxygen saturation declines precipitously, with commensurate perceptual and cognitive impairment. In mountaineering, ascents above 26,000 feet enter the Death Zone. A war which had started with cloth clad bi-planes ended with jet fighters.

Complexity bred complexity, and humans became the limiting factor in the mechanisation of war. Supplanting hand signals from open cockpits, modern fighters carried airborne short wave radios.¹⁹⁶ However, human centric communication was insufficient within the new informational and operational velocities of the Dowding System. Radar directed combat required an airborne electronic 'Identification Friend of Foe' transponder, which enabled one electronic system to automatically communicate with another, without human agency.

¹⁹⁵ L. Deighton, *Fighter: The True Story of the Battle of Britain*, (Penguin, London, 2021), p. 94.

¹⁹⁶ Deighton, *Fighter*, p. 72.

By 1945, the Allies had developed heavy bombers of such sophistication that maintaining their flight and aiming their payload required advancing mechanistic augmentation, and the corresponding replacement of their increasingly inadequate biological sensory and control sub-units. As with the macrocosmic Dowding System, these aircraft microcosmically embodied complex self-adaptive socio-technical systems which contained myriad interdependent sub-systems that fused meat and metal within interactive informational feedback loops to enact systemic control.

These novel and increasingly complex weaponised ontologies foregrounded new post-war questions about the nature and general limits of human agency within teleological systems. Especially in circumstances such as industrial production, where goal attainment necessitated dynamic systemic self-adaptation in highly volatile environments. These combat ontologies inculcated both a mechanistic view of systemic human agency, and a corresponding sense of functional equivalence between biological and non-biological mechanisms. During the war, this led the three PR committees towards broader considerations than shielding flesh from shrapnel, and they began to develop new research practices around enhancing systemic interactions between organic and manufactured mechanisms. Here, PR's goals became local optimisation of humans as systemically subordinate biological servomechanisms, and systemic optimisation of the meat-metal ontological composite. The externalised teleology of these ontologies rendered all their sub-systems systemically subject to both the pre-determined military goal and the ontology itself. PR practiced scientised sublimation of mechanised humans within machines.

The nominative unity between 'personnel' and 'operational' research signified the epistemological and sociological intersectionality between these novel spheres of military

scientific praxis. Both Zukerman and Bernal, for instance, served on the MPRC subcommittees on Body Armour and Helmets, and the Biological Assay of Weapons.¹⁹⁷ Similarly, the founders of the HRG included both PR and OR practitioners. Methodologically, both branches of weaponised research applied scientific methods to military systems. Both promoted rational mathematical analysis of complex socio-technical systems, and both aimed to optimise systemic interactions between humans and machines. The essential difference was of ontological scale. OR examined macro-systems, with humans and machines distinguished as categories, whereas PR resolved to micro-systems, and individuated entities within categories. Nevertheless, both prefigured the functional systemic equivalence between meat and metal asserted in *Cybernetics*.

Both OR and PR affirmed the praxical utility of interdisciplinary science, and like radar, they both also confounded initial pessimism about biologists undertaking mathematically based research on inorganic physical systems. Contemporaries noted that, unlike physicists, biologists could conceptualise the complex socio-technical ontologies of war in the same way they considered the social structures of their zoological subjects. Biologists, it was also observed, had already developed statistical techniques for the analysis of complex organismic systems, and they were schooled in the observational methods suiting the emergent behaviour of organisms, rather than in the atomist reductionism of recursive analysis practiced by physicists.¹⁹⁸ This presaged the cybernetic proposition of the analytical utility of probabilistic mechanical analogues of stochastic biological systems, and the idea that this utility derived from behavioural and informational isomorphisms that belied ostensible morphic differences.

¹⁹⁷ Privy Council, *Medical Research*, p. 135, 422.

¹⁹⁸ Crowther, Whiddington, *Science at War*, p. 114.

The epistemological core of PR synthesised experimentalist empiricist psychology and physiology. The central venue for this synthesis was Frederic Bartlett's Cambridge Psychological Laboratory. The investigation of the practical behavioural problems of human environmental adaptation had both ensured Bartlett's pre-war success in Whitehall's corridors and committees, and transformed the status and practice of Cambridge psychology. By 1934, Bartlett had already moved psychology from the moral sciences to the natural sciences tripos.¹⁹⁹ In 1939, the MRC established an ad-hoc PR group in Bartlett's laboratory, which it formalised as the APRU in 1944.²⁰⁰ Bartlett joined both the MPRC and the FPRC.²⁰¹ Bartlett's promotion of PR strengthened Cambridge's institutional commitment to experimentalism, and fostered a physiological and materialist approach to psychology that nurtured receptivity to cybernetics at Cambridge and elsewhere. Although favouring research, nevertheless Bartlett trained ten of the sixteen British psychology professors teaching in 1957.²⁰² Notwithstanding his antipathy to B. F. Skinner's ideas, Bartlett's own commitment to experimentalist observation facilitated post-war receptivity to the mathematised behaviourism of *Cybernetics*.²⁰³

Bartlett's applied psychology was constructive, not curative. Its purpose was the identification and analysis of mental characteristics and processes to improve the design and operation of human-machine systems. Hence, under the imperative of operating the

¹⁹⁹ B. Wagoner, *The Constructive Mind: Bartlett's Psychology in Reconstruction*, (CUP, Cambridge, 2017), p. 24.

²⁰⁰ Privy Council, *Medical Research*, p. 134, 421.

²⁰¹ D. E. Broadbent, "Frederic Charles Bartlett", *Biographical Memoirs of Fellows of the Royal Society of London*, Nov. 1970, Vol. 16, Iss. 16, p. 3.

²⁰² J. Forrester, L. Cameron, *Freud in Cambridge*, (CUP, Cambridge, 2017), p. 262.

²⁰³ Wagoner, *Constructive Mind*, p. 23.

amplifying complexity of novel weaponised ontologies, the objectives of PR became; matching tasks to humans, pairing humans to tasks, and optimising human performance through psychological and environmental governance.²⁰⁴ During the Second World War, a notable example of the instrumentation of this form of psychology came from the Army Directorate of Selection of Personnel. Formed in 1941, by 1942 the new unit had developed and deployed new forms of psychological personnel selection and allocation using PR techniques that were, in turn, derivations from Bartlett's physicalist approach.²⁰⁵ With PR, psychology became a functionalist engineering framework, capable of systemically melding humans and machines in complex multi-agent ontologies. As with any machine, human performance was governable. Minds were machines, within machines, within machines.

As the systemic capabilities of these novel military ontologies amplified, so the intra-systemic disparities between the capabilities of humans and machines widened. OR and PR both exposed humans as the limiting factor in complex socio-technical systems, and facilitated new emergences of amplifying complexity wherein organic limitations were further surpassed. As the MRC noted in 1947, whilst the systemic deficiencies imposed by organic inadequacy were remediated during the war by degrading machines to accommodate humans, this was only a short-term answer. After the war, the MRC predicted intensification of the problem.²⁰⁶ Humanity was locked into a positive feedback spiral of self-amplifying complexity. Herein lay seeds of post-war anxieties, and optimisms, about economic automation. For some who were to encounter *Cybernetics*, including John Bates and

²⁰⁴ Privy Council, *Medical Research*, p. 22.

²⁰⁵ R. H. Ahrenfeldt, "Military Psychiatry", in MacNalty, Mellor, *Medical Services in War*, pp. 175-216.

²⁰⁶ Privy Council, *Medical Research*, pp. 21-2, 149.

Edmund Hick, immersion in the epistemological and ontological products of OR and PR was also an experiential *a priori* which Wiener named and formalised.

Bates, a clinical neurologist, researched the mechanical augmentation of aiming moving tank guns at mobile targets in the MRC Physiological Research Laboratory at the Armoured Fighting Vehicle Training School in Lulworth.²⁰⁷ Created in 1941 by the MPRC Fighting Vehicle Subcommittee, the laboratory hosted a synthesis between OR and PR. Omond Solandt, the inaugural director, subsequently led the Army Operational Research Group (AORG) and served as Mountbatten's scientific advisor.²⁰⁸ Hick also researched improvements to tank gun aiming. In 1944, Hick, a clinical psychologist, left the Army and joined the Cambridge MRC APRU under its inaugural director, Bartlett's young and brilliant protégée, Kenneth Craik. Notably, Hick was amongst the founders of ergonomics.

Kenneth Craik and British Proto-Cybernetics

From the outset, Bates was unequivocal in his stipulation of the initial membership criteria for his cybernetics discussion group. Professors were excluded lest their status inhibit intellectual freedom, and eligibility was confined to those whom Bates knew personally to have been thinking cybernetically before *Cybernetics*.²⁰⁹ Bates specified his conditions in the original invitational letters, especially his proviso that members of his proposed group should already have had Wiener's ideas.²¹⁰ Partly, this reflected burgeoning post-war British

²⁰⁷ Privy Council, *Medical Research*, pp. 139-41.

²⁰⁸ J. S. Ridler, *Maestro of Science: Omond McKillop Solandt and Government Science in War and Hostile Peace, 1939-1956*, (University Press, Toronto, 2015), p. 64. "Omond McKillop Solandt", *Inspiring Physicians [Munk's Roll]*, www.history.rcplondon.ac.uk/inspiring-physicians/omond-mckillop-solandt, [2 Feb. 2022].

²⁰⁹ Ashby, *Journal*, 20 Sept. 1948, p. 2624, RADA/JOURNAL, www.rossashby.info/, [15 March 2022], <https://ashby.info/>.

²¹⁰ Letter, Bates to Walter, 27 July 1949. Letters, 3 Aug. 1949; Bates to Barlow, Uttley, Westcott, and Pringle, WC/GC/179/B.01/Box 12.

anti-Americanism. As he explained to Walter, Bates thought that Americans generally had an unduly inflated sense of their intellectual quality.²¹¹ Largely, however, this articulated Bates' particular sense that British scientists had intellectual priority over Wiener specifically. Bates' personal priority claim to a British proto-cybernetics was deeply rooted in his own direct war-time epistemological and sociological encounters.

Kenneth Craik, an Edinburgh philosopher turned Cambridge psychologist who personified the sociological and intellectual fluidity catalysed by the war, was central to Bates' assertion of British priority over Wiener. Craik joined Bartlett's laboratory in 1936, becoming the de-facto leader of the ad-hoc MRC PR group, and then the founding head of the APRU. By thirty, Craik was already widely renowned amongst OR and PR practitioners, and in his protégé's obituary, Bartlett pointedly remarked on Craik's prodigious war-time stature.²¹² Craik's military research centred on the information exchanges between humans and machines in dynamic and complex control systems. He adapted aircraft instrumentation to night vision, and he constructed the Cambridge Cockpit flight simulator to study pilot error.²¹³ Like many Ratio Club members, he took a gadgeteers' delight in constructing his own experimental equipment. War led Craik to conceptualise the human component of systems in functionally mechanistic terms, and to consider humans as biological servomechanisms.²¹⁴ For Craik, physicalist psychology engineered humans just as physics fabricated machines, and, as for Wiener, meat and metal were systemically equivalent.

²¹¹ Letter, Bates to Walter, 4 Oct. 1949, WC/GC/179/B.03/Box 12.

²¹² F. C. Bartlett, *Nature*, Vol. 155, No. 4946, 16 June 1945, p. 720.

²¹³ "MRC Cognition & Brain Sciences Unit", www.mrcbu.cam.ac.uk/history/influences/, [16 March 2022].

²¹⁴ K. J. W. Craik, "Theory of the Human Operator in Control Systems: I. The Operator as an Engineering System", *Brit. J. Psychology*, Vol. 38, Iss. 2, Dec. 1947, (received 4 March 1945), pp. 56-61. K. J. W. Craik, "Theory of the Human Operator in Control Systems: II. Man as an Element in a Control System", *Brit. J. Psychology*, Vol. 38, Iss. 3, March 1948, (received 1 April 1945), pp. 142-48. [both published posthumously].

Most of Craik's research was technically focused and classified, available only to those, like Hick and Bates, with security clearance and the need to know.²¹⁵ The seminal exception was *The Nature of Explanation* published in 1943.²¹⁶ Here, Craik constructed a materialist proposition about the nature of thought which he framed as an experimental hypothesis. Assuming both the externality of objective actuality, and the fallacy of any philosophy of mind, Craik suggested that reality directly caused thought, and that thought was a physiological process. Specifically, the viscera of sense data stimulated the patterning of contingent coherences within neurological corpora. Moreover, thought constituted physical models of the physical world because of an indivisible material isomorphism between the atomism of both neurons and world. The material patterns of thought replicated the relation structures of reality, enabling mental models to predict worldly events. Thus, as prediction defined thought, and as the predictive mind's materiality was mechanically replicable in tidal predictors and automatically predictive self-aiming guns, so machines could think. Observing that contemporary machines extended human sensorial and cognitive faculties, Craik argued that organic and inorganic calculating machines each contained equivalent, and communicable, corporeal analogues of reality. Thus, the cognitive utility of numbers derived not from Hardy's mathematical realism, but rather from the atomic commonality of neurological and mechanical calculators.²¹⁷ Craik's materialist atomism ironically echoed Leibniz's philosophical monadism.

²¹⁵ S. J. MacPherson, "Craik Bibliography", in S. L. Sherwood (ed.), *The Nature of Psychology: A Selection of Papers, Essays and Other Writings by Kenneth J. W. Craik*, (CUP, Cambridge, 1966), pp. 179-81.

²¹⁶ K. J. W. Craik, *The Nature of Explanation*, (CUP, Cambridge, 1943).

²¹⁷ "317 is a prime, not because we think so, or because our minds are shaped in one way rather than another, but *because it is so*, because mathematical reality is built that way.", G. H. Hardy, *A Mathematician's Apology*, (CUP, Cambridge, 1940), p. 70.

The commonalities between Craik's *Nature of Explanation*, and the physicalist isomorphism between computational and biological mentality subsequently expressed by Wiener in *Cybernetics* were striking. Likewise, Craik's apparently unknowing echo of Turing's pre-war idea about an embodied universal machine within which abstract models of other machines could exist. Moreover, whilst Craik and Gilbert Ryle differed on the utility of philosophy, there is nevertheless strong correspondence between Craik's materialism and Ryle's subsequent exorcism of Descartes's ghost from the human machine.²¹⁸ Towards the end of 1943 Craik started a companion to *Explanation*, however, the incomplete working draft of *The Mechanism of Human Action* was unknown until its posthumous publication in 1966.²¹⁹ Although unread by contemporaries, *Mechanism* nevertheless expressed ideas encountered by Bates, Hick and other Ratio Club members in their conversations with Craik. Some of the ideas in *Mechanism* were even closer to *Cybernetics* than those in *Explanation*; even Craik's word choices were similar to Wiener's.

In *Mechanism*, Craik discussed self-adaptive systemic behaviour, positing complexity not ontological particularism as its predicate. Preceding *Cybernetics*, Craik held that neither self-replication, nor purposeful behaviour were exclusively biological. His proposal that manufacturing synthetic analogues would facilitate the analysis of complex biological systems also predated Wiener's claim that electronic systems might mirror and explain neurological dysfunctions. Like Wiener, Craik deployed Walter Cannon's ideas about biological homeostasis within an ontologically agnostic generalisation about feedback mechanisms exercising systemically self-regulatory circular causation.²²⁰ However, unlike

²¹⁸ G. Ryle, *The Concept of Mind*, (Hutchinson's University Library, London, 1949).

²¹⁹ K. Craik, *The Mechanism of Human Action*, in Sherwood, *Nature of Psychology*, pp. 7-91.

²²⁰ W. B. Cannon, *The Wisdom of the Body*, (Norton, New York, 1932).

Wiener, Craik's distinction between negative and positive feedback was explicit. Craik also pre-empted Ross Ashby's ideas about dynamic systemic ultra-stability, and Wiener's insights about asynchronous feedback causing oscillatory disequilibrium. Before Turing, Craik explained learning as the abiding embodiment of systemic variations arising from environmental interaction. Before Shannon, Craik metaphorically characterised cognition as probabilistic resolution. Before Wiener, Craik suggested that gestalt and universals were the mechanics of perception, cognition and memory. With remarkable prescience, Craik also imagined the use of binary pulses as control signals in push-button systems. Ultimately, Craik repudiated vitalism with a mechanistically materialist conception of life, where dynamic sensitivity to disequilibrium, predictive discrimination of remedial action, and remedial actuation were its defining characteristics, regardless of its material form.

Craik's membership of the FPRC Vision Sub-Committee drew him into work on the Dowding System, where his research into radar visualisation took him to Grey Walter at the Burden Neurological Institute (BNI).²²¹ Walter had invented an automatic frequency analyser for consolidating EEG outputs which Craik needed to process human experimental data.²²² Walter was to subsequently reflect on the similarity between Craik and Wiener's ideas.²²³ Craik also found Horace Barlow, who had already read *Explanation*, whilst Barlow was working for the RNPRC at Mount Vernon Hospital in Northwood.²²⁴ In 1944, Ashby wrote to Craik to express admiration for *Explanation*, which he had already read twice.

²²¹ Privy Council, *Medical Research*, p. 133.

²²² W. G. Walter, *The Living Brain*, 2nd edn., (Pelican, London, 1961), pp. 112-13.

²²³ Letter, Walter to Adrian, 12 June 1947, SMG/NCC/BURD/A/09/31.

²²⁴ P. Husbands, "An Interview with Horace Barlow", in Husbands, Holland, Wheeler (eds.), *Mechanical Mind*, p. 412.

Further correspondence followed.²²⁵ Bates and Craik collaborated within the intersectionality of the FPRC and the MPRC, and in November 1944, Hick, now at Cambridge, introduced himself to Bates, citing Craik's recommendation as his bone fides.²²⁶ Hick and Bates began an increasingly informal correspondence. The "Dr. Craik" of Hick's first letter became "Craik", then "Ken".²²⁷ There was friendship as well as respect in their mutual relationship with Craik. Bates' sense of a British proto-cybernetics derived from his proximate sociology as much as from the wider epistemological context within which he operated during the war.²²⁸ Bates invited Ashby, Barlow, Hick and Walter to join his club.

Much as Bates admired Craik, he was not the only proximate basis for Bates' claim to British proto-cyberneticist priority. Writing to Hick in 1945, Bates reflected that Craik owed an intellectual debt to both Albert Uttley and Arnold Tustin.²²⁹ Moreover, Bates noted, Craik and Uttley had disagreed.²³⁰ Although Uttley joined the Ratio Club, Tustin was professorially

²²⁵ Letters: Ashby to Craik, 6 June 1944; Craik to Ashby, 1 July 1944; Ashby to Craik, 6 July 1944; Craik to Ashby, 10 July 1944, RADA/LETTERS, www.rossashby.info/index.html, [18 March 2022], <https://ashby.info/>.

²²⁶ Letter, Hick to Bates, 21 Nov. 1944, WC/GC/179/B.31/Box 12

²²⁷ Letters: Hick to Bates, 16 Feb. 1945; Hick to Bates, 28 May 1945, WC/GC/179/B.31/Box 12.

²²⁸ Bates articulated his belief that there were numerous British scientists who had been thinking along cyberneticist lines before *Cybernetics*, and set this attribute as a pre-condition for joining his proposed discussion group, in several of his invitation letters to prospective Ratio Club members. Writing to Walter, he said that he knew personally "about 15 people who had Wiener's ideas before Wiener's book appeared"; letter, Bates to Walter 27 July 1949, WC/GC/179/B.01/Box 12. Uttley was told that all of the "limited membership" of the new group would be "folk who I [Bates] know to have had Wiener's ideas and interests before Wiener's book"; letter, Bates to Uttley 3 Aug. 1949, WC/GC/179/B.01/Box 12. Much the same message was conveyed to Westcott, who learnt that the group's "strictly limited membership" would comprise those whom Bates knew "to have been thinking 'Cybernetics' before Wiener's book"; letter, Bates to Westcott 3 Aug. 1949, WC/GC/179/B.01/Box 12. Pringle was also granted entry to the "strictly limited membership" of "folk who I [Bates] know have had Wiener's ideas before his book"; letter, Bates to Pringle 3 Aug. 1949, WC/GC/179/B.01/Box 12. As was Sholl; who as well as having been "thinking along Wiener's lines before his book appeared", was also qualified for Bates' elect because he was, like the other membership candidates, "not just 'interested'" in cybernetics, but also likely to "use the concepts in [his] everyday" professional practice; letter, Bates to Sholl 17 Aug. 1949, WC/GC/179/B.01/Box 12. Similarly, Hick could join the fold because he too was known by Bates to have been "possessed of Wiener's notions before" *Cybernetics* was published; letter, Bates to Hick 17 Aug. 1949, WC/GC/179/B.01/Box 12.

²²⁹ Letter, Bates to Hick, 30 May 1945, WC/GC/179/B.31/Box 12.

²³⁰ Letter, Bates to Hick, 8 June 1945, WC/GC/179/B.31/Box 12.

excluded. Clearly, there was more to proto-cybernetics than Craik. Nevertheless, the Ratio Club missed Craik sorely. In a manuscript note of prompts for his introductory talk to the new dining club, Bates lamented both Craik's absence and the incompleteness of the group.²³¹ For his part, John Westcott wrote "Craik Club" with a cross alongside in his personal notes of the inaugural meeting.²³² Craik had died, aged thirty-one, on 7 May 1945, the eve of VE Day. A carelessly opened car door knocked him from his bicycle into the path of an oncoming lorry. Both Hick and his wife attended Craik's Cambridge memorial service, alongside Douglas Hartree and Paul Dirac.²³³ Youth notwithstanding, the word genius hovered around Craik, and his obituaries were fulsome in both praise and mourning of his intellectual powers.²³⁴ Tragedy denied history a meeting of the minds of Craik and Turing.

The day before performing the star turn at the Ratio Club's inaugural meeting on 14 September 1949, Warren McCulloch had spoken at a London symposium on the newly fashionable somatic psychiatry.²³⁵ In the discussion that followed his paper, McCulloch revealed that he already knew about Craik's work. He praised both Craik, and the young American psychologist John Stroud, and rehearsed a later private plea to Edgar Adrian to collect and publish Craik's work.²³⁶ Stroud was a hitherto unnoticed transatlantic vector for Craik's ideas. During the war he had served in the RAF, where his PR work had certainly

²³¹ Handwritten note, WC/GC/179/B.02/Box 12.

²³² J. Westcott, Notebook, personal correspondence.

²³³ "Deaths: Memorial Service Dr. K. J. W. Craik", *Times*, 18 May 1945, p. 7.

²³⁴ F. C. Bartlett, *Nature*, Vol. 155, No. 3946, 16 June 1945, p. 720. F. C. Bartlett, *Brit. J. Psychology*, Vol. 36, Iss. 3, 1946, pp. 109-16. T. Welford, *The Eagle*, Vol. 50, Nos. 231-232, CUP, Cambridge, 1947, pp. 388-89. O. L. Zangwill, "Kenneth Craik: The Man and His Work: The Kenneth Craik Lecture delivered in Cambridge 10 March under the auspices of St John's College", *Brit. J. Psychology*, Vol. 71, Iss. 1, Feb. 1980, pp. 1-16.

²³⁵ W. S. McCulloch, "Physiological Processes Underlying Psychoneuroses", *Proc. Royal Soc. of Medicine, Section of Psychiatry: Supplement, Anglo-American Symposium on Psychosurgery, Neurophysiology, and Physical Treatments in Psychiatry*, Vol. 42, Iss. 1, Sept. 1949, pp. 71-93.

²³⁶ Letter, McCulloch to Adrian, 23 Oct. 1951, UIA/WM, Box 1, www.digital.library.illinois.edu/items/8a40d1b0-29aa-0136-4d81-0050569601ca-9, [21 March 2022].

brought him into contact with Craik's research. Moreover, in a 1972 reminiscence, Stroud thought that he might even have met Craik in person.²³⁷

Encouraged by McCulloch, Stroud spoke at the sixth Macy conference in March 1949, explicitly surfacing Craik's ideas to the assembled American cyberneticians, including Wiener who contributed to the ensuing discussion.²³⁸ Craik had also been fleetingly mentioned at the Hixon Symposium in September 1948, during the discussion of von Neumann's "Automata" paper.²³⁹ However, although McCulloch attended the Hixon Symposium Wiener did not, and *Cybernetics*, published in October 1948, made no mention of Craik. Whilst Wiener visited people who knew about Craik's ideas during his 1947 trip to Britain, there was no indication that he knew about them directly before writing *Cybernetics*. Likewise, there was no sign that Craik knew of Wiener's pre-cyberneticist thinking. All but nominatively, despite his confessed mathematical deficiency, Craik independently developed a recognisably cybernetic episteme.

The exigencies of mechanised total war summonsed advancingly complex systematisations of synthetic multi-agent ontologies, and both Wiener and Craik worked on further systematising the sensorial, informational and control couplings between humans and machines within them. Their intellectual commonality underscored the generative

²³⁷ "Interview Transcripts: John Stroud, 1968-1975", telephone interview with S. J. Heims, MIT/MC-0361/Box:1, copy via e-mail. Stroud's contemporaneous knowledge of Craik was signposted in Heims, *Cybernetics Group*, p. 257.

²³⁸ J. Stroud, "The Psychological Moment in Perception", in H. von Foerster (ed.), *Cybernetics: Circular Causal, and Feedback Mechanisms in Biological and Social Systems: Transactions of the Sixth Conference March 24-25, 1949, New York, N.Y.*, (Josiah Macy Jr. Foundation, New York, 1950), in C. Pias (ed.), *Cybernetics: The Macy Conferences 1946-1953, The Complete Transactions*, (Diaphanes, Zurich, 2016), pp. 41-65.

²³⁹ J. von Neumann, "The General and Logical Theory of Automata", in L. A. Jeffress (ed.), *Cerebral Mechanisms in Behavior: The Hixon Symposium*, (Wiley, New York, 1951), pp. 40.

contextual unity between American pre-cybernetics and British proto-cybernetics; both were epistemological expressions of the amplification of complexity embodied in novel militarised ontologies. These new weapons were themselves synthetic emanations of underlying societal complexities which were both revealed and amplified by a war which also weaponised sociological and economic systemic interdependencies. Hence, the administrative co-location of the Ministry of Economic Warfare and the Special Operations Executive, and the parallel co-location of the Ministry of Information and the Political Warfare Executive. Just as war had exposed the systemic limitations of organic senses and brains within its novel micro-ontologies, so peace would progressively reveal the macro-ontological insufficiency of biological control and cognition within its new socio-economics and socio-technics. In Britain and America, the precursors to cybernetics responded to the inexorable intensification of the complexifying interconnectivity and interdependency of organismic society which was both revealed, and accelerated, by war. However, just as America's peace was different to Britain's, so to was their post-war cybernetics experience.

Robot War

By 1944, the RAF was chasing recognisably modern cruise missiles with recognisably modern jet fighters. The Gloster Meteor entered service on 27 July 1944, just in time to hunt the V1 rockets, which first struck Britain in the hours around midnight between 12 and 13 June.²⁴⁰ By 18 June, the terms 'robot bombs' and 'robot planes' were standard journalistic coinage for the pilotless aircraft.²⁴¹ Minted in Karel Čapek's 1920 play *Rossumovi Univerzální Roboti*, 'robot' entered British use with the first English translation and London

²⁴⁰ R. V. Jones, *Most Secret War*, (Penguin, London, 2009), pp. 417.

²⁴¹ "Steps Taken to Check Robot Planes", *Sunday Times*, 18 June 1944, p. 1.

staging of *Rossum's Universal Robots (RUR)* in 1923.²⁴² Čapek's robots were unthinking emotionless drones; slaves grown in vats from protoplasm. So, for British contemporaries the robotic deprecation of the V1 was doubly apt. The weapon itself was a soulless automata, a merciless death machine as devoid of humanity as of humans. But, these mindless robot bombs also exemplified fascism. Nazism roboticized humans, suborning them to unthinking servitude at the behest of the Führer. Hitler's death robots both embodied fascism's dehumanising evil and affirmed the Allies' humanitarian righteousness. In the British common-sense, the Third Reich would fall because its robots, of meat and metal, were no match for human flesh and blood freely given.²⁴³ However, General Pile, the head of Britain's anti-aircraft artillery, saw another truth. He recognised that the V1, and the British defences against it, had changed things forever. Pile witnessed robot war, on both sides.²⁴⁴

Propagandistic tales of plucky British pilots hunting Nazi death robots buoyed morale. However, necessity dictated that machines fought machines. Human pilots were markedly poor at downing the small and fast V1 and the bulwark of British defences against the robot flying bomb was itself a roboticized anti-aircraft system. Firstly, an SCR-584 (Set, Complete, Radio, #584) radar element automatically tracked the V1.²⁴⁵ Then, signals from the SCR-584 passed to a Bell Laboratories M9 Electrical Gun Director, an analogue electronic computer which extrapolated a predictive flight path from the radar data, and

²⁴² K. Čapek, *Rossumovi Univerzální Roboti*, 1st edn., (Aventinum, Prague, 1920). K. Čapek, P. Selver (trans.), *R.U.R. (Rossum's Universal Robots): A Play in Three Acts and an Epilogue by Karel Čapek; Translated from the Czech by P. Selver and Adapted for the English Stage by Nigel Playfair*, (OUP, Oxford, 1923). "“RUR” (Rossum's Universal Robots)", *Telegraph*, 25 April 1923, p. 6.

²⁴³ "Not Robots, but Men", *Sunday Times*, 18 June 1944, p. 4.

²⁴⁴ "Robots Start New Type of War", *Mail*, 12 Oct. 1944, p. 4.

²⁴⁵ D. A. Mindell, *Between Human and Machine: Feedback, Control, and Computing Before Cybernetics*, (Johns Hopkins University Press, Baltimore, 2004), pp. 245-59.

calculated aiming instructions for the guns and activation criteria for the shell fuses.²⁴⁶ The M9's electronic instructions activated both the Sperry servomotors actuating the guns and the electronic circuits setting the fuses. These Mk.53VT proximity fuses were robots within robots. They contained miniaturised Doppler radar systems which were inert until the shell was fired, and which initiated the payload only when the reflected frequencies reached the threshold determined by the M9.²⁴⁷ The 'VT' or 'Variable Time' designation obfuscated their robotic secret. Already, in 1944, only robots could defeat robots. Pile knew that without the SCR-584/M9/Mk.53VT Britain would have been defenceless against the V1.²⁴⁸

Of the ninety-seven V1s launched on 28 August 1944, four hit London, three ran out of fuel, two hit balloons, and human pilots downed fifteen. However, sixty-five robots were destroyed by radar directed, computer controlled, automated, robot guns.²⁴⁹ Although active defences countered eighty V1s that day, humans accounted for only 18% of that tally whereas robots destroyed 81%. Yet, between 18 June and 17 July 1944, the SCR-584/M9/Mk.53VT system had destroyed only 343 V1s, a mere 10% of those launched and 22% of those downed. But then, between 17 July and 31 August, the SCR-584/M9/Mk.53VT system claimed 1,286 V1 kills, or around 34% of the overall attack volume and 55% of those actively destroyed.²⁵⁰ The riddle of the figures was solved by the discovery of the removal of superfluous human agency from the operation of the SCR-

²⁴⁶ "Electrical Gun Director Demonstrated", *Bell Laboratories Record*, Dec. 1943, Vol. XXII, No. IV, www.worldradiohistory.com/Archive-Bell-Laboratories-Record/40s/Bell-Laboratories-Record-1943-Dec.pdf, [11 April 2022].

²⁴⁷ W. S. Hinman Jr., C. Brunetti, "Radio Proximity Fuze Design: U. S. Department of Commerce National Bureau of Standards Research Paper RP1723", *J. of Research of the National Bureau of Standards*, Vol. 37, July 1946, www.nvlpubs.nist.gov/nistpubs/jres/37/jresv37n1p1_A1b.pdf, [11 April 2022].

²⁴⁸ F. Pile, *Ack-Ack: Britain's Defence Against Air Attack During the Second World War*, 2nd ed., (Panther, London, 1959), pp. 275-76.

²⁴⁹ Jones, *Secret War*, pp. 427-28. Jones does not account for the disparity.

²⁵⁰ Mindell, *Human and Machine*, pp. 256-57.

584/M9/Mk.53VT system. Initially, its British crews resisted their robotic substitution and insisted on asserting the superiority of manual control over automation. However, this degraded exactly those attributes the system needed to target the speeding pilotless missiles.²⁵¹ When America responded to Churchill's urgent personal request for large consignments of the SCR-584/M9/Mk.53VT system in June 1944, a substantial cohort of trainers accompanied the equipment.²⁵² These American scientists instructed British soldiers to leave their robots alone.²⁵³ Thereinafter, system performance witnessed a dramatic improvement.

Performatively, the SCR-584/M9/Mk.53VT system was first deployed in London's environs, behind and subordinate to the RAF's fighters.²⁵⁴ The system was denied target acquisition if a human pilot was engaged, and although they were generally ineffective, these pilots typically refused to cede the V1s to the robot guns.²⁵⁵ However, by June 1944, imperative rationality overcame both an instinctive insistence on the primacy of human agency, and the emotive symbolism of proximate guns visibly shielding London. Within days, the entire compliment of 800 SCR-584/M9/Mk.53VT systems was relocated from the North Downs to the South Coast and re-formed as the unencumbered first line of anti-aircraft defence, with immediately beneficial effect.²⁵⁶ Only when British soldiers accommodated their systemic subordination, and RAF pilots accepted their comparative inadequacy, did the robot guns succeed. Ironically, an existential conflict against fascism temporarily overcame

²⁵¹ *ibid.*, pp. 254-55.

²⁵² *ibid.*, p. 254. S. Bennett, *A History of Control Engineering: 1930-1955*, (Peter Peregrinus/Institution of Electrical Engineers, Stevenage, 1993), p. 384.

²⁵³ Mindell, *Human and Machine*, p. 255.

²⁵⁴ Jones, *Secret War*, p. 427.

²⁵⁵ Mindell, *Human and Machine*, pp. 255-57.

²⁵⁶ Jones, *Secret War*, pp. 427-28.

humanist prejudices of human exceptionalism, and by 1945 the visible embodiment of autonomous machines supplanting humans had taken flight. Robots were literally in the air.

Like the Dowding System, the SCR-584/M9/Mk.53VT composite can be characterised proto-cybernetically and organismically. The SCR-584 radar was an electronic sense organ passing information to the M9 computer which, as an electronic brain, generated control signal outputs. The gun's servomotors were mechanical muscles regulated by electro-mechanical kinaesthetic proprioception. The guns were actuating limbs, throwing Mk.53VT fuses at airborne sources of environmental disturbance. The Mk.53VT fuse was a self-contained cybernetic sub-system of sensor, processor and actuator. The communicating cables were the electronic equivalent of a nervous system. Sensing the shell's effect, the system would either suspend, or correct and repeat, its composite negative feedback cycle.

My cumbersome naming of the SCR-584/M9/Mk.53VT composite was necessitated by the paucity of either historiographical or historical accounts of the system. David Mindell recognised it as the M-9/SCR-584 assembly and gave an outline description of its mechanical operation.²⁵⁷ Albeit superficially, Thomas Rid touched more directly on the sense whereby the British deployment of the system against the V1 presaged the advent of American cybernetics, and on the way in which contemporaries, like Pile, recognised the harbinger of automated warfare.²⁵⁸ However, neither accounts fully recognised the significance of the system for British proto-cybernetics. From my perspective, Mindell neglected the proto-cyberneticist nature of the overall system, whereas Rid's American focus

²⁵⁷ Mindell, *Human and Machine*, pp. 231-32.

²⁵⁸ Rid, *Rise of the Machines*, pp. 36-42.

obscured its British deployments. Neither identified the British implementation of the system as a skirmish between humans and proto-cyberneticist automation.

The Proto-Cybernetics of Servomechanisms

Within the SCR-584/M9/Mk.53VT composite, electronic control signals were converted into corporeal effects through servomechanisms. These systemically sublimated devices actuated and automated the direction of both the tracking radar, and the self-aiming guns. Notwithstanding their ostensible mundanity and black-box opacity, servomechanisms were pervasive across the complex human-machine ontologies spawning proto-cybernetics. During the war, alongside anti-aircraft guns, servomechanisms enabled automation and semi-automation of aircraft control, gun aiming from moving tanks, control of motorised gun turrets, searchlight tracking and marine navigation mechanisms.

Behaviourally, servomechanisms are continuous state systems. Physically, they are self-contained electro-mechanical devices which generally comprise an electrical power regulator (or amplifier), electric motors, electrical or electronic controls and analog sensors. Functionally, a separately generated control signal establishes a homeostatic set-point around which the servomechanism regulates the state of the other systems that it both senses, and actuates, through feedback. Thus, a servomechanism is a relative error-correction device which operates to reduce the differential between the current system state and its set-point. Operationally, servomechanisms smooth out the iterative error corrections that enable dynamic systemic self-adaptive regulation.²⁵⁹ They are the electro-mechanical and electronic equivalents of the kinaesthetic and proprioceptive self-regulation of human limbs.

²⁵⁹ E. L. Owen, "Origins of the Servo-Motor", *IEEE Industry Applications Magazine*, March/April 1996, pp. 74-6.

Servomechanisms are essential within control systems where comparative human deficiency is most acute.

The modern theory of servomechanisms originated in the thirties with Harold Hazen whilst he was Vannevar Bush's student at MIT.²⁶⁰ Hazen, an electrical engineer, developed the servomechanisms for Bush's Differential Analyser, the schematics for which were sent to Douglas Hartree at Manchester in 1930.²⁶¹ Hazen, who was also an MIT fixture, knew Wiener when Wiener was working on the mathematics of non-linear systems, which became a foundation of *Cybernetics*. During the war, Hazen directed Division 7 of the National Defense Research Committee (NDRC), whilst Warren Weaver led Section 5 of his division.²⁶² Weaver's section was responsible for developing automated fire control, and it was he who commissioned Wiener to research statistically predictive automated anti-aircraft gun aiming. This was a seminal episode in Wiener's authorship of *Cybernetics*. Just as servomechanisms embodied an epistemological and ontological precursor to cybernetics, so Wiener's mathematical spirit was in the 584/M9/Mk.53VT system.

Despite their importance, to most contemporaries the mere existence, let alone the theory, of servomechanisms was unknown and unknowable. Secrecy and novelty contributed equally to obscurity. Alongside the dissonance servomechanisms struck with the normative epistemologies of conventionally deterministic mechanistic ontologies, and even to those servicing the systems they regulated, servomechanisms were impenetrable black boxes. Yet,

²⁶⁰ H. L. Hazen, "Theory of Servomechanisms", *J. of the Franklin Institute*, Vol. 218, Iss. 3, Sept. 1934, pp. 209-331. H. L. Hazen, "Design and Test of a High Performance Servomechanism", *J. of the Franklin Institute*, Vol. 218, Iss. 5, Nov. 1934, pp. 543-80.

²⁶¹ S. Bennett, *Harold Hazen and the Theory and Design of Servomechanisms*, Research Report, ACSE Report 270, 1984, Automatic Control and System Engineering Dept., Sheffield University, www.eprints.whiterose.ac.uk/76934/, [13 April 2022].

²⁶² Bennett, *Control Engineering*, p. 121.

one British war-time scientific constituency dissipated this occlusion. The grouping known to its members as the Servo Panel was created in March 1942 by Arthur Solomon, a Harvard biophysicist, and Arthur Porter, a British analog computing pioneer.²⁶³ Porter first encountered servomechanisms whilst researching early radar gun direction in Blackett's AORG. In 1941, he moved to the Air Defence Research Development Establishment (ADRDE) at Malvern where he and Solomon essayed a fully automated anti-aircraft system. Adverse mathematics killed the project, but not Porter's fascination with servomechanisms.²⁶⁴

Not long after this unsuccessful but fruitful project, Porter discovered that his friend and colleague, F. C. Williams, was attempting to automate the tracking radar in the RAF's Airborne Interception System. Porter soon realised that servomechanisms were essential systemic compensators for the inability of humans to control the advancingly complex ontologies required to wage this new kind of warfare.²⁶⁵ Like Pile, Porter and Solomon grasped the realities of robot war. They convened the Servo Panel, which Williams promptly joined. The Servo Panel fruited from the same tree as Rowe's Sunday Soviets, which Porter probably also attended. However, unlike Rowe, Porter held a junior grade, and his unofficial convocation breached operational security by joining military scientists with researchers and engineers from industry. Nevertheless, Vickers Armstrong, British Thomson-Houston (BTH), Elliott Brothers and Ferranti joined, as did numerous delegates from American military, academic and research organisations. Douglas Hartree chaired the Servo Panel from October 1942, whilst Porter remained secretary throughout its life.²⁶⁶

²⁶³ A. Porter, *So Many Hills to Climb: My Journey from Cumbria to North Carolina*, (Beckham, Silver Spring, 2004), p. 123. "Arthur Kaskel Solomon: Memorial", www.fas.hms.harvard.edu/files/hmsofa/files/memorialminute_solomon_arthur_k.pdf, [21 April 2022].

²⁶⁴ Porter, *Hills*, pp. 116-17, 120-21.

²⁶⁵ *ibid.*, p. 123.

²⁶⁶ Bennett, *Control Engineering*, p.120. Porter, *Hills*, p. 124.

Notwithstanding its transgression, the Servo Panel grew rapidly in scale and influence. Within fourteen months its membership expanded from twelve to fifty, and it eventually peaked at seventy-five.²⁶⁷ Meetings settled into the Institution of Electrical Engineers' (IEE) Savoy Place offices in London. Tacit official acceptance of Porter's de-facto formation started with loose MoS oversight. By April 1943, the MoS had regularised matters, and in 1944 it formalised the Servo Panel as its Interdepartmental Technical Committee on Servomechanisms and Related Devices, which immediately assimilated the newly formed Manual Tracking Panel that had just emanated from the Lulworth laboratory. Solandt had established the Tracking Panel to address the problem of aiming a gun in a moving tank at another moving tank; its membership included Craik, Uttley, Bates, Hick and Tustin.²⁶⁸

In February 1945, Porter delegated for Hartree on a transatlantic mission investigating the industrial applications of servomechanisms. British officials feared that American advances in this arcane, yet vital, sphere would damage British economic competitiveness. Mustering at Waterloo Station, Porter met John Womersley, the Superintendent of the NPL's new Mathematics Division, who was on a separate but related mission investigating computers.²⁶⁹ On his return, Womersley recruited Turing to the NPL.²⁷⁰ In Porter's view, his servomechanism mission report spurred the NPL to create both its Control Mechanisms and Electronics (CME) Division in 1954, and its Autonomics Division in 1960, both led by

²⁶⁷ A. Porter, "The Servo Panel: A Unique Contribution to Control-Systems Engineering", *Electronics and Power*, Vol. 11, Iss. 10, Oct. 1965, p. 331.

²⁶⁸ Porter, "Servo Panel", pp. 332-33.

²⁶⁹ Porter, *Hills*, pp. 130-31.

²⁷⁰ Hodges, *Turing*, p. 307.

Uttley. For Porter, between 1941 and 1945, Britain fleetingly led the world in automation and control systems engineering.²⁷¹

Porter's Servo Panel was a formative intellectual and sociological site for both the Ratio Club, and for British post-war cybernetics more generally. It cohered Bates, Uttley, Hick, (and Craik), in an emerging mechanistic episteme that conceived of humans and machines as systemically interchangeable, and which constructed humans as biological servomechanisms. Amongst its members, this foregrounded the sense that machines could, and should, replace human control of complex systems to compensate for agentially inferior biology. The Servo Panel also connected future members of the Ratio Club with Porter and Tustin, who both participated in the wider British cybernetics experience. For Porter, the Servo Panel made seminal contributions to the understanding of human-machine interaction. He believed that Craik, Uttley and Tustin had broken new ground, and that Bates and Hick had helped to shape Craik's ideas.²⁷² Porter's Panel certainly constituted an important intersection between Craik and the others. Craik spoke about "Some Characteristics of the Human Operator in Control Systems" to the Servo Panel meeting on 4 February 1944. Whilst on 21 May 1943, Uttley had discussed "Servomechanisms Used in R.A.F. Synthetic Trainers and the human Link in the Cyclic Control System".²⁷³ Notably, Craik's two published papers about humans as mechanistic constituents of synthetic control systems were written after the merger of the Servo and Tracking panels.

²⁷¹ Porter, "Servo Panel", pp. 330-33. G. Sutherland, "Some Recent Developments at the National Physical Laboratory", *Proc. Royal Soc. of London, Series A, Mathematical and Physical Sciences*, Vol. 265, No. 1321, 23 Jan. 1962, pp. 141-60. MoS Interdepartmental Technical Committee on Servo-Mechanism, *Pub. No. 2; Memo. on: "The Application of Control Systems in Industry"*, Oct. 1945, restricted official circulation, referenced by Porter, "Servo Panel", p. 333.

²⁷² Porter, "Servo Panel", p. 333.

²⁷³ Table 2: Servo Panel Talks, 1942-1945.

The Servo Panel was also an important site for mediating American pre-cybernetics into British proto-cybernetics. Unusually, at a time when official suspicion was commonplace, not least between Allies, the Servo Panel fostered transatlantic scientific collaboration and hosted a standing American delegation. Consequently, its meetings discussed servomechanism work at MIT, and elsewhere. Hazen certainly knew about the Servo Panel, and the Servo Panel probably knew about Hazen's memorandum on "The Human Being as a Fundamental Link in Automatic Control Systems", which Hazen sent to Weaver in May 1941.²⁷⁴ Hazen's paper both presaged the conceptualisation of humans as biological servomechanisms, and prompted Weaver to fund Wiener's work on predictive anti-aircraft systems.

Then, there was the British mathematician Percy Daniell, another name in the long list of neglected characters involved in the British cybernetics experience.²⁷⁵ Like Wiener, earlier in his career Daniell had worked on the theory of stochastic systems, and the two had been youthful friends.²⁷⁶ During the war, Daniell was co-opted into government service from his professorship at Sheffield. Officially, he was employed by the MoS. However, it is possible that he joined MI6's scientific intelligence mission specifically to harvest American mathematical research. He certainly gave unstinting support to the Servo Panel, and mentored both Porter and Tustin in the advanced mathematics required for servomechanism theory.²⁷⁷ Porter believed that Daniell was the first British mathematician to understand

²⁷⁴ Bennett, *Control Engineering*, p. 146. H. L. Hazen, "The Human Being as a Fundamental Link in Automatic Control Systems", *Design Issues*, MIT Press, Winter 1983, Vol. 29, No. 1, pp. 30-7.

²⁷⁵ J. Aldrich, "'But You Have to Remember P. J. Daniell of Sheffield'", *Journal Electronique d'Histoire des Probabilités et de la Statistique/Electronic Journal for History of Probability and Statistics*, Vol. 3, No.2, Dec. 2007, p. 31. www.jehps.net/Decembre2007/Aldrich.pdf, [16 April 2022].

²⁷⁶ Aldrich, "'Remember P. J. Daniell'", pp. 40-1.

²⁷⁷ Porter, "Servo Panel", pp. 330-33.

Wiener's work on self-adaptive prediction, and the first to introduce Wiener's ideas about servomechanisms, and his name, into British war-time science. Porter cited two of Daniell's papers in support of his claim. Both were classified, and their distribution was limited to fifty copies of each. However, they were published in a post-war MoS report, and they supported Porter's case.²⁷⁸ Bates also bolstered Porter's case by including Daniell alongside Craik in the roll of lamentable absences at the Ratio Club's inaugural meeting.²⁷⁹

The mathematics mediated by Daniell's reports came from several American sources. One such source was certainly Wiener's report on automating predictive anti-aircraft fire which Weaver had commissioned in December 1940.²⁸⁰ Wiener delivered the report, his singular contribution to military research, on 1 February 1942. Weaver instantly classified it and ordered a registered distribution that was limited to 300 numbered, yellow bound, copies. Nevertheless, it reached Britain, officially or otherwise. As well as Daniell, copies were held by the physicists Ralph Fowler and Geoffrey Taylor, and the mathematicians Godfrey Hardy, John Littlewood, Louis Milne-Thompson, Richard Southwell, and John Whittaker.²⁸¹ Because of its fiendish difficulty, Wiener's report was nicknamed the 'Yellow Peril', in a racist allusion considered humorous at the time. Nevertheless, it was both an intellectual pivot in the history of control engineering and communications theory, and a foundation text

²⁷⁸ P. J. Daniell, "Report No. 1, Interpretation and Use of Harmonic Response Diagrams (Nyquist Diagrams) With Particular Reference to Servomechanisms, (Based on MoS Servo Report, June 1943), Prepared Under Extramural Contract", pp. 1-13. P. J. Daniell, "Report No. 2, Operational Methods for Servo Systems, (Based on MoS Servo Report, July 1944), Prepared Under Extramural Contract", pp. 13-34, both in *Selected Government Research Reports, Volume 5: Servo-Mechanisms: Issued by the Ministry of Supply, Published for the Technical Information and Document Unit of the Department of Scientific and Industrial Research*, (HMSO, London, 1951).

²⁷⁹ Manuscript note, WC/GC/179/B.02/Box 12.

²⁸⁰ N. Wiener, "The Extrapolation, Interpretation and Smoothing of Stationary Time Series with Engineering Applications. DIC Contract 6037, A Research Pursued on Behalf of the National Defense Research Council (Section D2), (NDRC, Washington, 1942)".

²⁸¹ Bennett, *Control Engineering*, p. 184, n. 49.

for *Cybernetics*.²⁸² In Wiener's stochastic conception, systemic control was no longer theorised as prescribed enactments of deterministic mechanisms, nor as thermodynamic energy conversions. Rather, control was the governance of the emergent systemic behavioural expressions of probabilistic outcomes.

Daniell's Servo Panel reports were also informed by the work of Harry Nyquist, Shannon's colleague at the Bell Telephone Laboratory, and an early contributor to communications theory.²⁸³ His ideas about regulating electronic feedback were also in the intellectual foundations for *Cybernetics*. As Wiener's name and ideas flowed eastwards through Porter's transatlantic conduit, so Servo Panel and Manual Tracking Panel members also encountered some of the deeper intellectual underpinnings for cybernetics before *Cybernetics*. As Husbands and Holland observed, with both chronological literalism, and in the sense of intellectual priority invoked by Bates, there were indeed people in Britain, including several Ratio Club members, who had had Wiener's ideas before *Cybernetics*.²⁸⁴

The contact was reciprocated. In February 1948, the Servo Panel obtained Wiener's address from the US Navy's London attaché and Porter wrote to Wiener requesting proceedings of a recent event that had explored the nexus of biology and mathematics in the intersectionality of neurophysiology and mechanical control systems.²⁸⁵ This was either the September 1946 New York Academy of Sciences conference on "Teleological Mechanisms in Society",

²⁸² Conway, Siegelman, *Dark Hero*, pp. 116-17.

²⁸³ H. Nyquist, "Certain Factors Affecting Telegraph Speed", *Bell System Technical Journal*, Vol. 3, No. 2, April 1924, pp. 324-26. H. Nyquist, "Certain Topics in Telegraph Transmission Theory", *Transactions of the American Institute of Electrical Engineers*, Vol. 47, No. 2, Feb. 1928, pp. 617-44. H. Nyquist, "Regeneration Theory", *Bell System Technical Journal*, Vol. 11, No. 1, Jan. 1932, pp. 126-47.

²⁸⁴ Husbands, Holland, "Ratio Club", in Husbands, Holland, Wheeler (eds.), *Mechanical Mind*, p. 112.

²⁸⁵ Letter, Secretary Inter-Departmental Technical Committee to Wiener, 24 Feb. 1948, MIT/NWP/Box 5, Fldr. 80, <https://hdl.handle.net/1721.3/193686>, [20 Nov. 2023].

inspired by the first Macy cybernetics conference that March, or the second Macy conference in October.²⁸⁶ Wiener's reply directed Porter to a forthcoming paper.²⁸⁷ Just as British proto-cyberneticians recognised their American counterparts, so Wiener used *Cybernetics* to acknowledge both that statistical theories of communication and prediction were already known to engineers on both sides of the Atlantic, and that Daniell particularly had directly contributed to the historical development of his new ideas.²⁸⁸ Not only did the hitherto neglected Daniell mediate Wiener's ideas directly into British proto-cybernetics, but he also assisted the development of cybernetics itself.

Minds Across the Atlantic

As peace resuscitated transatlantic scientific sociologies from the hiatus of war, Wiener quickly realised that British proto-cybernetics extended beyond the Servo Panel. Ross Ashby, a young clinician who had spent most of the war practicing neuro-pathology in a mental hospital, was one of the first to make contact. Unusually amongst Ratio Club members, Ashby's prior publication record was extensive. By 1949, he had around thirty papers in print, of which twelve were discernibly proto-cybernetic.²⁸⁹ By 1940, Ashby was already writing about physiological feedback mechanisms within dynamically self-adaptive systems, and rehearsing his rejection of philosophical accounts of mind.²⁹⁰ By 1944, he had read *Explanation* and resolved to write to Craik.²⁹¹ In 1945, Ashby privately recorded further

²⁸⁶ L. K. Frank, G. E. Hutchinson, W. K. Livingston, W. S. McCulloch, N. Wiener, "Teleological Mechanisms", *Annals of the New York Academy of Science*, Vol. 50, Art. 4, Oct. 1948, pp. 187-278.

²⁸⁷ Letter, Wiener to Secretary Inter-Departmental Technical Committee, 18 April 1948, MIT/NWP/Box 5, Fldr. 82, <https://hdl.handle.net/1721.3/193688>, [20 Nov. 2023].

²⁸⁸ Wiener, *Cybernetics*, p.24.

²⁸⁹ "Bibliography", <http://ashby.de/rossashby.info/>, [13 Sept. 2023].

²⁹⁰ W. R. Ashby, "Adaptiveness and Equilibrium", *J. of Mental Science*, Vol. 86, Iss. 362, May 1940, pp. 478-83.

²⁹¹ Ashby, *Journal*, 31 May 1944, pp. 1666-68, RADA/JOURNAL, www.rossashby.info/, [5 April 2022], <https://ashby.info/>.

signals of his growing proto-cyberneticist inclinations. His journal for January has pages pasted from a book offering an early proposal for a maze learning machine with striking resemblances to Walter's later electro-mechanical 'tortoise' robots.²⁹² In April 1945, Ashby journaled notes from Schrödinger's *What is Life?*, and in May from H. G. Wells' *World Brain*.²⁹³ In September, he clipped a *Nature* article suggesting that electromechanical analogues illuminated the opacity of complex biological systems.²⁹⁴ In December 1947, Ashby confided a tentative preliminary definition of an intelligent machine to his journal.²⁹⁵

In October 1946 Ashby wrote to both Wiener, and to the anthropologist and Macy stalwart Gregory Bateson, introducing himself to each as a kindred mind.²⁹⁶ Wiener and Bateson then corresponded favourably with each other about Ashby.²⁹⁷ Replying directly to Ashby, Bateson praised his work, and suggested that he contact Warren McCulloch.²⁹⁸ However, Ashby had already done so, and been answered.²⁹⁹ By December 1947, Ashby had read both the paper by Pitts and McCulloch on the neurological mechanisms of pattern recognition,

²⁹² Cuttings from T. A. Ross, *An Introduction to Analytical Psychotherapy*, (Edwin Arnold, London, 1932), in Ashby, *Journal*, 22 Jan. 1945, pp. 1853-56, RADA/JOURNAL, <http://www.rossashby.info/>, [5 April 2022], <https://ashby.info/>.

²⁹³ References to, E. Schrödinger, *What is Life? The Physicist's Approach to the Subject-With an Epilogue on Determinism and Free Will*, (CUP, Cambridge, 1944), and H. G. Wells, *World Brain*, (Methuen, London, 1938), in Ashby, *Journal*, 2 April 1945, p. 1910, RADA/JOURNAL, www.rossashby.info/, [5 April 2022], <https://ashby.info/>.

²⁹⁴ Cutting from *Nature*, Vol. 156, No. 3953, 4 August 1945, p. 151, "Electromechanical Analogies", in Ashby, *Journal*, 17 Sept. 1945, pp. 2016-17, RADA/JOURNAL, www.rossashby.info/, [5 April 2022], <https://ashby.info/>.

²⁹⁵ Ashby, *Journal*, 16 Dec. 1947, p. 2305, RADA/JOURNAL, www.rossashby.info/, [5 April 2022], <https://ashby.info/>.

²⁹⁶ Letter, Ashby to Wiener, 28 Oct. 1946, MIT/NWP/Box 5, Fldr. 72, <https://hdl.handle.net/1721.3/193678>, [20 Nov. 2023].

²⁹⁷ Letter, Bateson to Wiener, 5 Dec. 1946, MIT/NWP/Box 5, Fldr. 72, <https://hdl.handle.net/1721.3/193678>, [20 Nov. 2023].

²⁹⁸ Letter, Bateson to Ashby, 4 Dec. 1946, RADA/LETTERS, <http://www.rossashby.info/index.html>, [23 March 2022], <https://ashby.info/>.

²⁹⁹ Letter, McCulloch to Ashby, 25 Nov. 1946, RADA/LETTERS, www.rossashby.info/index.html, [23 March 2022], <https://ashby.info/>.

and the paper by Rosenblueth, Wiener and Bigelow on purposeful and teleological behaviour, both of which were seminal to *Cybernetics*.³⁰⁰ Ashby's letters to the Americans enclosed reprints of a *Nature* article of his that argued for a revocation of the centralised war-time command economy and a restoration of the dynamic feedbacks of socio-economic self-adaptability.³⁰¹ Before the Ratio Club formed, Ashby had already made his mark directly with Wiener and McCulloch, and although Wiener did not mention his disciple in *Cybernetics*, he praised him fulsomely in *The Human Use of Human Beings*.³⁰²

Ashby was not the only British proto-cybernetician and future Ratio Club member gaining Wiener's attention during the approach to *Cybernetics*. In December 1946, Wiener and Grey Walter met at the Eastern Association of Electroencephalographers' conference in the Massachusetts General Hospital, organised by Walter's friend, the neurologist Mary Brazier.³⁰³ Within weeks, Wiener had learnt of two young British brain scientists with ideas matching his. Robert Schwab, president of the organisation hosting the conference, had pressed Wiener's presence specifically because Walter would be demonstrating his new EEG automatic frequency analyser at the event.³⁰⁴ Wiener's conference talk also dealt with the statistical analysis of brain activity, and as Walter later recalled, although both men were

³⁰⁰ Ashby, *Journal*, 17 Dec. 1947, p. 2308, 2309, RADA/JOURNAL, <http://www.rossashby.info/>, [6 April 2022], <https://ashby.info/>. W. Pitts, W. S. McCulloch, "How we Know Universals: The Perception of Auditory and Visual Forms", *Bull. Mathematical Biophysics*, Vol. 9, No. 3, Sept. 1947, pp. 127-47. A. Rosenblueth, N. Wiener, J. Bigelow, "Behavior, Purpose and Teleology", *Philosophy of Science*, Vol. 10, Iss. 1, Jan. 1943, pp. 18-24.

³⁰¹ W. R. Ashby, "Effect of Controls on Stability", *Nature*, Vol. 155, No. 3930, 24 Feb. 1945, pp. 242-43.

³⁰² N. Wiener, *The Human Use of Human Beings: Cybernetics and Society*, 2nd edn. 1954, (Da Capo Press, Boston, 1988), pp. 34, 37-8, 48, 173.

³⁰³ J. S. Barlow, "The Early History of EEG Data-Processing at the Massachusetts Institute of Technology and the Massachusetts General Hospital", *Int. J. of Psychophysiology*, Vol. 26, Iss. 1-3, June 1997, pp. 443-54.

³⁰⁴ Letter, Schwab to Wiener, Nov. 1946, MIT/NWP/Box 5, Fldr. 72, <https://hdl.handle.net/1721.3/193678>, [20 Nov. 2023].

initially peeved to discover potential competition, nevertheless their friendship blossomed.³⁰⁵ This early meeting with Wiener, which Walter mentioned in his often cited, yet rarely interrogated, letter to Edgar Adrian written after Wiener's 1947 jaunt to the BNI en route to Paris, resolves the manifest oddity of an eminent American mathematician visiting a fledgling British scientist in an obscure Bristol mental hospital.³⁰⁶

The historic Boston encounter occurred in the epistemological intersection between mathematics and neurophysiology which nucleated many of the core elements of *Cybernetics*. Just as Wiener's theories mathematicised neurological mechanics, so Walter's electronic device concretised and instrumentalised this mathematisation. Wiener's ideas suggested that because mental processes were essentially statistical in nature, then their enactment could form the basis of an abstract mathematical model for a corporeal electronic brain analogue. Walter's electromechanically augmented EEG analysis seemed to offer a way to harvest precisely the empirical data Wiener's theory called for. If electronic devices could mathematically represent the equally mathematical mechanics of brain activity, then electronics could replicate, and reveal, mental mechanisms. For Wiener, the combination of the EEG and Walter's frequency analyser bolstered both his mathematical conception of an embodied mechanistic mind, and his assertion of functional equivalence between organic and inorganic electronic binary computers. For Walter, Wiener's mathematics theorised the medicalisation and scientisation of psychiatry and neurology which was already physicalised by the EEG's instrumentality and affirmed by the frequency analyser's empiricism.

³⁰⁵ W. G. Walter, "Neurocybernetics (Communication and Control in the Living Brain)", in J. Rose (ed.), *Survey of Cybernetics: A Tribute to Dr. Norbert Wiener*, (Iliffe Books, London, 1969), pp. 93-109.

³⁰⁶ Letter, Walter to Adrian, 12 June 1947, SMG/NCC/BURD/A/09/31.

Although Wiener's encounters with Ashby and Walter abutted *Cybernetics*, his connections with Britain were deeper and older. Wiener had become a professed Anglophile in 1913, during his postgraduate fellowship under Bertrand Russell at Cambridge.³⁰⁷ In December 1946 Wiener wrote to his old friend, the biologist and communist J. B. S. Haldane, and outlined the intellectual prospectus for *Cybernetics* by explaining that his military research on the statistics of mechanised artillery anticipation had suggested functional and behavioural commonalities between electronic computers, neurology, electrical communications systems and servomechanisms.³⁰⁸ Haldane was not the only elite British scientist aware of Wiener's pre-cybernetic thinking. Whilst in Cambridge, Wiener had also befriended F. C. Bartlett, and as was his custom, he had nurtured the relationship.³⁰⁹ So, whilst visiting a group in Philadelphia developing fire control systems for the US Navy's Franklin Institute in April 1947, Bartlett introduced his American hosts to ideas about mathematically modelling humans as biological servomechanisms and directed them towards Wiener as a leader in the new field.³¹⁰ Whilst his friends were predisposed to register Wiener's ideas, other British minds were also taking note of his pre-cyberneticist interests, especially those that had experienced the generative ontologies and epistemologies of proto-cybernetics.

Douglas Hartree had worked on analogue computers with Vannevar Bush in the thirties. After supervising Porter's pre-war doctorate on Bush's differential analyser at Manchester,

³⁰⁷ N. Wiener, *A Life in Cybernetics*, (*Ex Prodigy: My Childhood and Youth* [1953]), (*I Am a Mathematician: The Later Life of a Prodigy* [1956]), (MIT Press, Cambridge, 2017), p. 144.

³⁰⁸ Letter, Wiener to Haldane, 3 Dec. 1946, MIT/NWP/Box 5, Fldr. 72, <https://hdl.handle.net/1721.3/193678>, [20 Nov. 2023].

³⁰⁹ Wiener, *Life in Cybernetics*, p. 146.

³¹⁰ Letter, Van Valkenburgh to Wiener, via Chief of the Bureau, Bureau of Ordnance Navy Department, 24 April 1947, MIT/NWP/Box 5, Fldr. 78, <https://hdl.handle.net/1721.3/193684>, [20 Nov. 2023].

he became a steadfast war-time supporter of his student's Servo Panel and worked closely with P. J. Daniell.³¹¹ In the summer of 1945 Hartree undertook what may have been a private trip to survey American advances in computing, which introduced him to the unfinished ENIAC at Pennsylvania University.³¹² Subsequently, he joined the select few invited to the Moore School computing lectures which were convened in the summer of 1945 in response to the interest generated by ENIAC's public inauguration on 15 February.³¹³ Hartree gave his inaugural professorial lecture at Cambridge on ENIAC, and on his instructions a copy of the transcript was sent to Wiener.³¹⁴ There is no indication that the two mathematicians ever met. Nevertheless, Hartree knew of Wiener's interest in electronic digital computers, and as of April 1947, Wiener knew that Hartree reciprocated.

In December 1946, Wiener's fellow mathematician, Szolem Mandelbrojt, invited him to a Nancy University conference on harmonic analysis which was to be held in June 1947 under the aegis of the French National Centre for Scientific Research and funded by the Rockefeller foundation.³¹⁵ Curious about his potential transatlantic proto-cyberneticist allies, Wiener planned to visit Britain en-route to France. Wiener sailed from America on 21 May 1947, and he started his homeward voyage on 11 July.³¹⁶ He attended the Nancy

³¹¹ C. G. Darwin, "Douglas Rayner Hartree", *Biographical Memoirs of Fellows of the Royal Society*, Vol. 4, Iss. 4, Nov. 1958, p. 108.

³¹² D. R. Hartree, "U.S. Developments in Calculating Machines: An Informal and Unofficial Survey by D. R. Hartree from Notes Made in The Course of a Visit to U.S.A. May-July", 1945, NAHC/HAR/C1.

³¹³ M. Campbell-Kelly, M. R. Williams (eds.), *The Moore School Lectures: Theory and Techniques for Design of Electronic Digital Computers: Charles Babbage Institute Reprint Series for the History of Computing, Volume 9*, (MIT Press, Cambridge; Thomas, Los Angeles; 1985).

³¹⁴ D. R. Hartree, *Calculating Machines: Recent and Prospective Developments and their Impact on Mathematical Physics*, (CUP, Cambridge, 1947). Letter Dolgenow to Wiener, 14 April 1947, MIT/NWP/Box 5, Fldr. 77, <https://hdl.handle.net/1721.3/193683>, [20 Nov. 2023].

³¹⁵ Letter, Mandelbrojt to Wiener, 3 Dec. 1946, MIT/NWP/Box 5, Fldr. 72, <https://hdl.handle.net/1721.3/193678>, [20 Nov. 2023].

³¹⁶ Letter, French National Centre of Scientific Research to Wiener, 7 April 1947. Letter, University Travel Co. to Wiener, 15 April 1947, MIT/NWP/Box 5, Fldr. 77, <https://hdl.handle.net/1721.3/193683>, [20 Nov. 2023].

conference from 15 to 22 June, and he probably joined a meeting at UNESCO in Paris two days later.³¹⁷ Wiener visited Britain on both legs of his journey. From his base at Haldane's London address, he visited (at least) Manchester and Cambridge universities as well as several of London's university colleges and the NPL on the outward leg, and Oxford and Bristol on his way home.³¹⁸ Although Wiener and Ashby had corresponded about meeting, there is no evidence that they did so in 1947.³¹⁹ Whilst in Paris, buoyed by his British affirmations, Wiener agreed to write a book about his new ideas, sealing his promise to Enrique Freymann with perhaps the most consequential cup of cocoa in history.³²⁰ On 16 December 1947, Wiener posted his manuscript to Paris from Mexico.³²¹ As Wiener himself recognised, his 1947 British interludes were seminal; *Cybernetics* was neither exclusively his, nor entirely American.

Wiener recorded these British visits in *Cybernetics*, mostly in its extensive introduction where he mentioned many of those whose intellectual support he claimed. There was no textual sense that his authorial motives here were either academic professional courtesy or assertion of priority. Rather, Wiener gave the impression that he was recruiting British scientific prestige to pre-emptively defend his transgressive radicalism against a feared backlash from the American academic establishment. Hence also his neologistic nominative invocation of Classical kudos for his iconoclastic science. Fittingly, post-war Britain was already becoming Greece to America's Rome. However, whilst Wiener burnished

³¹⁷ Wiener, *Life in Cybernetics*, p. 453. Letter, UNESCO to Wiener, 3 April 1947. Letter, Wiener to Friedmann, 22 April 1947, MIT/NWP/Box 5, Fldr. 77, <https://hdl.handle.net/1721.3/193683>, [20 Nov. 2023].

³¹⁸ Wiener, *Life in Cybernetics*, p. 456.

³¹⁹ Letter, Wiener to Ashby, 5 May 1947, MIT/NWP/Box 5, Fldr. 78, <https://hdl.handle.net/1721.3/193684>, [20 Nov. 2023].

³²⁰ Wiener, *Life in Cybernetics*, p. 454.

³²¹ Letter, Freyman to Wiener, 21 Jan. 1948, MIT/NWP/Box 5, Fldr. 80, <https://hdl.handle.net/1721.3/193686>, [20 Nov. 2023].

Cybernetics with reflected British scientific glory, he also promoted both his own unique ability to mature previously jejune ideas, and America's organisational ascendancy. In his view, although British scientists were clever, he was cleverer. And, although venerable, British research institutions were impoverished and ineptly managed. In Wiener's opinion, only in America could his brilliance have nurtured the synthesis that became Cybernetics.³²²

Wiener wanted it understood that he rubbed shoulders with giants. First, he credentialised himself as having been Bertrand Russell's student.³²³ Then, he claimed Haldane, a renowned evolutionary biologist, as an ally in his defenestration of Newtonian determinism. In the same vein, Wiener also asserted both that he was one of the original architects of quantum mechanics, and that his new ideas extended the analytical utility of probabilistic indeterminacy from the sub-atomic realm to the manifest world of the systems humans constructed and inhabited. Nebulously, Wiener also claimed both Haldane and Bernal's agreement that cybernetics addressed the most profound, yet unspecified, scientific and philosophical challenges of the age.³²⁴ Regarding the statistical theory of information, whilst Wiener conceded Shannon's mutual credit, he also argued that they jointly shared their invention with the venerable R. A. Fisher. Having been forced to yield to combined paternity, Wiener downgraded their common formulation from an act of original discovery to a mere uncovering of almost self-revelatory ideas.³²⁵ Perhaps mindful of the Servo Panel, Wiener paid general credit to comparable contemporaneous British engineering advances,

³²² Wiener, *Cybernetics*, p. 32-3.

³²³ *ibid.*, p. 20.

³²⁴ *ibid.*, pp. 32-3, 47, 111.

³²⁵ *ibid.*, p. 18.

and he specifically cited Bartlett and his laboratory as important contributors to human servomechanism theory.³²⁶ However, he made no mention of Craik.

Cybernetics also demonstrated Wiener's firm grasp of, and admiration for, the condition of British computing. However, whilst he approved of F. C. Williams' use of cathode ray tubes as computer memory stores at Manchester, he nevertheless insisted that RCA had beaten him in establishing their viability as components of electronic information processing systems.³²⁷ Wiener also took the opportunity to openly support Walter's speculations about the commonality between the alpha rhythm scanning patterns of brain activity detected by the EEG, and the electron beam scanning mechanism in cathode ray tube computer memory devices.³²⁸ Conspicuously, although he had visited Cambridge in 1947, Wiener included neither Maurice Wilkes nor EDSAC amidst *Cybernetics*' extensive name-checks. Whilst EDSAC was incomplete at the time of Wiener's visit, it was still considerably ahead of the NPL's ACE; yet, Wiener's omission of Wilkes contrasted starkly with *Cybernetics*' enthusiasm for Turing. Wiener believed that he and Turing shared the vital cybernetic precept of mind as a logical, mathematical, material machine. He promoted Turing's "Computable Numbers" as the inspiration for the seminal 1943 work on the mathematics of neurological networks by Pitts and McCulloch, and he granted Turing overall pre-eminence in British computing; intriguingly alluding to Turing's secret war-work.³²⁹ Wiener considered his time with Turing to have been the highpoint of his trip.³³⁰ Hailing Turing as

³²⁶ *ibid.*, p. 24, 32.

³²⁷ *ibid.*, pp. 144-45.

³²⁸ *ibid.*, p. 166.

³²⁹ *ibid.*, p. 21.

³³⁰ *ibid.*, p. 32.

the leading British proto-cybernetician, Wiener directed his Parisian publisher, Enrique Freymann, to send Turing an advanced proof of *Cybernetics* in April 1948.³³¹

The ripples of Wiener's 1947 British excursions radiated beyond the people and places he visited. Before setting off for home on 11 July, Wiener was written to by Dr M. Lloyd, a physiologist at the Middlesex Hospital Medical School.³³² Lloyd expressed his regret at missing Wiener and professed his shared interest in applying quantum mathematics to the mechanics of neurological behaviour. He told Wiener that he was forming a small gathering of like minds and mentioned that Wiener knew "Mr Sholl", Lloyd's fellow anatomist, and the source of his knowledge about Wiener. This was future Ratio Club member, Donald Sholl, whose 1948 review of *Cybernetics* confirmed his 1947 encounter with Wiener.³³³ Lloyd also mentioned that a Dr Woodger shared his Wienerian interests. This Woodger was the father of Turing's young assistant at the NPL. Both Wiener's physical, and intellectual, presence spread far more widely during his 1947 British visits than hitherto realised.

Cybernetics was shaped by an intellectual cross-fertilisation and contextual commonality between American and British science. It was a transatlantic creation that was both intended, and epistemologically equipped, to inhabit transatlantic minds. Bates' claim about British proto-cybernetics was validated by Wiener himself, notwithstanding his silence about Craik. Moreover, unnoticed by Bates, and historians, British proto-cybernetics acted on American pre-cybernetics. Especially through Porter's Servo Panel, which also hosted reciprocal

³³¹ Letter, Wiener to Freymann, 2 April 1948, MIT/NWP/Box 5, Fldr. 82, <https://hdl.handle.net/1721.3/193688>, [20 Nov. 2023].

³³² Letter, Lloyd to Wiener, 7 July 1947, MIT/NWP/Box 5, Fldr. 78, <https://hdl.handle.net/1721.3/193684>, [20 Nov. 2023].

³³³ D. Sholl, *British Journal of Statistical Psychology*, Vol. 2, Iss. 2, July 1949, pp. 122.

mediations of Wiener's ideas, and American pre-cybernetics more generally, into British proto-cybernetics. Similarly historiographically obscured, British proto-cyberneticians helped Wiener surface *Cybernetics*. Particularly Turing, who was instrumental in Wiener's authorship; notwithstanding the subsequent scholarly neglect of his cyberneticist imbrications. Ostensibly, the conditions were ripe for the assimilation of cybernetics into the same British epistemologies which had helped to create it.

Absorption in British war-science imbued future Ratio Club members with sufficiently stimulated intellectual and social appetites for Bates' proposal to catch. His nucleic membership was intellectually catalysed by the proto-cybernetics of servomechanisms, biologically cross-fertilised radar systems, and computerised codebreaking. And, it was correspondingly sociologically pre-disposed by the Sunday Soviets and Porter's Servo Panel. Moreover, the leviathan of epistemological weaponization extended these foundational experiences of proto-cybernetics more broadly across British science, creating pre-conditions, favourable and otherwise, for later encounters with *Cybernetics*. Beyond the laboratory, legions of military personal became living machines; co-inhabiting and co-controlling novel and complex weapons systems as biological servomechanisms alongside their synthetic proto-cybernetic counterparts. Every pilot knew that their lives and missions depended on machines more capable than them. Civilians faced death by robot bombs. Radar directed, computer controlled and servomechanically automated guns mimicked life, and outperformed humans. Bletchley's initiate saw electronics emulate brains. After this, even echoes of *Cybernetics* resonated. Harmoniously for some. Discordantly for others.

Cybernetics Arrives in Britain

Cybernetics was re-published in Britain around April 1949 by Chapman and Hall, although seemingly without much of a publisher's fanfare. Alongside its formal British release, Wiener sent copies directly to several leading British scientists and mathematicians, including his post-doctoral tutor Bertrand Russell, his close friend J. B. S. Haldane, and the physicist Max Born.³³⁴ Wiener's prestige, combined with his extensive network, ensured that upon its release, *Cybernetics* landed directly in the centre of elite British academic scientific and mathematical practice. After its British re-publication, Wiener also received several plaudits from other British readers. These included enthused letters from David Kendall, an Oxford mathematician, who reported wider interest from both other mathematicians, and biologists; and, from F. F. M. Roberts at the Fairey Aviation Company, who declared that not only was *Cybernetics* animating his colleagues, but also that it had inspired him to seek an academic post at UCL to research it further.³³⁵ However, this was an epistolary trickle compared to the deluge of American affirmation that Wiener received for *Cybernetics*.

Similarly, the British critical and journalistic reception of *Cybernetics* was quiescent compared to the ebullience of the American textual welcome which had spanned both continent and society. Nevertheless, whilst sparse, British reviews were warm. The psychologist William Hick welcomed both Wiener's attempt at a unified theory of automata,

³³⁴ Handwritten index card, MIT/NWP/Box 5, Fldr. 84, <https://hdl.handle.net/1721.3/193690>, [6 Jan. 2024]. Letter, Haldane to Wiener, 1 Jan. 1949, MIT/NWP/Box 6, Fldr. 89, <https://hdl.handle.net/1721.3/200266>, [6 Jan. 2024]. Letter, Born to Wiener, 10 July 1949, MIT/NWP/Box 7, Fldr. 101, <https://hdl.handle.net/1721.3/200278>, [6 Jan. 2024].

³³⁵ Letter, Kendall to Wiener, 28 April 1949, MIT/NWP/Box 6, Fldr. 96, <https://hdl.handle.net/1721.3/200273>, [6 Jan. 2024]. Letter, Roberts to Wiener, 14 Nov. 1949, MIT/NWP/Box 7, Fldr. 106, <https://hdl.handle.net/1721.3/200283>, [6 Jan. 2024].

and his mechanistic psychological model.³³⁶ Turing focused on the capacity of Wienerian information theory to unify telecommunications, sociology, physiology, biochemistry, genetics, servomechanisms, brains and electronic computers.³³⁷ Likewise, the economist Harry Johnson foresaw that information held the key to explaining the feedback and communications systems which themselves explained the dynamics of economic oscillations.³³⁸ Characteristically, Ross Ashby hitched his review to a promotion of his own preoccupation with adaptive neurological equilibrium.³³⁹ The psychologist Oliver Zangwill endorsed Wiener's analogy between brains and computers, and foresaw cybernetics mapping vital psychological research.³⁴⁰ Hick, Turing and Ashby joined the Ratio Club.

Nevertheless, as the example of F. F. M. Roberts showed, there was no British equivalent of the American cybernetics craze. In January 1950, whilst on holiday, he sent Wiener a second letter; this time on plain paper not company stationary.³⁴¹ His move to UCL had stalled, and whilst he still believed that Wiener would eventually be ranked alongside Darwin, Freud and Marx, that day now lay in the distant future. For now, he and Wiener must keep the faith, stabilise the foundations for the cyberneticist enlightenment to come, and stave off incursions from cranks and charlatans. Alas for Roberts, and cybernetics, the guardians of British intellectual respectability shared neither his faith, nor his discernment of the cyberneticist sheep from the goats. Unlike in America where both prophet and prophesy were honoured, the modest British readership of *Cybernetics* garnered more sceptics than disciples.

³³⁶ W. E. Hick, *Quarterly Journal of Experimental Psychology*, Vol. 1, Iss. 4, Oct. 1949, pp. 193-4.

³³⁷ A. M. Turing, *Mathematical Gazette*, Vol. 33, No. 305, Oct. 1949, pp. 221-22.

³³⁸ H. G. Johnson, *Economic Journal*, Vol. 59, No. 236, Dec. 1949, pp. 573-75.

³³⁹ W. R. Ashby, "Critical Review: The Facts and Methods of Cybernetics", *Journal of Mental Science*, Vol. 95, Iss. 400, July 1949, pp. 716-24.

³⁴⁰ O. L. Zangwill, *British Journal of Medical Psychology*, Vol. 23, Iss. 3-4, Dec. 1950, pp. 229-30.

³⁴¹ Letter, Roberts to Wiener, 17 Jan. 1950, MIT/NWP/Box 7, Fldr. 110, <https://hdl.handle.net/1721.3/200287>, [6 Jan. 2024].

Chapter Two: Who and What Were the British Cyberneticians?

The Ratio Club: Biographical Flesh

There were only ever twenty-one members of the Ratio Club, seventeen of whom attended the first meeting on 14 September 1949. Turing, Woodward and Rushton joined in 1950, whilst Good formally enrolled in 1951.³⁴² Thereinafter, membership closed.

William Ross Ashby (1903-1972)

The Ashby's occupied respectably modest circumstances. Ross' birth home was an upstairs rented flat at 28a Chalsey Road in Brockley, Lewisham. His father, a commercial traveller, was paternally ambitious, and strove sufficiently to finance Ross' advance. Parental aspiration propelled Ross through successive minor public schools, culminating in four years as a day pupil at Edinburgh Academy. Ross, along with his mother and sister moved north, leaving his father in Croydon. Next, came medicine at Sidney Sussex, Cambridge, and by 1928, a physician's licence. In 1931, Ross married Elsie Maud Thorne, an assistant on Liberty's Regent Street millinery counter. His father gifted a house as their wedding present.³⁴³

³⁴² For some of my subjects there is a wealth of material; for others, a dearth. Occasionally sources disagree on basic life facts, and frequently they gloss omissions, embarrassments and ambiguities. Induction and deduction have been judiciously exercised in assembling these micro-biographies. Alongside the footnotes in this chapter, there is a section in the bibliography listing biographical sources by subject. There is also detailed biographical information for the Ratio Club's members in the Annex.

³⁴³ The W. Ross Ashby Digital Archive contains a rich source of biographical information about Ross. "Biography: W. Ross Ashby (1903-1972)", *W. Ross Ashby Digital Archive*, <https://ashby.info/>, [13 July 2024]. The material in this archive was compiled by Ross' daughter, Jill, who also wrote a substantive biographical essay on her father: J. Ashby, "W. Ross Ashby: A Biographical Essay", *Int. J. of General Systems: The Intellectual Legacy of W. Ross Ashby*, Vol. 38, No. 2, Feb. 2009, pp. 103-10. Valuable insights into Ross' personality were recounted in the obituaries and recollections of his friends, notably Stafford Beer and Roger Conant. S. Beer, "Requisite Ross", typescript obituary marked "For Publication in a Special Edition of *Forum*, a Journal of the American Society for Cybernetics", LJMU/SB/1/130. S. Beer, "A Filigree Friendship", *Kybernetes*, Vol. 30, No. 5/6, pp. 551-60. R. Conant, *Int. J. of General Systems*, Vol. 1, No. 1, 1974, pp. 4-7.

Ross' first job, as a Bethlem Hospital house physician, brought an unfashionable psychiatric turn. He joined the RMPA in 1930, gaining his Certificate in Psychological Medicine in 1931.³⁴⁴ The certificate became a diploma in 1948, reflecting the enhanced post-war stature of psychiatry. By 1939, Ross had practiced pathology at St Andrew's Mental Hospital in Northampton for three years. In March 1945, he was drafted into Emergency Medical Service (EMS), and commissioned into the Royal Army Medical Corps (RAMC). Medically discharged in 1946 with the rank of major, he joined Barnwood House Hospital in Gloucester as a research biochemist in 1947, remaining there until 1959 and becoming Director of Research. By 1949, Ross was already an established clinical neurophysiologist who evidently preferred laboratory specimens to live patients.³⁴⁵

Ross' commitment to neurophysicalist psychiatry considerably predated the Ratio Club, as did his ideas about dynamically self-adaptive and self-stabilising systems.³⁴⁶ Around 1948, he built his Homeostat: an electromechanical analogue of biological homeostasis which embodied abstract enactments of idealised neurophysiological mechanisms. Built using four surplus RAF bomb sights, themselves products of PR, the Homeostat was, literally and figuratively, a black box. Ross vigorously publicised the Homeostat, on both sides of the

³⁴⁴ [Ashby], *Royal Medico Psychological Association Membership Report 1958-59*.

³⁴⁵ He had already authored thirty five publications by 1949. RADA/BIBLIOGRAPHY, www.rossashby.info/index.html, [3 June 2022], <https://ashby.info/>.

³⁴⁶ W. R. Ashby, "The Physiological Basis of the Neuroses", *Proc. Royal Soc. of Medicine*, Vol. 26, No. 11, Sept. 1933, pp. 1454-460. W. R. Ashby, A. Glynn, "The Chemistry of the Brain in the Mental Defective", *J. Neurology and Psychiatry*, Vol. 15, No. 59, Jan. 1935, pp. 193-209. W. R. Ashby, "The Nervous System as Physical Machine: With Special Reference to the Origin of Adaptive Behavior", *Mind*, Vol. 56, No. 221, Jan. 1947, pp. 44-59. W. R. Ashby, "The Physical Origin of Adaptation by Trial and Error", *J. General Psychology*, Vol. 32, No. 1, 1945, p. 13-25. W. R. Ashby, "Dynamics of the Cerebral Cortex: The Behavioral Properties of Systems in Equilibrium", *Amer. J. Psychology*, Vol. 59, No. 4, Oct. 1946, pp. 682-86. W. R. Ashby, "Principles of the Self-Organizing Dynamic System," *J. General Psychology*, Vol. 37, No. 2, 1947, pp. 125-28.

Atlantic.³⁴⁷ By September 1949, Ross was already enthusiastically promoting both materialist and behaviourist conceptions of mind, and the analytical use of synthetic analogues of complex biological systems. Before the Ratio Club, all but nominatively, Ross was a cybernetician. However, his proto-cybernetics emerged without any sociological or intellectual intersections with either radar or servomechanisms, or with PR and OR more generally. Ross found cybernetics through clinical pathology and psychiatry, and by theorising about the mind's materiality and the embodied physicality of adaptive behaviour.

Horace Basil Barlow (1921-2020)

If post-war Britain had an hereditary intellectual aristocracy, Horace was a member. His father, Sir James Alan Noel Barlow GCB, KBE, KCB, CB, CBE, an Oxford classicist, was Ramsay MacDonald's Principal Private Secretary. During the war, Sir James joined the Scientific Policy Advisory Council, which facilitated the militarisation of science that spawned proto-cybernetics.³⁴⁸ Horace's grandfather, Sir Thomas Barlow, Royal Physician to Victoria, Edward VII and George V, died in 1945, passing the baronetcy to Horace's elder brother through their father.³⁴⁹ Their mother, (Emma) Nora, was Sir Horace Darwin's daughter, and Charles Darwin's grand-daughter. As a botanist, she studied genetics at Cambridge under William Bateson, and stirred Horace's early scientific inclinations. She and William's wife Beatrice became life-long friends. When the Bateson's son, Gregory, became engaged to the American anthropologist Margaret Mead, Beatrice asked Nora to

³⁴⁷ "Checkmate in 390,625: If the Electro-Brain Plays Chess", *Mail*, 13 Dec. 1948. W. R. Ashby, "Design for a Brain", *Electronic Engineering*, Vol. 20, No. 239, Jan. 1948, pp. 379-383. W. R. Ashby, "The Electronic Brain", *Radio Electronics: Special Television Number*, March 1949, pp. 77-80. "The Thinking Machine", *Time*, 24 Jan. 1949.

³⁴⁸ R. Lowe, "Sir James Barlow (1881-1968)", *ODNB*, doi.org/10.1093/ref:odnb/30594, [3 June 2022].

³⁴⁹ R. Aspin, "Sir Thomas Barlow (1845-1945)", *ODNB*, doi.org/10.1093/ref:odnb/30595, [3 June 2022].

travel to Bali and evaluate Margaret's suitability. Margaret Mead and Gregory Bateson often visited the Barlows at Chesham Boi. They each became pioneers of American cybernetics.

Horace's educational trajectory was assured, albeit unexpectedly compressed by the war. Although initially favouring mathematics at Winchester, his luminary schoolmates Freeman Dyson, James Lighthill, and Christopher Longuet-Higgins outshone him, so he pivoted towards biology. A switch supported by his mother, who pushed him towards medicine and exemption from conscription. Horace's father had attended Marlborough with a Cambridge admissions tutor. A telephone call was made, and Horace went up to Trinity. His truncated war degree notwithstanding, Horace self-provisioned a motorcycle and became a Home Guard despatch rider. Despite winning a Rockefeller grant in 1943, Horace deferred Harvard Medical School in favour of PR work in the MRC Medical Research Laboratory at London's Mount Vernon Hospital, where Craik found him. A year investigating the physiological effects of diving for the Royal Navy impelled a switch from medicine to research, and although he completed his clinical training after returning from America in

1946, he impressed himself upon Edgar Adrian as a PhD student. He was with Adrian from 1947 to 1950.³⁵⁰

John Alexander Vincent Bates (1918-1993)

John Bates was born into medicine. His father, John Vincent Bates, received the Military Cross during the 1916 Somme Offensive. Demobilised, Dr Bates established a general practice in West Malling, Kent, with his wife as his medical secretary. Both their sons entered medicine.³⁵¹ After Rugby, John went up to Pembroke, Cambridge, and following his clinicals at London's University College Hospital, he qualified in 1942. Whereupon, he joined the MRC Lulworth Physiological Research Laboratory to develop improvements in dynamic tank gun aiming systems. His early location in the epistemological and sociological epicentre of British proto-cybernetics, and his immersion in servomechanism theory, were foundational to both his early cyberneticist orientation, and his creation of the Ratio Club.

³⁵⁰ There were numerous biographically rich obituaries to Horace, including: C. Blakemore, "Scientist of vision", *Nature Neuroscience*, Vol. 23, Iss. 9, 7 Sept. 2020, pp. 1177-78; D. Burr, S. Laughlin, *Current Biology*, 17 Aug. 2020, Vol. 30, Iss. 16, pp. 907-10; G. Ferry, "Neuroscientist Who Explored the Principles of How the Brain Enables us to See", *Guardian*, 23 Aug. 2020, <https://www.theguardian.com/science/2020/aug/23/horace-barlow-obituary>, [13 July 2024]; J. A. Movshon, *Perception*, Vol. 50, No. 2, Feb. 2021, pp. 183-92; T. J. Sejnowski, "A Vision Scientist for the Ages", *Biological Cybernetics*, Vol. 115, Iss. 1, Feb. 2021. In addition, Horace gave several interviews in which he often discussed his biographical hinterland in some depth. Notable examples include: "Society for Neuroscience Archival Interview", 20-21 March 2003, *YouTube*, (5 July 2012), https://www.youtube.com/watch?v=cv9hje42i_E, [13 July 2024]; R. Bingham, "From Grandmother Cells to Tales of a Great-Grandfather: A Conversation with Horace Barlow: The Science Studio Interview", 15 May 2009, <http://thesciencenetwork.org/media/videos/411/Transcript.pdf>, [13 July 2024]; D. Burr, *Current Biology*, Vol. 18, Iss. 12, June 2008, pp. 502-3; P. Husbands, "An Interview with Horace Barlow", in Husbands, Holland, Wheeler, *Mechanical Mind*, pp. 409-29; A. Macfarlane, S. Harrison (ed.), "Film Interviews with Leading Thinkers", *University of Cambridge*, <https://www.sms.cam.ac.uk/media/1385749>, [13 July 2024]; K. Mogi, "Brain World", May 2015, *YouTube*, (7 July 2020), <https://www.youtube.com/watch?v=FN2srZvBR68>, [13 July 2024]; A. Silver, D. Tolhurst, M. Rosenberg, "The Physiological Society Oral History Programme", 21 May 2010, *YouTube*, (1 April 2015), <https://www.youtube.com/watch?v=0HXFMXtqKTU>, [13 July 2024]. Horace was also listed in *Who's Who*: "Barlow, Dr Horace Basil", *Who's Who 2023/Who Was Who*, <https://doi.org/10.1093/ww/9780199540884.013.U6515>, [13 July 2024].

³⁵¹ Emily Retter, "Moving Love Letters from a British Army Officer in the Somme Trenches: Captain John Vincent Bates Wrote Wonderfully Touching Letters to his Sweetheart Back Home", *Mirror*, 24 Feb. 2014, www.mirror.co.uk/news/real-life-stories/moving-love-letters-british-army-3177727, [7 June 2022].

In 1947, Bates, now a clinical neurologist, spoke at an electrical engineering convention on servomechanisms.³⁵² Echoing Craik, he proposed a theoretical design methodology for engineering the systemic performance of humans by conceiving of them as biological servomechanisms.³⁵³ Heralding *Cybernetics*, Bates repudiated vitalism and asserted a biologically mechanist mind. He posited that regulatory feedback drove the dynamically self-adaptive homeostasis of his human servomechanisms, and he ventured that asynchronous feedback produced homeostatic disequilibrium which manifested as mental disorder. Bates was frustrated that the IEE published only an abstract of his paper, deeming it inappropriately biological for engineers.³⁵⁴ This foreshadowed the resistance *Cybernetics* encountered from the institutionalised disciplinary demarcations it decried, and suggested that the Ratio Club was a shelter from the intellectual conservatism exemplified by the IEE.

After the war, John married Dianna Rushforth, a fellow Cambridge medical graduate, and joined the MRC Neurological Research Unit at the National Hospital in London, specialising in EEG.³⁵⁵ He remained there until retirement in 1978.³⁵⁶

³⁵² *J. Institution of Electrical Engineers-Part IIA: Automatic Regulators and Servo Mechanisms*, Vol. 94, Iss. 1-2, May 1947, [Convention on Automatic Regulators and Servo Mechanisms, 19-22 May 1947].

³⁵³ J. A. V. Bates, Design and Performance of the Human Servo, WC/GC/179/A.150/Box 12

³⁵⁴ Letter, Bates to Campbell, 29 May 1947. Letter, Campbell to Bates, 30 May 1947, WC/GC/179/A.85/Box 12. J. A. V. Bates, "Some Characteristics of a Human Operator", *J. Institution of Electrical Engineers-Part IIA: Automatic Regulators and Servo Mechanisms*, Vol. 94, Iss. 1, May 1947, pp. 298-304.

³⁵⁵ "Dr Diana Bates-In Memorium", www.craigencalt.co.uk/people/dibates.html, [7 June 2022]. D. J. Williams, "E. A. Carmichael", *Inspiring Physicians [Munk's Roll]*, www.history.rcplondon.ac.uk/inspiring-physicians/edward-arnold-carmichael, [7 June 2022]. "Editorial", *J. Neurology, Neurosurgery and Psychiatry*, Vol. 44, No. 10, Oct. 1981, pp. 859-60.

³⁵⁶ [Bates, obituary], *Times*, 9 Aug. 1993, p. 14. C. Foster, [Bates, obituary], *BMJ*, Nov. 1993, Vol. 307, No. 6914, p. 1278. P. W. Nathan, "John Alexander Vincent Bates", *Inspiring Physicians [Munk's Roll]*, Vol IX, p. 32, <http://www.history.rcplondon.ac.uk/inspiring-physicians/john-alexander-vincent-bates>, [13 July 2024].

George Duncan Dawson (1912-1983)

George was born in Manchester. His father, also George, was a pathologist at Manchester Royal Infirmary. Following school at Repton, young George qualified to practice from Manchester Medical School in 1936.³⁵⁷ In 1933 he received a research scholarship, and an M.Sc., with a dissertation on “The Recording of Nerve Action Potentials”. During his medical training, George had discovered both Berger’s foundational EEG work, and the seminal paper by Adrian and Mathews affirming Berger’s controversial discovery.³⁵⁸ Even before graduating, George had hand built his first single channel EEG. From 1938 to 1939, he was a neurological researcher in the laboratory of the small neurosurgery unit at the Manchester Royal Infirmary, created especially for its eminent neurosurgeon Geoffrey Jefferson.³⁵⁹ Dawson gave Jefferson one of the world’s first clinical EEG capabilities, outfitted with George’s own hand-built equipment.

In 1939, George volunteered as an RAF doctor; but in 1941, tuberculosis forced a medical discharge upon Flt. Lt. Dawson.³⁶⁰ However, George worked whilst convalescing, becoming both a resident and a researcher at the David Lewis Manchester Epileptic Colony where he used his home-made EEG on patients with myoclonic epilepsy.³⁶¹ During this period, George joined the informal peripatetic discussion group led by Walter, which became the

³⁵⁷ “Medical Education in Manchester”, www.archiveshub.jisc.ac.uk/search/archives/b489e047-e6b1-3992-aaa3-5e40e2147729?component=1e67bb32-6e5e-3b48-964b-142c0075ef69, [7 June 2022].

³⁵⁸ H. Berger, “Über Das Elektrenkephalogramm Des Menschen”, *Archiv Für Psychiatrie Und Nervenkrankheiten*, Vol. 87, No. 1, Dec. 1929, pp. 527-70. E. D. Adrian, B. H. C. Matthews, “The Interpretation of Potential Waves in the Cortex”, *J. Physiology*, Vol. 81, No. 4, July 1934, pp. 440-71.

³⁵⁹ F. M. R. Walshe, “Geoffrey Jefferson: Obituary”, *Biographical Memoirs of Fellows of the Royal Society*, Vol. 7, Iss. 7, Nov. 1961, pp. 126-35.

³⁶⁰ [Dawson, RAF commission], *London Gazette: Supplement*, No. 34610, 24 March 1939, p. 2012.

[Dawson, promotion to Flt. Lt.], *London Gazette: Supplement*, No. 34817, 26 March 1940, p. 1783.

[Dawson, resignation, RAF commission], *London Gazette: Supplement*, No. 35090, 28 Feb. 1941, p. 1216.

³⁶¹ “The David Lewis Epileptic Colony at Sandlebridge, Cheshire”, *BMJ*, Vol. 2, No. 2281, 17 Sept. 1904, p. 685.

EEG Society in 1943. This took him to Dennis Hill's EEG research laboratory at the Sutton Emergency Hospital in Belmont, Surrey, where Slater was the Clinical Director until 1945.³⁶² There, George met biochemist and neurologist Mollie Heppenstall, also a leading EEG researcher, whom he married.³⁶³ In 1944, George joined the National Hospital's Neurological Research Unit, remaining until 1961. Bates and Merton joined him in 1946.³⁶⁴

Thomas Gold (1920-2004)

Tommy spent his first ten years in Viennese luxury, the next three in the disintegrating Weimar Republic, and the next five at the Lyceum Alpinum in Zuoz, Switzerland. His father was a wealthy industrialist, and only after the Wall Street Crash, did Tommy learn that servants were unusual. The Gold's wisely fled from the peril of being Jewish in Hitler's Reich. Tommy was despatched to Swiss boarding school, and his parents settled in England. However, Tommy's Alpine idyl ended abruptly. The day after Anschluss, he flew to England. Overnight, Greater Germany had nullified Tommy's Austrian passport, and his parents feared an equally alacritous British revocation of his residency permit. After cramming Latin, and to satisfy his father's devotion to vocational knowledge, Tommy went to Cambridge to read mechanical sciences at Trinity. In September 1939, Tommy volunteered for the RAF. He had just passed pilot selection when the government barred

³⁶² "J. D. N. Hill", www.collection.sciencemuseumgroup.org.uk/people/ap28719/hill-john-denis-nelson, [7 June 2022].

³⁶³ "M. E. Heppenstall", www.collection.sciencemuseumgroup.org.uk/people/ap28730/heppenstall-mollie-e, [7 June 2022].

³⁶⁴ [Dawson, obituary], *Times*, 25 Nov. 1983, p. 16. A.E., [Dawson, obituary], *Lancet*, 3 Dec. 1983, Vol. 322, Iss. 8362, pp. 1318. P. A. Merton, H. B. Morton, "George Dawson (1912-1983) and the Invention of Averaging Techniques in Physiology", *Trends in Neurosciences*, Oct. 1984, Vol. 7, Iss. 10, pp. 371-73. F. F. Offner, "Tribute: George Duncan Dawson", *Electroencephalography and Clinical Neurophysiology-Evoked Potentials Section*, Sept. 1984, Vol. 59, Iss. 5, pp. 345-46. F. F. Offner, "In Memoriam: George Duncan Dawson (1912-1983)", *Journal of Clinical Neurophysiology*, July 1984, Vol. 1, Iss. 3, p. 355. P.A.M., [Dawson, obituary], *Lancet*, 3 Dec. 1983, Vol. 322, Iss. 8362, pp. 1318. W.A.C., *BMJ (Clinical Research Edition)*, Dec. 1983, Vol. 287, No. 6407, pp. 1803-4.

Austrian nationals from military service. Then, after Dunkirk, the panicked British authorities indiscriminately interned anyone with German or Austrian identity papers.

Nine months in a Canadian prison camp followed. On the first night of imprisonment in Britain, in a requisitioned abandoned factory, Tommy met Cambridge mathematics student Hermann Bondi. After his release, Tommy graduated in 1942, without honours; whereupon Bondi persuaded his boss, Fred Hoyle, to recruit Tommy to join them in Section XRC8 of the Admiralty Signal Establishment (ASE). Whilst waiting for his security clearance, he laboured as a farm hand and lumberjack. During his war service, Tommy directed the Tantalum Admiralty radar trials site, became the Deputy Head of the New Devices Section where he invented a system to detect the surfaced snorkel of a submerged U-boat, and devised a radar navigation system that directed ships to their assigned D-Day locations. He also designed and built a viable mercury acoustic delay memory line for use in sensitive target tracking radar.³⁶⁵ As an acting wing commander, he led a scientific intelligence mission in occupied Germany.

In 1946, Tommy became a technician at Cambridge's Cavendish Laboratory where he built a new type of radar magnetron and gifted his working mercury delay line design to Maurice Wilkes who used it for the EDSAC's memory. In 1947, with MRC funding, Tommy joined Cambridge's Zoological Laboratory to investigate the ear's frequency discrimination capabilities. This research extended a proto-cybernetic idea of feedback from electronic to biological systems; foreshadowing both the cybernetic technique of analogues, and

³⁶⁵ This system stored information by encoding binary electrical impulses into modulated ultrasound pulsed through mercury encased in metal tubing. At the receiving end, the sonic digit was electronically regenerated and either used by the system, or returned to the tube's acoustic transmitter and recycled.

information theory more generally, and winning him a Trinity Fellowship.³⁶⁶ In 1949, Tommy re-joined the Cavendish as a demonstrator. Then, in 1952, he moved to the Royal Observatory as the Astronomer Royal's chief assistant, where he remained until 1956.³⁶⁷

John Irving Good (1916-2009)

Isadore Jacob Goodak inhabited bohemian London. Fleeing persecution in the Congress Kingdom of Poland, his father, Edward Goodak, settled in London's East End in 1903. Here, Edward met Isadore's mother, Sophia Polikoff, another Jewish emigree from the Russian Empire's pogroms. Edward became both a celebrated jeweller who counted King George V, Queen Mary, and the American sculptor Mitzi Cunliffe as his clients, and a successful author who wrote under the names Moysheh Oyved and Mosheh Oved. He was a patron of Yiddish culture, and with the sculptor Jacob Epstein he founded London's Ben Uri Gallery and Museum.³⁶⁸ By 1923, Edward and Sophia were separated. Edward's new partner, Gwendolyn Ethel Rendle, was apprenticed to John Paul Cooper, a major figure in the Arts and Crafts movement. Edward and Gwendolyn became Moshe and Sah Oved, and they built their bohemian reputation, and their jewellery business, at Cameo Corner in Bloomsbury.³⁶⁹ Isadore became Jack Good and drew scant attention to his family in later life.

³⁶⁶ T. Gold, R. J. Pumphrey, "Hearing. I: The Cochlea as a Frequency Analyzer", *Proc. Royal Soc. of London: Series B, Biological Sciences*, Vol.135, No. 881, 14 Dec. 1948, pp. 462-91. T. Gold, "Hearing. II: The Physical Basis of the Action of the Cochlea", *Proc. Royal Soc. of London: Series B, Biological Sciences*, Vol.135, No. 881, 14 Dec. 1948, p.492-98.

³⁶⁷ Gold's later fame as an astronomer and astrophysicist solicited a host of obituaries, many of which are listed in the bibliography. However, because of the nature of this fame, the prevailing theme in Gold's obituaries was his scientific iconoclasm. The best source of biographical information about Gold is his autobiography: T. Gold, S. Mitton (ed.), *Taking the Back off the Watch: A Personal Memoir*, (Springer, Berlin, 2012). Other valuable sources include: H. Bondi, "Thomas Gold", *Biographical Memoirs of Fellows of the Royal Society*, Vol. 52, Dec. 2006, pp. 117-35. S. Mitton, "Gold, Thomas [Tommy]", *ODNB*, <https://doi.org/10.1093/ref:odnb/94185>, [13 July 2024]. "Gold, Prof. Thomas", *Who's Who 2023/Who Was Who*, <https://doi.org/10.1093/ww/9780199540884.013.U17372>, [13 July 2024].

³⁶⁸ "Moshe Oved: Artist", www.buru.org.uk/record.php?id=118, [9 June 2022].

³⁶⁹ "A Rare Emerald and Gem-Set Choker, By Sah Oved, 1931, With Additional Ring And Earring Fittings Designed By Mitzi Cunliffe", www.bonhams.com/auctions/13917/lot/136/, [9 June 2022].

Jack attended Haberdashers' Aske's Boys' School, where he flourished thanks to his precociously prodigious mathematical prowess. In 1935, he won both Sate and Major scholarships to Jesus, Cambridge, and after his first in mathematics in 1938, he earned his PhD in 1941 under Godfrey Hardy. After winning the Cambridgeshire chess championship in 1939, he had gained the attention of Hugh Alexander who, as well as being the 1938 British Chess Champion was, by 1941, Turing's deputy in Hut 8 at Bletchley Park. Alexander and Gordon Welchman interviewed Jack in Cambridge in 1941.³⁷⁰ Jack remembered being offered two vaguely described jobs. One led to radar, the other to the Government Code and Cipher School (GCCS) at Bletchley. Jack chose the seeming romance of secret codes.

Jack's first encounter with Turing was inauspicious; an irate Turing found him asleep in Hut 8 during night duty. However, Jack soon redeemed himself with a flash of mathematical brilliance about improving the Banburismus system and the two became friends.³⁷¹ In 1945, Jack was recruited by Max Newman, another Bletchley boss, to lecture in pure mathematics at Manchester. However, teaching was not Jack's vocation. In 1948 Jack resumed secret government service with GCHQ (the successor to GCCS), where he remained until 1959.³⁷²

³⁷⁰ Hugh Sebag-Montefiore, *Enigma: The Battle for the Code*, (Cassell, London, 2004), pp. 217.

³⁷¹ Sebag-Montefiore, *Enigma*, pp. 217-18.

³⁷² Although his time at Bletchley and his connections with Turing and computers brought Good a measure of fame in later life, he was markedly taciturn about his childhood and his family background. Much of the apparently extensive biographical and memorial material listed in the bibliography in fact deals with his code breaking work and his friendship with Turing. The best source of biographical information for Good is in D. L. Banks, "A Conversation With I. J. Good", *Statistical Science*, Vol. 11, No. 1, Feb. 1996, pp. 1-19. See also, D. R. Cox, "Good, Irving John [Jack]", *ODNB*, <https://doi.org/10.1093/ref:odnb/101736>, [13 July 2024].

William Edmund Hick (1912-1974)

William qualified into medicine from Durham in 1938, and he was commissioned into the RAMC in 1941. Promoted to captain, he was an Army doctor until a medical discharge in 1944.³⁷³ The practice of military medicine stimulated his interest in psychology. In October 1945, Hick wrote to the *BMJ*, rebutting the assertions of Wg. Cdr. Kenneth Bergin of Inverness who believed that the military personnel who claimed psychiatric injury were cowards or malingerers, and that any medical officers who diagnosed mental illness were incompetent or gullible.³⁷⁴ William's refutation drew on his extensive Army medical experience, and displayed both humour and compassion.³⁷⁵ Upon discharge, William joined Craik's newly formalised MRC unit, which brought him directly to proto-cybernetics and the Servo Panel. He remained at Cambridge until 1966, when declining health forced an early retirement; William had experimented extensively with hallucinogens, on himself.

In 1946, William was a founder member of Oliver Zangwill's Cambridge Experimental Psychology Group, serving as its treasurer from 1953 to 1956, and its president in 1958.³⁷⁶ He used his presidency to oversee the group's re-incarnation as the Experimental Psychology Society (EPS). In July 1949, William attended the informal Admiralty meeting of PR and OR practitioners which spawned both the Human Research Society and its successor, the Ergonomics Research Society. In 1949, the EPS elected William to its governing council.³⁷⁷

³⁷³ [Hick, RAMC commission], *London Gazette: Supplement*, No. 35071, 7 Feb. 1941, p. 816. [Hick, resignation, RAMC commission], *London Gazette: Supplement*, No. 36471, 18 April 1944, p. 1758.

³⁷⁴ K. G. Bergin, "Psychiatry In The Army", *BMJ*, Vol. 2, No. 4423, 13 Oct. 1945, p. 508.

³⁷⁵ W. E. Hick, "Psychiatry In The Army", *BMJ*, Vol. 2, No. 4425, 27 Oct. 1945, p. 583.

³⁷⁶ O. L. Zangwill, "The Experimental Psychology Group: 1946-1958", *Quarterly J. Experimental Psychology*, Vol. 19, No. 4, 1 Nov. 1967, pp. 368-70.

³⁷⁷ Edholm, Murrell, "Ergonomics Research Society", *Ergonomics*, Vol. 10, Sup. 1, 1967, p. 78.

In November 1957 he helped to edit the inaugural issue of *Ergonomics*, the new journal of the Ergonomics Research Society.³⁷⁸

Victor Ivor Little (1920-1976)

Graduating in 1941 from a short war degree at Kings College, London (KCL), probably in physics, Victor entered scientific war service. Somewhere amidst the vast compass of the MoS, he worked on radar, and on defences against the V1 and V2. He may well have encountered the SCR-584/M9/Mk.53VT system. After the war, Victor briefly returned to KCL, and had he not met Donald MacKay during the war, they would have met here. Teaching was Victor's vocation. He advanced from his junior KCL position to become a physics lecturer at London's Bedford College, and in 1965 he joined Royal Holloway as a reader in experimental physics. Here, he founded the Non-Linear Optics Research School, and became Dean of the Science Faculty. At some point, Victor acquired a PhD and a wife.³⁷⁹

Donald MacCrimmon MacKay (1922-1987)

Henry, Donald's father, was the general practitioner (GP) for Lybster, a Caithness fishing village where the MacKay's were generationally rooted in Free Church ministry, and herrings had brought transient nineteenth century prosperity. However, as Donald grew, Lybster declined; its railway station closed in 1944, and for the young Donald, school was thirteen miles north at Wick, with John o' Groats scarcely sixteen miles further on. St

³⁷⁸ A. T. Welford, [Hick, obituary], *Quarterly Journal of Experimental Psychology*, Vol. 27, Iss. 2, May 1975, pp. 1-2.

³⁷⁹ [Little, obituary], *Times*, 16 June 1976, p. 16. [Little, obituary], *Nature*, Vol. 262, No. 5566, 22 July 1976, p. 335.

Andrews furnished a physics degree in 1943, after which Donald spent three years at the ASE developing radar automated gun aiming. In 1946, Donald joined Victor as an assistant physics lecturer at KCL where he combined teaching with his PhD research on high speed analogue computers. He married his student, Valerie Wood in 1955, and he became a reader in 1959. He left KCL in 1960 to inaugurate Keele's Granada Research Professorship of Communication and Neuroscience.

In 1948, after a lecture from Reijer Hooykaas, History of Science Professor at Amsterdam's Free University, Donald joined the Research Scientists' Christian Fellowship (RSCF). Founded in 1944 by Oliver Barclay, a Cambridge zoology PhD student, the RSCF promoted the Christian apologia for science by equipping scientist theists with the intellectual resources for epistemological evangelism. Donald found his vocation, rapidly becoming a leading apologist, and an adept publicist for the RSCF.³⁸⁰ Following his 1951 Rockefeller Fellowship, Donald visited America frequently and became unsurprisingly beloved amongst his brethren there. Remarkably however, he also sustained a deep friendship with Warren McCulloch who was, according to contemporary normativity, a louche libertine.³⁸¹

³⁸⁰ C. M. Rios, Chapter 3, "Unexpected Resistance: The Research Scientists' Christian Fellowship, 1940s to 1965", *After the Monkey Trial: Evangelical Scientists and a New Creationism*, (Fordham University Press, New York, 2014), pp. 73-104.

³⁸¹ E. F. Evans, [MacKay, obituary], *Experimental Brain Research*, Vol. 66, Iss. 2, April 1987, pp. 225-27. E. F. Evans, [MacKay, obituary], *Biological Cybernetics* Vol. 59, Iss. 3, Aug. 1988, pp. 149-50. H. C. Longuet-Higgins, [MacKay, obituary], *Nature*, Vol. 326, No. 6112, 8 April 1987, pp. 446. M. W. DeLashmutt, "Donald MacCrimmon MacKay", *Gifford Lectures Biography*, <https://www.giffordlectures.org/lecturers/donald-maccrimmon-mackay>, [13 July 2024]. J. W. Haas Jr., "Donald MacCrimmon MacKay (1922-1987): A View from the Other Side of the Atlantic", *The American Scientific Affiliation*, March 1992, <https://www.asa3.org/ASA/PSCF/1992/PSCF3-92Haas.html>, [13 July 2024]. S. Watt, "MacKay, Donald MacCrimmon", in S. Brown (ed.), *Dictionary of Twentieth-Century British Philosophers, Volume 2: M-Z*, pp. 615-16. "MacKay, Prof. Donald MacCrimmon", *Who's Who 2023/Who Was Who*, <https://doi.org/10.1093/ww/9780199540884.013.U166634>, [13 July 2024].

Turner McLardy (1916-1988)

Netherfield House, the McLardy seat in Strathaven, South Lanarkshire, was a three story, five bedroom, eighteenth century mansion in extensive grounds, from where Turner entered medical training at Glasgow University. Qualifying in 1939, he briefly joined the Maudsley Hospital Medical School, perhaps meeting Slater who was there until 1939. On 5 September 1939, the *Telegraph* announced the marriage of a Dr McLardy and Faye Cameron, daughter of the Rev John and Mrs Cameron, of Kilmichael-Glassery, Argyll.³⁸² On 25 September, a Dr McLardy was commissioned into the RAMC.³⁸³ Then, on 12 June 1942, the *Times* announced the birth of a son to a Major Turner McLardy and Faye, née Cameron, at Alexandria, Egypt two days before.³⁸⁴ Whilst the cross-identification of the reported Major and Mrs McLardy and the correlation with Netherfield are conjecture, the balance of probability is that this McLardy was both he of the Ratio Club and of Netherfield.³⁸⁵

By 1943, Turner had been captured, and as a prisoner of war (PoW) he was working on the psychiatric ward of the prisoner's hospital at Stalag 344 in Lamsdorf, south-west Poland.³⁸⁶ In February 1945, he endured the Lamsdorf Death March which formed part of the mass evacuation of concentration and PoW camps precipitated by the Red Army's Western advance. He and his fellow prisoners were forced to walk for up to nine hours a day in temperatures as low as -20°C on starvation rations.³⁸⁷ Turner was awarded a military MBE.³⁸⁸

³⁸² "Forthcoming Marriages, Dr McLardy and Miss Faye Cameron", *Telegraph*, 5 Sept. 1939, p.9.

³⁸³ [McLardy, RAMC commission], *London Gazette: Supplement*, No. 34712, 17 Oct. 1939, p. 7025.

³⁸⁴ "Births: McLardy", *Times*, 12 June 1942, p.1.

³⁸⁵ "Turner McLardy", *Geni.Com*, <https://www.geni.com/people/Turner-McLardy/6000000000304534931?through=6000000000419097076>, [13 July 2024].

³⁸⁶ "WW2 People's War", www.bbc.co.uk/history/ww2peopleswar/stories/53/a6038453.shtml, [10 June 2022].

³⁸⁷ J. Fusniak, "Lamsdorf Death March 1945", www.buckdenpike.co.uk/lamsdorf-march.html, [10 June 2022].

³⁸⁸ [McLardy, MBE award], *London Gazette: Supplement*, No. 37861, 21 Jan. 1947, p. 441.

In 1946, he re-joined the Maudsley as a senior assistant neuropathologist in the research laboratory, and in 1948 he received both his PhD from Glasgow and his Diploma in Psychiatric Medicine from the RMPA.³⁸⁹ In 1953 he moved to Northampton's St Andrew's Hospital for Nervous and Mental Disorders, where Ashby had also once practiced. It was Turner who booked McCulloch to address the Ratio Club's inaugural meeting, and in 1950 he joined McCulloch at the Illinois Psychiatric Institute.³⁹⁰

Patrick Anthony Merton (1920-2000)

Pat's father, Gerald, was a distinguished astronomer and the son of the German portraitist and theosophist Hermann Schmiechen. Pat's mother, Mary, née Crowley, was from Cork and devoutly Catholic. At her insistence, Pat attended Ampleforth and Beaumont College. In adulthood, he spurned religion generally, and Catholicism especially. Pat studied medicine at Cambridge, qualifying in 1946. Favouring research over clinical practice, he joined Bates and Dawson at the National Hospital where he remained until 1957.³⁹¹

³⁸⁹ [McLardy], *Royal Medico Psychological Association Membership Report 1948-49*. [McLardy], *Royal Medico Psychological Association Membership Report 1952-53*. [McLardy], *Royal Medico Psychological Association Membership Report 1953-54*.

³⁹⁰ L. R. Squire (ed.), "Arnold Bernard Scheibel", in *The History of Neuroscience in Autobiography*, (Society for Neuroscience, Washington DC, 1996), p.667.

³⁹¹ "Demonstrating That Muscles Work in a Similar Way to Servo-Assisted Steering or Brakes", [Merton, obituary], *Times*, 29 June 2000, p. 25. "Editorial", *Journal of Neurology, Neurosurgery & Psychiatry*, Vol. 44, No. 10, Oct. 1981, pp. 859-60. K. B. Bhattacharyya, "Edgar Adrian and Patrick Merton: Names Blurred with the Passage of Time", *Annals of the Indian Academy of Neurology*, Vol. 21, Iss. 1, Jan.-March 2018, pp. 19-23. J. Rothwell, I. Glynn, "Patrick Anthony Merton", *Biographical Memoirs of Fellows of the Royal Society*, Vol. 52, Dec. 2006, pp. 189-201. "Patrick Anthony Merton", *Inspiring Physicians [Munk's Roll]*, Vol XI, p. 395, <https://history.rcplondon.ac.uk/inspiring-physicians/patrick-anthony-merton>, [13 July 2024]. Merton, Patrick Anthony, *Who's Who 2023/Who Was Who*, <https://doi.org/10.1093/ww/9780199540884.013.U180482>, [13 July 2024]. P. A. Merton, "Neurophysiology on Man: The first Carmichael Memorial Lecture (Given at the National Hospital Queen Square on 23rd Oct. 1980)", *Journal of Neurology, Neurosurgery, and Psychiatry*, Vol. 44, Iss. 10, Oct. 1981, pp. 861-70.

John William Sutton Pringle (1912-1982)

The son of a prosperous GP working in Manchester and Rochdale, John's daily industrial cityscapes were punctuated by scenic holidays to the Lakes, Donegal and the Alps. Having twice contracted bronchopneumonia, John's preparatory school was at Langley Place in St Leonard's-on-Sea. Winchester was attained through a major scholarship, as was King's, Cambridge, where he read natural sciences. Whilst at Cambridge, he acquired his lifelong passion for flying gliders, and he was probably the inspiration for the avid engineless pilot Simon Gloster in Walter's utopian science fiction novel, *Further Outlook*.³⁹² King's furnished a postgraduate studentship in 1934 and a Fellowship in 1938, and from 1937 to 1938 he was university demonstrator in Zoology. In 1939, he sailed to America to take up a Rockefeller Fellowship with the biophysicist Detlev Bronk. However, landing as war was declared, he immediately returned to Britain and despite volunteering as an RAF pilot, the Central Register diverted him into the legion of biologists consumed by radar.³⁹³

John's military scientific ascent was vertiginous. By 1942, he was already a TRE Senior Scientific Officer and in command of the Malvern Telecommunications Flying Unit.³⁹⁴ John undoubtedly attended the Sunday Soviets, and Rowe personally appointed him to the Invasion Panel which was tasked with investigating the use of radar to assist Operation Overlord. Although he briefly oversaw all airborne radar development, John's principal military achievement was his development of the REBECCA-EUREKA ground to air radio targeting system from the earlier work of F. C. Williams. In use by 1943, the system

³⁹² W. G. Walter, *Further Outlook*, (Duckworth, 1956). "Gliding Under Difficulties: 70 Mile Flight at Low Altitude, *Times*, 17 April 1939, p. 19. "Glider's 76 Miles in 4 Hours", *Sunday Times*, 14 Aug. 1949, p. 5.

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³⁹⁴ "[TRE] Directors Chart", *Purbeck Radar*, <http://www.purbeckradar.org.uk/people/pdf/tre-chart-12Mar42.pdf>, [13 July 2024].

facilitated covert blind airdrops, instrument guided aircraft landings, and accurate bomb aiming. Unusually, the Americans adopted REBECCA-EUREKA without modification.³⁹⁵

In 1942, honorary Sqn. Ldr. Pringle had inspected the American and European military trials of his invention in person.³⁹⁶

In 1945, John received the American Medal of Freedom for REBECCA-EUREKA, and on 14 August 1945, Stafford Cripps, President of the Board of Trade, named him, and REBECCA-EUREKA, at a major MoI press conference.³⁹⁷ In 1946 John received a civilian MBE.³⁹⁸ A luminous government scientific career beckoned, and was considered. In 1944, John served as secretary to a Transport Ministry committee investigating radar use in merchant shipping. However, whilst he enjoyed government work, academia prevailed.³⁹⁹ In 1945 John returned to Cambridge, where he stayed until a surprise move to Oxford in 1961.⁴⁰⁰

³⁹⁵ “Eureka/Rebecca/BABS/Lucero”, www.qsl.net/pe1ngz/airforce/airforce-raf/raf-eureka-rebecca.html#Rebecca%20Mk%20I, [13 June 2022].

³⁹⁶ [Pringle, honorary RAF commission], *London Gazette: Supplement*, No. 36063, 18 June 1943, p. 2824. [Pringle, cessation, honorary RAF commission] *London Gazette: Supplement*, No. 37526, 5 April 1946, p. 1797.

³⁹⁷ “Radar’s Great Part in Winning the War: Immediate Benefits for Peace: Secrets Now Revealed”, *Scotsman*, 15 Aug. 1945, p. 6.

³⁹⁸ [Pringle, MBE award], *London Gazette: Supplement*, No. 37617, 18 June 1946, p. 3132.

³⁹⁹ “University News”, *Times*, 15 Feb. 1945, p. 7. “Zoology at Oxford”, *Nature*, Vol. 193, No. 4811, Jan. 1962, p. 119.

⁴⁰⁰ “Biography: Prof Sir John W S Pringle FRS”, *Purbeck Radar*, http://www.purbeckradar.org.uk/biography/pringle_john.htm, [13 July 2024]. P. Schmidt, “Pringle, John William Sutton”, in S. Brown (ed.), *Dictionary of Twentieth-Century British Philosophers, Volume 2: M-Z*, pp. 818-19. V. B. Wigglesworth, “John William Sutton Pringle”, *Biographical Memoirs of Fellows of the Royal Society*, Vol. 29, Nov. 1983, pp. 524-51. P. L. Miller, “Pringle, John William Sutton”, *ODNB*, <https://doi.org/10.1093/ref:odnb/31568>, [13 July 2024]. “Pringle, John William Sutton”, *Who’s Who 2023/Who Was Who*, <https://doi.org/10.1093/ww/9780199540884.013.U168275>, [13 July 2024]. J. W. S. Pringle, “Zoology at Oxford”, *Nature*, Vol. 193, No. 4811, Jan. 1962, p. 119.

William Albert Hugh Rushton (1901-1980)

William was born as an Edwardian to a dentist father of Liverpoolian extraction. After The Hall, he joined Gresham's School at Holt in 1915 where he stayed until 1920. Next came a medical studentship at Emmanuel, Cambridge, where he finished his degree, but not his medical training, in 1925. William had been distracted by his PhD on the electrical excitation of peripheral nerves under Edgar Adrian, which he was awarded in 1928. He was a novelty. The first Cambridge PhD was only submitted in 1921.⁴⁰¹ From 1929 to 1931, he joined Detlev Bronk in Philadelphia, and upon returning to Cambridge, he secured a medical teaching position which was made contingent on the completion of his own medical training. However, despite repeatedly failing his finals, he became university lecturer in physiology in 1935. Nevertheless, to bolster his teaching credibility he persevered, and in 1937 he gained his medical licence.

In 1938, Trinity elected William to a Staff Fellowship in medical physiology, whereupon he also became its director of medical studies. William spent the First World War as a school pupil, and the Second teaching medical students. Cambridge awarded him an ScD in 1946, and he was elected to the Royal Society in 1948. From 1948 to 1949, William was at Ragnar Granit's neuroscience department in the Karolinska Institute's Nobel Institute for Neurophysiology. William was not a professor in 1949, but he was a senior academic, and

⁴⁰¹ S. Kent, "A Degree of a Different Character': 100 Years of the Cambridge PhD", www.specialcollections-blog.lib.cam.ac.uk/?p=17052#:~:text=The%20first%20Cambridge%20PhD%20was,the%20PhD%20to%20over%2039%2C000, [13 June 2022].

he certainly tutored or mentored Barlow, Merton and Gold, and possibly Bates. Ashby and Slater were his undergraduate contemporaries, but there is no evidence of student contact.⁴⁰²

Harold William Shipton (1920-2007)

Harold led a remarkable life. Although tantalisingly little is known of his biography, its outline alone resembles a feature film elevator pitch.⁴⁰³ He was born in Cotton Mount, Shrewsbury, in a council house without upstairs electricity.⁴⁰⁴ His father was a foreman in Shrewsbury's Parks Department. After St Michael's School, Harold attended Shrewsbury Technical College, and honed his electronics expertise in the upstairs workshop of A. R. Mitchell's radio and electrical goods shop on the corner of Mardol and Claremont Street.

In 1939, the nineteen year old Harold joined the RAF. His aptitude for electronics sent him to RAF St Athan as a technician on airborne radar for night-fighters. Although no degree meant no commission, nevertheless his talent gained him promotion. So, in the early days of peace, it was Corporal Shipton who was volunteered to investigate the odd purchase of

⁴⁰² [Rushton, obituary], *BMJ*, Vol. 281, No. 6233, July 1980, p. 152. [Rushton, obituary], *Telegraph*, 20 Oct. 1980, p. 16. [Rushton, obituary], *American Journal of Optometry and Physiological Optics*, Vol. 58, No. 2, Feb. 1981, p. 186. [Rushton, obituary], *Vision Research*, Vol. 22, Iss. 6., 1982, pp. 611-14. "Rushton, William Albert Hugh: (1901-1980) British Physiologist", *Oxford Dictionary of Scientists*, (OUP, Oxford, 1999), <https://www-oxfordreference-com.ezproxy-prd.bodleian.ox.ac.uk/display/10.1093/acref/9780192800862.001.0001/acref-9780192800862-e-1223?rskey=KjvMMw&result=1>, [13 July 2024]. "William Albert Hugh Rushton: Biographical Details", *Vision Research*, Vol. 22, Iss. 6., 1982, pp. 615-21. A. L. Hodgkin, "Some Recollections of William Rushton and his Contributions to Neurophysiology (1925-52)", *Vision Research*, Vol. 22, Iss. 6., 1982, pp. 623-25. H. B. Barlow, "William Rushton", *Biographical Memoirs of Fellows of the Royal Society*, Vol. 32, Dec. 1986, pp. 421-59. H. Barlow, "Rushton, William Albert Hugh", *ODNB*, <https://doi.org/10.1093/ref:odnb/31634>, [13 July 2024]. "Rushton, William Albert Hugh", *Who's Who 2023/Who Was Who*, <https://doi.org/10.1093/ww/9780199540884.013.U159219>, [13 July 2024].

⁴⁰³ "Professor Harold Shipton: Distinguished Medical Engineer Who Helped Pioneer the EEG, Which Measures the Brain's Electrical Activity", [Shipton, obituary], *Times*, 14 May 2007, p. 52. "Shipton, Engineer, EEG Machine Pioneer, 86", [Shipton, obituary], *Washington University St. Louis: The Source: Newsroom*, 13 June 2007, <https://source.wustl.edu/2007/06/obituary-shipton-engineer-eeeg-machine-pioneer-86/>, [13 July 2024]. "Shipton, Harold William 1920-2007" *Science Museum Group*, <https://collection.sciencemuseumgroup.org.uk/people/ap28698/shipton-harold-william>, [13 July 2024].

⁴⁰⁴ "When Shropshire Boffin Harold Married Attlee's Daughter", *Shropshire Star*, 23 March 2015, www.shropshirestar.com/news/2015/03/23/1945-churchill-gets-boot-by-wind-of-change/, [6 May 2022].

vast amounts of surplus military equipment by a Bristol mental hospital.⁴⁰⁵ Thus, Harold met Walter; whose EEG machines satisfactorily explained the BNI's voracious electronics consumption. They became friends, and Harold joined Walter's department in Spring 1946.

Shortly thereafter, at a local party, Harold met Janet, a Bristol University psychologist. In August 1947, British newspapers announced that Harold Shipton, an unknown electronics technician, was to marry Janet Helen Attlee, the Prime Minister's daughter. Before the engagement was approved, Harold had met the Attlees at Chequers, and the Attlees had met Harold's widowed mother at her Shrewsbury council house. Harold recalled that Clement initially seemed haughtily patrician.⁴⁰⁶ Thus, there were two establishment nuptials in late 1947, both attended by a blaze of international publicity. On 20 November, Princess Elizabeth and Philip Mountbatten married at Westminster Abbey. However, they followed Harold and Janet, whose wedding on 15 November at Ellesborough Church in Chequers, was attended by 200 guests, including most of Attlee's cabinet. Winston had a plausible cold, but a diplomatically untroubled Lady Churchill attended in his stead. The king and queen sent a silver tea set, the queen mother gifted a dinner service, the Speaker gave a china coffee set, and the Churchills presented a silver casket.⁴⁰⁷ Walter was best man.⁴⁰⁸

Janet joined the BNI, working with Harold until they emigrated to America in 1957. A story that started with an electronics technician from a Shrewsbury council house, ended with a

⁴⁰⁵ Husbands, Holland, "Ratio Club", in Husbands, Holland, Wheeler (eds.), *Mechanical Mind*, p. 127.

⁴⁰⁶ "When Shropshire Boffin Harold Married Attlee's Daughter", *Shropshire Star*, 23 March 2015, www.shropshirestar.com/news/2015/03/23/1945-churchill-gets-boot-by-wind-of-change/, [6 May 2015].

⁴⁰⁷ "Marriages: Mr. H. W. Shipton and Miss J. H. Attlee", *Times*, 17 Nov. 1947, p. 6..

⁴⁰⁸ Alongside the extensive newspaper reporting of Harold and Janet's wedding, a selection of which is listed in the bibliography, there were two newsreels of the event; British Movietone, "Premier's Daughter Weds", 20 Nov. 1947, *YouTube*, (21 July 2015), <https://www.youtube.com/watch?v=dx36KvzSTUs>, [13 July 2024]. British Pathé, "People Were News", 1947, *YouTube*, (13 April 2014), <https://www.youtube.com/watch?v=VZz76pJUBS4>, [13 July 2024].

beloved professor leading the biomedical engineering programme at a prestigious American medical school.⁴⁰⁹ Along the way, Shippy, as he was affectionally known, acquired a doctorate.⁴¹⁰

Donald Arthur Sholl (1903-1960)

By 1947, Donald had joined the embryology department at UCL.⁴¹¹ By 1956 he was a reader in anatomy.⁴¹² Although chronologically eligible for conscription, Donald was presumably reserved as a medical educator and researcher; and, after the war, he became a noted neurophysiologist and mathematical biologist. Donald died early. J. Z. Young, UCL's anatomy professor, and his friend, mourned the premature loss of a colleague who had significantly advanced the understanding of the cerebral cortex.⁴¹³ Alongside these woefully sparse fragments, there is an insubstantial, yet tantalising, biographical trace. A genealogy web-site for the Jewish family diaspora flowing from one Bär Joachim Behrendt shows a

⁴⁰⁹ “Dr. Harold Shipton, Biomedical Engineering, Washington University School of Medicine”, *Becker Archives Database*, Washington University School of Medicine in St. Louis, <https://beckerarchives.wustl.edu/VC266-S07-B01-i01>, [13 July 2024]. “Washington University Record”, 28 Oct. 1982, Vol. 8, No. 9, p. 3, <https://digitalcommons.wustl.edu/record/249>, [13 July 2024]. “Washington University Record”, 1 Sept. 1983, Vol. 9, No. 1, p. 4, <https://digitalcommons.wustl.edu/record/276>, [13 July 2024]. “Washington University Record”, 10 Oct. 1985, Vol. 10, No. 8, p. 3, <https://digitalcommons.wustl.edu/record/351>, [13 July 2024]. “Washington University Record”, 13 Nov. 1986, Vol. 11, No. 13, p. 3, <https://digitalcommons.wustl.edu/record/391>, [13 July 2024]. “Washington University Record”, 5 Feb. 1987, Vol. 11, No. 21, p. 6, <https://digitalcommons.wustl.edu/record/399>, [13 July 2024].

⁴¹⁰ D. Bendersky, D. E. Roberson (eds), “The Application of Aerospace Technology to Biomedical Problems”, *Midwest Research Institute, Quarterly Report No.1, 15 June-31 Aug. 1969*, Contract No. NASW1936, MRI Project No. 332-E, for National Aeronautics and Space Administration, Office of Technology Utilization, Technology Utilization Division, p. ii, <https://ntrs.nasa.gov/citations/19700001902>, [13 July 2024].

⁴¹¹ D. A. Sholl, Department of Embryology, University College, London, “Allometry of the Vertebrate Brain”, *Nature*, Vol. 159, No. 4034, 22 Feb. 1947, pp. 269-70.

⁴¹² “University News”, *Times*, 28 Jan. 1956, p. 8.

⁴¹³ J. Z. Young, “Exact Study Of The Body”, *Times: Supplement on University College London*, 3 March 1965, p. v.

Donald Arthur Sholl who joined the family through marriage to a Marianne Luise Salomon. This Donald was born at Romford in 1903 and died at Wood Green in 1960.⁴¹⁴

Eliot Trevor Oakeshott Slater (1904-1983)

Eliot's father, Gilbert, was a noted Fabian, a Principal of Ruskin, Oxford, and an economics professor at Madras University. Eliot chose Cambridge and medicine. Qualifying from St John's in 1928, Eliot practiced psychiatry from the outset, starting at London's West End Hospital for Nervous Diseases, and moving to Derby County Mental Hospital in 1930. However, asylum-warehouses proved unappealing. In 1931, he joined the Maudsley Hospital Medical School, a noted venue for psychiatric genetics and eugenics, and in 1934, he used a Rockefeller Fellowship to study psychiatric genetics in Nazi Germany. Eliot spent most of this time with Ernst Rüdin at the Kaiser Wilhelm Institute for Psychiatric Research in Frankfurt. Favoured by Hitler, Rüdin helped draft the 1933 "Law for the Prevention of Offspring with Hereditary Diseases", and earned the sobriquet 'Reichsführer for Sterilization'. Eliot also visited the Kaiser Wilhelm Institute of Brain Research in Berlin-Buch, which harvested brains from victims of the judicial murders committed under the T-4 Aktion forced euthanasia programme.⁴¹⁵ Eliot retained fond memories of his time in Nazi Germany.

In 1935, Eliot returned to the Maudsley, which was then assimilated by the EMS in 1939 and bifurcated into two new emergency mental hospitals. One of which took its name from the requisitioned Mill Hill School where it was sited; and the other, which was lodged in a former workhouse, became the Sutton Emergency Hospital. As the anticipated surge in

⁴¹⁴ "Behrendt Family History", www.behrendt.co.uk/familychart.php?personID=I289&tree=tree1, [14 June 2022].

⁴¹⁵ W. E. Seidelman, "Science and Inhumanity: The Kaiser-Wilhelm/Max Planck Society", *If Not Now*, Vol. 2, Winter 2000, www.doew.at/cms/download/b1c46/en_seidelman_max_planck_society.pdf, [14 June 2022].

civilian psychiatric casualties did not materialise, the new hospitals were put to military psychiatric use. Eliot was clinical director at the Sutton for the duration. In 1946, he became a senior clinician at the National Hospital, outranking Bates, Dawson and Merton. In 1949, he joined the Royal Commission on Capital Punishment. Like Rushton, Slater held considerable professional seniority over his Ratio Club colleagues.

Slater was a lifelong advocate of involuntary eugenics and genetic hygiene, notwithstanding the horrors of the Third Reich.⁴¹⁶ Even after 1945, his disagreement with Nazi eugenics was over efficacy, not principle.⁴¹⁷ Moreover, Slater explained antisemitism as a normal response to an unfortunate and unnecessary choice by Jews to maintain a visibly distinctive identity.⁴¹⁸ Alongside voluntary cultural practices, Slater argued that Jews had racially distinguishing physiological characteristics which interbreeding would easily eradicate. Therefore, if Jews unreasonably refused the erasure of their Jewishness through social and biological assimilation, then they themselves perpetuated antisemitism.⁴¹⁹ Following contemporary medical normativity, Slater diagnosed homosexuality as an illness. However, for Slater this was not neurosis, but a physiological feminisation arising from incomplete biological sexual

⁴¹⁶ E. T. O. Slater, "German Eugenics in Practice", *Eugenics Review*, Vol. 27, Iss. 4, Jan. 1936, pp. 285-95.

⁴¹⁷ J. Fraser-Roberts, E. T. O. Slater, "Genetics, Medicine and Practical Eugenics", *Eugenics Review*, Vol. 40, Iss. 2, July 1948, pp. 62-9. E. T. O. Slater, "Modern Tendencies in Eugenics", *Health Education J.*, Vol. 3, Iss. 4, Dec. 1945, pp. 182-85.

⁴¹⁸ E. T. O. Slater, "A Biological View on Anti-Semitism", *Jewish Monthly*, Vol. 1, No. 8, Nov. 1947, pp. 22-8.

⁴¹⁹ E. T. O. Slater, "A Note on Jewish-Christian Inter-marriage", *Eugenics Review*, Vol. 39, Iss. 1, April 1947, pp. 17-21.

differentiation caused by dysfunctional sex chromosomes.⁴²⁰ One wonders about Slater's opinions on Gold, Sholl (probably), Good, and Turing; and, about theirs on him.⁴²¹

Alan Mathison Turing (1912-1954)

The historical giant rightly depicted by Andrew Hodges was not the Ratio Club's Alan. They saw a typically upper-middle class child of Empire; and, a brilliant, vibrant, affable, yet occasionally socially awkward boffin, who radiated the unmistakable aura of war-time secrets. Alan was also a man struggling to find a place in a post-war Britain that increasingly seemed to have no place for him, and by 1949 he was not strenuously concealing either his sexuality, or his intellectual frustration with his less able professional peers.

Alan graduated as Wrangler from King's, Cambridge, in 1934, with a distinction in his schedule B paper. A Studentship then preceded his Fellowship in 1935. Attending Princeton from 1936 to 1938, Alan earned his PhD, and became reacquainted with John von Neumann whom he had met at Cambridge in 1935. Alan returned to Cambridge in July 1938 under gathering war-clouds, and GCCS quickly drafted him into cryptanalytic training at their Broadway Buildings headquarters. Whereupon, Alan spent the summer of 1938 flitting

⁴²⁰ E. T. O. Slater, "A Study in The Assessment of Homosexual Traits", *Brit. J. Medical Psychology*, Vol. 21, Iss. 1, March 1947, pp. 61-74.

⁴²¹ E. T. O. Slater, "Autobiographical Sketch (1969)", in J. Shields, I. I. Gottesman (eds.) *Man, Mind, and Heredity: Selected Papers of Eliot Slater on Psychiatry and Genetics*, (Johns Hopkins, Baltimore, MD. & London, 1971), pp. 1-25. E. T. O. Slater, "Short Communication: On Accepting the Second Annual Theodosius Dobzhansky Memorial Award for Research in Behavior Genetics", [autobiographical material], *Behaviour Genetics*, Vol. 8, Iss. 6, Nov. 1978, pp. 533-34. "Eminent Psychiatrist of Wide Interests", [Slater, obituary], *Times*, 21 May 1983, p. 12. [Slater, obituary], *Lancet*, Vol. 321, Iss. 8335, 28 May 1983, pp. 1231-32. [Slater, obituary], *BMJ (Clinical Research Edition)*, Vol. 286, No. 6381, 11 June 1983, p. 1906. [Slater, obituary], *BMJ (Clinical Research Edition)*, Vol. 287, No. 6384, 2 July 1983, p. 67. M.R., [Slater, obituary], *Bulletin of the Royal College of Psychiatrists*, Vol. 7, Iss. 9, Sept. 1983, pp. 175-76. W. Thomson, [Slater, obituary], *Telegraph*, 24 May 1983, p. 14. Sir M. Roth, "Eliot Slater: An Appreciation", *British Journal of Psychiatry*, Vol. 122, Iss. 571, June 1973, pp. 621-23. Sir M. Roth, "Eliot Trevor Oakeshott Slater", *Inspiring Physicians [Munk's Roll]*, Vol VII, p. 541, <https://history.rcplondon.ac.uk/inspiring-physicians/eliot-trevor-oakeshott-slater>, [13 July 2024]. H. Series, "Slater, Eliot Trevor Oakeshott", *ODNB*, <https://doi.org/10.1093/ref:odnb/51739>, [13 July 2024]. "Slater, Eliot Trevor Oakeshott", *Who's Who 2023/Who Was Who*, <https://doi.org/10.1093/ww/9780199540884.013.U169185>, [13 July 2024].

between Cambridge and London. The day after war was declared, by arrangement, Alan reported to Bletchley, where GCCS had relocated only the previous month.

During the war, Alan inhabited the secret state's strongest citadels, and he became intellectually and socially invisible to both the remnants of the academy, and the commensurately vast military research community. From 1939 to 1943, whilst at Bletchley, he also spent November 1942 to March 1943 in America as a cryptologic liaison officer; smoothing Anglo-American friction around the development and use of the Bombe, and assisting in the development of what became the SIGSALY digitised voice encryption system. From January to March, he visited New York, where he and Shannon met frequently in the Bell Lab's canteen. In September 1943, Alan segued directly from GCCS to the Secret Intelligence Service (MI6). And, moving to Hanslope Park, he joined Secure Communications Unit No. 3 in Section VIII of the Radio Security Service, where he developed the Delilah speech-encryptor.⁴²² From July to August 1945, Alan joined Tommy Flowers, the designer of Bletchley's Colossus, on a scientific intelligence mission in occupied Germany. That summer, Alan also visited the Dollis Hill Post Office Research Station where Flowers worked.

In 1945, at John Womersley's behest, Alan transferred from MI6 to the NPL's new Mathematics Division as a Temporary Senior Scientific Officer. In 1946, he received his OBE, and a promotion to Senior Principal Scientific Officer. From December 1946 to February 1947, Alan delivered some of a lecture series about the NPL's ACE computer at the MoS in London. Also in February 1947, Alan lectured on the ACE to the London

⁴²² "History of the R.S.S.", www.rssmars.com/brief-history/, [16 June 2022].

Mathematical Society. The ACE was Alan's design, and although it attracted considerable recognition, his frustration with the NPL's inability to materialise his computer was growing and he spent the rest of 1947 on sabbatical in Cambridge. Then, reneging on his agreement to re-join the NPL, in 1948 Alan went to Manchester as both a reader in mathematics, and the Deputy Director of the Royal Society Computing Laboratory. In 1951, Alan joined the Royal Society. On Tuesday 8 June 1954, Alan's housekeeper discovered his corpse.⁴²³

Albert Maurel Uttley (1906-1985)

Albert was born in the North London borough of Stoke Newington, a longstanding enclave of radical left politics. By 1926, he had a first in mathematics from KCL. From 1927 to 1943, Albert taught, almost certainly mathematics, probably in London and possibly in Stoke Newington. In 1934, he took a second undergraduate degree, also at KCL, in psychology. In 1940, KCL awarded Albert a psychology PhD. Thereinafter, his intellectual practice was a creative fusion of mathematics and neurophysiologist psychology.

⁴²³ [Turing, obituary], *Guardian*, 10 June 1954, p. 10. [Turing, obituary], *Hazelhurst Gazette*, Autumn 1954, pp. 5-7, *Turing Archive*, King's College Cambridge, AMT/K/5. [Turing, obituary], "King's College Cambridge: Annual Report, Nov. 1954", pp. 5-6, *Turing Archive*, King's College Cambridge, AMT/K/5. "Obituary Notice for National Physical Laboratory", [Turing, obituary], *Turing Archive*, King's College Cambridge, AMT/K/5, [internal NPL circulation]. R. O. Gandy, [Turing, obituary], *Nature*, Vol. 174, No. 4429, 18 Sept. 1954, pp. 535-36. R.O. Gandy, [Turing, obituary], *Turing Archive*, King's College Cambridge, AMT/A/6, [unpublished]. M. H. A. Newman, "Dr Alan Turing: An Appreciation", [Turing, obituary], *Guardian*, 11 June 1954, p. 10. M. H. A. Newman, [Turing, obituary], *Times*, 16 June 1954, p. 10. G. O'Hanlon, [Turing, obituary], *Shirburnian*, Summer 1954, Vol.44, No. 2, pp. 54-5, <https://oldshirburnian.org.uk/wp-content/uploads/2019/01/1954-Summer.pdf>, [13 July 2024]. A. Hodges, *Alan Turing: The Enigma*, (Burnett Books, London, 1983). J. Swinton, *Alan Turing's Manchester*, (Infang, Manchester, 2019). D. Turing, *Prof: Alan Turing Decoded*, (History Press, Brimscombe, 2015). E. S. Turing, *Alan M. Turing*, (W. Heffer & Sons, Cambridge, 1959). M. H. A. Newman, "Alan Mathison Turing", *Biographical Memoirs of Fellows of the Royal Society*, Vol. 1, Nov. 1955, pp. 252-63. A. Hodges, "Turing, Alan Mathison" *ODNB*, <https://doi.org/10.1093/ref:odnb/36578>, [13 July 2024]. "Turing, Alan Mathison", *Who's Who 2023/Who Was Who*, <https://doi.org/10.1093/ww/9780199540884.013.U243891>, [13 July 2024]. J. Turing, "Alan Turing", *Shirburnian*, March 1980, pp. 18-21, <https://oldshirburnian.org.uk/wp-content/uploads/2019/01/1980-March.pdf>, [13 July 2024].

As a PhD student, Albert was exempt from call-up; yet, in 1941, Dr Uttley joined TRE's Group 13 as a Temporary Scientific Officer. Stationed at both Worth Matravers and Dunford House, Albert became a Temporary Senior Scientific Officer in 1943, and a Temporary Principal Scientific Officer in 1945. He developed radar training systems for pilots and aircrew, including a real-time cockpit visualisation display for the Type 19 airborne interception radar combat flight simulator, and a simulator for the airborne H2S ground scanning radar. Like Gold, Albert pioneered acoustic delay line information storage, and although Presper Eckert and John Mauchly filed a US patent for mercury delay lines in 1947, either Uttley or Gold may have priority in their use as practical storage mechanisms in complex electronic information systems.⁴²⁴ By 1945, Albert and F. C. Williams were collaborating to replace volatile mercury filled metal pipes with cathode ray tubes.

After the war, Albert remained as a civil servant and forged a largely successful career in government science. In 1945, he moved to TRE's Malvern headquarters, where, from 1947 to 1953, he led the design and development of the TRE Automatic Computer.⁴²⁵ In 1947, he was promoted to Senior Principal Scientific Officer, and, in 1951, he became a Deputy Chief Scientific Officer. Thereinafter he became Assistant Superintendent of the Physics Research Group, and then Superintendent of the Electronics Division. In 1953, TRE became the Radar Research Establishment (RRE), which Albert left in 1957 to join the NPL as both Deputy

⁴²⁴ J. P. Eckert, J. W. Mauchly, US patent US783328A, submitted 31 Oct. 1947, granted 24 Feb. 1953, Google Patents, www.patents.google.com/patent/US2629827, [16 June 2022].

⁴²⁵ Lavington, *Early British Computers*, p. 54.

Chief Scientific Officer, and the Superintendent of the CME Division. Albert transitioned the CME Division to the Autonomics Division in 1960, and left the NPL in 1966.⁴²⁶

William Grey Walter (1910-1977)

Grey was born in Kansas City. At five, his left-wing journalist parents warehoused him in England, and resumed their globe-trotting. After Westminster came King's, Cambridge, and a first in natural sciences, followed by an MA under Edgar Adrian from 1931 to 1935. Grey joined the Apostles in 1933. He was the only Ratio Club member who did, and also the only one with overt political affiliations. He maintained his communist sympathies during the war, and then gravitated through anarchism to anarcho-syndicalism via his AScW activism.

At Cambridge, Grey discovered both Pavlov's theories on conditioned reflexive responses, and Berger's EEG work. Following Adrian's endorsement of EEG, Grey rapidly became a world leader in its practical application. In 1953, Frederick Golla, the director of the Maudsley Hospital's Central Pathological Laboratory, asked Adrian to suggest someone who could develop clinical EEG applications for him. After Adrian's recommendation, Grey worked at the Maudsley from 1935 to 1939, with a short interlude at the Maida Vale

⁴²⁶ [Uttley, obituary], *Telegraph*, 17 Sept. 1985, p. 12. [Uttley, obituary], *Times*, 17 Sept. 1985, p. 32. "Biography: Dr Albert M Uttley", *Purbeck Radar*, http://www.purbeckradar.org.uk/biography/uttley_albert_m.htm, [13 July 2024]. D. M. Yates, "Annex A: People: A. M. (Pete) Uttley", *Turing's Legacy: A History of Computing at the National Physical Laboratory, 1945-1995*, (Science Museum, London, 1997), p. 312. "Uttley, Prof. Albert Maurel", *Who's Who 2023/Who Was Who*, <https://doi.org/10.1093/ww/9780199540884.013.U169978>, [13 July 2024]. "[TRE] Directors Chart", *Purbeck Radar*, <http://www.purbeckradar.org.uk/people/pdf/tre-chart-12Mar42.pdf>, [13 July 2024]. "Albert Maurel Uttley", *Geni*, <https://www.geni.com/people/Albert-Uttley/6000000014242559571>, [13 July 2024]. "King's College London Calendar: 1937-1938", *King's Collections*, <https://kingscollections.org/calendars/collection/1937-1938/page-333#page-header>, [13 July 2024]. "University of London: The Historical Record (1836-1926). Bachelor of Science: Honours and Higher Degrees: Internal Students", *British History On-Line*, <https://www.british-history.ac.uk/no-series/london-university-graduates/180-210#highlight-first>, [13 July 2024]. K. Moore, "The History of Flight-Sim", *GoFlight Technologies Inc.*, <http://www.goflightinc.com/flightsimhistory.shtml>, [13 July 2024]. H. Williams, G. D. Whitaker, "1952-TRE Automatic Computer, "TREAC"", *Malvern Radar and Technology History Society*, https://mraths.org.uk/?page_id=633, [13 July 2024].

Hospital for Nervous Diseases. In 1935, Grey also secured a Rockefeller Fellowship which, like Slater, he spent in Nazi Germany. Grey visited Berger at the Friedrich Schiller University, Otfried Foerster and Hans Altenburger at the University of Breslau's Neurological Research Institute, and A. E. Kornmüller and J. F. Tönnies in the Neurophysiology Department of the Kaiser Wilhelm Institute of Brain Research at Berlin-Buch. However, Walter's enthusiasms were for the clinical applications of EEG, not racialized eugenicist genetics.

In 1938, Golla became the director of the new Burden Neurological Institute (BNI), set in the Stoke Park Estate outside Bristol. Grey joined him. During the war, the BNI was subsumed by the EMS, and, although not a physician, as a clinician Grey was reserved from conscription. Nevertheless, Second Lieutenant Walter willingly joined the Home Guard and became notorious for his frequent and gleeful use of explosives. Although he was a pre-war member of the Peace Pledge Union, as for many others, the defeat of fascism prevailed over pacifism.

While at the Maudsley, Grey befriended his fellow neuroscientist Mary Brazier who invited him to the 1946 Boston EEG conference, and his fateful first meeting with Wiener. By then, Grey was already pivotal in the burgeoning international clinical EEG community. He founded the British EEG Society in the early forties, and promoted its scion of the Electrophysiological Technologists' Association.⁴²⁷ Grey also initiated the first International EEG Congress in London in 1947, and, in 1949, he was both co-founder of the International Federation of Societies for Encephalography and Neurophysiology, and founding editor of

⁴²⁷ Dr Grey Walter, "EPTA Genesis", (*"Proc EPTA*, Vol, 1, July 1950, No. 1"), [photocopy of journal article describing Walter's role in founding the Electrophysiological Technologists' Association, date and journal title handwritten on copy], SMG/NCC/BURD/D/1.

its journal, *Electroencephalography and Clinical Neurophysiology*. In 1947, his EEG work secured him a Cambridge ScD, and, in 1949, Aix-Marseilles University made him both an honorary MD and a professor. The Ratio Club politely ignored this elevation.

By 1949, Grey was in the second of his three co-habitational relationships, one of which was a wife swap. Grey openly practiced a flamboyant hedonism and a sexual freedom which was at odds with post-war British conservatism; he and McCulloch bonded.⁴²⁸

John Hugh Westcott (1920-2014)

John's father, also John, was a refrigeration engineer and a member of the Institute of Mechanical Engineers. Growing up on Whitehall Gardens in Chiswick, John discovered electronics and built shortwave two-way radios in his bedroom. At Wandsworth Grammar, he excelled at physics and matriculated with a London County Council university scholarship. However, John senior valued training over education, and John junior was

⁴²⁸ [Walter, obituary], Anon., *Times*, 9 May 1977, p. 16. R. Cooper, [Walter, obituary], *Nature*, Vol. 268, No. July 1977, pp. 383-84. D. H., [Walter, obituary], *Lancet*, Vol. 309, Iss. 5618, 8022, 28 May 1977, pp. 1164-65. G. P., [Walter, obituary], *Lancet*, Vol. 309, Iss. 8021, 21 May 1977, pp. 1113-14. H. W. Shipton, [Walter, obituary], *American Journal of EEG Technology*, Vol. 17, Iss. 3, 1977, p. 123. H. W. Shipton, [Walter, obituary], *Electroencephalography and Clinical Neurophysiology*, Vol. 43, Iss. 3, Sept. 1977, pp. iii-iv. W. Thomson, [Walter, obituary], *Telegraph*, 10 May 1977, p. 14. "Walter, William Grey: Curriculum Vitae", in Bates, John, A. V., and the Ratio Club, Wellcome Collection, GC/179/B.35/Box 12. K. Barrett, "Topsy Goes to Norway", *Ken Barrett*, 2017, <https://irp-cdn.multiscreensite.com/f89ff536/files/uploaded/TOPSY%20GOES%20TO%20NORWAY%20essay.pdf>, [13 July 2024]. P. F. Bladin, "W. Grey Walter, Pioneer in the Electroencephalogram, Robotics, Cybernetics, Artificial Intelligence", *Journal of Clinical Neuroscience*, Vol. 13, Iss. 2, Feb. 2006, pp. 170-77. W. A. Cobb, "E.E.G.: Historical, Personal and Anecdotal: Second Grey Walter Memorial Lecture, Runwell Hospital, Essex, on 27th Oct. 1979", *Journal of Electrophysiological Technology*, Vol. 7, No. 2, June 1981, pp. 58-66. R. Cooper, "A Random Walk Through the Work of Grey Walter", *American Journal of EEG Technology*, Vol. 16, Iss. 4, pp. 157-68. W. J. Freeman, "Walter, Grey", in L. Nadel, D. Chalmers, P. Culicover, R. French, R. Goldstone (eds.), *Encyclopedia of Cognitive Science: Vol. 4, Similarity-Zombies*, (Nature Publishing, London, 2003), pp. 537-539. P. Kellaway, "W. Grey Walter: A Memoir of an Extraordinary Man", *Journal of Clinical Neurophysiology*, Vol. 7, No.2, April 1990, pp. 157-62. P. St.John-Loe, "The Jackson Burrows Memorial Prize", *Journal of Electrophysiological Technology*, Vol. 13, No. 2, June 1987, pp. 85-94. R. Cooper, "Walter, (William) Grey". ODNB, <https://doi.org/10.1093/ref:odnb/38104>, [13 July 2024]. "Walter, William Grey", *Who's Who 2023/Who Was Who*, <https://doi.org/10.1093/ww/9780199540884.013.U160698>, [13 July 2024]. W. G. Walter, "My Miracle", *THEORIA to Theory*, Vol. 6, No. 1, Jan. 1972, pp. 39-50.

apprenticed at the Willesden factory of BTH, a large heavy engineering company with extensive interests in military electrical and electronic equipment. Despite his father, in 1938, John started a night-school electrical engineering degree at Battersea Polytechnic. After the BTH factory was evacuated to Rugby in 1940, John transferred to London University as an external student.

War offered John an opportunity to break free from the strictures of a menial apprenticeship, and, after graduating in 1941, he campaigned for change.⁴²⁹ Initially, BTH tasked him with developing a submarine detection system based on Patrick Blackett's ideas for a new magnetometer. However, in 1942, John was seconded to the ADRDE at Bawdsey Manor, where, in 1943, he was promoted from the technical grades to the scientific staff, the civilian equivalent of an elevation from the ranks to the officer corps. In 1944, he moved to ADRDE at Malvern, where he probably joined Rowe's Sunday Soviets. John developed the Shell-Splash coastal defence artillery system which used high resolution signals from short wavelength radar to automatically track the small and fast German torpedo boats. In a post-war reminiscence, he praised both Daniell and the Servo Panel, and noted their joint mediation of the ideas in Wiener's 'Yellow Peril' report.⁴³⁰

In 1945, John joined the Control Commission for Germany's scientific staff, and was duly despatched to appropriate German heavy-industrial electrical transmission equipment. The Russians beat him, and he was diverted to a team negotiating the further division of the spoils of war. However, unlike Pringle, he disliked staff work. In 1946, John started a PhD on

⁴²⁹ Husbands, Holland, "The Ratio Club", in Husbands, Holland, Wheeler, *Mechanical Mind*, p. 105.

⁴³⁰ J. H. Westcott, "20 Years After-A Review of Postwar Developments", *Electronics and Power*, Oct. 1965, p. 334.

servomechanisms under Willis Jackson at Imperial; where he would also meet Colin Cherry and Dennis Gabor, who joined the electrical engineering department in 1947 and 1948 respectively. John's supervision was problematic. Imperial lacked sufficient early expertise in servomechanisms, and Tustin and Porter did not arrive there until 1955. So, from 1946 to 1948, John spent three days a week at the Dollis Hill GPO Research Station.

On his own initiative, and with a meagre £500 Commonwealth Scholarship, John spent the 1948-1949 academic year at MIT researching servomechanisms. Here, he met Wiener, who gave him a pre-publication draft of *Cybernetics*, and Hendrik Bode, who worked at Bell Labs with Shannon and Nyquist. Bode, like Nyquist, had set some of the early foundations for both Shannon and Wiener's information theory, and John had already read his work, possibly at Dollis Hill.⁴³¹ By September 1949, John was finalising his PhD, and he was already practising a recognisably Wienerian form of cybernetics.⁴³²

Philip Mayne Woodward (1919-2018)

Philip grew up in Ipswich. After Ipswich Grammar, came Blundell's in Devon, followed by a mathematics degree at Wadham, Oxford on a Minor Scholarship. In 1941, the freshly graduated Philip joined TRE's mathematicians in Group 26 at Durnford House as a Grade 3 Assistant; a lowly technical grade which ranked above only a laboratory assistant. Although

⁴³¹ H. Nyquist, "Certain Factors Affecting Telegraph Speed", *Bell System Technical Journal*, Vol. 3, No. 2, April 1924, pp. 324-46. H. Nyquist, "Certain Topics in Telegraph Transmission Theory", *Trans. Amer. Institute of Electrical Engineers*, Vol. 47, No. 2, April 1928, pp. 617-44.

⁴³² R. Vinter, "John Westcott: Pioneer in the Field of Control Engineering", [Westcott, obituary], *Guardian*, 22 Dec. 2014, <https://www.theguardian.com/technology/2014/dec/22/john-westcott>, [13 July 2024]. "John Hugh Westcott", *Physics Tree*, <https://academictree.org/physics/peopleinfo.php?pid=757997>, [13 July 2024]. "Prof. John H. Westcott", *Department of Electrical and Electronic Engineering Imperial College*, <http://www.ee.ic.ac.uk/CAP/Staff/JHW/>, [13 July 2024]. D. Q. Mayne, "John Hugh Westcott", *Biographical Memoirs of Fellows of the Royal Society*, Vol. 61, Aug. 2015, pp. 541-54. R. Vinter, "Westcott, John Hugh", *ODNB*, <https://doi.org/10.1093/odnb/9780198614128.013.109453>, [13 July 2024]. "Westcott, Prof. John Hugh", *Who's Who 2023/Who Was Who*, <https://doi.org/10.1093/ww/9780199540884.013.U39400>, [13 July 2024].

oddly junior, Philip worked on discriminating between the radar energy reflected from the target, and that returning from extraneous environmental objects or leaking within the system. Initially, the signal was differentiated from the noise through electrical amplification of the cathode ray tube input. This increased the display brightness of the target trace, but still required the operator to visually identify, and filter, the residual screen clutter.

Philip solved the problem by replacing analogue amplification with mathematics. After theoretically reconstructing filtered historic output signals as expressions of probability density, he encoded the resulting probabilistic equations into the circuits converting returned radar energy into display images, and thus the operator's screen became less noisy because a real-time electronic processing system had mathematically reconstructed information. The electronic filter's first iteration processed the time interval indicating target range. The second, processed the Doppler frequency differential determining target velocity. Inadvertently, Philip had stumbled upon conditional inverse probability; knowing no more about Bayes in the eighteenth century, than he did about Turing and Good at Bletchley.

Philip's career charted the convolutions and contractions of British post-war military scientific research. In 1945, he was promoted to Scientific Officer in TRE's Mathematics Group, which he subsequently led. After which, he became Superintendent of the Computing Division, and then Deputy Chief Scientific Officer for the organisation overall. From 1953 to 1957, he served the Radar Research Establishment; whereas between 1957 and 1976, his employer was the Royal Radar Establishment. Then, until his retirement in 1979, he joined the Royal Signals and Radar Establishment. Philip accomplished all of this without leaving Malvern. In April 2000, the Defence Evaluation and Research Agency

(DERA) named a new building after him. DERA, the Malvern site, and the Woodward Building were privatised to QinetiQ in 2001.⁴³³

The Ratio Club: Gestations, Commonalities and Intersections

The Ratio Club was an exclusively male preserve, and unlike the contemporaneous Macy Conferences, it accommodated neither philosophers nor anthropologists. Bates' group were all either scientists, clinicians, mathematicians or engineers. As Clark noted, it therefore lacked the intellectual depth and capacity to accommodate the broader abstractions that Craik, for instance, might have contributed.⁴³⁴ Whilst its gendered homogeneity was contemporaneously normative, elsewhere, the Ratio Club was, in similarly contemporary terms, unusually diverse. Although they were all graduates, apart from Shipton, nevertheless, the Ratio Club's members spanned a broad spectrum of stratification within the middle class. The coherences of the Ratio Club were epistemological and experiential, not sociological. Neither was the Ratio Club driven by either interventionist will or improving zeal. It existed to satisfy the internalised intellectual appetites of its members, not to externalise a cause. There was no collective effort to promulgate cybernetics as a

⁴³³ "Scientist who Coined Phrase 'Artificial Intelligence' Dies", [Woodward, obituary], *Worcester News*, 10 April 2018, <https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:5S2W-RSP1-JD39-X010-00000-00&context=1519360>, [13 July 2024]. "Dr Philip Mayne Woodward, DSc: Obituary", [Woodward, obituary], *Old Blundellian Club*, <https://my.blundells.org/obclub/obclub/obituaries/woodward-pm.htm>, [13 July 2024]. D. Bateman, "Philip Mayne Woodward DSc, FBHI: Mathematician, Scientist and Horologist:", [Woodward, obituary], *Horological Journal*, Vol. 160, May 2018, pp. 202-5. S. Bond, S. Woodward, "Dr. Philip Mayne Woodward, DSc, Applied Mathematician who Coined the Term 'Artificial Intelligence'", [Woodward, obituary], *IEEE Aerospace and Electronic Systems Magazine*, Vol. 33, Iss. 4, April 2018, pp. 55-7. P. Woodward, *My Own Right Time: An Exploration of Clockwork Design*, (Oxford University Press, Oxford, 1995). P. Woodward, "Philip Woodward on Philip Woodward: Radar, Clocks and Coincidences", *Significance*, Vol. 9, Iss.1, 8 Feb. 2012, pp. 35-9. "Biography: Philip Woodward", *Purbeck Radar*, http://www.purbeckradar.org.uk/biography/woodward_philip.htm, [13 July 2024]. "Philip M. Woodward", *IEEE Dennis J. Picard Medal Citation*, <https://ieee-aess.org/contact/philip-m-woodward>, [13 July 2024]. "Philip Mayne Woodward", *Malvern Radar and Technology History Society*, https://mraths.org.uk/?page_id=2796, [13 July 2024]. "[TRE] Directors Chart", *Purbeck Radar*, <http://www.purbeckradar.org.uk/people/pdf/tre-chart-12Mar42.pdf>, [13 July 2024]. "School History", *Blundell's*, <https://blundells.org/senior-school/about-us/school-history>, [13 July 2024]. "University News: Oxford December 13", *Times*, 14 Dec. 1937, p. 13.

⁴³⁴ Clark, *Enclosing*, p. 97.

universal science, nor to promote it as either a path to ideological enlightenment, or a contribution to the arc of positivist progress. When individual Ratio Club members were performatively cyberneticist, this was constitutionally incidental to their membership.

Except for Gold and Walter, the Ratio Club were all British born. Seventeen were English; and two, MacKay and McLardy, were Scottish. Of the English; fourteen were southerners, Dawson and Pringle were Mancunians, and Hick hailed from the north-east. Of the southerners; nine were Londoners, and four hailed from points within a hundred mile radius of the capital, except for Woodward who came from Ipswich. Technically, MacKay and McLardy render the Ratio Club compositionally British. Substantively, however, it was English, with a predominantly southern membership nucleated around a metropolitan core. Whilst unremarkable for a contemporary congregation of the intellectual elite, the innate metropolitan bias of the Ratio Club contributed to its demise, as those based in Malvern, Bristol, Gloucester, Cambridge and Manchester wearied of the expense and time spent attending meetings in London. Ironically however, only nine out of the twenty-one Ratio Club members lived and worked in the capital.

Shipton notwithstanding, the Ratio Club was hermetically middle class. However, inasmuch as the historical typification of the British middle class expressed a sociological unity, or at least a notional distinction between its two flanking strata, it also encompassed considerable secondary stratification within its distant and liminally porous edges. The ostensible middle class cohesion of the Ratio Club refracted through this secondary stratification. At one edge, Ratio Club members hailed from the middle class penumbra where the working class were neighbours, not servants. At the other, it contained the scion of minor nobility.

There were also three Ratio Club members where biographical paucity necessitates inference; and one, Hick, where even inference is unsound. Hick qualified from Durham in 1938, when Durham's College of Medicine was in Newcastle, and Durham was the only English university beyond Leeds. Some, but not all, of the medically trained Ratio Club members inherited medicine. Likewise, not all of them enjoyed the wealth of the Barlow or McLardy families. The limit of supposition is that Hick was clever and from the north east.

The inferential three, Little, Sholl and Uttley, all lived and studied in London. Little's degree was in physics, Uttley's was in mathematics, and Sholl probably trained in mathematics before becoming a mathematical neurophysiologist. None of them attended university residentially. The pattern suggested three grammar school high-flyers from lower-middle class families who matriculated sufficiently well in technical subjects to earn coveted local authority university scholarships, whilst continuing to live at home. The cases of Ashby and Westcott were similar, Ross' father was a commercial traveller who rose to sales management and John's was a chartered mechanical engineer. Both were the first graduates in their families. It is probable that the others in this lower-middle class cohort of six made the same familial educative breakthrough. *Cybernetics'* difficult technocratic iconoclasm drew strong and independent minds with roots outside the intellectual establishment.

Six Ratio Club members inhabited the middle class median. Bates, MacKay and Pringle were fathered by general practitioners, Dawson by a pathologist, and Rushton by a dentist. Conformant to solid middle class respectability, all except MacKay were consigned to boarding school. Bates went to Rugby, Dawson was despatched to Repton, Pringle was delivered to Winchester, the Rushton's chose Gresham's, and the Woodward's opted for Blundell's. Money and geography combined to constrain MacKay's schooling closer to

home. General practice in a moribund fishing village near the northernmost tip of Scotland was neither lucrative, nor conducive to mobility. Bates, Dawson and Rushton initially followed their fathers into medicine, and Pringle remained at least paternally proximate by choosing zoology. However, instead of following his father into an atrophying practice in a shrivelling community, MacKay chose physics and the wider world. The paternal proximity of Woodward's mathematics degree is unknown. His life-pattern, and the silence about his domestic intellectual provenance, suggested a prosperous middle class Ipswich family rooted in a commercial or upper-managerial profession, rather than one requiring academic training.

Five Ratio Club members were steadfastly upper-middle class. Turing and Barlow belonged to families with generationally storied pedigrees. Sara Turing's biography of Alan roots the Turings in the early fourteenth century, and, whilst for him, the Turing baronetcy had followed an adjacent line, vicissitudinous heredity bridged the narrow gap for his brother.⁴³⁵ Horace, a scion of the Darwin-Wedgewood dynasty, came closer still to titular gentrification when his elder brother inherited the Barlow baronetcy.⁴³⁶ McLardy was titleless, but both the Netherfield stately home, and his life-pattern, suggested lairdship. Merton's father had been President of the British Astronomical Association, and Vice President of the Royal Astronomical Society, and Slater's was Principal of Ruskin, Oxford. Although a Scottish branch of the Pringle family held a baronetcy, its lineage diverged from the Mancunian Pringles, and a separate Pringle baronetcy of Pall Mall became extinct in 1782. Thus, although some sources erroneously elevated him, John was excluded from this cohort.

⁴³⁵ S. Turing, *Alan M. Turing: Centenary Edition*, (CUP, Cambridge, 2012), p. 3.

⁴³⁶ Whilst hereditary, baronetcy's are not within the peerage and baronets are thus commoners.

Three Ratio Club members were simultaneously de facto inhabitants of the British middle class, and also inescapably Other. The emigree, Gold, was marked as much by his familial familiarity with enormous wealth as by his Austrian accent, his European sensibilities and his Jewish heritage. Despite Good's conspicuously assimilative nominative anglicisation, his performatively bohemian father was equally conspicuously displayed in his famous shop alongside the British Museum.⁴³⁷ Good was almost as close to being a Jewish refugee as Gold. Whilst Walter was not a refugee, he was similarly rootless as his American mother and British father had delegated their parenthood to an English boarding school when he was little more than a toddler.⁴³⁸ For Walter, public school established at least some grounds of experiential commonality with his Ratio Club colleagues. Less so for Good, however, as he attended a day school with deep connections to London's Jewish community; and, not at all for Gold, who finished his schooling skiing in Switzerland. Perhaps the scientific Otherness of *Cybernetics* exercised a particular appeal for this cluster of Ratio Club outsiders.

Shipton was the only working class Ratio Club member. He attended neither grammar school nor university, and was the only one in military service without a commission. Given contemporary sociological strictures, Shipton's admittance to the Ratio Club is remarkable in itself. Perhaps Walter's left-wing sensibilities and his personal sponsorship of Shipton were instrumental. Indeed, without his chance meeting with Walter, and the resulting encounter with Janet, it is difficult to imagine Harold's post-war life differing from any other skilled member of the working class. It is permissible to imagine Shipton being a subject

⁴³⁷ J. Benjamin "A Curious Little Shop in Bloomsbury and the Impact it Has Had on My Life", www.thejva.org/articles/curious-little-shop-bloomsbury-and-impact-it-has-had-my-life, [1 July 2022].

⁴³⁸ R. Cooper, "William Grey Walter", *ODNB*, doi.org/10.1093/ref:odnb/38104, [1 July 2022].

of, and perhaps subjected to, the barbs and sneers of snobbery from some of the Ratio Club's more patrician members.

Educationally, thirteen Ratio Club members endured public schools, typically as boarders. Five attained grammar school, and two attended local authority schools.⁴³⁹ Eleven of them graduated from Cambridge, one from Oxford, four from London, and one each from Manchester, Durham, St Andrews and Glasgow. Ratio Club meetings must sometimes have felt like Cambridge common rooms or public school debates. Eleven members took degrees in life sciences; nine in medicine and two in biology.⁴⁴⁰ Five were mathematicians, two were physicists, and two were engineers; one electrical and one mechanical. Therefore, including the non-graduate Shipton, ten Ratio Club members practiced mathematics or mathematically based disciplines; and so, at least by initial training, the Ratio Club was about evenly split between hard and soft science. By September 1949, the balance had shifted marginally towards life science. Sholl now practiced neurophysiology, and Uttley had a PhD in psychology; although both remained mathematically inclined. Arguably, Turing also gravitated towards mathematical biology with his morphogenesis work, which accelerated after he joined the Ratio Club. Constitutionally, the Ratio Club's inter-disciplinarity was limited to liaison between its core life scientists on one hand, and the adjunct physical scientists, engineers and mathematicians on the other. The Ratio Club was less intellectually adventurous than its American Macy counterpart, and less transgressive of disciplinary boundaries than *Cybernetics* exhorted. Culturally, the Ratio Club belonged to its Cambridge neurophysiologists.

⁴³⁹ Table 3: Ratio Club Educational Backgrounds. Hick is missing from this tally.

⁴⁴⁰ Table 4: Ratio Club Primary Training.

Most of the Ratio Club's members encountered the war as youths.⁴⁴¹ In September 1939, eight were teenagers, eight were in their twenties, and only five were over thirty. Of those below thirty, eight were undergraduates for at least part of the war, and Merton did not qualify until 1946.⁴⁴² Rushton also remained at Cambridge, as both medical students, and their teachers, avoided conscription. Otherwise, all of the Ratio Club saw medical, military or scientific service.⁴⁴³

Those who became boffins tasted the intellectual exhilaration and sociological empowerment exemplified in Rowe's Sunday Soviets. They were the warrior technocrats who spoke scientific truth unto establishment power with the bravado of youth and the zeal of existential imperative. Their maturing personalities, and strengthening intellects, were intoxicated by adrenaline and tempered in vicarious combat. Fittingly, given the voracity and promiscuity of its epistemological appetite, radar consumed eight of the Ratio Club's boffins. Gold was a mechanical engineer, Westcott an electrical engineer, and Shipton an electronics technician. Little and McKay were physicists, and Woodward and Uttley were mathematicians. They all thrived amidst intellectual and social novelty; Pringle, a biologist, especially so. Circa Thirty-eight percent of the Ratio Club worked amidst the proto-cybernetic epistemologies and ontologies of radar research and development.

The weaponization of radar iterated a fusion of synthetic analogues of biological sense organs, proprioceptive muscle motor control, and kinaesthesia, into complex socio-technical systems in which human and machine agency was functionally equivalent, and information

⁴⁴¹ Table 5: Ratio Club Comparative Ages, 1939.

⁴⁴² Excluding: Westcott, part-time student; Hick, graduated 1938, joined the RAMC 1941; Sholl, graduation date unknown; Uttley, graduated 1936, PhD awarded 1940.

⁴⁴³ Table 6: Ratio Club War-Work.

exercised systemic control. As with the other newly complex ontologies of war, radar extended the systemic fungibility of humans and machines from familiar industrialisations of muscle, and into mechanised augmentations of sensing, cognition, communication and control. For the Ratio Club's radar cohort, *Cybernetics* offered a scientifically realist account of their recent lived experiences amidst the generative epistemologies for ontologies whose advancing systemic capabilities rendered human agency progressively problematic. As biological faculties were routinely surpassed, both mechanically and electronically, so naturalistically normative assertions of humanistic ascendancy dissolved in the ontological necessity flowing from the imperative existential teleology of weaponised systems. When machines replaced humans, especially as analogues of neurological instrumentality and agency, systems improved. Machines saw one another at night. They conversed silently and imperceptibly; identifying themselves as friend not foe without troubling the already taxed agency of their human sub-systems. Machines directed machines in safe flight. Some flew themselves. Others operated guns with tireless accuracy. Increasingly, machines predicted; perhaps, some humans thought, machines might soon think.

The next largest group of Ratio Club boffins were immersed in the practices of PR. Although rooted in the crafting of the Dowding System's socio-technics, PR quickly extended beyond the synthesis of humans and radar, and generalised into a methodology for fusing humans and machines as systemically optimised teleological symbiotes across a wide range of ontological forms. Alongside its theoretical impetus to proto-cybernetics, PR materialised the behaviourally functionalist fungibility of humans and machines in the form of the servomechanisms that were deployed extensively in tanks, artillery and aircraft. Thus, it was servomechanism research particularly that constituted the sociological and intellectual nexus which assimilated Craik, Bates, Hick and Uttley, and connected them with Porter and

Tustin. Tangentially, this nexus also connected Craik with Walter and Barlow, who whilst not linked with servomechanisms or each other, were nevertheless imbricated in PR. MacKay, Westcott and Little may not have found the Servo Panel, but they certainly deployed servomechanisms in the course of their work on gun actuators. Excluding Walter, and accepting both the overlap between servomechanism work and PR, and the consequent double counting of Little, MacKay, Uttley and Westcott, the extended PR nexus encompassed seven Ratio Club members: or some thirty-three percent of the total. Taken together, and excluding the double counting allowed for in the PR nexus; radar, PR and servomechanism research accounted for around fifty-two percent of the Ratio Club's membership.

Bletchley's secrecy isolated Good and Turing intellectually, and sociologically shrouded them from proto-cybernetic formations like the Servo Panel. Nevertheless, they too were driven by the existential imperatives of combat with, and against, the burgeoning ontological and epistemological complexities of total war. For them, the conflict of weaponised complexity was waged through mathematical abstractions of symbolically expressed human thought. They became combat epistemologists; inventors of new mathematical techniques as epistemological defences against new epistemological weapons. The conceptual correlations between the probabilistic techniques of sequentially conditional predictive analysis which they developed at Bletchley, and the probabilistic mathematics of stochastically indeterminate systems which Wiener proposed in *Cybernetics* were striking. As was the overlap between the Bayesian mathematics of Good and Turing, and Woodward's statistical radar signal discrimination techniques. In the extremis of war, the indeterminacies of complex human reality were breaking through the illusory linear

certainties of the Laplacian universe, and overwhelming their embodiments in the deterministic mechanisms of the Industrial Revolution.

Like Woodward, Turing embodied probabilistic mathematics in mechanism. However, unlike occult circuits within inert radar electronics, Turing's Bombes made the functional congruity between machines and brains motile and manifest. Moreover, whilst radar and servomechanisms analogized mechanical organic physiologies, the Bombe performatively and explicitly instrumentalised the functional equivalence between machines and mentality. Turing's Bombe mechanised and automated the trial and error logic of problem solving; it guessed. Together, the Bombe and Flowers' Colossus combined to concretise Turing's radical pre-war thought experiment. The universal computing machine was no longer merely an abstraction authored to resolve a deep conundrum of mathematical philosophy. If computation was formalised thought, and if machines could compute, then machines could think. Although unseen by outside eyes, those within Bletchley gazed out. Towards the end of the war, Turing visited Gold who, as an obscure radar researcher, knew nothing of Bletchley's star cryptanalyst. Gold surmised that Turing had learnt about his mercury tube memory work, and he vividly recalled Turing's enthusiastic prediction that computers would incite a social revolution by replacing human brains on a massive scale.⁴⁴⁴

The remainder of the Ratio Club spent the war in medicine, although not all of this diffuse cohort were practitioners; Sholl was a researcher, Rushton was an educator, and Merton was a student. This brought Sholl under the aegis of the MRC Committee which sponsored the UCL unit where he worked on developing techniques for physically repairing traumatic

⁴⁴⁴ T. Gold, *Taking the Back of the Watch: A Personal Memoir*, S. Mitton (ed.), (Springer, Berlin, 2012), pp. 33-4.

nerve damage; a subject which he wrote on in the MRC's official post-war report.⁴⁴⁵ Whilst Sholl was not a member of the MRC Nerve Injuries Committee itself, J. Z. Young was, and it was probably through this connection that they met and became friends.⁴⁴⁶ This link may also have facilitated Young's unexpected move from Oxford to his post as professorial head of Sholl's UCL department in 1945. Notably, Young served on this committee alongside Geoffrey Jefferson, the eminent Manchester University neurosurgery professor who would excoriate cybernetics in his 1949 Lister Oration.⁴⁴⁷

Ashby, Slater, Walter and Dawson all practiced civilian brain medicine during the war. Thus, with the addition of Hick and McLardy, six Ratio Club members -or some twenty-three percent of the total- were directly involved in medical practice.⁴⁴⁸ Whilst Ashby worked as a neuropathologist despite his physicians' licence, Walter practised clinical neurology despite his lack of medical qualifications. For his part, Dawson served as an RAF medical officer from 1939 to 1941, and then became a working neurologist during his post-tuberculosis convalescence. Hick was an Army doctor from 1941 to 1944, after which he joined Craik at Cambridge, where he turned first to PR, and then to psychiatry. McLardy spent the entire war in uniform. In 1946, he embraced psychiatry and joined the Maudsley, where he was close to Slater, Bates, Merton and Dawson, at the National Hospital. Although Dawson's commitment to neurology predated the war, tellingly, McLardy and Hick both

⁴⁴⁵ R. E. Bowden, D. A. Sholl, "Part II: Rates Of Regeneration", in H. J. Seddon (ed.), *Peripheral Nerve Injuries: By The Nerve Injuries Committee of the Medical Research Council: Privy Council Medical Research Council Special Report Series, No. 282*, (HMSO, London, 1954), pp. 16-24.

⁴⁴⁶ J. Z. Young, "Exact Study Of The Body", *Times: Supplement on University College London*, 3 March 1965, p. v.

⁴⁴⁷ "Nerve Injuries Committee", in Seddon, *Peripheral Nerve Injuries*, p. iii. G. Jefferson, "The Mind of Mechanical Man: An Oration on 9 June 1949 Upon Receipt of the 1948 Royal College of Surgeons' Lister Medal", *BMJ*, Vol. 1, No. 4616, 25 June 1949, pp. 1105-10.

⁴⁴⁸ The remaining twenty-three percent was accounted for by Rushton, Sholl, Merton, Good and Turing. The residual 0.42% was a rounding artefact.

turned to mind medicine after practicing as general military medical officers. All of the Ratio Club's medics experienced the literal and figurative madness of war in settings which rendered them receptive to a post-war epistemology that offered a scientific framing of mental illness. For them, *Cybernetics* offered a rationalist diagnosis of madness as a mathematically comprehensible disequilibrium of an otherwise self-regulating adaptive mechanism, caused by empirically observable dysfunctions of material mechanisms.

War psychiatry strengthened Slater's already deep pre-war commitments to somatic therapies and mental materiality, and his post-war career flourished amidst the new status afforded to psychiatry after its manifest military utility. In 1944, Slater consolidated both his kudos, and that of his particular professional practices, with the publication of *An Introduction to Physical Methods of Treatment in Psychiatry* which drew heavily on the authority of his war-work and became a standard university text.⁴⁴⁹ However, Slater's motives for joining the Ratio Club were unclear, as was his commitment to cybernetics itself. Perhaps, insofar as *Cybernetics* mathematised the materiality of mind, it served his conception of mechanistic mentality. Or, perhaps it validated his eugenicist commitments by suggesting that through the unity of matter and mentality, breeding better brains would breed better minds. Certainly, any assertion of the physicality of mind justified his cherished Heroic surgical and chemical interventions. Slater remained at the Sutton throughout the war, and his likely gateway to the Ratio Club was his 1946 appointment as a clinical psychiatrist at the National Hospital where Bates, Dawson and Merton also worked. Whilst his seniority jarred with Bates' professorial prohibition, his recruitment may have been expedient in securing the use of hospital resources for Ratio Club meetings.

⁴⁴⁹ W. Sargant, E. T. O. Slater, *An Introduction to Physical Methods of Treatment in Psychiatry*, (Livingstone, Edinburgh, 1944).

In common with his Ratio Club colleagues, Ashby scorned the pseudo-scientific impressionism of psychotherapy. However, whereas Slater dispensed somatic therapies in place of word-play, Ashby was drawn to theorise about the underlying materialist pathology of mental illness and, thus, about the materiality of mind itself. As early as 1928, he had hypothesised that synapsial activation alone created thought.⁴⁵⁰ By 1939, he had ventured beyond nature, and imagined synthetic self-adaptive life-forms that would be behaviourally indistinguishable from their biological counterparts.⁴⁵¹ He started designing the mathematical models for his Homeostat in 1945, and by 1948 he had built it.⁴⁵² Like many other Ratio Club members, Ashby found proto-cybernetics, and then *Cybernetics*, through brain science. However, he began his version of this intellectual journey well before any of the others, and he travelled most of the way towards cybernetics in intellectual and social isolation from them. The war nourished Ashby's proto-cyberneticist ideas, but it did not initiate them.

As well as advancing somatic psychiatry, the war also promoted the medicalisation of EEG as a neurological diagnostic instrument. The ability to read the living brain's electrical activity promised to unveil the operational mechanics of physicalist mentality. Inevitably, Walter took centre stage amidst the post-war emergences of interest in this new brain scanning technology. In May 1941 the MRC convened an EEG meeting which he

⁴⁵⁰ Ashby, *Journal*, 7 May 1928, p. 0001, RADA/JOURNAL, www.rossashby.info/, [5 June 2022], <https://ashby.info/>.

⁴⁵¹ Ashby, *Journal*, 25 April 1939, p. 0580, RADA/JOURNAL, www.rossashby.info/, [5 June 2022], <https://ashby.info/>.

⁴⁵² Ashby, *Journal*, Vol. 9, 12 Sept. 1945, pp. 2004-5, RADA/JOURNAL, www.rossashby.info/, [5 June 2022], <https://ashby.info/>.

attended.⁴⁵³ Writing to Edgar Adrian in October 1942, he mentioned his membership of a new informal MRC EEG sub-committee, and reported a meeting about a portable EEG machine at the National Hospital where he also noted meeting Dawson, probably for the first time.⁴⁵⁴ Denis Hill and Denis Williams were also there. Hill was using EEG at the Sutton, under Slater.⁴⁵⁵ Hill and Walter had first met in 1936.⁴⁵⁶ Williams, then an RAF Medical Officer, had first overlapped with Dawson at medical school in Manchester, and then also perhaps at an EMS military head injuries hospital in a requisitioned Oxford college where J. Z. Young also probably worked.⁴⁵⁷ In 1946, Williams became a physician to the National Hospital. It was Walter's early commitment to EEG that brought him to the epistemologies and sociologies of proto-cybernetics, and, his youth notwithstanding, by the time the Ratio Club convened, he had garnered considerable professional seniority within the tightly knit and highly energised community of his fellow practitioners.

EEG also brought Dawson his friendship with Walter, and his 1944 appointment at the National Hospital, two years in advance of Bates. In 1943, the informal 1942 MRC EEG sub-committee, which Walter had in fact convened, became the EEG Society and Dawson joined both.⁴⁵⁸ Dawson's path, from convalescence in Cheshire to EEG practice in London, was paved by Walter. Typically, for Walter, business and pleasure merged. By summer

⁴⁵³ Walter, "EPTA Genesis", SMG/NCC/BURD/D/1.

⁴⁵⁴ Letter, Walter to Adrian, 8 Oct. 1942, SMG/NCC/BURD/A/6.

⁴⁵⁵ "Printer, apparently home-made, for 3-channel Grass electroencephalograph (EEG) used by Dr William Sargent and Dr Dennis Hill at the Maudsley Hospital in London and at Belmont Hospital (Sutton Emergency Hospital), 1940-46", www.collection.sciencemuseumgroup.org.uk/objects/co8362560/prINTER-APPARENTLY-home-made-for-3-channel-grass-electroencephalograph, [6 July 2022].

⁴⁵⁶ "Sir J. D. N. Hill", *Inspiring Physicians [Munk's Roll]*, www.history.rcplondon.ac.uk/inspiring-physicians/sir-john-denis-nelson-hill, [6 July 2022].

⁴⁵⁷ "D. J. Williams", *Inspiring Physicians [Munk's Roll]*, www.history.rcplondon.ac.uk/inspiring-physicians/denis-john-williams, [6 July 2022]. M. F. Wiener, J. Silver, "St Hugh's Military Hospital (Head Injuries): Oxford 1940-1945", *J. Royal Coll. Physicians of Edinburgh*, Vol. 47, Iss. 2, June 2017, pp. 183-89.

⁴⁵⁸ "EEG Society", www.collection.sciencemuseumgroup.org.uk/people/ap28640/the-EEG-society, [7 July 2022].

1943, Dawson and Walter's letters were switching, intratextually, from the personal to the professional.⁴⁵⁹ In one, Dawson seamlessly mingled EEG business, descriptions of bomb damage to his new London flat, and his trepidation about the deadly V1s.⁴⁶⁰ In October 1947, the friends jointly planned their attendance at a London meeting of the Neurological Club.⁴⁶¹ And, in 1944 and 1945, they co-authored papers on the design and operation of EEG devices.⁴⁶² By 1948, they were both leading figures in the burgeoning institutions that were coalescing around the clinical use of EEG, and Walter's charisma.

As they formed, these new EEG institutions helped to weave the wider networks which further facilitated the Ratio Club's creation. At Walter's instigation, the British EEG Society catalysed the International EEG Society; and, its first incarnation in July 1947, was organised by Walter, chaired by the British EEG Society's president Edgar Adrian, and held at the National Hospital.⁴⁶³ Walter's papers contain only fragments about the various EEG formations he activated. He was neither an assiduous archivist, nor a meticulous record keeper. Nevertheless, despite the absence of delegate lists, it is plausible that several future Ratio Club members attended the July 1947 inauguration of the International EEG Society. By 1946, Bates, Merton, Dawson and Slater had all arrived at the National Hospital. Equally, Adrian's presence may have attracted Barlow, his new PhD student, and both the

⁴⁵⁹ Letter, Walter to Dawson, 11 Aug. 1943, SMG/NCC/BURD/A/6.

⁴⁶⁰ Letter, Dawson to Walter, 17 July 1944, SMG/NCC/BURD/A/6.

⁴⁶¹ Letter, Walter to Dawson, 16 Oct. 1947, SMG/NCC/BURD/A/6.

⁴⁶² G. D. Dawson, W. G. Walter, "The Scope and Limitations of Visual and Automatic Analysis of the Electroencephalogram", *J. Neurology, Neurosurgery and Psychiatry*, Vol. 7, Nos. 3-4, July 1944, pp. 119-33. G. D. Dawson, W. G. Walter, "Recommendations For The Design And Performance Of Electroencephalographic Apparatus", *J. Neurology, Neurosurgery and Psychiatry*, Vol. 8, Nos. 3-4, July 1945, pp. 61-4.

⁴⁶³ M. R. Nuwer, C. H. Lücking, Chapter 1, "1947-1949: The Founding Years", in M. R. Nuwer, C. H. Lücking (eds.), *Wave Length and Action Potentials: History of the International Federation of Clinical Neurophysiology: Supplements to Clinical Neurophysiology*, Vol. 61, (Elsevier, Amsterdam, 2010), pp. 3-10, [doi.org/10.1016/S1567-424X\(10\)61001-X](https://doi.org/10.1016/S1567-424X(10)61001-X), [7 July 2022].

subject and the social network would have interested Sholl, McLardy, Ashby and Rushton. All of them were attuned to the deepening interest in EEG's instrumentalization for neurological and psychiatric medicine and research. Undoubtedly, the intersection between the EEG Society and the Ratio Club was inhabited by more than Dawson and Walter.

EEG encouraged the materialist neurological theories of mind held across the Ratio Club's membership. In his pre-war Gifford Lectures, Charles Sherrington, the venerable Oxford physiologist, famously declared the brain to be an 'enchanted loom'; thereby conjuring mystery to obfuscate scientific, and personal, ignorance about the putative organ of thought.⁴⁶⁴ To those with commitments to a neurophysicalist mind, EEG promised a rationalist rebuttal of the metaphysical quasi-mysticism evoked by Sherrington's poetic evasion. Before EEG, the brain was scientifically impenetrable. Operationally, it was observationally inert. Post-mortem, dissection revealed nothing of its mechanics, and too little of its structure. In life, the mind's neurophysiology was as occluded as in death. Now, however, the brain's secret workings could be quantised, statiscised and visualised. As Walter observed, just as radar was an electronic eye on the sky, so EEG now cast an electronic eye on the brain.⁴⁶⁵ Ostensibly, empiricism would shatter enchantment.

EEG also presaged Wiener's assertion of the mathematical and behavioural isomorphism between computers comprising electronic digital circuits, and computers comprising biological digital circuits. The electronics of EEG worked on the brain because of this isomorphism. Hence, *Cybernetics* cited EEG as evidencing both, Walter's assertions of a

⁴⁶⁴ C. Sherrington, *Man on his Nature: The Gifford Lectures, Edinburgh: 1937-8*, 2nd edn., (Pelican, London, 1955), p. 187.

⁴⁶⁵ W. G. Walter, "Electroencephalography", *Endeavour*, Vol. 8, No. 32, Oct. 1949, reprint, BURD/D/1.

neurological synapsial scanning mechanism underpinning perceptual recognition of universals, and Wiener's argument that this biological mechanism was electronically replicable using cathode ray tubes as computational memory.⁴⁶⁶ For several Ratio Club members, *Cybernetics* theorised a scientific positivism that explained and extended EEG's instrumentality. Wiener proposed using synthetic isomorphic stochastic analogues to observe and analyse the otherwise opaque black-box behaviours of their equivalent neurological systems. He hoped that EEG's mathematised mind representations might help design these electronic brain analogues. The amenability of EEG readings to computational statistical analysis, such as that performed by the frequency analyser which Walter demonstrated in Boston in 1946, seemed to support Wiener's ideas of computational and cognitive isomorphism. Given his contention that probabilistic observational analysis might predicate governing the behaviours of stochastic systems, a melding of cybernetics and EEG suggested a potent new medico-scientific praxis for neurophysiology and psychiatry.

The Fellow Travellers: Biographical Flesh

Focussing merely on the Ratio Club would conceal more than it revealed about the nature of the wider British cybernetics experience. The Ratio Club was nucleic, but not totalising; and neither was it uniquely significant. The intellectual locus of the Ratio Club's inductions of cybernetics coalesced around constructions of a material mind; and, whilst this was an important and independent feature of wider British cybernetics, it also co-existed with cybernetics influenced constructions of information theory, and with mediations of cybernetics beyond brain science. Consequently, the next two sections profile collections of agents within British cybernetics who operated beyond the Ratio Club. This both

⁴⁶⁶ Wiener, *Cybernetics*, p. 165-6.

individuates the embodiment of this wider experience, and specifies some of the ways in which proto-cybernetics constituted it. My categorisation of these agents typifies their operant epistemological location. Fellow Travellers merely assimilated elements of *Cybernetics* into their intellectual practices; without becoming cyberneticians. Whereas, for the Other Cyberneticians, *Cybernetics* catalysed a life-changing intellectual epiphany. Ironically, most Ratio Club members would otherwise have been designated as Fellow Travellers.

I have excluded the neurologist Jack Cowan who was, as Husbands has recorded, strongly influenced by *Cybernetics* early in his career.⁴⁶⁷ He was a school pupil in 1949, and an Edinburgh physics undergraduate until 1955. He encountered Gabor, Porter and MacKay whilst working for Ferranti and attending Imperial for a year; and, he met Ashby, Uttley and Walter briefly at Namur in 1956. He attended MIT from 1958 to 1962, where Shannon, Wiener and McCulloch taught him. From 1962 to 1967, he re-joined Imperial, spending much of 1967 with Uttley at the NPL before emigrating to America. Cowan intersected with British cybernetics, but on balance, and for my chronology, he belongs more to America.

Giles Skey Brindley (1926-)

Giles entered Downing, Cambridge, as a war-time medical student, and was probably taught by Rushton. Qualifying in 1951, he remained at Cambridge, conducting physiological research. From 1952 to 1954, he undertook National Service. Initially, he served as an RAF Medical Officer in Norfolk. Then, he was posted to Farnborough, where he researched aviation medicine, developed protective clothing for aircrew, and investigated the effects of

⁴⁶⁷ P. Husbands, "An Interview with Jack Cowan", Husbands, Holland, Wheeler (eds.), *Mechanical Mind*, pp. 431-46.

fast flight on vision. Returning to Cambridge, he researched the neurological mechanisms of colour vision, and the conversion of photic stimuli into nervous activity. He remained at Cambridge until 1968.⁴⁶⁸ Giles was a guest at the Ratio Club's 1952 Cambridge meeting. In the 1970s he pioneered radical forms of neurologically integrated and computer assisted human prosthesis; creating, in effect, cyborgs.⁴⁶⁹

(Edward) Colin Cherry (1914-1979)

Depression denied Colin university. So, in 1932, he joined the General Electric Company's (GEC) Hirst Research Centre as an assistant. Then, in 1936, a night-school degree in electrical engineering via Northampton Polytechnic elevated him to researcher. GEC seconded him to war-time military research, probably at RRDE, Malvern. In 1945, he began lecturing at what was then the Manchester Municipal College of Technology, and, in 1947, he moved to the electrical engineering department at Imperial College, London.⁴⁷⁰ He spent 1952 at MIT with Wiener. A DSc and a readership in telecommunications at Imperial followed in 1956; then a professorship in 1958. Colin deployed information theory to analyse socio-technical communications systems, and he trailblazed popular science

⁴⁶⁸ J. Kan, T. Z. Aziz, A. L. Green, E. A. C. Pereira, "Biographical Sketch: Giles Brindley, FRS", *Brit. J. Neurosurgery*, Vol. 28, Iss. 6, May 2014, pp. 704-6.

⁴⁶⁹ At the time of writing, Giles Brindley was the only one of the subjects included in this thesis who was still living. Other than the extensive Internet coverage of his notorious 1983 lecture in Las Vegas when he demonstrated the self-induced effects of a possible cure for erectile disfunction in the flesh, the best source of biographical information about him is; J. Kan, T. Z. Aziz, A. L. Green, E. A. C. Pereira, "Biographical Sketch: Giles Brindley, FRS", *British Journal of Neurosurgery*, Vol. 28, Iss. 6, May 2014, pp. 704-6.

⁴⁷⁰ The Manchester Municipal College of Technology became the University College of Technology in 1956, and the University of Manchester Institute of Science and Technology (UMIST) in 1966. In 1994, UMIST became an autonomous university. In 2004 the University of Manchester was created through the merger of the Victoria University of Manchester and UMIST. "History of UMIST", <https://www.manchester.ac.uk/discover/history-heritage/history/umist/>, [22 June 2024]; "History of the Victoria University of Manchester", <https://www.manchester.ac.uk/discover/history-heritage/history/victoria/>, [22 June 2024]; "Our History", <https://www.manchester.ac.uk/discover/history-heritage/history/>, [22 June 2024].

discussions about the social consequences of information technology. He was proposed for Ratio Club membership.⁴⁷¹

Dennis Gabor (1900-1979)

Born in Budapest, Gábor Dénes became a noted industrial physicist and electronics engineer in Weimar Germany. In 1934, he fled the Reich, and the anglicised Dennis Gabor joined BTH in Rugby. Dennis volunteered for military service in 1939, and although his nationality earned him a rejection, he was admitted to the Register of Aliens with Special Qualifications. So, although secrets were forbidden, BTH built him a research hut abutting their security perimeter. In 1949, Imperial appointed him as a reader in electronics, and, in 1958, they awarded him a personal chair in Applied Electron Physics.⁴⁷² The second edition of *Cybernetics* cited Gabor's inaugural professorial lecture at Imperial in support of Wiener's ideas about 'self-reproducing' machines.⁴⁷³ An accolade Wiener repeated in *God & Golem, Inc.*⁴⁷⁴ Dennis also pioneered both information theory, and popular science socio-technical futurology.

⁴⁷¹ "Major Work on Communication", [Cherry, obituary], *Times*, 29 Nov. 1979, p. 18. "E. Colin Cherry: Marconi Prize Recipient", <https://www.marconisociety.org/fellow-bio/e-collin-cherry/>, [13 July 2024]. J. J. O'Connor, E. F. Robertson, "Edward Colin Cherry", *MacTutor: University of St Andrews*, July 2008, https://mathshistory.st-andrews.ac.uk/Biographies/Cherry_Colin/, [13 July 2024]. "Cherry, Prof. (Edward) Colin", *Who's Who 2023/Who Was Who*, <https://doi.org/10.1093/ww/9780199540884.013.U153141>, [13 July 2024].

⁴⁷² T. E. Allibone, "Dennis Gabor", *Biographical Memoirs of Fellows of the Royal Society*, Vol. 26, Iss. 26, Nov. 1980, pp. 106-47.

⁴⁷³ D. Gabor, *Electronic Inventions and their Impact on Civilization: Inaugural Lecture 3 March 1959*, (Imperial College, London, 1959). Wiener, *Cybernetics*, 1961, 2nd edn., (MIT, Cambridge, 1965), p. xi, xii, 178, 180.

⁴⁷⁴ N. Wiener, *God & Golem, Inc.: A Comment on Certain Points where Cybernetics Impinges on Religion*, (MIT Press, Cambridge, 1964), p. 41, 45.

Gabor was the sole recipient of the 1971 Nobel Prize in Physics for his “invention and development of the holographic method”.⁴⁷⁵ The award was made in recognition of the ground breaking theoretical work which Gabor had published in the late forties.⁴⁷⁶ Gabor’s achievement was all the more remarkable in light of the fact that it was not until the invention of the laser by Theodore Maiman in 1960 that the technology existed to make Gabor’s insights a practical reality. Gabor was able to give a remarkably direct first-hand account of the creation and history of the entire field for which he was being honoured in his Nobel Lecture in December 1971.⁴⁷⁷ It is fitting that so much of our contemporary electronic communications infrastructure now relies on the application of the invention of one of the pioneers of information theory.⁴⁷⁸

Arthur Porter (1910-2010)

Arthur befriended Wiener, and shared an office with Shannon, whilst he was a postdoctoral researcher in analogue computing under Bush at MIT from 1937 to 1939.⁴⁷⁹ Arthur’s PhD, with Hartree, was on Bush’s differential analyser. In September 1939, Arthur joined the Admiralty Research Laboratories in Teddington as a Science Officer. In July 1940, Blackett

⁴⁷⁵ “The Nobel Prize in Physics 1971”, *The Nobel Prize*, <https://www.nobelprize.org/prizes/physics/1971/summary/>, [11 July 2024].

⁴⁷⁶ D. Gabor, “A New Microscopic Principle”, *Nature*, Vol. 161, No. 4098, May 1948, pp. 777-78. D. Gabor, “Microscopy by Reconstructed Wave-Fronts”, *Proceedings of the Royal Society of London. Series A, Mathematical and Physical Sciences*, Vol. 197, No. 1051, July 1949, pp. 454-87.

⁴⁷⁷ D. Gabor, “Holography, 1948-1971: Nobel Lecture, Dec. 11, 1971”, <https://www.nobelprize.org/prizes/physics/1971/gabor/lecture/>, [11 July 2024].

⁴⁷⁸ D. Gabor, “The Nobel Prize in Physics 1971: Biographical”, *The Nobel Prize*, <https://www.nobelprize.org/prizes/physics/1971/gabor/biographical/>, [13 July 2024]. [Gabor, obituary], *Telegraph*, 10 Feb. 1979, p. 10. “In Memorium”, [Gabor, obituary], *Telegraph*, 16 March 1979, p. 16. [Gabor, obituary], *Times*, 16 Nov. 1979, p. 8. S. T. Keith, “Dennis Gabor”, *Complete Dictionary of Scientific Biography*, (Scribner’s, Detroit, 2008), Vol. 17, pp. 324-28, <https://go-gale-com.ezproxy-prd.bodleian.ox.ac.uk/ps/i.do?p=GVR&sw=w&u=oxford&v=2.1&it=etoc&id=GALE%7C9780684315591>, [13 July 2024]. A. Barrett, “Gabor, Dennis [formerly Dénes Gábor]”, *ODNB*, <https://doi.org/10.1093/ref:odnb/31131>, [13 July 2024]. “Gabor, Prof. Dennis”, *Who’s Who 2023/Who Was Who*, <https://doi.org/10.1093/ww/9780199540884.013.U154671>, [13 July 2024].

⁴⁷⁹ Porter, *Hills*, P. 63.

poached him to develop radar directed automated anti-aircraft systems for the AORG.⁴⁸⁰ In 1942, Arthur joined the ADRDE where he deployed servomechanisms in radar directed artillery, and convened the Servo Panel.⁴⁸¹ During a 1945 American visit, Arthur met Nyquist and Bode, the architects of electronic feedback theory, at Bell Labs in New York. He already knew their work through the Servo Panel. In 1946, during a mission from Blackett to foil a Soviet plot to kidnap German scientists, Arthur lunched with Werner Heisenberg.

From April to July 1946, Arthur joined the NPL as the Principal Scientific Officer leading the Metrology Division's Control Mechanisms Section. Next, he became professorial head of the Military College of Science's Instrument Technology Faculty at Shrivenham. Porter's autobiography records a visit to Hick, his Servo Panel colleague, at Cambridge in April 1947 whilst Arthur was at Shrivenham. In this previously unknown account; Wiener strode unannounced into Hick's office, remembered Porter, removed his jacket, and gave an impromptu lecture declaring his invention of cybernetics.⁴⁸² Although Wiener did not depart from America until 21 May 1947, the proximity is sufficient for temporal blurring to have caused Porter's chronological error. Arthur also recalled attending Turing's ten ACE lectures at the GPO Dollis Hill Research Station at around this time.⁴⁸³ Porter's recall of detail is again faulty.⁴⁸⁴ The nine ACE lectures were variously delivered by Turing and his NPL assistant, Jim Wilkinson, at the MoS headquarters in London's Adelphi Hotel, from

⁴⁸⁰ *ibid.*, p. 101.

⁴⁸¹ *ibid.*, pp. 116-17.

⁴⁸² *ibid.*, p. 156.

⁴⁸³ *ibid.*, p. 157-8.

⁴⁸⁴ Or, there was another, hitherto unknown and undocumented series of Turing ACE lectures at Dollis Hill.

December 1946 to February 1947. In 1949, Porter became head of the research section of Ferranti's Canadian subsidiary.⁴⁸⁵

Wladek (Wladyslaw) Sluckin (1919-1985)

Presciently, Wladyslaw left Warsaw in 1937, became Wladek, and enrolled at Queen Mary, London. The war both interdicted his familial funding, and evacuated Queen Mary to Cambridge. His family later perished in the 1944 Warsaw Uprising.⁴⁸⁶ Wladek failed his disrupted electrical engineering degree, and, in 1941, he became a power station engineer in Leeds. Retaking his finals in 1942, he passed. Bored by electricity, Wladek returned to Cambridge, where he worked in a radio shop, punched his boss during an argument, got sacked, disregarded his Polish call-up, and volunteered for the British Army. Before his Army application was processed, the Cambridge Electric Supply Company drafted him into a reserved occupation. Wladek took a Birkbeck psychology degree in 1950, and then joined Durham's psychology department in 1951. In 1955, he gained a PhD. In 1960, Wladek

⁴⁸⁵ "Dean Arthur Porter: Obituary", [Porter, obituary], *Winston Salem Journal*, 5 March 2010, <https://www.legacy.com/us/obituaries/winstonsalem/name/dean-porter-obituary?pid=140283640>, [13 July 2024]. K. S. Jardine, "Memorial Tribute to Arthur Porter", [Porter, obituary], *University of Toronto Faculty of Applied Science and Engineering*, 26 Feb. 2010, <https://www.engineering.utoronto.ca/wp-content/blogs.dir/28/files/2015/02/Memorial-Arthur-Porter-May-26-10.pdf>, [13 July 2024]. "Founding Chair of Industrial Engineering Inducted into the Canadian Science and Engineering Hall of Fame", *University of Toronto Engineering News*, 22 Oct. 2013, <https://news.engineering.utoronto.ca/founding-chair-industrial-engineering-inducted-canadian-science-engineering-hall-fame/>, [13 July 2024]. R. S. C. Cobbold, "Tribute to Arthur Porter", *University of Toronto, Industrial Engineering Faculty*, 2 Feb. 2011, <https://web.archive.org/web/20160802181240/https://www.mie.utoronto.ca/IE50th/people/memorial/>, [13 July 2024]. "Porter, Prof. Arthur", *Who's Who 2023/Who Was Who*, <https://doi.org/10.1093/ww/9780199540884.013.U31173>, [13 July 2024]. "Porter, Arthur 1910-2010", *Science Museum Group*, <https://collection.sciencemuseumgroup.org.uk/people/ap24886/porter-arthur>, [13 July 2024].

⁴⁸⁶ "Prof. Wladyslaw Sluckin: Contributions to Experimental Psychology", [Sluckin, obituary], *Times*, 27 May 1985, p. 12.

moved to Leicester's new psychology department.⁴⁸⁷ Lacking any manifest intersections with proto-cybernetics, he wrote a popular book assimilating cybernetics into psychology.⁴⁸⁸

Christopher Strachey (1916-1975)

Christopher was Bloomsbury Set progeny, and he inhabited the squares wherein the triangles loved. His father, Oliver, was a Bletchley cryptanalyst, and his mother, Raye, née Costelloe, was a mathematician and engineer. Intellectually gifted, yet scholastically indolent, he drifted at school. At King's, Cambridge, undergraduate distractions prevailed over flimsy academic diligence and so physics replaced mathematics. Following a nervous breakdown, he repeated his third year, taking a lower second in 1938. In August 1939, he began researching radar at Standard Telephone and Cables' (STC) Valve Development Laboratories. Upon release from his Essential Work Order in October 1945, Christopher became a physics and mathematics teacher. First, at St Edmund's in Canterbury; and then at Harrow, where, in September 1949, he read *Cybernetics*.⁴⁸⁹ The encounter with Wiener's

⁴⁸⁷ "Sluckin Room Inauguration, 14 Dec. 2017", www.le.ac.uk/-/media/uol/docs/academic-departments/npb/sluckinroominauguration-accessible.pdf, [20 June 2022].

⁴⁸⁸ W. Sluckin, *Minds and Machines*, (Pelican, London, 1954).

⁴⁸⁹ M. Campbell-Kelly, "Christopher Strachey, 1916-1975: A Biographical Note", *IEEE Annals of the History of Computing*, Vol. 7, No. 1, Jan. 1985, pp. 19-42. "A Pioneer of Computing", [Strachey, obituary], *Times*, 23 May 1975, p. 16. "Strachey 100: Celebrating the Life and Research of Christopher Strachey", <https://www.cs.ox.ac.uk/strachey100/>, [13 July 2024]. D. Barron, "Pioneer Profiles-Christopher Strachey", *Computer Resurrection: The Bulletin of the Computer Conservation Society*, No. 43, Summer 2008, <https://www.computerconservationsociety.org/resurrection/res43.htm#e>, [13 July 2024]. M. Campbell-Kelly, "Christopher Strachey", *Complete Dictionary of Scientific Biography*, (Scribner's, Detroit, 2008), Vol. 24, pp. 532-36, <https://go-gale-com.ezproxy-prd.bodleian.ox.ac.uk/ps/i.do?p=GVRL&sw=w&u=oxford&v=2.1&it=etoc&id=GALE%7C9780684315591>, [13 July 2024]. M. J. C. Gordon, "Christopher Strachey: Recollections of His Influence", *Higher-Order and Symbolic Computation*, Vol. 13, Iss. 1-2, April 2000, pp. 65-7, [Christopher Strachey memorial issue]. M. Jackson, "Christopher Strachey: A Personal Recollection", *Higher-Order and Symbolic Computation*, Vol. 13, Iss. 1-2, April 2000, pp. 73-4, [Christopher Strachey memorial issue], J. A. N. Lee (ed.), "Christopher Strachey", *International Biographical Dictionary of Computer Pioneers*, (Fitzroy Dearborn, Chicago, 1995), pp. 644-52. R. Penrose, "Reminiscences of Christopher Strachey", *Higher-Order and Symbolic Computation*, Vol. 13, Iss. 1-2, April 2000, pp. 83-4, [Christopher Strachey memorial issue]. M. Campbell-Kelly, "Strachey, Christopher", *ODNB*, <https://doi-org/10.1093/ref:odnb/31727>, [13 July 2024]. "Strachey, Prof. Christopher", *Who's Who 2023/Who Was Who*, <https://doi.org/10.1093/ww/9780199540884.013.U160007>, [13 July 2024].

book was transformative; it spurred Strachey's life changing letter to Turing, and activating his lifelong commitment to computing.⁴⁹⁰

Arnold Tustin (1899-1994)

Arnold combined his apprenticeship at C. A. Parsons in Tyneside, with a Durham masters at Armstrong College in Newcastle. Thence, came a graduate traineeship at Metropolitan Vickers Electrical, and a promotion to Chief Assistant Engineer in 1925. At Vickers, he specialised in heavy electrical traction systems; joining both the Manual Tracking and Servo Panels, and giving five Servo Panel talks between 1942 and 1945.⁴⁹¹ Here, he met Porter, Craik, Hick, Bates, Uttley and possibly Wescott, and indirectly encountered Wiener. In 1947, he became engineering professor at Birmingham. From 1953 to 1954, he was the Sibley Webster Professor of Electrical Engineering at MIT. The announcement for his inauguration lecture, delivered on 11 February 1954, described his subject as the extension of automation and control theory from engineering to socio-economic and neurological systems.⁴⁹² Wiener was overseas when Tustin gave his lecture, however, he was at MIT for most of Tustin's term.⁴⁹³ In 1955, Arnold became Professor of Heavy Electrical Engineering at Imperial, just as Porter took the chair of Light Electrical Engineering. Westcott, Gabor

⁴⁹⁰ Letter, Strachey to Turing, 15 May 1951, TK/GBR/0272/AMT/D/5.

⁴⁹¹ Table 2: Servo Panel Talks.

⁴⁹² "From the News Service for Release in Sunday Papers Jan. 31, 1954", *Mass. Institute of Technology, Cambridge 39, Massachusetts*, MIT Archives, (AC0069), www.libraries.mit.edu/app/dissemination/DIPonline/AC0069_NewReleases/NewsRelease_1950/AC0069_1954/AC0069_195401_004.pdf, [21 June 2022].

⁴⁹³ Wiener, *Life in Cybernetics*, p. 471.

and Cherry were already there.⁴⁹⁴ In 1955, Arnold published a book assimilating cybernetics into economics.⁴⁹⁵

John Zachery Young (1907-1997)

After graduating in zoology from Magdalen, Oxford, in 1928, John became a junior research fellow, specialising in mechanisms of electro-chemical conduction in the neurophysiology of learning and memory. He chose the invertebrate, but relatively neurologically rich, cephalopods as his experimental analogues for the neuronal mechanics of mind in higher vertebrates. War brought both disruption and opportunity to the otherwise placid trajectory of an advancing young Oxford academic. Fearing massive civilian casualties from aerial bombardment, the MRC Nerve Injuries Committee commissioned John to research the surgical repair of peripheral nerve damage. John's unit was probably hosted in the EMS brain injuries hospital at St Hugh's, Oxford and his work there possibly brought him into contact with Dawson and Sholl. In 1945, John became FRS, and unexpectedly left Oxford to become the professor of anatomy at UCL.⁴⁹⁶ The appointment of a mere academic biologist to teach fledgling doctors incensed the medical establishment. Strong letters and controversy ensued.⁴⁹⁷ John was a Ratio Club guest, and was proposed for membership; his

⁴⁹⁴ C. C. Bissell, [Tustin, obituary], *Int. J. of Control*, Vol. 60, No. 5, 1994, pp. 649-51. L. B. Curzon, [Tustin, obituary], *Independent*, 18 Feb. 1994, p. 30. C. C. Bissell, "Not Just Norbert", *Kybernetes*, Vol. 39, No. 4, May 2010, pp. 496-509. P. Wellstead, "Systems Biology and the Spirit of Tustin", *IEEE Control Systems Magazine*, Vol. 30, Iss. 1, Feb. 2010, pp. 57-102, [based on the Tustin Lecture, 1 May 2008, Institute of Engineering and Technology, Savoy Place, London]. "Tustin, Arnold", *Who's Who 2023/Who Was Who*, <https://doi.org/10.1093/ww/9780199540884.013.U175973>, [13 July 2024].

⁴⁹⁵ A. Tustin, *The Mechanism of Economic Systems: An Approach to the Problem of Economic Stabilisation from the Point of View of Control-System Engineering*, (Heinemann, London, 1953).

⁴⁹⁶ "A Chair of Anatomy", *Lancet*, Vol. 246, Iss. 6371, 6 Oct. 1945, p. 440.

⁴⁹⁷ J. C. Brash, E. R. A. Cooper, D. V. Davies, J. Davies, W. L. H. Duck-Worth, D. A. W. Edwards, J. D. Green, H. L. H. Green, R. B. Green, G. W. Harris, H. A. Harris, W. C. O. Hill, R. G. Inkster, E. B. Jamieson, J. Kay Jamieson, J. Tudor Jones, F. Wood Jones, Arthur Keith, R. D. Lockhart, A. Low, M. A. MacConaill, J. W. Millen, W. R. M. Morton, E. L. Patterson, G. F. Romanes, J. H. Scott, D. Stewart, R. Walmsley, T. Walmsley, W. H. Wood, "The Teaching Of Human Anatomy", *Lancet*, Vol. 246, Iss. 6377, 17 Nov. 1945, p. 651. S. Wright, "Teaching of Human Anatomy", *Lancet*, Vol. 246, Iss. 6378, 24 Nov. 1945, p. 690.

professorship notwithstanding. *Cybernetics* and information theory made deep inscriptions in his work, and both were manifest in his 1950 Reith Lectures.⁴⁹⁸

The Other Cyberneticians: Biographical Flesh

Just as most of the Ratio Club could be more accurately characterised as Fellow Travellers, so to all of the Other Cyberneticians exhibited unassailable intellectual claims to membership of a cybernetics group. All, except Porter, were proposed for Ratio Club membership. None, except Porter, were professorially disqualified. None attended; not even as guests.

Alex Andrew (1924(?)-2013)

Alex's mathematics and physics degree at Glasgow was interrupted by conscription and work on voice encryption at Royal Aircraft Establishment (RAE) in Farnborough. After his delayed graduation in 1949, and a short sojourn in industrial radar research, Alex started a PhD at Glasgow, where he joined both the departments of physiology and psychological medicine, and immersed himself in the epistemological synthesis of electronics and physiology. Conceivably, he had read *Cybernetics* before seeing McCulloch lecture at Glasgow. Alex spent all of 1954, and some of 1955, with McCulloch at MIT, where he met MacKay when he visited McCulloch socially. Alex saw Wiener at MIT, but only in passing.

⁴⁹⁸ J. Z. Young, in L. R. Squire (ed.), *The History of Neuroscience in Autobiography: Volume I*, (Academic Press, Cambridge, MA., 1998), pp. 554-86. *Times*, [Young, obituary], 9 July 1997, p. 21. [Young, obituary], *Daily Telegraph*, 11 July 1997, p. 31. Q. Bone, [Young, obituary], *Independent*, 8 July 1997, p. 14. G. Gabella, [Young, obituary], *Kybernetes*, Vol. 27, No. 1, Feb. 1998. J. Messenger, [Young, obituary], *Nature*, Vol. 388, No. 6644, Aug. 1997, p. 726. A. Tucker, "Broad Grasp of the Brain", [Young, obituary], *Guardian*, 14 July 1997, p. 13. M. J. Wells, [Young, obituary], *The Conchological Society*, <https://conchsoc.org/eminent/Young-JZ.php>, [13 July 2024]. R. Keynes, "John Zachary Young" *Proceedings of the American Philosophical Society*, Vol. 143, No. 4, 1999, pp. 729-32. B. B. Boycott, "John Zachary Young", *Biographical Memoirs of Fellows of the Royal Society*, Vol. 44, Jan. 1998, pp. 487-509. B. B. Boycott, "Young, John Zachary", *ODNB*, <https://doi.org/10.1093/ref:odnb/67360>, [13 July 2024]. "Young, John Zachary", *Who's Who 2023/Who Was Who*, <https://doi.org/10.1093/ww/9780199540884.013.U182955>, [13 July 2024].

Wiener and McCulloch had fallen out and, for Wiener, Alex was probably tainted by association. After Glasgow, Alex joined the NPL's CME Division, where he worked on Uttley's Conditional Probability Computer, the DEUCE (an indirect successor to Turing's ACE), and industrial automation.⁴⁹⁹ Notwithstanding Bates' rebuttal of his express desire to join the Ratio Club, which is discussed in the next chapter, Alex became a cybernetician and a systems theorist of international standing.

Anthony Stafford Beer (1926-2002)

In an act of rebellion against curricula constrictions, Stafford engineered his expulsion from school in 1942, and, at sixteen, he started a philosophy degree at UCL. Whereupon, he renounced his youthful High Anglicanism, converted to Catholicism and joined the Franciscan Third Order. After the evacuation of his UCL faculty to Aberystwyth, an unsettled Stafford joined the Royal Artillery as a private soldier in 1944; leaving his degree forever unfinished. Stafford was commissioned into the Royal Fusiliers whilst serving in India, and, upon promotion to captain, he initially took command of a Gurkha Rifles company, before becoming an intelligence staff officer. In 1947, Captain Beer returned to Britain as an Army psychologist, and conducted personnel selection in the Royal Engineers, probably using techniques from the Cambridge APRU. Whilst commanding a remedial teaching unit, he also researched the psychology of illiteracy. Demobbed in 1948, Stafford became an apprentice manager at United Steel Companies in Sheffield, where he trained at their Samuel Fox subsidiary. Sidney Howes, Fox's managing director, mentored Stafford and invented the role of Production Controller for his protégé. Reciprocally, Stafford built

⁴⁹⁹ A. M. Andrew, "Autobiographical Retrospectives: Some Reminiscences of Cybernetics and Systems", *Int. J. General Systems*, Vol. 40, No. 2, Feb. 2011, pp. 131-44.

an OR group at Fox's.⁵⁰⁰ In 1950, Stafford read *Cybernetics*; with seismic effect.⁵⁰¹ He immediately wrote to Wiener and declared himself a cybernetician.⁵⁰² Neither Stafford's cyberneticist epiphany, nor his friendships with Ashby and Walter, furnished Ratio Club membership.⁵⁰³

Frank Honywill George (1921-1997)

Frank spent his war in the RAF. He served first as a fighter pilot, possibly in the Battle of Britain, then as a pilot instructor, possibly in Canada, and then as an administrator. He ended his military service as a flight lieutenant and station adjutant.⁵⁰⁴ In 1946, Frank joined Sidney Sussex, Cambridge, where he read philosophy and mathematics; and found *Cybernetics*. He

⁵⁰⁰ S. Beer, CV and autobiographical material, LJMU/SB/Box 80.

⁵⁰¹ S. Beer, "Knowing Norbert", *Kybernetes*, Vol. 23, No. 6/7, Aug. 1994, pp. 17-20.

⁵⁰² S. Beer, "On Managerial Cybernetics", *Falcondale Collection: Tape 1 History and Origins of Cybernetics: Part 1*, transcript, p. 17, LJMU/SBFC/doi.org/10.24377/LBEER_ARCHIVE.d.00000006, [28 June 2002].

⁵⁰³ "Cybernetician Who Advised Allende in the 1970's", [Beer, obituary], *Daily Telegraph*, 28 Aug. 2002, p. 23. "Cybernetics Expert", [Beer, obituary], *Sunday Times*, 1 Sept. 2002, p. 4.12. "World Leader in the Development of Operational Research, Who Combined Management Systems with Cybernetics", [Beer, obituary], *Guardian*, 4 Sept. 2002, p. 20. "Management Guru Who Enlisted Cybernetics in His Bid to Transform Decision Making", [Beer, obituary], *Times*, 9 Sept. 2002, p. 8. A. Leonard, "Stafford Beer: The Father of Management Cybernetics", [Beer, obituary], *Cybernetics & Human Knowing*, Vol. 9, No. 3-4, 2002, pp. 133-36. J. Rosenhead, [Beer, obituary], *Journal of the Operational Research Society*, Vol. 54, No. 12, Dec. 2003, pp. 1231-33. J. Rosenhead, D. Martin, "Stafford Beer", [Beer, obituary], *Systems Research and Behavioral Science*, Vol. 20, Iss. 1, Jan./Feb. 2003, pp. 81-3. V. Beer, A. Leonard, *Stafford Beer: The Father of Management Cybernetics: Big Data Analysis, Including Cybernetic Glossary*, (Foundation Oroborus, Switzerland, 2019). D. Whittaker, *Stafford Beer: A Personal Memoir*, (Wavestone, Charlbury, 2003). "Profile and Academic Vita of Stafford Beer", *Kybernetes*, Vol. 22, Iss. 6, June 1993, pp. 8-14. "Stafford Beer-Celebration of a Life", [event held at the RSA, London, 11 Oct. 2002], *Kybernetes*, Vol. 32, No. 4, <https://doi.org/10.1108/k.2003.06732daa.003>, [13 July 2024]. A. Andrew, "Stafford Beer: Personal Reminiscences and Reflections", *Kybernetes*, Vol. 22, Iss. 6, June 1993, pp. 60-73. J. Rosenhead, "Anthony Stafford Beer", in A. A. Assad, S. I. Gass (eds.), *Profiles in Operations Research*, (Springer, New York, 2011), pp. 593-612. J. Rose, "A Tribute to Stafford Beer: Reflections and Reminiscences", *Kybernetes*, Vol. 22, Iss. 6, June 1993, pp. 6-7. D. Whittaker, "Threads from a Life", "The Chilean Experience", in S. Beer, D. Whittaker (ed.), B. Eno (fwd.), *Think Before You Think: Social Complexity and the Knowledge of Knowing*, (Wavestone Press, Charlbury, 2009), pp. 353-75. A. J. S. Mann, "Beer, (Anthony) Stafford", *ODNB*, <https://doi.org/10.1093/ref:odnb/77237>, [13 July 2024]. "Beer, Prof. (Anthony) Stafford", *Who's Who 2023/Who Was Who*, <https://doi-org.ezproxy-prd.bodleian.ox.ac.uk/10.1093/ww/9780199540884.013.U7043>, [13 July 2024]. J. Hancock, A. Naughten, "Guide to The Stafford Beer Collection: Or 92 Boxes Of Beer", Business School, Liverpool John Moores University, October 1993, <https://www.ljmu.ac.uk/microsites/library/special-collections-and-archives/special-collections/stafford-beer-collection>, [13 July 2024].

⁵⁰⁴ "Report From the Editor", *John Bull*, Vol. 99, No. 2601, 5 May 1956, p. 3.

immediately resolved to adopt the new science as the philosophical foundation for the construction of new models for an improved society. In 1949, only two years after Janet had married Harold, Frank started teaching in Bristol's psychology department. He remained at the university, only five miles from the BNI, for the next fifteen years.⁵⁰⁵ In the seventies, he published numerous popular science books. Some of which encouraged the positive application of cybernetics to psychology and management, and some of which signalled the societal and humanist dangers of abusing cybernetics and computers for malign political and economic ends. However, Frank's underlying anxiety was that the failure to replace human cognition with cyberneticist automation itself entailed existential peril.⁵⁰⁶

Andrew Gordon Speedie Pask (1928-1996)

Gordon encountered *Cybernetics* in 1951, whilst he was a Cambridge natural science undergraduate. Wiener had punctuated a trip to Paris with a visit to England, and a lecture at Cambridge.⁵⁰⁷ Wiener's host, the philosopher Richard Braithwaite, recruited Gordon to chaperone the venerable guest.⁵⁰⁸ The mesmerised student became an instant cybernetician, and, from that moment on, Pask both lived and practiced his life-changing philosophy in a

⁵⁰⁵ M. Elstob, "Frank George: A Personal Appreciation", *Kybernetes*, Vol. 27, No. 1, Feb. 1998, pp. 23-5.

⁵⁰⁶ [George, obituary], *Times*, 9 Oct. 1997, p. 23. "University News: Brunel", [George, appointment as professor of cybernetics and £70,000 grant from International Publishing Corp], *Times*, 8 Aug. 1968, p. 8.

⁵⁰⁷ Wiener, *Life in Cybernetics*, p. 467.

⁵⁰⁸ Pickering, *Cybernetic Brain*, p. 313, [unpublished biographical note by Gordon's wife, Elizabeth].

multitudinous eclecticism of sociological and epistemological liminalities. Gordon flowered in the sixties.⁵⁰⁹

⁵⁰⁹ P. Pangaro, “Dandy of Cybernetics”, [Pask, obituary], *Guardian*, 16 April 1996, p. 16. L. Rocha, [Pask, obituary], *Int. J. of General Systems*, Vol. 26, Iss. 3, 1997, pp. 219-22. B. Scott, [Pask, obituary], *Independent*, 11 April 1996, p. 12. S. Beer, “Easter: For Gordon, With Love”, *Systems Research: Special Issue Festschrift for Gordon Pask*, Vol. 10, Iss. 3. Jan. 1993, pp. 13-17. P. Cook, “The Extraordinary Gordon Pask”, *Kybernetes: Special Double Issue: Gordon Pask, Remembered and Celebrated, Part I*, (eds. B. Scott, R. Glanville), Vol. 30, No. 5/6, July 2001, pp. 571-72. M. Elstob, “Working with Gordon Pask: Some Personal Impressions”, *Kybernetes: Special Double Issue: Gordon Pask, Remembered and Celebrated, Part I*, (eds. B. Scott, R. Glanville), Vol. 30, No. 5/6, July 2001, pp. 588-93. M. Fernández, “Gordon Pask: Cybernetic Polymath” *Leonardo*, Vol. 41, No. 2, April 2008, pp. 162-68. K. Forsythe, “Fond Memories of Gordon Pask”, *Kybernetes: Special Double Issue: Gordon Pask, Remembered and Celebrated, Part I*, (eds. B. Scott, R. Glanville), Vol. 30, No. 5/6, July 2001, pp. 631-41. R. Glanville, “Gordon Pask: A Skeleton for an Unofficial Biography”, *Systems Research: Special Issue Festschrift for Gordon Pask*, Vol. 10, Iss. 3. Jan. 1993, pp. 9-11. B. Scott, R. Glanville, “About Gordon Pask”, *Kybernetes: Special Double Issue: Gordon Pask, Remembered and Celebrated, Part I*, (eds. B. Scott, R. Glanville), Vol. 30, No. 5/6, July 2001. R. L. Gregory, “Memories of Gordon”, *Kybernetes: Special Double Issue: Gordon Pask, Remembered and Celebrated, Part I*, (eds. B. Scott, R. Glanville), Vol. 30, No. 5/6, July 2001, pp. 685-88. D. Gregory, “A Letter from Dik Gregory”, *Kybernetes: Special Double Issue: Gordon Pask, Remembered and Celebrated, Part I*, (eds. B. Scott, R. Glanville), Vol. 30, No. 5/6, July 2001, pp. 638-84. J. Littlewood, “Gordon Pask”, *Kybernetes: Special Double Issue: Gordon Pask, Remembered and Celebrated, Part I*, (eds. B. Scott, R. Glanville), Vol. 30, No. 5/6, July 2001, pp. 760-62. R. Mckinnon-Wood, “Early Machinations”, *Systems Research: Special Issue Festschrift for Gordon Pask*, Vol. 10, Iss. 3. Jan. 1993, pp. 129-32. H. Moor, “Some Memories of Gordon”, *Kybernetes: Special Double Issue: Gordon Pask, Remembered and Celebrated, Part I*, (eds. B. Scott, R. Glanville), Vol. 30, No. 5/6, July 2001, pp. 768-71. T. Nelson, “Gordon Pask”, *Computer Lib/Dream Machines*, (Ted Nelson, 1974), pp. 82, 116. T. O’Shea, “Gordon Pask: An Appreciation”, *Kybernetes: Special Double Issue: Gordon Pask, Remembered and Celebrated, Part I*, (eds. B. Scott, R. Glanville), Vol. 30, No. 5/6, July 2001, pp. 789-90. P. Pangaro, “Gordon Pask, 1928-1996”, *North American Gordon Pask Archive*, <https://www.pangaro.com/Pask-Archive/Pask-Archive.html>, [13 July 2024]. P. Pangaro, “Pask as Dramaturg”, *Systems Research: Special Issue Festschrift for Gordon Pask*, Vol. 10, Iss. 3. Jan. 1993, pp. 135-142. C. Price, “Gordon Pask”, *Kybernetes: Special Double Issue: Gordon Pask, Remembered and Celebrated, Part I*, (eds. B. Scott, R. Glanville), Vol. 30, No. 5/6, July 2001, pp. 819-20. S. Beer, “A Filigree Friendship”, *Kybernetes: Special Double Issue: Gordon Pask, Remembered and Celebrated, Part I*, (eds. B. Scott, R. Glanville), Vol. 30, No. 5/6, July 2001, pp. 551-60. L. Thomas, S. Harri-Augstein, “Gordon Pask at Brunel: A Continuing Conversation About Conversations”, *Systems Research: Special Issue Festschrift for Gordon Pask*, Vol. 10, Iss. 3. Jan. 1993, pp. 183-92. H. von Foerster, “On Gordon Pask”, *Systems Research: Special Issue Festschrift for Gordon Pask*, Vol. 10, Iss. 3. Jan. 1993, pp. 35-42. H. von Foerster, “On Gordon Pask”, *Kybernetes: Special Double Issue: Gordon Pask, Remembered and Celebrated, Part I*, (eds. Scott, B., Glanville, R.), Vol. 30, No. 5/6, July 2001, pp. 630-36. “University News: Brunel”, [Pask, appointment as professor of cybernetics and £70,000 grant from International Publishing Corp], *Times*, 8 Aug. 1968, p. 8.

Chapter Three: The Birth, Life, Times, and Death of The Ratio Club

The Britain of British Cybernetics

Britain in 1945 was a nation devastated by victory. Six years earlier, a punitive professional military expedition to France had catastrophically failed, and European war again erupted; igniting an all-consuming global conflagration. As the vanquished British Expeditionary Force fled Dunkirk, the weight of its defeat lay measured in the litter of forsaken machines carpeting the abandoned sand. No longer was European soil host to epochal British victories; and, for the first time in centuries, invasion loomed. As existential combat spanned the Earth, so it subsumed the totality of British life. There was a Home Front; on which, civilians perished in vast numbers as their cities were pulverised by relentless aerial bombardment. Information and culture were weaponised. The economy was militarised. The strictures of sociologically normative practices, especially around class and gender, loosened under the strain of war. Although statutorily summonsed, nevertheless, a population scale citizen militia permitted its conscription with near universal consent. Defiant and stoic in war, in peace Britain was shattered. Its economy was near bankruptcy, its cities were ruined, its survivors were exhausted, its empire was fatally fractured, and its immense moral debts were unpaid.

This victory without triumph brought apprehension and uncertainty. In 1939, Britannia still basked under a never setting sun. Despite the Great War's attritionally murderous challenge to imperious civilizing legitimacy, and despite the League of Nations' fulsome embrace of America's doctrine of national self-determination, Britain's Empire remained stubbornly realpolitik. Consequently, the Churchillian myth of a tiny island standing valiantly alone against the mighty Reich, whilst the American giant belatedly bestirred itself, was a rousing

delusion. India alone contributed some 2,500,000 military volunteers and, by 1943, was Britain's creditor.⁵¹⁰ As the metropole devoured its dominions' blood, treasure and trust in desperate self-preservation, so it drained both the moral and material capital of empire. Auschwitz, Hiroshima and Dresden then bankrupted whatever scant moral reserves European paternalism had salvaged from the Somme. The foreclosure of these debts was the final end of a fragile relic. By 1948, India, Palestine, Burma and Sri Lanka were already independent. When Macmillan eventually publicly articulated the inevitable Establishment acceptance of decolonisation, the inexorable wind of change he finally bowed to had been stirred by the trumpets of war two decades earlier.⁵¹¹

Peace did not immediately bring palliative prosperity to ameliorate declinist uncertainty. Britons endured the scarcities of war with the forbearance of common cause; rationing predicated victory. However, deprivation worsened with peace. In 1945, bacon, fat and soap rations fell. In 1946, bread was rationed, and potatoes followed in 1947; neither were restricted during the war. Meat rationing persisted until 1954. The shock termination of Lend Lease in August 1945 forced Britain into a \$4 billion American loan in 1946, merely to sustain liquidity. The American insistence on Dollar convertibility as a condition of the bail-out then precipitated the Sterling Crisis which haemorrhaged Britain's Dollar reserves. This impelled Attlee's government to further sacrifice domestic consumption, and public spending, to an intensified export drive, intended to restore the balance of payments and defend the Sterling exchange rate.

⁵¹⁰ S. Raghavan, *India's War: The Making of Modern South Asia*, (Allen Lane, London, 2016), p. 1, 340.

⁵¹¹ H. McMillan, "The Wind of Change", *Address to Members of both Houses of the Parliament of the Union Of South Africa, Cape Town, 3 Feb. 1960*, <https://www.bbc.co.uk/archive/tour-of-south-africa--rt-hon-macmillan/zv6gt39>, [21 Jan. 2024].

In 1946, the Council of Industrial Design staged the Britain Can Make It exhibition at the V&A. The name played on the titles of two 1940 MoI propaganda films. One, “London Can Take It!”, was targeted at American audiences, the other, “Britain Can Take It”, was a shorter domestic version. The 1946 exhibition aimed to promote industrial design’s contribution to reconstruction and exports. However, even before the activation of the convertibility condition, popular sentiment had supplanted nominative optimism with ‘Britain Can’t Have It!’.⁵¹² Notwithstanding his terminal illness, Orwell protested that 1949’s *1984* condemned Soviet Stalinism, not Britain’s Labour government.⁵¹³ Nonetheless, Ingsoc’s bleak vision of unceasing shortages and grinding toil held a mirror to the grim food, drab garb and dull truth of many British lives.

In early 1947 Britain announced the cessation of aid funding to Greece and Turkey, thereby prompting Truman’s eponymous doctrine. This merely set the seal of grand strategy on a reality already manifest in America’s supreme command of the Allied Expeditionary Force in Operation Overlord. After 1945, there were two world superpowers; one was Britain’s defiant enemy, the other was Britain’s unyielding creditor. The reconfigured geo-politics of the Cold War expressed economic reality; Britain could not afford world power. However, America boomed. As Britons endured their austere peace, Americans blossomed in an apparent Golden Age of Capitalism. Whilst, in Britain, tens of thousands homelessly squatted in disused barracks and hotels, in America, a housing bonanza erupted, fuelled by

⁵¹² “Tailpiece. (Overheard yesterday: A Bradford merchant was telling his companion ... “I’ve just sent my buyer down to London to have a look at the ‘Britain Can’t Have It’ Exhibition””), *Bradford Observer*, 30 Sept. 1946, p. 2. “Britain Can’t Have It”, *Barnoldswick and Earby Times*, 25 Oct. 1946, p. 2.

⁵¹³ In a letter of 16 June 1949 to Francis Henson, a senior official in the American United Automobile Workers trade union, Orwell explicitly denied that *1984* was an attack on either socialism or the British Labour Party. S. Orwell, I. Angus (eds.), *The Collected Essays, Journalism and Letters of George Orwell: Volume 4, In Front of Your Nose, 1945-1950*, (Penguin, Harmondsworth, 1970), p. 564. Parts of the lost letter were published in ED, *Life*, Vol. 27, No. 4, 25 July 1949, pp. 4, 6; and in R. Thompson, “In and Out of Books”, *New York Times*, 31 July 1949, p. BR8.

government secured credit and sustained by mass production techniques adapted from automobile production.⁵¹⁴ New houses needed new furniture, new appliances and new services. New factories needed new workers. New working households needed new cars which needed new roads. State support mobilised capital, and redeemed war bonds released pent-up demand. The Arsenal of Democracy retooled into a consumerist powerhouse.⁵¹⁵

Mechanisation and efficiency were shibboleths of the American Dream. With Henry Ford's assembly lines, and Frederick Taylor's scientised management, the productive practices of mass consumption capitalism were conflated into America's idea of itself. America was consumerism, and consumerism was American. Manifest destiny had already delivered dominion over one continent and saved another. Now, an enriched Columbia had a globe to stride, and Hollywood to bear her torch. After 1945, America was compelled to both export its economic materiality, and to culturally evangelise its self-idealisation as capitalism's Zion. Dollars alone would not build Pax Americana. Hollywood did more than satiate the recreational appetites of consumerist Americans with gratifyingly affirmative reflections of their projected selves, it also projected these likenesses to the war-torn world beyond. The silver screen proselytized Columbia's consumerist secular theology. For some, this offered a technicolour promised land; a weekly refuge from Airstrip One. For others, it threatened an automated and dehumanising decadence, where callow hubris replaced taste and wisdom

⁵¹⁴ H. Webber, "A Domestic Rebellion: The Squatters' Movement of 1946", www.humanities.exeter.ac.uk/media/universityofexeter/collegeofhumanities/history/exhistoria/volume4/Webber-Squatters_movement.pdf, (8 March 2023). J. Guldi, "World Neoliberalism as Rebellion From Below?: British Squatters and the Global Interpretation of Poverty, 1946-1974", *Humanity*, Vol. 10, Iss. 1, Spring 2019, pp. 29-57, www.proquest.com/docview/2630531986/fulltextPDF/5ED74E114BFE4251PQ/1?accountid=13042, [8 March 2023].

⁵¹⁵ S. Pruittmay, "The Post World War II Boom: How America Got Into Gear, *History*, 14 May 2020, www.history.com/news/post-world-war-ii-boom-economy, [8 March 2023].

with brash ostentation. Regardless of perspective, America vigorously exported its identity, culture, and wealth to a world in desperate need of reconstruction; including Britain.

Austerity continued to grip Britain throughout the remaining forties. The 1948 London Olympics, dubbed the ‘Austerity Games’, were cobbled together without a single new building. This was ‘mend and make do’ on a national scale; British athletes ate whale meat for protein, and RAF airfields housed the Olympians.⁵¹⁶ However, as the fifties progressed, austerity lifted. Housebuilding attained meaningful volumes, especially under local authorities, and the production of domestic goods followed suit. Car production also expanded, as the new suburbanites discharged their vestigial filial obligations with rapidly ritualised Sunday conveyances of their nuclear families to the relatives sundered by the diaspora of reconstruction. Britain’s teenagers were invented by American capitalism, and schooled by Hollywood in aspirational consumerism. They bought record players, danced, inhabited milk bars, rode motorcycles and scooters, became sub-cultural; and, were morally panicked about.

By 1957, Macmillan’s banishment of austerity, first proclaimed to Bedfordshire’s Tory faithful, was justified. However, the deeper point was his typically neglected caveat. It was true, he said, that the British people had ‘never had it so good’. Yet, he added, it was also true that this prosperity was precarious.⁵¹⁷ Macmillan articulated a general sentiment which held that Britain’s fragile success was threatened both from without by global events over

⁵¹⁶ L. Elliott, “London’s 1948 Olympics: The Real Austerity Games”, *Guardian*, 30 March 2012, www.theguardian.com/sport/2012/mar/30/london-1948-olympics-austerity-games, [8 March 2023].

⁵¹⁷ H. Macmillan, “Never Had It So Good”, speech to Conservative Party rally marking twenty-five year’s Parliamentary service by Lennox-Boyd, Mid-Bedfordshire MP, Bedford Town football ground, 20 July 1957. Macmillan’s self-avowed purpose was to jolt people out of affluent complacency with a stark warning about inflation. H. Macmillan, *Riding the Storm: 1956-1959*, (Macmillan, London, 1971), pp. 350-53.

which Britain no longer held sway, and from within by the vested interests and restrictive practices of labour or capital - depending on one's ideology.

For America, the fifties was a decade of exuberant optimism. However, for Britain, it was a time to cherish hard-won, and delicate, domestic peace and prosperity. Against the relentlessly disruptive radicalism of American technocratic modernism, fifties Britain sought refuge in a generalised conservatism. Nationalisation notwithstanding, there was little substantive change on shop and factory floors, let alone in boardrooms and offices. In the 1950 general election, the middle classes gave notice of foreclosure on their electoral loan to Labour, and, in 1951, the apostles of New Jerusalem were cast into thirteen years of parliamentary wilderness. The tide of radical social change that had swept Labour to an historic landslide victory began to ebb away almost as quickly as it had surged.

Correspondingly, in peace, the expedient war-time dissolutions of normative sociological conventions were comprehensively and aggressively reversed. The sculpted silhouette of Christian Dior's New Look was as much a visible re-assertion of conventional pre-war femininity, as it was a rejection of war-time austerity. The yards of fabric that were required to create the full calf length skirts which blossomed out from beneath a fitted jacket that tapered to a nipped waist, were as lavishly opulent as they were impractical. Dior's post-war oeuvre offered nothing for women working in either factories or fields. The Labour MPs Bessie Braddock and Mabel Ridealgh both decried Dior's sartorial absurdity. For Braddock, the extravagant use of material was an affront to the hardships that most British women continued to face, even though the war was over. And, as well as sharing Braddock's disgust at the wastefulness of Dior's confection, Ridealgh also condemned what she saw as

Dior's attempt to deprive women of the hard won freedom which they had earned during the war.

Nevertheless, the New Look was a roaring success, and whilst the hostility towards it from prominent Labour politicians would not have been decisive in the reversal of electoral fortunes after the landslide victory in 1945, it certainly contributed to an aura of Puritanical egalitarianism around the party that many readers saw reflected in Orwell's *1984*.⁵¹⁸ There was an unavoidably performative dimension to the public embrace of the New Look. Wearing and promoting Dior's clothes was an assertion of conformity to the normativities of gender that the war had disrupted. And, as Turing discovered in a different but related societal realm, in post-war Britain, the public avowal of a vigorously enforced social conformity was the *sine qua non* of polite public respectability.

As austerity transitioned to affluence, the 1951 Festival of Britain marked an inflection point. Styled as a 'Tonic to the Nation', it rewarded endurance and sacrifice by materialising a future held in trust since 1945. The South Bank raised an otherworldly vision of vibrant colour and futuristic form that radiated an exuberant modernist optimism across a bomb scarred city. Progress offered Britain new designs, new architecture, new art, and new homes that were replete with leisure promising labour saving contrivances. The Skylon drew gazes, wearied by peace and war alike, upwards from still shattered streets to the stars. Although, as the waspish quipped, like Britain, it also lacked any visible means of support. The Festival also constructed a heartening past that both softened the sharp edges of apprehension about an uncertain future in an unsure world, and appeased the moral jeopardy

⁵¹⁸ D. Kynaston, *Tales of a New Jerusalem: Austerity Britain, 1945-51*, (Bloomsbury, London, 2008), pp. 257-58.

instilled by prosecuting total war. Festival literature welled national pride in a newly abiding, and freshly unproblematic, historical British greatness. Modern Britain was now deeply rooted in civilized and civilizing industry, bucolic pastoralism, noble science, heroic technology, and uplifting culture.⁵¹⁹ Officially, the Festival was an ‘autobiography’ of Britain’s land, industry and people.⁵²⁰

The Festival offered both a new post-war idea of Britain, and a reformulated post-imperial sense of Great Britishness; each glowing in past glory as they strained to shine forward. Unlike the British Empire Exhibition in the twenties, or the Great Exhibition of the Works of Industry of All Nations a century before, the 1951 pageant was exclusively and insularly British. Nominatively and constitutively, the Festival was an act of collective introspection; a performative national catharsis of forgiveness and redemption. War had violated Britons’ sense of national decency. Terrible deeds were done by the righteous, albeit in the name of civilisation. Civilians had been slaughtered, and cities had been destroyed, by the very machines that had once betokened the moral foundations of Britain’s global ascendancy. However, the Empire was lost and Columbia’s torch now eclipsed Britannia’s sun.

The Festival re-legitimised Britain’s wholesomeness and restored the British sense of self-decency. It declared a new Britishness; crafted through the union of a re-constituted historic greatness, and a newly cast salvatory modernist humanism. Here lie the roots of both the modern sense of a values based Britishness, and of the ‘British Values’ with which it is populated. The Festival received benediction from the Archbishop of Canterbury, who

⁵¹⁹ The comparison with Danny Boyle’s *Isles of Wonder* opening for the 2012 London Olympics is unavoidable.

⁵²⁰ “The Autobiography of a Nation”, in *The Festival of Britain*, (HMSO, London, 1951), p.3.

blessed it as a paragon of British restraint and decency, and a profession of modest, yet assured, self-confidence. It was a healing; a clarion call to unity, and a renunciation of the necessary evils of the near past.⁵²¹ For many of his contemporaries, the Archbishop's castigation of un-British boastfulness and aggressive attention seeking was also a softly coded yet unmistakable rejection of Americanism.

Although not universal, post-war British anti-Americanism was deep and pervasive.⁵²² America's swagger inflamed already deeply wounded British sensibilities. As Britain struggled to reconstruct, America flipped an ally into a debtor. Teenagers scorned their parents and embraced the alien culture which had spawned them. America's craving for economic efficiency lionised precisely the expert managerialism that was disdained in post-war Britain. British Operational Research was appropriated as American Operations Research, and enjoyed a post-war popularity unknown at home. Productive efficiency and consumerist cravings were reciprocating imperatives. Hoggart and Williams' disdain of vacuous material affluence was commonplace across the political spectrum.⁵²³ Incipient American cultural imperialism was visible even without a Marxist lens. Just as British authenticity was conjured to avert American superficiality, so American corporatist collectivism was contested by the individualistic mythos of the free-born Englishman. Ironically, Britain nourished its scorn of America's sacrifice of individuality for consumption with ideas from American intellectuals that were delivered in best-selling

⁵²¹ Archbishop of Canterbury, in *The Festival of Britain*, inside front cover.

⁵²² G. Goodman, 'Who is anti-American?': *The British Left and the United States, 1945-1956*, (PhD thesis, UCL, 1996).

⁵²³ R. Hoggart, *The Uses Of Literacy: Aspects of Working-Class Life*, (Chatto & Windus, London, 1957). R. Williams, *Culture and Society*, (Chatto & Windus, London, 1958).

consumerist paperbacks. Wilson's *The Man in the Grey Flannel Suit* was re-published in Britain in 1956.⁵²⁴ Whyte's *The Organization Man* arrived in 1957.⁵²⁵

The Matter of the Mind Machine

Amidst the first stirrings of these post-war anxieties, on the evening of Thursday 31 October 1946, the British Institution of Radio Engineers gathered at London's Savoy Hotel for its twenty-first annual dinner. The dismal culinary prospect of an austerity dinner notwithstanding, these boffins were basking in the glory of soldier-scientists; many of them had worked on radar. They were to be addressed by their institution's president, Lord Louis Mountbatten. Latterly, Supreme Allied Commander South East Asia and George VI's cousin, Mountbatten, a one-time Royal Navy wireless officer, was one of them. Routinely, the press attended. Mountbatten's address opened with the ritual acknowledgement of the debt victory owed to science, which he developed somewhat by stressing the importance of scientific praxis. Had this been his substance, the press would have been courteously indifferent. However, Mountbatten pivoted, and his talk became both revelatory and incendiary. Although this speech was a formative episode in the history of public attitudes to technology, it has been neglected in most accounts of early British computing.⁵²⁶

Mountbatten made a string of astonishing predictions. First, he foresaw machines superseding humans as operators of automated global communications networks. Then, characterising radar as human sensorial augmentation, he imagined a radar-like visualisation

⁵²⁴ S. Wilson, *The Man in the Grey Flannel Suit*, (Simon & Schuster, New York, 1955). British re-publication: 1956; Reprint Society, 1957; Pan Books, 1958.

⁵²⁵ W. H. Whyte, *The Organization Man*, (Simon & Schuster, New York, 1956). British re-publication: Cape, 1957; Penguin, 1960, 1963.

⁵²⁶ Although Hodges did at least mention it. Hodges, *Turing*, pp. 347-48.

of internal human anatomy. Intriguingly, Gold had already experimented with body scanning ultrasound radar.⁵²⁷ Next, Mountbatten suggested wiring humans to an electronic “sense-machine”, and transmitting information directly from this device into the brain. He concluded with what he called “the most Wellsian development of all”, as he revealed the existence of a new automatic “electronic brain” with radio valves as brain cells. Now, he said, the exercise of mental functions, including decision, discrimination and memory, was no longer exclusively human. Electronic valve-brains could already play chess, albeit only indifferently currently, and they would soon replace human cognition in a “new revolution” of mind rather than industry.⁵²⁸

This articulation of proto-cybernetics was striking, but not astonishing. Mountbatten was a technocrat, and as a senior military commander he knew some of the secrets of radar and Bletchley. However, Mountbatten spoke not of Britain’s Colossus, but rather of America’s ENIAC. This electronic valve-brain became operational on 10 December 1945, and was dedicated into service at Pennsylvania University’s Moore School of Electrical Engineering on 15 February 1946. ENIAC was a general purpose, re-programmable (but not stored program), electronic, digital (decimal) computer.

In October 1946, very few Britons knew of the American computer, and perhaps only five had actually seen it. Womersley certainly had, and it was his encounter with ENIAC during his computer reconnaissance visit in March 1945 that had prompted him to recruit Turing to the NPL. Hartree had witnessed its construction in 1945, and, at his suggestion, F. C.

⁵²⁷ Gold, *Taking the Back off the Watch*, pp. 33, 47-8.

⁵²⁸ “An Electronic Brain: Solving Abstruse Problems: Valves with a Memory”, *Times*, 1 Nov., 1946, p. 2.

Williams visited it during a 1946 radar mission.⁵²⁹ Wilkes perhaps heard about ENIAC from Leslie Comrie, the founder of Scientific Computing Service Ltd, who visited America in May 1946. Comrie returned with a rare copy of von Neumann's EDVAC report, which Wilkes borrowed for overnight reading during Comrie's fleeting trip to Cambridge in mid-May.⁵³⁰ Wilkes, a self-proclaimed computer pioneer whose life was transformed by ENIAC, oddly claimed amnesia about the original source of his knowledge.⁵³¹ In summer 1946, Hartree generously secured Wilkes a late place on the Moore School Lectures on the Theory and Techniques for Design of Electronic Computers, where Hartree taught. In April and October 1946, Hartree published short articles about ENIAC in *Nature*. These sober accounts of an abstruse American mathematical machine, by an obscure British mathematician, were roundly ignored.⁵³² Although, the *Guardian* did run a short description of ENIAC in July.⁵³³ In October 1946, Hartree made ENIAC the subject of his inaugural professorial lecture in Cambridge, but this was not published until April 1947.

Mountbatten's awareness of ENIAC may have come directly from America. His talk made much of Vannevar Bush, then the director of the US Office for Scientific Research and Development (OSRD), whom Mountbatten thanked for information about a proposed "electronic memory machine" that would be capable of storing compressed information equivalent to the contents of the British Library.⁵³⁴ During the war, OSRD had directed most

⁵²⁹ Lavington, *Manchester Computers*, p. 5.

⁵³⁰ John von Neumann, "First Draft of a Report on the EDVAC, June 1945", reproduced in *IEEE Annals of the History of Computing*, Vol 15, No. 4, Oct./Dec. 1993, pp. 28-75.

⁵³¹ M. Wilkes, *Memoirs of a Computer Pioneer*, (MIT, Cambridge, 1985), pp. 106-08.

⁵³² D. R. Hartree, "The ENIAC, An Electronic Calculating Machine", *Nature*, Vol. 157, No. 3990, 20 April 1946, p. 527. D. R. Hartree, "The ENIAC, An Electronic Computing Machine", *Nature*, Vol. 158, No. 4015, 12 Oct. 1946, pp. 500-6.

⁵³³ "Mathematics by Machine", *Guardian*, 5 July 1946, p. 4.

⁵³⁴ "Science on Verge of the Electronic Brain: Lord Mountbatten's Disclosure: Memory Machine and Robot Mathematician", *Telegraph*, 1 Nov. 1946, p. 5.

of America's military research, including the Manhattan Project and the development of radar directed predictive anti-aircraft fire. Although directly commissioned by the US Army, ENIAC was first used in nuclear weapons research. Bush, therefore, had a uniquely privileged view across the scope of American pre-cybernetics, and he would have been one of the very few Americans who knew about Bletchley's cryptanalytic machines. In 1945, he published "As We May Think" in the American popular press.⁵³⁵ This proposed the Memex, or memory extender; an electronic and electromechanical device that augmented human cognition. The Memex offered optical character recognition and scanning, electronic storage of transcoded sound and video, contingently associative data retrieval, and the idea of hyperlinks upon which the World Wide Web was coded. Mountbatten did not mention Bush's Memex explicitly, nevertheless he evidently had it in mind.

Mountbatten's speech provoked vigorous press coverage. Alongside comprehensive, yet temperate, coverage by the *Times* and *Telegraph*, the *Mail* trumpeted Mountbatten's wild claims about electronic brains superseding humans, and his outlandish ideas about computers electronically amplifying and projecting thought.⁵³⁶ Similarly, *Western Daily Press* readers, perhaps including some at the BNI, learnt of Mountbatten's prediction that electronic computers would break humankind's monopoly over cognition.⁵³⁷ The *Illustrated London News* ran a full page photographic feature about ENIAC.⁵³⁸ By 15 November, ENIAC reached Hull.⁵³⁹

⁵³⁵ V. Bush "As We May Think", *Atlantic*, July 1945, pp. 101-08. V. Bush "As We May Think", *Life*, Sept. 1945, pp. 112-124.

⁵³⁶ "'Electric Brain' Will Think For Man: It Has a Memory", *Mail*, 1 Nov. 1946, p. 1, 6.

⁵³⁷ "New Robot Brain Machines: Electronic Memory: It Will Obey Orders", *Western Daily Press and Bristol Mirror*, 1 Nov. 1946, p. 4.

⁵³⁸ "The 'Electronic Brain', With 18,000 Valves to Help in Solving 'Impossible' Problems", *Illustrated London News*, 9 Nov. 1946, p. 531.

⁵³⁹ W. J. Bentley, "Machines May Link With Body and Think for Us", *Hull Daily Mail*, 15 Nov. 1946, p. 4.

Those respectable scientists who already knew about ENIAC, alacritously rebutted Mountbatten's auguries. In the *Times* of 7 November, Hartree lamented his sensationalism, scorned the term 'electronic brain', and repudiated the idea of thinking machines. ENIAC was a complicated calculator; a tool that replaced the rote labour of computation, but not the prior human thought required to make it work. Electronic computers slavishly implemented instructions through mechanisms that were devoid of volition, creativity or autonomy. Hartree's by-line semiotically endowed him with professorial authority. Textually, he asserted his unique expertise about ENIAC; sub-textually, he declared that Mountbatten spoke nonsense.⁵⁴⁰ Within a week, the NPL Director, Sir Charles Darwin, also wrote to the *Times* in direct support of Hartree.⁵⁴¹ Darwin also believed that computers were mere machines, devoid of the vitalist uniqueness of the human mind. These were consequential and courageous acts; the age of deference lived. Yet, here, two Establishment figures were publicly contradicting a royal war hero. Darwin, perhaps mindful of his obligations to Crown service, generously suggested that Mountbatten was misreported. However, this was not the case. In 1946, neither the *Times* nor the *Telegraph* would have risked royal censure for misrepresentation.

Others were less forgiving than Darwin. The *Mail's* science editor, John Langdon-Davies, cheered Darwin and Hartree's affirmation of the vitalist mind's inimitable wonders; whereas the two eminent scientists proclaimed common sense, Mountbatten spouted nonsense. Langdon-Davies declared that Fleet Street was blameless in accurately reporting his

⁵⁴⁰ "The 'Electronic Brain': A Misleading Term: No Substitute for Thought", *Times*, 7 Nov. 1946, p. 5.

⁵⁴¹ C. G. Darwin, "The Electronic Brain", *Times*, 13 Nov. 1946, p. 7.

Lordship's idiocy.⁵⁴² Computers were machines, and modish reduction of mind to mechanism carried grave, albeit unnamed, peril. His Lordship, of all people, should have known better. Hartree had already been explicit about the danger Langdon-Davies alluded to. The *Telegraph* had cited Hartree's early fear that mechanistic mental reductionism negated humanism and risked fascism.⁵⁴³ If human minds were mere mechanisms, then susceptibility to Nazi roboticization was immanent in the human condition. In 1946, this was a potent charge.

Besides humanism, Langdon-Davies offered *Mail* readers nationalism, garnished with anti-Americanism, to further rebuke Mountbatten's portentous proclamation. By promoting ENIAC, Mountbatten had stained the honour of British science. Langdon-Davies patriotically invoked the legacy of Charles Babbage as the original British inventor of the

⁵⁴² John Langdon-Davies, "Electronic Brains Can't Reason", *Mail*, 19 Nov. 1946, p. 2.

⁵⁴³ "'Ace' Will Speed Jet Flying: Solving Problems in Aerodynamics", *Telegraph*, 8 Nov. 1946, p. 5. The article was based on first hand conversations between an unnamed *Telegraph* reporter; and Turing, Womersley and Hartree which had occurred at the NPL the day before. Turing, who was explicitly credited with having "conceived the idea of Ace", was paraphrased as having said that "he foresaw the time, possibly in 30 years, when it would be as easy to ask the machine a question as to ask a man". Hartree's riposte was given in part as paraphrase, and in part as direct quote. In paraphrase, the reporter wrote that Hartree had "deprecated ... any notion that Ace could ever be a complete substitute for the human brain". In direct quotation, the reporter gave Hartree the last words of his article: "'The fashion which has sprung up in the last 20 years to decry human reason is a path which leads straight to Nazism'". Hartree's intended meaning was clear, and clearly communicated by the journalist; claiming mechanistic cognitive equivalence between electronic computers and biological brains was a step towards a repetition of the horrors of Hitler's Reich.

computer in an early public mention of Babbage's now celebrated paternity claim.⁵⁴⁴ Connecting past and present, Langdon-Davies cited a modern British computer then under construction by the Department of Scientific and Industrial Research (DSIR); a machine which, when built, would beat the Americans and restore British prestige. Separately, Babbage's, and therefore Britain's, priority in computer invention appeared in a letter to the *Times* from Lt Cdr Rupert Gold, who recalled the efforts of Babbage's son, Major General Henry Prevost Babbage, to preserve his father's legacy.⁵⁴⁵ Henry had constructed six working models of elements of his father's Difference Engine No. 1, one of which went to Harvard. Ironically, it was this model that led Harvard physicist, Howard Aiken, to discover Babbage's Analytical Engine, whilst he was designing his own machine to automate numerical solution of differential equations. Aiken's machine, known variously as the IBM Automatic Sequence Controlled Calculator, or the Harvard Mark 1, was a general-purpose, programmable, electromechanical computer. It began operation in May 1944.

⁵⁴⁴ There was an earlier mention of Babbage's foundational role in the history of "mechanical computing" in an Oct. 1946 review by L. J. Comrie of the operator's manual for the IBM Automatic Sequence Controlled Calculator, an electromechanical computer also known as the Harvard Mark I. Comrie, who had trained as an astronomer, founded the Scientific Computing Service Ltd in 1937. He visited America in May 1946. In his review, Comrie excoriated the failure of Babbage's "government of the day" to equip the great man to realise his dream. Heralding the now commonplace computational variant of the declinist narrative about the historical paucity of the technological vision of Britain's political class, Comrie believed that the short-sighted parsimony of the nineteenth century politicians had "cost Britain the leading place in the art of mechanical computing, and that this "black mark" had yet to be erased by their equally incompetent heirs. L. J. Comrie, "Babbage's Dream Comes True", *Nature*, Vol. 158, No. 4017, Oct. 1946, pp. 576-68, [review of "*A Manual of Operation for the Automatic Sequence Controlled Calculator*, by the Staff of the Computation Laboratory, (Annals of the Computation Laboratory of Harvard University, Vol. 1.), (Harvard University Press, Cambridge, MA.; Oxford University Press, Oxford; 1946)"]. Babbage's great grandson, Richard, also highlighted Charles' work in a talk he gave at the 1947 Harvard computer symposium which was attended by Turing. R. H. Babbage, "The Work of Charles Babbage", in *Proceedings of a Symposium on Large-Scale Digital Calculating Machinery*, in M. Campbell-Kelly, W. F. Aspray (eds.), *Proceedings of a Symposium on Large-Scale Digital Calculating Machinery: Charles Babbage Institute Reprint Series for the History of Computing, Volume 7*, (MIT Press, Cambridge, MA.; Thomas, Los Angeles, CA.; 1985), pp. 13-22. Whilst considerable attention has been paid to the work and historical significance of Babbage, particularly by Doron Swade and Martin Campbell-Kelly, there has been less discussion of the ways in which the ideas about Babbage's legacy were surfaced across the discourse around the emergence of electronic computation in the immediate aftermath of the Second World War. This would reward further attention.

⁵⁴⁵ Lt Cdr (RN) (ret'd.) R. T. Gold, "The "Electronic Brain"", *Times*, 29 Nov. 1946, p. 5.

Although unnamed, Langdon-Davies's heroic British computer was the ACE; then in planning at the NPL. Mountbatten's speech pushed Darwin into an unplanned press release on 6 November, which patriotically postured the unbuilt British machine as a rival to ENIAC.⁵⁴⁶ Darwin had mentioned the ACE in his initial affirmation of Hartree's repudiation of Mountbatten on 7 November, although he had again pulled his punch. Whilst Darwin admitted briefing Mountbatten about the ACE before the October speech, he also reported that he had asked Mountbatten to withhold his knowledge. Langdon-Davies' tabloid fulminations followed the more sober coverage of Darwin's precipitous press release in the *Telegraph* and the *Times*.⁵⁴⁷ Both broadsheets had foregrounded Turing's invention of the ACE; explicitly emphasising his Britishness and its superiority. British electronic brains would be better, because British biological brains were smarter. The *Telegraph* was particularly struck by Turing's youth. This press coverage instantly propelled him into the public realm. On 11 November, the British Institution of Radio Engineers wrote to Turing. Noting Darwin's revelation of the ACE, and the publicity stirred by their president's disclosure of ENIAC, they asked Turing to speak about his creation at their Bournemouth convention. Recognised Turing's new found fame, their invitation stressed that Mountbatten himself had requested the paper.⁵⁴⁸

On 8 November, the *Telegraph* ran a second ACE article in order to set Turing directly against Hartree. First, the *Telegraph* framed Turing's now famous prediction about computers matching the reasoning ability of humans within decades as a strawman. Then,

⁵⁴⁶ Most of the press release was reproduced verbatim in "Calculations and Electronics: Automatic Computator Designed by the N.P.L.", *Electrician*, Vol. 137, No. 19 (3571), 8 Nov. 1946, pp. 1279-80.

⁵⁴⁷ "Britain to Make a Radio Brain: "ACE" Superior to U.S. Model: Bigger Memory Store", *Telegraph*, 7 Nov. 1946, p. 1. "An Automatic Computing Engine: Novel Machine Designed by British Scientists", *Times*, 8 Nov. 1946, p. 2.

⁵⁴⁸ Letter, G. D. Clifford, General Secretary, The British Institution of Radio Engineers to Turing, Mathematics Division, NPL, 11 Nov. 1946, SMG/NCC/NPL/M/11.

they burnished both Hartree's repudiation of the equivalence between computers and humans, and his counter-prediction that this dehumanisation presaged fascism.⁵⁴⁹ The charge ignited. Later that month, the *Hull Daily Mail* claimed that Frankenstein's soulless nightmare was now incarnate in a robotic electronic thinking machine.⁵⁵⁰ The *Telegraph's* editorialised juxtaposition had publicly decried Turing's advocacy of a proto-cybernetic mechanistic idea of cognition as a dangerous fantasy; just as it had pronounced that it had been swiftly denounced, intellectually and humanistically, by respectable and responsible scientists. Hartree and Darwin then continued their public assault on the heterodoxy of mechanistic cognition through the remainder of 1946. Darwin on the BBC Home Service news broadcast on 9 November, and Hartree during the Home Service *Science Survey* programme on 11 December.⁵⁵¹ Both were featured in the *Listener*.⁵⁵² They each stressed the reductive functionalism of the new machines, and they united in claiming their exclusive discursive authority over them. This seeded the British Cartesian computational controversy; which publicly erupted three years later, with Turing at its epicentre.

In the discourse championed by Hartree and Darwin, computers were neither brains nor minds. They relieved algebraic drudgery, but they could only act upon instructions from a uniquely creative human.⁵⁵³ They were mathematician's tools; complex, but unmysterious,

⁵⁴⁹ ““Ace” Will Speed Jet Flying: Solving Problems in Aerodynamics”, *Telegraph*, 8 Nov. 1946, p. 5.

⁵⁵⁰ W. J. Bentley, “Machine May Link with Body and Think for Us”, *Hull Daily Mail*, 15 Nov. 1946, p. 4.

⁵⁵¹ C. Darwin, “The Automatic Calculating Engine”, News Talk, BBC Home Svc., 9 Nov. 1946, BBC/WAC/GB/898/BBC/R/RPAB/T107. D. Hartree, “Automatic Calculating Engine”, *Science Survey*, BBC Home Svc., 11 Dec. 1946, 22:00.

⁵⁵² “Did You Hear That?: An Arithmetical Robot”, *Listener*, Vol. 36, No. 931, 14 Nov. 1946, pp. 663. D. Hartree, “What Giant Calculating Machines Can Do”, *Listener*, Vol. 36, No. 937, 26 Dec. 1946, p. 932.

⁵⁵³ Although Hartree never entirely disavowed the remote, abstract, possibility that far distant machines might eventually emulate minds, nevertheless he repeatedly stressed his opposition to even the faintest suggestion that electronic digital computers were in any way capable of thought. An argument he made vigorously, and in explicit rebuttal to Turing, in the first instalment of a Third Programme series on “Automatic Calculating Machines”, BBC Third Prog., 5 May 1951, 20:45, BBC/WAC/GB/898/BBC/R/RPAB/T200. Turing's instalment was broadcast on 15 May.

and certainly not talismans against Sherrington's enchantment. Although the ACE was Turing's invention, because of his transgression he was deliberately denied either discursive authority, or intellectual agency, in shaping the epistemological paradigm for electronic digital computation. As well as portending the British Cartesian computational clash between mechanism and vitalism, this consequential early contest also initiated an epistemological formalisation which led eventually to the disciplinary scientisation of computing. The institutionalised legitimisation of British computer science was predicated on the deliberate construction of Turing as Other to the scientific sociology which validated it. Starting with its appropriation of the ACE, and its disavowal of Turing's credentials, the nascent elite of the embryonic computing establishment vigorously asserted discursive ownership and definitional control. Every modern utterance to the effect that that a computer can only follow a programme given to it by a human, or that a computer can't be creative, or that a computer can't exercise any other faculty considered by the speaker to be an exclusively human attribute, is inscribed with the outcome of the controversy that Mountbatten ignited in October 1946; and which Turing lost.⁵⁵⁴

At the public birth of modern computing in Britain, a formative epistemological and international schism was riven. On one side, there was a dilettante aristocrat making wild claims about American electronic thinking machines that were supported only by a renegade mathematician. On the other, there was respectably restrained British science. The primal orthodoxy of British scientific knowledge about computers was constructed and authorised as a counter reaction to Mountbatten's effusion and Turing's deviation. Ironically, sober

⁵⁵⁴ Indeed, this counter to computational cognition was directly repudiated by Turing in "Computing Machinery and Intelligence" where he famously described it as "Lady Lovelace's Objection". A. M. Turing, "Computing Machinery and Intelligence", *Mind*, Vol. LIX, Iss. 236, Oct. 1950, pp. 450-52 (p. 450 for the quote).

British empiricists claimed irrefutable discursive authority by boldly asserting an insubstantial and occult essentialism as evidential fact. In an incoherent philosophical alliance, the early British computing mainstream simultaneously deployed vitalism as both a scientised assault on mechanist mentality, and as a metaphysically humanist defence of both the ontological imponderability, and the epistemological irreducibility, of the human mind. Thus, and counter to Americanised hyperbole and un-British romantic speculation, computers were insensate, regardless of any apparent behavioural commonality with their makers. Definitional binary categorical opposition was inviolable. Computers were machines; humans were not. Humans possessed minds; computers could not. Transgression subverted scientific respectability; and Britishness.

By the end of 1946, the first flare of the computational controversy had faded. However, in 1949, following *Cybernetics*, a second and far larger storm broke. In 1948, Jeffrey Jefferson, neurosurgery professor at Manchester, received the Lister Medal for surgery. His acceptance Oration at the Royal College of Surgeons on 9 June 1949 became the epicentre of the new tempest. Although marginally better noticed by historians than Mountbatten's talk, the significance of Jefferson's lecture has, nevertheless, been neglected. The *BMJ* published Jefferson's oration with intentional alacrity. Its editorial introduction praised his medico-philosophical insight, deprecated Turing's chimera of electronic brains, and condemned *Cybernetics* as a harbinger of mechanistic tyranny akin to Nazism.⁵⁵⁵ The popular press were similarly energised in their support of Jefferson's vitalist humanism. That September, Jefferson broadcast his talk on the BBC Third Programme, and the *Listener* printed his

⁵⁵⁵ G. Jefferson, "The Mind of Mechanical Man", *BMJ*, 25 June 1949, Vol. 1, No. 4616, pp. 1105-10, 1129-1130.

text.⁵⁵⁶ Jefferson's subject, "The Mind of Mechanical Man", overtly referenced the controversy previously stirred by Mountbatten, and newly sparked by *Cybernetics*; and, it signalled a conscious public reignition of this contest. Tacitly, Jefferson's title declared opposition to Turing and Wiener, whom he now implicitly cast together. Textually, he explicitly drove *Cybernetics* into the heart of a computationally framed dispute between mechanism and vitalism which continues today.

Jefferson raised Descartes' ghost to guide his spirited defence of vitalism. As an eminent neurosurgeon, he accepted neither the literalism of substance dualism, nor the Cartesian correlate of the pineal gland as the neurological dormitory for the immaterial rational soul. Nevertheless, he railed against the scientisation of medicine, and staunchly defended the humanistic craft-wisdom of naturally gifted healers; like him. Despite decrying metaphysics, Jefferson avowed that his innate gifts and experiential learning offered conclusive proof that the unknowably wondrous human mind defied merely scientific explanation. Descartes was wrong in substance, but right in spirit. No automata, no matter how faithfully it mimicked life, could ever prove mechanism through behaviour alone. Computers lacked free-will and purpose, and, like Descartes' parrot, without the vitalist animus of transcendent and ontologically unknowable reason, machine brains operated without comprehension. In Jefferson's syllogism, computers were machines and therefore mindless. In his solipsism, they lacked emotion and imagination. Following Descartes, Jefferson believed that a computer's thoughtless behaviour was preordained by its maker's

⁵⁵⁶ G. Jefferson, "The Mind of Mechanical Man" BBC Third Prog., 14 Sept. 1949, 21:15, BBC/WAC/GB/898/BBC/R/RPAB/T261. G. Jefferson, "The Mind of Mechanical Man", *Listener*, Vol. 42, No. 1078, 22 Sept. 1949, pp. 479-83.

mind. Following Hartree and Darwin, he seeded the hegemonic contemporary discourse of computational determinism.

Jefferson delivered his Lister Oration on 9 June. It was reported uncritically in the next day's *Times*, with a follow on feature that Saturday which emphasised the connections between Jefferson's talk, and the new computer at Manchester University.⁵⁵⁷ This followed Jefferson's lead. He had referenced the Manchester computer in his Oration, and warmly credited its architect, F. C. Williams, as the source of his knowledge. Jefferson extolled Williams' scientific rectitude in both promulgating the mindless mechanism of computers, and in responsibly denying the cyberneticist conceit that computers were explicatory brain analogues. Williams embodied Jefferson's ideal of scientific computational expertise. Regrettably, however, Jefferson recognised that romantic illusion could easily seduce lesser intellects. Pointedly, Jefferson's talk did not mention Turing by name. However, deviating from the prevailing vitalism championed by Jefferson, the *Times*' reportage around his talk did cite Turing; and, without either overt or editorialised criticism. Drawing a structural comparison between the Manchester computer and a human brain, the journalist allowed Turing to assert the behavioural equivalence between computers and minds, and to predict that computers might eventually surpass their makers, even as artists. However, journalistic forbearance notwithstanding, once again Turing had publicly transgressed scientific orthodoxy.

Turing's optimism that the admittedly primitive Manchester machine merely glimpsed at future wonders was not universal. That June, Dom Illtyd Trethowan, a Benedictine Monk,

⁵⁵⁷ "No Mind For Mechanical Man: An Insoluble Problem", *Times*, 10 June 1949, p. 2. "The Mechanical Brain: Answer Found to 300 Year Old Sum", *Times*, 11 June 1949, p. 4.

priest and theologian, thunderously intervened; invoking Christ against Turing and his calamitous computers. In a righteous intercession from the sacred to the secular, the cleric wrote to the *Times*, imploring responsible scientists to denounce Turing, and exhorting governmental abjuration of computers as instruments of societal regulation. Scientifically, the monk recognised Jefferson's vitalist truth. Theologically, he disputed that computers rivalling humans disavowed the divinity of mind and soul, or negated free-will.⁵⁵⁸ Fictively, the twentieth century priest anointed Samuel Butler as a new prophet, and blessed the Erewhonians' pre-emptive destruction of their machines.⁵⁵⁹ Ironically, Butler himself had ruthlessly vilified his subjects. Their obliteration of mechanism was an especially damaging instance of their perverse idiocy. The credulous Erewhonians had egregiously stunted their societal progress by needlessly heeding a self-proclaimed prophet of doom. Nevertheless, this mis-reading of Butler's Victorian satire is now memetic as a preordained fact bolstering catastrophist predictions of human extermination in transhumanist appropriations of the Technological Singularity.

Turing also had adversaries closer to home; spatially and spiritually. That same June, the *Illustrated London News* ran a lavish feature which, whilst not naming him, nevertheless offering a stinging rebuke to his reckless notion of thinking machines. The explicit purpose of the piece, which covered the front, and a two page spread, was to correct deceptive and baseless ideas about computers that had been reported by the sensationalist press after Jefferson's Lister Oration. The journalistic tone was openly hostile to the suggestion of computers exhibiting human attributes. The report featured the Manchester computer, and its two makers, Freddie Williams and Tom Kilburn; neither of whom entertained the

⁵⁵⁸ "The Mechanical Brain: Successful Use of Memory Storage", *Times*, 14 June 1949, p. 5.

⁵⁵⁹ S. Butler, *Erewhon: or, Over the Range*, (Trübner, London, 1872).

ludicrous notion that computers could be anything other than fast and powerful automatic calculators.⁵⁶⁰ The article can only have been produced with their full support. Likewise, they must have known that Turing was the unnamed target of this journalistic scorn. Perhaps this was their intent. This, combined with Jefferson's oratorical warmth towards Williams, suggested that Kilburn and Williams not only assisted Jefferson's refutation of Turing, but also that they prosecuted this rejection themselves. Conspicuously, despite his growing public profile, and notwithstanding his titular designation as Deputy Director of the Manchester Royal Society Computing Laboratory, Turing was absent from Williams' and Kilburn's article.

Jefferson's Oration explicitly attacked *Cybernetics*; patronisingly dismissing it as more entertainment than science. Moreover, insofar as Wiener's ideas possessed any substance; they were wrong. Jefferson specifically targeted Wiener's neurologically mechanistic stance; particularly, the American's frivolous analogy between the human central nervous system and automated telephone exchanges; and, especially, his proposal that dysfunctional human neurology and malfunctioning electronic computers manifested a symptomatic similarity that indicated both an essential ontological unity, and a curative commonality. In *Cybernetics*, Wiener had argued that just as computer pathologies could be remediated by purging memory, surging power, or removing the faulty component; so, brain pathologies could be treated by sleep, electrical and chemical jolt, or lobotomy.⁵⁶¹ Wiener was the first to suggest fixing a computer by turning it off and on again. Jefferson also openly denigrated Walter's ideas about constructing robot tortoises as electromechanical analogues of the

⁵⁶⁰ "A Marvel of Our Time: The "Memory" Machine Which Can Solve the Most Complex Mathematical Problems", *Illustrated London News*, 25 June 1949, pp. 882-83.

⁵⁶¹ Wiener, *Cybernetics*, pp. 172-73.

human sensorial and nervous system; mockingly joking about the frustration a biological tortoise would experience in attempting sex with a robot. Such toys were merely amusements for children or the gullible. Jefferson was forcefully direct. *Cybernetics* was mechanistic anti-humanist heresy, and Wiener was its false American prophet. Neither humanists, nor credible scientists, should associate with either. Those that did were heretics.

Wiener took early note of Jefferson's derision. Writing to Walter in September 1949, he mentioned a *BMJ* article that had attacked both him, and *Cybernetics*.⁵⁶² However, declaring the argument spiritual not scientific, Wiener had declined to respond. Walter replied ten days later, reporting on the formation of the as yet unnamed British cybernetics dining club, and advising Wiener to continue ignoring the *BMJ* article.⁵⁶³ According to Walter, its author, who although unnamed was obviously Jefferson, was an elderly medical eminence; a Cartesian dinosaur doomed to intellectual extinction by the vigour of youthful scientific progress. Walter was descriptively correct, and predictively wrong. Rather than provoking the evolutionary overthrow of vitalism, Jefferson's excoriation of cybernetics provoked a British public philosophical argument about computers and minds which Descartes won and Wiener lost.

Jefferson was not alone in publicly attacking *Cybernetics* in summer 1949. Writing in the *Aberdeen Journal*, George Godwin reflected on the prospect of thinking machines, and on Turing's predictions about them.⁵⁶⁴ Whilst his article overtly connected Turing's ideas and

⁵⁶² Letter, Wiener to Walter, 12 Sept. 1949, MIT/NWP/Box 7, Fldr. 104, <https://hdl.handle.net/1721.3/200281>, [6 Jan. 2024].

⁵⁶³ Letter, Walter to Wiener, 22 Sept. 1949, MIT/NWP/Box 7, Fldr. 104, <https://hdl.handle.net/1721.3/200281> [6 Jan. 2024].

⁵⁶⁴ G. Godwin, "What Is Likely to Happen If Machines Can Be Made to Think?", *Aberdeen Journal*, 23 June 1949, p. 2.

Cybernetics, Turing himself was mentioned only tacitly (and erroneously) as an unnamed inventor of the Manchester computer. Godwin believed that *Cybernetics* was as deadly as the atom bomb. In a remarkable pre-vision of the cyborg, the nightmare of cybernetic machines with computer brains rising to rival and supplant humans terrified him.⁵⁶⁵ Like Jefferson, Godwin raised Descartes' spirit to both ward off mechanism, and avert the imperilment of vitalist humanism. Like Dom Trethowan, he professed his faith in a uniquely divine human soul. Godwin proclaimed that a vigil should be kept on cybernetics, and its dangers contained. Jefferson's Oration articulated and empowered the mainstream of respectable scientific and popular opinion, and the public furore he sparked in summer 1949 shaped the intellectual and social climate within which Bates conceived and convened the Ratio Club that autumn. From the outset; *Cybernetics* was neither safe, nor respectable, nor British.

The Meetings of Bates' Brains

The Ratio Club was catalysed by a meeting organised by Walter and Shipton at the BNI on Saturday 7 May 1949, a month before Jefferson's polemic and exactly four years after Craik's death. The invitation explained the meeting's purpose in detail.⁵⁶⁶ Just as Wiener's book was about *Control and Communication in the Animal and the Machine*, so the meeting would discuss "Control Mechanisms in Machines, Animals and Communities". Indeed, the organisers said, Wiener himself had suggested the meeting. He certainly knew about it. In April 1949, Walter wrote to Wiener, reporting that he and others were reading *Cybernetics*

⁵⁶⁵ For the genesis of the cyborg, see N. S. Kline, M. E. Clynes, "Drugs, Space, and Cybernetics: Evolution to Cyborgs", in B. E. Flaherty (ed.), *Symposium on Psychophysiological Aspects of Space Flight (Brooks Air Force Base, Texas, 1960)*, (Columbia University Press, New York, 1961), pp. 345-71; and M. E. Clynes, N. S. Kline, "Cyborgs and Space", *Astronautics*, Sept. 1960, pp. 26-27, 74-76.

⁵⁶⁶ "Discussion on Control Mechanisms in Machines, Animals, and Communities (To be held at the Burden Neurological Institute, Stoke Lane, Stapleton, Bristol, on Saturday 7th May, at 3 p.m.)", WC/GC/179/B.23/Box 12.

avidly and mentioning his plans for a cybernetics conference in Bristol.⁵⁶⁷ The invitation recognised that *Cybernetics* had incited considerable antipathy as well as enthusiasm. Yet, the organisers insisted, despite its errors it synthesised an explicit and mathematically rigorous consolidation of hitherto disparate and implicit scientific sub-currents. This fusion, they argued, had emerged from military devices that had replicating automatic self-regulation through mechanised sensorial feedback and integrated it with self-actuating motor-control. Such behaviour, they said, was formally considered exclusively biological.

Invoking proto-cybernetics, the invitation beckoned the hinterland of scientists working in ostensibly sundered disciplines whose investigations of the natural, physical and social realms had already felt the epistemological gravity of *Cybernetics*. It noted that neurologists were straying into electrical circuit theory, computer designers were exploring neurology, and sociologists were using communications engineering. The meeting was explicitly pitched at scientists who were resisting the ossifying antipathy towards Wiener that was already marking respectable British intellectualism. Whilst the invitation promised vigorous debate about cybernetics, it was evident that the gathering was intended to serve minds that were more fascinated than repelled by this epistemological radicalism. Particularly, those whose lived experiences of proto-cybernetics had drawn them towards *Cybernetics*. This was a meeting in both praise and defence of *Cybernetics*. Yet, it was consigned to the margins. These excited scientists gathered at the weekend, as had Rowe's Soviets. They convened in a provincial mental hospital under the aegis of the AScW, an organisation conspicuously associated with prominent communists like J. D. Bernal. Sociologically, epistemologically and institutionally, the meeting was liminal and unorthodox.

⁵⁶⁷ Letter, Walter to Wiener, 21 April 1949, MIT/NWP/Box 6, Fldr. 96, <https://hdl.handle.net/1721.3/200273>, [6 Jan. 2024].

It is now evident that this BNI conference was a vital episode in the early formation of British cybernetics. Not only did it spur the creation of the Ratio Club, but it also spread Wiener's ideas far beyond Bates' limited social and professional spheres. In May 1949, Walter reported the success of the conference to Wiener.⁵⁶⁸ Around eighty cross-disciplinary scientists had converged in Bristol, and their conversations had been as energetic as Walter had hoped. Clearly, the invitation, which included a comprehensive reading list, had been circulated far beyond Walter's direct circles, or even those of his BNI colleagues. Given that the event was held under the aegis of the AScW, it was probably circulated across their network. Indeed, Ashby's review of *Cybernetics* cited the meeting as a major British entry point for Wiener's ideas.⁵⁶⁹ However, equally tellingly, whilst Walter lauded the success of his BNI conference to Wiener, the letter also told of his concern that the meeting had been too large. Exclusivity had been sacrificed to enthusiasm and Walter already looked forward to smaller meetings of true believers. This was an alacritous expression of the intellectual and social insularity which characterised the Ratio Club's constitution and practices.

Previously, it was thought that Bates conceived the Ratio Club in July 1949, after a Cambridge symposium on the Physiological Mechanisms in Animal Behaviour organised jointly by the Association for the Study of Animal Behavior and the Society for Experimental Biology.⁵⁷⁰ This Cambridge symposium certainly felt Wiener's influence. Writing to Walter in July 1949 to propose his 'dining-club', Bates mentioned his

⁵⁶⁸ Letter, Walter to Wiener, 12 May 1949, MIT/NWP/Box 6, Fldr. 97, <https://hdl.handle.net/1721.3/200274>, [6 Jan. 2024].

⁵⁶⁹ W. R. Ashby, "Critical Review: the Facts and Methods of Cybernetics", *Journal of Mental Science*, Vol. 95, Iss. 400, July 1949, pp. 716-24, p. 716.

⁵⁷⁰ Husbands, Holland, "The Ratio Club", in Husbands, Holland, Wheeler (eds.), *Mechanical Mind*, p. 99.

conversations about cybernetics at the Cambridge symposium as one of the recent episodes prompting his suggestion.⁵⁷¹ Bates did not need to cite the BNI cybernetics meeting, which he attended, because Walter had organised it. However, whilst the Cambridge symposium was part of the Ratio Club's formative process, the record of the May BNI meeting and newly surfaced material from MacKay's private papers reveal that the primary stimulus was Bristol, not Cambridge. An August letter from Bates to Hick supports this.⁵⁷² Inviting Hick to join his club, Bates reminded him that they had recently discussed the idea in Cambridge. Assuming this was in July, the idea was probably on Bates mind before the Cambridge symposium.

The new information supporting the primacy of the BNI meeting came from MacKay's diary and from letters to his mother, which were given to Professor Phil Husbands by Valerie, Donald's wife, and generously copied to me via personal correspondence with Professor Husbands.⁵⁷³ MacKay explicitly diarised the May BNI event as a cybernetics meeting. Later entries indicated MacKay's absence from the July Cambridge symposium. His diary confirmed that Slater, Ashby, Porter and Bates were at the BNI cybernetics meeting, and also suggested Young's presence. MacKay found the BNI event simultaneously engaging and frustrating. Writing to his mother, he lamented that, whilst he had spoken, there was no common language through which the assembled computer designers, control engineers, economists, psychologists and physiologists could discuss cybernetics. MacKay's roll-call

⁵⁷¹ Letter, Bates to Walter, 27 July 1949, WC/GC/179/B.1/Box 12.

⁵⁷² Letter, Bates to Hick, 17 Aug. 1949, WC/GC/179/B.1/Box 12.

⁵⁷³ However, Pamela McCorduck had previously indicated that the genesis of the Ratio Club occurred during a conversation between Bates and MacKay as they returned to London by train after attending the BNI cybernetics meeting. Although McCorduck did not nominatively particularise the reference to the BNI cybernetics event, it is evidently this gathering that MacKay had described. She would have gleaned this information at first hand from the interview with MacKay she conducted as part of the research for her book. McCorduck, *Machines Who Think*, 1st edn., p. 78.

for the BNI babel suggested the possibility that some (or all) of Tustin, Turing, Uttley and Woodward attended. Turing was certainly invited. In April 1949, Ashby sent Turing an off-print of an article on the Homeostat. His letter mentioned their meeting in November 1946, and wondered whether Turing had read *Cybernetics* yet. Noting Turing's interests, Ashby invited him to the BNI meeting.⁵⁷⁴ Turing responded warmly, but noncommittally.⁵⁷⁵

When Bates surfaced the idea of an informal cybernetics dinner club to Walter in late July, he had already canvassed support from MacKay, Barlow, Hick, Sholl, Gold and Pringle.⁵⁷⁶ Bates noted both a need to assemble and discuss this powerful new science that was commanding increasing attention despite its critics, and an imperative to release these discussions from intellectual orthodoxy and academic respectability. Bates worried that Establishment conservatism would choke British cybernetics at birth. For Bates and his putative club, whilst the war had brought transient intellectual and sociological freedom. *Cybernetics* now gave nominative and epistemological form to the fruits of that freedom and scientised their lived experiences. However, cybernetics was now also vulnerable to the tightening strictures of the rapidly re-forming normativities of mind and institution within which post-war livings must be made. Careers could not wantonly be jeopardised through professional ridicule or self-isolating iconoclasm, but neither could *Cybernetics* slip away. The Ratio Club's formalised informality was a defensive screen, shielding the transgressive conduct of an unconventional discourse through a purposeful enactment of casual sociology. From the outset, its character was more undergraduate, than professional, scholarly, or interventionist. As Clark noted, the Ratio Club's founding purpose was never to proselytise

⁵⁷⁴ Letter, Ashby to Turing, 13 April 1949, NAHC/TUR/ADD/2.

⁵⁷⁵ Letter, Turing to Ashby, April 26 1949, NAHC/TUR/ADD/2.

⁵⁷⁶ Letter, Bates to Walter, 27 July 1949, WC/GC/179/B.1/Box 12.

cybernetics into academic acceptance, but rather to springboard the post-war careers of its members.⁵⁷⁷

Bates explained the nature and constitution of his proposed club in his inaugural offers; varying each letter a little to suit the recipient. Barlow, a student, was enticed with food and alcohol.⁵⁷⁸ Whereas Uttley, a military scientist, was promised unpretentious speculation grounded in reality.⁵⁷⁹ Bates told all his prospects that the dinner club would be closed and informal, and that all of its members would have thought cybernetically before *Cybernetics*. Bates advertised the Ratio Club as exclusionary, insular and immune to professional authority; thus, the explicit professorial prohibition that formed as soon as the group convened. Impending parenthood kept Walter from the first meeting; at which this rule was set. So, writing to Bates directly afterwards, Walter proposed that Tustin should be invited to join the new group.⁵⁸⁰ Bates replied that the group had already frozen its composition and disqualified professors; citing both Tustin and Young as early exclusions.⁵⁸¹ Bates enforced this policy, unswervingly, throughout the Ratio Club's lifetime. The Ratio Club was a sanctuary from the vicissitudes of daily existence. Especially at the start, when easy food and drink satisfied stomachs and lubricated cherished conviviality amidst austerity and rationing. The more refined post-war psychological and emotional appetites of these brilliant young technocrats were also satiated by their exclusive belonging to a quasi-covert cabal devoted to a semi-illicit science that radiated epistemological danger. Their meetings revitalised the subversive iconoclastic thrill of the Sunday Soviets.

⁵⁷⁷ Clark, *Enclosing*, p. 74.

⁵⁷⁸ Letter, Bates to Barlow, 3 Aug. 1949, WC/GC/179/B.1/Box 12.

⁵⁷⁹ Letter, Bates to Uttley, 3 Aug. 1949, WC/GC/179/B.1/Box 12.

⁵⁸⁰ Letter, Walter to Bates, 29 Sept. 1949, WC/GC/179/B.1/Box 12.

⁵⁸¹ Letter, Bates to Walter, 4 Oct. 1948, WC/GC/179/B.3/Box 12.

Bates' resolve to shield the Ratio Club from ignorant neophytes and scornful eminences was doubtless stiffened by encounters such as that with Dr G. L. Brown at the National Institute for Medical Research in London.⁵⁸² Prompted by the fertility of war-time intersections between electronics and biology, Brown, previously secretary of the RNPRC, was cultivating a post-war dialogue with Dr Megaw, the Chief Scientist at the Admiralty Signals and Radar Establishment.⁵⁸³ Megaw, who had helped develop the British cavity magnetron for shortwave and miniaturised radar early in the war, invited Brown to come and talk about cybernetics. Although Brown was delighted to have biological common sense dispensed to physicists, nevertheless, for him, cybernetics was outré. Brown delegated to Bates; remarking on his known proclivity for outlandish intellectual exuberances. Bates good naturedly agreed to lecture Megaw, and his physicist colleagues, about cybernetics. Brown was disarmingly humorous in his evasion of association with cybernetics, and elegantly charming in his dismissal of its faddishness. Bates was reciprocally jocular. Others whom Bates encountered would not have been as graceful.

Bates explicitly typified his initial invitational cohort into two broad disciplinary sets. Firstly, the physiologists and psychologists with inclinations towards electronics. Secondly, the electrical engineers and communications theorists with biological leanings. Pringle was specifically told that there would be others like him who had come at radar from biology.⁵⁸⁴ Immediately, the Ratio Club realised their need of mathematical help with the obtruse core of *Cybernetics*. They offered Turing membership after their first meeting, and extended

⁵⁸² Letter, Brown to Bates, 28 July 1949, WC/GC/179/A.89.

⁵⁸³ "Dr. G. L. Brown, C.B.E., F.R.S", *Nature*, Vol. 163, No. 4139, 26 Feb. 1949, p. 315.

⁵⁸⁴ Letter, Bates to Pringle, 3 Aug. 1949, WC/GC/179/B.1/Box 12.

their mathematical supplement with Woodward and Good in February and December 1950. Turing's inclusion was unanimously affirmed.⁵⁸⁵ Intellectually, he had known proto-cyberneticist leanings. Socially, Pringle knew him from Cambridge. Professionally, Gold had met him during the war, and Uttley had encountered him at the NPL in 1946 whilst attending ACE planning meetings. Uttley, himself a British computer pioneer, was there when Turing's ACE lecture series was agreed, and he possibly attended the lectures themselves.⁵⁸⁶ By design, the Ratio Club's conception of cybernetics was considerably narrower than that adopted by the Macy conferences.

The Ratio Club was Bates' creation, and energised informal argumentation notwithstanding, it remained his creature. As it lacked either a written constitution or appointed functionaries, control vested entirely with him. He often consulted Ratio Club members, both collectively and individually, and he sometimes accommodated their views. There were also several evidently robust discussions about the nature, composition and conduct of the Ratio Club; both in meetings and privately. Nevertheless, ultimately all decisions were centralised, with Bates as the singular centre. A point he himself jokingly made, when self-declaring as the Ratio Club personified, he unilaterally renewed McLardy's membership.⁵⁸⁷ The Ratio Club was Bates' gang, and he was generally adept at retaining control, maintaining his original vision, and sustaining the support of a sufficient nucleus of his original cohort; at least for a while. However, both the Ratio Club's control dynamics, and its fragilities, were exposed in an open and extended power struggle between Ashby and Bates; a contest that was

⁵⁸⁵ Letter, Bates to Turing, 22 Sept., 1949, WC/GC/179/B.2/Box 12.

⁵⁸⁶ An undated note of a meeting held on 22 November 1946 in the TRE Director's office (which Uttley attended) records the decision to proceed with Turing's ACE lectures, SMG/NCC/NPL/M/11. A formal minute, dated 25 Nov., records a meeting about the ACE with the NPL director, Uttley, Turing and F. C. Williams, SMG/NCC/NPL/M/15. Uttley was also invited to attend the ACE lectures, Manuscript note in Womersley's hand, SMG/NCC/NPL/M/11.

⁵⁸⁷ Letter, Bates to McLardy, 18 Jan. 1952, WC/GC/179/B.12/Box 12.

initiated, and driven, solely by Ashby. *Inter alia*, the strong sub-textual sense in Bates' papers supports Husbands and Holland's sense that Ashby was not generally well liked by other Ratio Club members.⁵⁸⁸

Ashby's attempted takeover of the Ratio Club came early. In February 1950, he sent Bates an unsolicited list proposing thirty-four discussion topics for future meetings.⁵⁸⁹ Later that month, Ashby again wrote to Bates, presumably replying to Bates' response to this list.⁵⁹⁰ Ashby believed that the Ratio Club approached an existential moment. He predicted that after the initial introductions, and once the first excitement had inevitably faded, the Ratio Club would atrophy, unless it formalised and expanded. Ashby advocated adopting an agreed schedule of subjects to be successively grappled toward constructive resolution in tightly disciplined scholarly meetings; hence his list. His insinuation that the current sub-standard discussions were overly philosophical and insufficiently technical did nothing to endear him to his fellows. Although Ashby proposed the social, political and economic applications of cybernetics that *Cybernetics* itself promoted, the Ratio Club was unwilling to stray far beyond human neurophysiology. Perhaps, as Clark hinted, the privations of austerity, and the inhibitions of post-imperial uncertainty, constricted the Ratio Club's intellectual realm.⁵⁹¹ Or, perhaps its self-limitation stemmed from its constricted disciplinarity. Whatever the cause, the expansive sociological deployments of cybernetics that were spurred across American intellectual life by the Macy conferences, went unmatched by emanations from its British counterpart.

⁵⁸⁸ Husbands, Holland, "The Ratio Club", in Husbands, Holland, Wheeler (eds.), *Mechanical Mind*, p. 141.

⁵⁸⁹ Letter, Ashby to Bates, 18 Feb. 1950, WC/GC/179/B.5/Box 12.

⁵⁹⁰ Letter, Ashby to Bates, 26 Feb. 1950, WC/GC/179/B.5/Box 12.

⁵⁹¹ Clark, *Enclosing*, p. 97.

At meeting eight, on 21 April 1950, the Ratio Club discussed itself.⁵⁹² Subsequently, Ashby sent Bates a revised version of his candidate discussion subject list. His covering letter was dated 26 April, and the new list was dated 15 May.⁵⁹³ Bates retained a loose second copy of Ashby's second list, also dated 15 May, and an undated annotated typescript which reads as Ashby's text for an intervention at a Ratio Club meeting.⁵⁹⁴ If so, this could have been for meeting nine on 18 May 1950, which may have continued the previous meeting's introspection. Ashby's script, if thus it was, mirrored his earlier letter to Bates. The Ratio Club must forsake its self-indulgent abstractions, and embrace scientific rigour and intellectual formality; or it would inevitably perish. Whilst Ashby now relinquished his demand for a standing meeting chair, nevertheless, he wanted each subject from his list to be allocated a "Navigator" who would ensure that it was discussed with requisite rigour and efficiency. Not only was Ashby intent on formalising the Ratio Club and controlling its agenda, but he was also intimating that Bates was an inept administrator.

In December 1951, the Ratio Club once again introspected; and again, Ashby sought control. Bates proposed that meeting twenty on 21 December should address various suggestions about the direction of the Ratio Club, including Ashby's. Bates sent a pre-meeting circular which noted that whilst, from one perspective, the Ratio Club was succeeding because its members were making suggestions about future work, yet, from another view, it was failing because attendance had declined precipitously.⁵⁹⁵ Ashby missed the 21 December meeting, but he sent Bates an advance note containing his increasingly strident views. Ashby now wanted to transform the Ratio Club into a formally constituted cybernetics society with an

⁵⁹² Meeting notice from Bates, WC/GC/179/B.5/Box 12.

⁵⁹³ Letter, Ashby to Bates, 26 April 1950, WC/GC/179/B.5/Box 12.

⁵⁹⁴ Ashby, "Suggested Topics for Discussion"; "Here are my suggestions ... ", WC/GC/179/B.6/Box 12.

⁵⁹⁵ Ratio Club circular from Bates, WC/GC/179/B.11/Box 12.

open membership.⁵⁹⁶ If it remained in its current form, he would resign, because convivial intellectualised carousal was now insufficient. Although, one suspects that Ashby had endured, rather than enjoyed, such frivolity all along. In January 1952, Bates reported the outcome of the 21 December meeting to Ashby. The Ratio Club had rejected his views.⁵⁹⁷ Explicitly, Bates invited Ashby to remain a member, notwithstanding an earlier collective sentiment that repeated absence constituted a *de facto* resignation. Implicitly, Bates asserted control and invited Ashby to put up or shut up.

Ashby made a last ditch attempt to usurp Bates. In May 1952, he formally proposed J. Z. Young for membership.⁵⁹⁸ He knew, in advance, that this would violate the professorial prohibition, and that Young had been explicitly rejected at the first meeting for that reason, and also that Young was Sholl's boss. However, apart from his academic status, Young was a perfect fit for the Ratio Club. This was another direct challenge to Bates' authority; and, although Ashby chose his weapon wisely, again he lost. Sholl expressed the consensus view directly to Bates.⁵⁹⁹ He recognised that Ashby was attempting to overturn a founding principle of the Ratio Club in order to take control, and he feared that Ashby's path would replace the Ratio Club's intellectual vibrancy with the mediocrity of a second rate academic association. Sholl, better than any of them, knew Young's quality. However, for both him, and the others, this was a fight over principle not pragmatism. Nothing in Ashby's behaviour did anything to dispel their sense of him as an interloper intent on exorcising the Ratio Club of its free spirit.

⁵⁹⁶ Letter, Ashby to Bates, 18 Dec. 1951, WC/GC/179/B.11/Box 12.

⁵⁹⁷ Letter, Bates to Ashby, 18 Jan. 1952, WC/GC/179/B.12/Box 12.

⁵⁹⁸ Meeting notice from Bates, WC/GC/179/B.14/Box 12.

⁵⁹⁹ Letter, Sholl to Bates, 28 May 1952, WC/GC/179/B14/Box 12.

The Ratio Club met, with decaying frequency, between September 1949 and November 1958.⁶⁰⁰ Thirty-four of its thirty-seven meetings were at the National Hospital in Queen Square, typically in the basement: a fittingly furtive subterranean venue for subversive gatherings. Between September and December 1949, there were four monthly meetings. The cadence was sustained in 1950 with ten gatherings, but dropped in 1951 to six, and rose only marginally to seven in 1952. Thereinafter, the decline accelerated. There were four meetings in 1953, three in 1954, and only two in 1955. After which, whilst it remained notionally extant, the Ratio Club was effectively moribund. Bates then convened a valedictory gathering in the margin of the 1958 NPL Mechanisation of Thought Symposium organised by Uttley.⁶⁰¹ Poignantly, this decline validated Ashby's prognosis. Not only did the Ratio Club's initial allure diminish, but attendance at its meetings became both professionally problematic, and personally expensive. Because the Ratio Club was unofficial, its members could neither allocate attendance to business, nor expense their travel. Neither could Bates access hospital funds for the food and drink. Many Ratio Club members used their annual leave to attend; and paid for the privilege. Additionally, the Metropolitan bias was especially burdensome for the provincial members. As early as June 1950, Walter excused his absence by explaining that the Ratio Club had already consumed his full annual travel quota.⁶⁰²

In 1951, matters came to a head. In October, Woodward formally resigned from his Ratio Club membership, citing both an inability to claim its meetings as legitimate Civil Service

⁶⁰⁰ Bates' numbering system shows the NPL symposium reunion as meeting 38. Although meeting 26 was cancelled, Bates preserved the sequence.

⁶⁰¹ Table 7: Ratio Club Meetings, 1949-1958.

⁶⁰² Letter, Walter to Bates, 21 June 1950, WC/GC/179/B.7/Box 12.

business, and his unwillingness to bear the costs personally.⁶⁰³ Walter echoed this in November, telling Bates that his conscience balked at expending £2 or £3 of his employer's money indulging his personal intellectual gratification.⁶⁰⁴ Replying to Woodward, Bates recognised that his dilemma was shared by other provincial members.⁶⁰⁵ This exchange, combined with Ashby's agitation and declining attendance more generally, triggered December's angst about the Ratio Club's future. Some tinkering temporarily patched the crisis over. Uttley persuaded Woodward towards a more relaxed interpretation of TRE business, and some limited constitutional reforms to the Ratio Club itself were attempted.⁶⁰⁶

Bates summarised these changes in a second circular in January 1952.⁶⁰⁷ Meeting frequency would reduce, and there would be two a year outside London. Additionally, there would be no more than two papers presented at each meeting, and material would be communicated between meetings through specified postal distribution circuits. In reality, little changed. Predictably, the postal circuits atrophied quickly, and only two provincial gatherings occurred: one in Cambridge in 1952; the other, a 1955 weekend tour around the TRE, the BNI, and Barnwood House. Although the January reforms buoyed meetings in 1952, the decline was terminal. Ashby was unpopular; but right. The underlying problem was the cherished nature of the Ratio Club itself. Its insistence on liminal informality cost it institutional life support.

⁶⁰³ Letter, Woodward to Bates, 29 Oct. 1951, WC/GC/179/B.11/Box 12.

⁶⁰⁴ Letter, Walter to Bates, 15 Nov. 1951, WC/GC/179/B.11/Box 12.

⁶⁰⁵ Letter, Bates to Woodward, 21 Nov. 1951, WC/GC/179/B.11/Box 12.

⁶⁰⁶ Letter, Woodward to Bates, 15 Jan. 1952, WC/GC/179/B.12/Box 12.

⁶⁰⁷ Bates' circular, 18 Jan. 1952, WC/GC/179/B.12/Box 12.

Ironically, the self-professed cyberneticist Ratio Club collapsed through both a failure to self-adapt, and an insensitivity to feedback. The degrading effects of the Ratio Club's constitutional stasis, and the debilitating intellectual insularity of its constrained disciplinary compass, were exacerbated by its hermetically sealed membership. By 1950, after the inclusion of Turing, Good, Woodward and Rushton, membership closed. The example of Bates' colleague, William Goody, shows that this was an unforced choice. In January 1950 Goody, a newly appointed neurologist at the National Hospital, wrote to Wiener to congratulate him on *Cybernetics*.⁶⁰⁸ Goody had found the book in the hospital by happenstance. It had appeared unannounced, and Goody had read it on a whim. Amazingly, he said, Wiener had theorised his own observational clinical experiences. Declaring *Cybernetics* to be an exceptional text which revealed a new and universalising science, Goody vowed to re-orientate his entire medical practice around Wiener's ideas. There is no record of any contact between Goody and the Ratio Club.

Moreover, the Ratio Club occasionally entertained guests, some of whom spoke. Although guests were personally vouched for by Club members, and were not numerous, nevertheless, such attendance could easily have become a vetting process for probationary members. At meeting thirty-three on 11 February 1954, for instance, the Ratio Club hosted Ian Whitfield and Jack Allanson from Birmingham University, where Whitfield was a reader in physiology and Allanson lectured on electrical engineering. Their joint paper proposed an information theoretic approach to aural biomechanics; the very subject which had brought Gold to the Ratio Club.

⁶⁰⁸ Letter, Goody to Wiener, 20 Jan. 1950, MIT/NWP/Box 7, Fldr. 110, <https://hdl.handle.net/1721.3/200287>, [6 Jan. 2024].

Then, there was Alex Andrew, the young EEG researcher who had met McCulloch at Glasgow. In 1950, Andrew joined a group touring the British sites of EEG practice; including, naturally, the BNI. Here, Andrew seized the opportunity to ask Walter about British mathematicians known to be familiar with cybernetics. Walter mentioned the Ratio Club, oddly suggesting that Andrew write to MacKay to discuss joining. Andrew did, using Walter's name as an introduction. Ruefully remarking on the Ratio Club's lack of published proceedings or journal, Andrew enquired about the group's membership criteria and objectives. MacKay deferred to Bates, noting Walter as the root of Andrew's interest. As Holland and Husbands' observed, Bates' policed his group's membership vigorously.⁶⁰⁹

Bates then wrote to Walter, expressing his specific indifference to Andrew's recruitment, and his general antipathy to new members. After markedly observing that the only possible path to membership was a gruelling probation, Bates ostensibly gave Walter the decision. Reading the situation, Walter demurred from the unequivocal personal endorsement that Bates required as a precondition for Andrew's candidacy, and dismissed him as a seemingly able neophyte whom he had merely chanced on in passing. Pointedly, Walter also mentioned that Andrew had apparently visited Bates at the National Hospital in London before the BNI episode in Bristol.⁶¹⁰

As Andrew lamented, the Ratio Club kept no formal records. Its member's self-introductions were untitled, and all that remained of most of the subsequent talks and exchanges were their titles or fragments. Alas, the exceptions are easily summarised.

⁶⁰⁹ Holland, Husbands, "Origins of British Cybernetics", *Kybernetes*, Vol. 40, Iss. 1/2, p. 114.

⁶¹⁰ Letter, Andrew to MacKay, 27 Nov. 1950 (passed from McKay to Bates). Letter, Bates to Walter, 13 Dec. 1950. Letter, Walter to Bates, 20 Dec. 1950, WC/GC/179/B.07/Box 12.

Westcott and Bates retained Ashby's paper on pattern recognition from the ninth meeting on 18 May 1950.⁶¹¹ Bates appointed Walter to 'steer' or 'govern' meeting nine, perhaps to appease Ashby, and Westcott and Bates also kept a copy of Walter's contribution.⁶¹² Similarly, they both held Ashby's note describing his talk on the statistical mechanics of the brain at meeting seventeen on 17 May 1951.⁶¹³ Westcott stored the paper on the mathematics of information accompanying Woodward's introduction to information theory at meeting ten on 22 June 1950.⁶¹⁴ However, while Bates filed Ashby's note about cybernetics and mental illness, and a reprint of his paper about a mechanical chess player, neither are recorded as featuring at meetings.⁶¹⁵ Additionally, Bates preserved some ad-hoc notes about feedback by Uttley and McLardy from a correspondence discussion amongst Bates, Uttley, McLardy, Westcott and Woodward in April 1952 which was operating just as the postal circuit broke.⁶¹⁶ Pringle received, and retained, five of Uttley's official technical reports, and a paper from Ashby produced under contract to the US Office of Naval Research.⁶¹⁷

⁶¹¹ W. R. A., "Pattern Recognition in Animals and Machines", WC/GC/179/B.6/Box 12.

⁶¹² W. G. Walter, "Pattern Recognition", WC/GC/179/B.6/Box 12.

⁶¹³ W. R. A. "Statistical Machinery", WC/GC/179/B.9/Box 12.

⁶¹⁴ P. M. Woodward, "Notes on the Mathematical Definition of Information", Westcott Private Papers.

⁶¹⁵ W. R. Ashby, "Cybernetics and Insanity", WC/GC/179/B.29/Box 12. W. R. Ashby, "Can a Mechanical Chess-Player Outplay its Designer?", *Brit. J. Philosophy of Science*, Vol. 3, No. 9, May 1952, pp. 44-57, WC/GC/179/B.29/Box 12.

⁶¹⁶ A. Uttley, "On this question of explicit and implicit feedback ..."; "Remarks by T. McLardy (on prior notes by Bates, Uttley, Woodward and Westcott)", WC/GC/179/B.13/Box 12.

⁶¹⁷ Ashby, W. R., Riguet, J., "The Avoidance of Over-Writing in Self-Organising Systems, Technical Report No. 1, Sponsored by the Information Systems Branch, U.S. Office of Naval Research, Contract No. N62558-2404/NR049-147, 19 Oct. 1960, Burden Neurological Institute Bristol, England", MSS/Eng/Misc/c/944/A.13. A. M. Uttley, "The Computation of Pattern Differences, (T. R. E. Great Malvern, 17 November 1952)", MSS/Eng/Misc/c/944/A.8. A. M. Uttley, "The Classification of Signals in the Nervous System, (R.R.E. Memorandum No. 1047, Sept. 1954)", MSS/Eng/Misc/c/944/A.9. A. M. Uttley, "The Probability of Neural Connections, (R.R.E. Memorandum No. 1048, 1954)", MSS/Eng/Misc/c/944/A.10. A. M. Uttley, "The Conditional Probability of Signals in the Nervous System, (R.R.E. Memorandum No. 1109, Feb. 1955)", MSS/Eng/Misc/c/944/A.11. A. M. Uttley, "A Theory of the Mechanism of Learning Based on the Computation of Conditional Probabilities (Conditional Probability as a Principle of Learning), R.R.E. Great Malvern, 11 November 1955)", MSS/Eng/Misc/c/944/A.12.

None of Pringle's holdings were directly related to Ratio Club meetings, but they nevertheless signified the existence of related extramural communications. Finally, Bates had a copy of Sholl and Uttley's *Nature* article which supported their paper at meeting twenty-nine on 19 February 1953.⁶¹⁸ Apart from scraps, and notes about the West Country weekend tour stored by Westcott, this is the substance of the known records of Ratio Club proceedings.

The Ratio Club's proceedings were characterised by an intellectual parochialism which contrasted starkly with its foundational embrace of cybernetics' epistemological radicalisms. Rushton, for instance, explored neuronal physiology, whilst Sholl discussed the mechanics of the brain, and MacKay contemplated probability. Gold's talk at meeting nineteen on 1 November 1951, under the tantalising title, "On Popper: What is Happening to the Universe", owed more to Gold's recent co-authorship of the steady state theory of the universe than to Wiener.⁶¹⁹ Popper had just published a notable deconflation of quantum theory and classical physics which centred on the nature of indeterminism.⁶²⁰ Although, whilst discussing mathematical prediction, Popper had, *inter alia*, pointedly disavowed dehumanising equivalences between brains and electronic calculators.⁶²¹ Whilst this narrowness exemplified a natural professional tendency to abide within avowed competence, it also juxtaposed the actuality of the Ratio Club's behaviour to its ostensible intellectual disinhibition and adventurousness. Audacity was more constitutionally professed than

⁶¹⁸ A. Uttley, D. Sholl, "Pattern Discrimination in the Visual Cortex", *Nature*, Vol. 171, No. 4348, 28 Feb. 1953, pp. 387-88, WC/GC/179/B.16/Box 12.

⁶¹⁹ H. Bondi, T. Gold, "The Steady State Theory of the Expanding Universe", *Monthly Notices of the Royal Astronomical Society*, Vol. 108, No. 3, June 1948, pp. 252-70.

⁶²⁰ K. R. Popper, "Indeterminism In Quantum Physics And In Classical Physics I", *Brit. J. Philosophy of Science*, Vol. 1, Iss. 2, Aug. 1950, pp. 117-33. K. R. Popper, "Indeterminism In Quantum Physics And In Classical Physics II", *Brit. J. Philosophy of Science*, Vol. 1, Iss. 3, Nov. 1950, pp. 173-95.

⁶²¹ Popper, "Indeterminism II", p. 193.

constitutively practiced. Thus, Bates discussed telepathy to debunk, not explore, the (pseudoscientific) idea of brains remotely communicating via electromagnetic radiation.⁶²²

Alongside this reluctance to venture beyond familiar intellectual terrain, there was a marked absence of both *Cybernetics* and cybernetics from the Ratio Club's deliberations. There was little sign of either bold interdisciplinarity, or the construction of new transdisciplinary cyberneticist knowledge. Revealingly, the guest talk from the biologist Conrad Waddington on "Development as a Cybernetic Process" at meeting thirty-five on 25 November 1954 made the only recorded titular reference to Wiener's new science. Contrastingly, the Ratio Club devoted considerable energy to digesting and developing information theory. Overall, and especially amidst the initial cohort of seventeen, the Ratio Club enriched its members' existing individual professional and intellectual practices with information theory, rather than impelling their creation and mediation of new cyberneticist science beyond them. This was not lost on Rushton. In a superficially jovial note to Bates, he pointedly remarked that the Ratio Club's discussions were characterised by a dearth of facts insufficiently connected to information theory, and a sparsity of information theory tenuously connected to facts.⁶²³ Whilst declaratively cyberneticist, the Ratio Club was substantively information theoretic.

Ashby and Walter were avowedly cyberneticist exceptions to these general patterns; Ashby more so than Walter. When Walter demonstrated his robot tortoise at meeting fifteen on 22 February 1951, under the title "Adaptive Behaviour", he certainly concretised cyberneticist methodology by instrumenting electro-mechanical behavioural analogues to idealise and analyse the operation of biological systems. Nevertheless, Walter's primary professional

⁶²² Invitation slip for meeting 18, 26 July 1951, WC/GC/179/B.10/Box 12.

⁶²³ Letter Rushton to Bates, 19 Feb. 1951, WC/GC/179/B.8/Box 12.

and intellectual concern was the absorption of cybernetics within neurology, not the propagation of cybernetics itself.

Ashby, however, exhibited stronger and more explicit cyberneticist affinities than Walter, or indeed, than any other Ratio Club member. His theoretical generalisations of dynamic self-adaptation reciprocated strongly with Wiener's mathematical abstractions of systemic homeostasis, as did his deployment of electro-mechanical analogues to explore the neuronal enactments of self-adaptive behaviour. And, as Ashby's lists of suggested discussion subjects showed, like Wiener, he envisaged the social, economic and political applications of cybernetics. Ashby's lists even glimpsed at an intersection between cybernetics and dialectical materialism. Ironically, Ashby's spurned subjects were closer to the spirit and intent of *Cybernetics* than most Ratio Club meetings.⁶²⁴ Whilst pointedly embraced psychiatry, computers, physiology, information theory and mathematical biology, his lists also attempted to draw the Ratio Club beyond its intellectual heartland and into the realms of politics, philosophy, economics and sociology. The inertia was only partly explained by antipathy towards Ashby; there was a far deeper collective intellectual conservatism at play within the Ratio Club.

Turing was also an exception to the Ratio Club's general refusal of epistemological adventurousness; but, in an entirely different way to Walter or Ashby. At meeting fourteen on 7 December 1950, Turing discussed "Educating a Digital Computer"; clearly referencing his radical proposal in October's "Computing Machinery and Intelligence".

⁶²⁴ Tables 8 and 9: Ashby's Lists, V1 and V2.

Turing's *Mind* paper was a direct intervention in the Cartesian computational controversy, and an explicit refutation of Jefferson's vitalist syllogistic solipsism. It proposed that if the starting configurations of computers were made to simulate the innate brain mechanism of new-born humans, then computers would shed their deterministic dependence upon external (human) programmers to activate or specify their operation, and they would learn and cognitively self-transform; like human children.⁶²⁵ At meeting fourteen, Turing delivered this transgressive and overtly cyberneticist radicalism directly to the Ratio Club, perhaps rehearsing his three BBC appearances the following year. There was certainly an intimation of intellectual rehearsal in Turing's talk at meeting twenty-one on 8 February 1952 about "The Chemical Basis of Biological Form" which preceded the publication of "The Chemical Basis of Morphogenesis" in August.⁶²⁶ Notably, the publisher received the paper on 9 November 1951, and then a revision on 15 March 1952. Moreso than the others, Turing used the Ratio Club as a sanctuary for the free exposition of intellectual heterodoxy.

The Ratio Club Meets the Other British Brains

In 1961, Grey Walter sardonically 'discovered' a new scientific breed. Dubbed 'Conference Man', this epistemological parasite trotted the globe, consuming the budgets and intellects of the left-behind laboratory labourers; he had a point.⁶²⁷ From 1946 to 1961, excluding the Ratio Club's meetings, but including the ACE lectures and the publicly known Macy conferences, there were at least forty-eight academic events related to cybernetics, computers and information theory. Britain and America hosted twenty-two each, whilst one

⁶²⁵ A. M. Turing, "Learning Machines", in "Computing Machinery and Intelligence", *Mind*, Vol. LIX, No. 236, Oct. 1950, pp. 455-60.

⁶²⁶ A. M. Turing, "The Chemical Basis of Morphogenesis", *Philosophical Transactions of the Royal Society of London*, Series B, Biological Sciences, Vol. 237, No. 641, Aug. 1952, pp. 37-72.

⁶²⁷ Walter, *Living Brain*, p. 19.

was held in France and three took place in Belgium.⁶²⁸ These events were vital sociological and epistemological venues for constructing, mediating and disseminating new scientific and technical knowledge which had, at best, fledgling contemporary institutional instantiations. In this examination of the role of these extra-institutional venues in staging the wider British cybernetics experience, I have focussed on seven of the domestic events. Namely: the 1949 Cambridge University High Speed Automatic Calculating Machines Conference; the 1950 London Information Theory Symposium; the 1951 Manchester University Inaugural Computer Conference; the 1952 London Applications of Communication Theory Symposium; the 1953 NPL Automatic Digital Computation International Symposium; the 1955 London Information Theory Symposium; and the 1958 NPL Mechanisation of Thought Processes Symposium.

This omits: the 1949 Bristol and Cambridge meetings preceding the Ratio Club; the 1946 and 1947 ACE lectures; Turing's 1947 London Mathematical Society lecture; Dorothy Emmet's 1949 Manchester philosophy seminar on The Mind and the Computing Machine; and, a 1956 technical computer convention organised by F. C. Williams at the IEE. Many of these exclusions were closed events, and none of them generated formal records. Even for the inclusions, records vary. The NPL Mechanisation of Thought Symposium published comprehensive proceedings, whilst others, such as the three London information theory symposia, published proceedings without delegate lists. In these instances, the speakers constitute the delegate count, notwithstanding the incompleteness this necessitates.

The substantive majority of the Ratio Club's members intersected directly with the war-time ontologies and epistemologies that spawned proto-cybernetic; many generatively. These

⁶²⁸ Table 11: Events Relating to Cybernetics, Computing and Information Theory, 1946-1961.

experiences resonated with *Cybernetics*' assertion of trans-ontological systemic informational isomorphism, and inculcated some degree of receptivity to post-war epistemological emergences around computers and information theory. Accordingly, Ratio Club members appeared at each of the seven events. However, apart from the terminal gathering at the 1958 NPL symposium, attendance at the computer conferences was restricted to the Ratio Club's mathematicians and engineers; and, apart from the first iteration in 1950, only the Ratio Club's life-scientists attended the London information theory symposia. Overall, although the Ratio Club was represented at each of the seven events, delegation was circumscribed and uneven. Little and McLardy attended none, Bates went to two, and Hick and Pringle visited one each.⁶²⁹ No Ratio Club member attended all seven events. Here, as elsewhere, the Ratio Club's constitutional insularity and epistemological narrowness expressed themselves behaviourally. The notable exceptions were Good, MacKay, and Uttley who each attended five of the seven events, and Turing and Woodward who both attended four. The Ratio Club's mathematicians were evidently more willing to engage in, and across, the wider sociologies of nascent knowledge than their life scientist colleagues.⁶³⁰

The leviathan of war-time science and technology generated expansive engagements with proto-cybernetics which encompassed many more minds than the overall delegations to these seven events. So, whilst most of these attendees had probably encountered proto-cybernetics directly, nevertheless, they constituted a merely fractional sub-set of those who had. Those Ratio Club members who were willing to attend these events constituted a deeply proto-cyberneticist sub-set of this sub-set, and yet not even they flocked to these venues.

⁶²⁹ Table 14: Ratio Club at British Events.

⁶³⁰ Table 15: Ratio Club and Other British Protagonists at British Events.

Clearly, experience of proto-cybernetics could ease acceptance of *Cybernetics* and incline some minds to computers and information theory; but, equally clearly, it did not necessarily drive such uptake broadly across post-war British science and technology. Although proto-cybernetics generated an epistemological potential, this remained sublimated in the majority of the minds that encountered it. Nevertheless, this sublimation also prepared the ground within which later, often tacit, manifestations of cybernetics rooted. Many of those who watched Doctor Who's first victory over the Cybermen in 1966 harboured decades deep experiential memories of robot war.

The disciplinary constitution of the Ratio Club, and its intellectual attendance bias, was reflected across the wider academic delegation to these events. Institutionally, this broader attendance was inclusive.⁶³¹ Metropolitan delegates came from Birkbeck, UCL, Imperial, KCL, and LSE. Regionally; Birmingham, Leeds, Bristol, Reading and Southampton contributed, as did both Manchester's university and its technology college; and, Oxford and Cambridge also ventured forth. Even St Andrews, Glasgow and Edinburgh journeyed south. However, intellectually, the spectrum narrowed. The overwhelming majority of these delegates came from mathematics or electrical engineering departments, or from their budding computing laboratories. Whilst significantly smaller, the next largest cohort was from life-sciences, where institutional attendance bunched around Ratio Club members. Sholl in UCL's anatomy department, Rushton and Barlow in Cambridge's physiology laboratory, and Hick in Cambridge's psychological laboratory all nucleated their colleagues' attendances. Likewise in medicine, where, Apart from Ashby who was invariably unaccompanied, and three disparate singletons at the 1958 NPL symposium, Bates and

⁶³¹ Table 17: All British Delegates at British Events.

Walter drew the only clinicians. Interlopers were rare, and the anomaly of UCL's phonetics department comprised two energetic individuals with a pioneering interest in machine translation. Neither Manchester's lone classicist, nor Cambridge's trio of applied economists, broke the pattern.

Ostensibly, this pattern was unremarkable. Nominatively and substantively, these were conferences about computers and information theory, and their affinity to engineering and mathematics was manifest. Yet, less obviously, this pattern suggested that cybernetics either failed to resonate, or was actively resisted (or both) across British academia. *Cybernetics* stressed the isomorphism between electronic digital computers and neurological systems. It argued that the axioms of information theory were transposable between, and equally operable within, organic and inorganic communications systems, and it posited the common applicability of cybernetics to social as well as corporeal systems. A point Wiener underscored with the sociological subtitle of *The Human Use of Human Beings* in 1950.⁶³²

Wiener offered *Cybernetics* as the foundation text of a trans-disciplinary and supra-ontological systems science. Yet, sociologists, anthropologists, political scientists, and (bar the Cambridge three) economists, were conspicuously absent from these events. Even amongst psychiatrists, psychologists and neurophysiologists, the delegation scarcely strayed beyond the clusters that gathered around the Ratio Club's members. Had *Cybernetics* caught on, the disciplinary spectrum would have been broader. However, post-war conservative counter currents neutralised the contemporary epistemological potential of proto-

⁶³² N. Wiener, *The Human Use of Human Beings: Cybernetics and Society*, (Eyre & Spottiswoode, London, 1950).

cybernetics, and a century of institutionalised knowledge demarcation easily withstood Wiener's American iconoclasm.

The disciplinary constriction at these events was not caused by interdisciplinary ignorance. *Cybernetics* had not ignited the same intellectual or cultural explosion in Britain as it had in America, nevertheless, it had impacted on landing. In May 1951, the LSE philosopher John Wisdom, warmly introduced readers of the *British Journal for the Philosophy of Science* to cybernetics; liberally citing Wiener, McCulloch, Ashby and Craik.⁶³³ In June, the sociologist, Donald Macrae, Wisdom's LSE colleague, used the *British Journal of Sociology* to endorse *Cybernetics* as a valuable contribution to his discipline.⁶³⁴ Although, for his part, Macrae also lamented Wiener's mathematical impenetrability, acknowledging that many more sociologists would hear about *Cybernetics* than would read it. Both of these British academics emphasised that cybernetics postulated the behavioural and informationally constitutive commonality of biological, sociological and electronic computational systems. However, Macrae argued, ultimately, cybernetics was not a science of society, nor could sociology fully assimilate cybernetics, because society itself was invulnerable to mathematisation.⁶³⁵ This incommensurability conveniently obviated the feared inability of sociologists to grasp Wienerian mathematics.

Revealingly, the Ratio Club spurned Wisdom's embrace of cybernetics. Bates was especially hostile to his attempted disciplinary ecumenicalism. Writing to Sholl in January

⁶³³ J. O. Wisdom, "The Hypothesis of Cybernetics", *Brit. J. Philosophy of Science*, Vol. 2, No. 5, May 1951, pp. 1-24.

⁶³⁴ D. G. Macrae, "Cybernetics and Social Science", *Brit. J. Sociology*, Vol. 2, No. 2, June 1951, pp. 135-49.

⁶³⁵ D. G. Macrae, "Cybernetics and Social Science", *Brit. J. Sociology*, June 1951, Vol. 2, No. 2, pp. 135-49.

1952, Bates described his lengthy and awkward correspondence with Wisdom. Casting a withering verdict on Wisdom's paper, he scorned the presumption that philosophers had any business with cybernetics.⁶³⁶ The Ratio Club policed the disciplinary containment of cybernetics more vigorously than outsiders.

Although these events also drew attendance from beyond academia, here also the spectrum was comparably narrow. The prevailing pattern was of delegation from organisations with direct involvement in proto-cybernetics, especially radar; or, from organisations now commercialising or deploying computing or information theory. Within this, the scene was dominated by commercial and military delegates. Most of the conspicuously small civil government delegation came from either the GPO research station at Dollis Hill, the NPL, the DSIR, or the NRDC; who were all either researching or commercialising computers, or applying information theory, or all three. Once they are discounted, the government tally shrinks dramatically. The Treasury only sent delegates to the 1958 NPL symposium, and GCHQ's attendance is almost entirely accounted for by Good. Which then left the Atomic Energy Research Establishment providing the only other sustained governmental attendance.⁶³⁷ Inasmuch as conference attendance signifies bureaucratic acceptance, and funding, of active interest, then there was little appetite within Whitehall for computers or information theory across the fifties, and even less official inclination towards cybernetics.

The commercial delegation to the seven British events signified a comparably scant contemporary appetite for the operationalisation of computing or information theory across

⁶³⁶ Letter, Bates to Sholl, 18 Jan. 1952. Letter, Bates to Sholl, 22 Jan. 1952, WC/GC/179/B.12/Box 12.

⁶³⁷ The contemporary cover was that the Atomic Energy Research Establishment developed civil nuclear power, whereas the Atomic Energy Authority conducted military research.

civil society. Most commercial delegates represented companies such as Elliott, Ferranti and Lyons who were all developing their own computer manufacturing capabilities; or, large electronics and valve manufacturing firms such as EMI, Marconi and Mullards, who were all seeking their business. Intriguingly, IBM's attendance was limited to the 1953 NPL computer event and the 1958 NPL Mechanisation of Thought symposia. Perhaps the rudimentary British competition left them unperturbed. The commercial delegate pattern also contained sporadic attendances from aircraft and avionics companies who were grappling mathematically with the fluid mechanics of jet aerodynamics, and from niche electronics manufacturers who were hunting for growth. The attendances by ICI, Westminster Bank, Prudential Assurance, Marks and Spencer, and the market research consultancy Nielson's, at the 1951 Manchester computer conference are intriguing. However, their appearance was singular, and it does not evidence widespread contemporary commercial vibrancy around computers or information technology.

Military attendance came overwhelmingly from research establishments, and especially from those specialising in radar. Predictably, the largest delegate contingent was the TRE at Malvern. This would have been the case, even without the undoubted influence of Uttley and Woodward. Equally predictably, the stalwart presence of the MoS reflected its comprehensive purview over the research, procurement and deployment of military equipment. There was also a sustained representation from the RAE at Farnborough. This period coincided with the development of the V class of strategic bombers as the delivery system for British nuclear weapons. Researching the avionics of the new delta wing geometry required the kinds of mathematics which, in turn, necessitated the use of electronic digital computers; and, the extensive record of aeronautical work in the NPL archive suggested that, in effect, it became Farnborough's computer bureau. At this point, military

interest in computers was confined to research; their operational use lay in the future. Potentially, as the venue and heir of proto-cybernetics, military research might have afforded a more fertile ground for cybernetics than civil government. However, in practice it did not. Partly, this was because cybernetics was excised from British events on computers and information theory in response to the Cartesian computational controversy. And, partly, it was because the controversy itself directly nullified conceptualising computers beyond their use to mechanise mathematics.

The attendances at these events affirmed the absence of a British cybernetics movement comparable with the American academic and social phenomenon triggered by *Cybernetics*. As did their intellectual composition, insofar as this was denoted by the contents of the papers that were read at them. Even accounting for the transatlantic dissipation of the cybernetics shock wave, this warrants attention. British proto-cybernetics indicated at least the prior potential for a discernible echo of the American explosion. Yet, cybernetics was marked more by its absence than its presence across these British computing and information theory events. Moreover, unlike in America, and apart from the tiny and liminal 1949 Bristol meeting, there were no explicitly cyberneticist conferences in fifties Britain. Arguably, the 1958 NPL Mechanisation of Thought Symposium organised by Uttley did exhibit consciously cyberneticist undercurrents. However, not only were these nominatively invisible, but they were generally only expressed in tacit discourse, even by Uttley. Wiener's absences across these events were emphatic. Notwithstanding the epistemological claims Wiener made on computers and information theory, his knowledge of the Ratio Club, or his lifelong Anglophilia, Wiener's behaviour gave no suggestion that he considered post-war Britain as an important site for cybernetics. His absence from these events, and from

meetings of the Ratio Club, is cast into stark relief by his known presence in Britain to deliver the Fawley Lecture in 1955.

These British events occurred in an intellectual and academic climate enculturated by the controversy precipitated by Jefferson's 1949 polemic. This normalised the burgeoning scientific and humanist orthodoxies that computers, brains, and minds occupied irreconcilable ontological and epistemological categories. Cybernetics, and cyberneticians, were Other to this truth. The engineers and mathematicians who were making and programming computers became the guardians of this orthodoxy. Their repudiation of cognitive equivalence expressed epistemic appropriation and asserted definitional discursive authority. They alone commanded the faculty to legitimise the narrative of computing. Life-scientist cyberneticians might be excused; mere biologists perhaps knew no better. However, renegade mathematician cyberneticians were culpably irresponsible and dangerously deviant. Either way, chimerical thinking machines were hazardous fantasies, and Turing and his ilk were perilous fantasists. Wilkes, Williams and Kilburn personified scientific rectitude. Wilkes and Williams were knighted, and the formal academic designation of computing as a science became institutionally naturalised.

This orthodoxy gouged a post-war British schism between computing and cybernetics which was inscribed in the enactments of the seven events. Performatively, Wilkes, Williams and Kilburn attended all three of the computer conferences, but not the information theory symposia, or the tacitly cyberneticist 1958 NPL symposia. The agendas for the three computer conferences were circumscribed within narrow treatments of the physics, mathematics and operation of computers. Besides a talk by Ferranti's Bertram Bowden on the commercial use of computers in 1951, and another in the same vein by Lyons' Thomas

Thompson in 1953, there was little sense of computers belonged anywhere but within a university mathematics department or laboratory and under the custodianship of responsible mathematicians or electrical engineers.⁶³⁸ The denial of cybernetics by computing at these events was reflected in Ratio Club attendances. Although Gold, Good, MacKay, Turing, Uttley, Westcott, Woodward, and Cherry, joined the 1949 Cambridge conference, Ratio Club attendance fell to Turing, Good and Uttley at Manchester in 1951, and to Turing and Uttley at the NPL in 1953. Indeed, the atmosphere of antipathy towards cybernetics at the June Cambridge computer conference may have helped coalesce the Ratio Club in September.

Just as a partial pre-formation of the Ratio Club foregathered at the 1949 Cambridge computer conference, so all but Little and McLardy from the now convened Ratio Club decamped to the first London information theory symposium in 1950. Reflecting the Ratio Club's information theoretic spirit, and expressing its early optimism about the fecundity of cyberneticist fusions of information theory and biology, eleven of the twenty papers at the 1950 event were from Ratio Club members. Notably, Colin Cherry was a prime mover in the three information theory symposia, and he had attended the 1949 Cambridge computer conference. Perhaps this intersection facilitated the Ratio Club's colonisation of the agenda in 1950; or, perhaps this colonisation mirrored Cherry's own initial receptivity to *Cybernetics*. Whatever the cause, the 1950 event radiated an intellectual exuberance which was unmatched until Uttley's 1958 NPL gathering. Hick proposed applying information theory to psychology; Walter discussed building analogue brain machines; Bates presented

⁶³⁸ Table 13: Papers at British Events.

information as a neuronal control mechanism; Uttley asserted the mechanism of brains; and, MacKay constructed time as a transformational derivative from information and entropy.

The inaugural London information theory symposium was the first, and last, manifestation of the Ratio Club as anything like a cohesive or interventionist cyberneticist formation. It was also the only one of the three information theory symposia where either cybernetics or the Ratio Club were discursively overt. Because cybernetics and information theory were monozygotic epistemological twins, *Cybernetics*' echoes could never be silenced in such venues; nevertheless, they became whispers. Information theoretic perspectives on human perception and communication did emerge; but, whilst they were stimulated by cybernetics, they nevertheless framed an internalised and abstract mathematisation of linguistics and a concrete mechanisation of language, rather than an extrapolative interrogation of the underlying informational isomorphism between biological and non-biological systems. The focus became sensibly technological, not speculatively biological, or philosophical. The point was not to comprehend or replicate human perception and thought, but merely to mathematise and mechanise the communication of its manifestation. Conspicuously, MacKay was the only Ratio Club member who spoke at the symposia after 1950, and he restrained himself to the mathematics of technological communications systems. Ratio Club attendance dropped to Good, MacKay and Woodward in 1952, and then Good, MacKay and Merton in 1955. Although Cherry's decision processes in setting the agenda for the events after 1950 were opaque, the performative conformance to the orthodox repudiation of cybernetics at the events he activated was not.

Sociologically and epistemologically, the seven British events were potential quasi-institutional venues for the construction and mediation of cybernetics; and for its imbrication

with computing and information theory. However, in practice, they became mechanisms for expunging cybernetics from the British scientific practices of computing and information theory at the very moment that their intellectual genomes were encoded. Whilst cyberneticist appetites initially drew a tiny cohort of those who had experienced proto-cybernetics to the sites where knowledge about computers and information theory was being constructed, their interest rapidly dissipated in the counter currents against cybernetics stirred by the Cartesian computational controversy. Concomitantly, separately held commitments to computing and information theory neither necessitated nor compelled cyberneticist commitments. Whilst conference delegates effortlessly encountered individual Ratio Club members socially, intellectual engagements with cybernetics were less easy, and, apart from the NPL in 1958, they were consigned to the events' social and intellectual fringes. Nevertheless, despite the agency of these events in purging cybernetics from respectable science, some liminal intellectual seepage and transference occurred. Whilst these events aided the banishment of cybernetics as the exiled science of the last century, they were also mechanisms for diffusing it as the intellectual dark matter of this one.

Cybernetic Celebrity

The Ratio Club knew Walter for his showiness and self-promotion; justifiably. On 15 June 1954, Walter appeared in "What's It For?", a BBC TV programme challenging contestants to discern the use of obsolete domestic objects taken from the display at Bristol's Blaise Castle House Folk Museum. Walter cheated; he visited the museum the day beforehand, and memorised the explainers for the items that had been removed.⁶³⁹ More generally, the scripts of his several BBC scientific talks read like sensationalist journalism. To the chagrin

⁶³⁹ R. Cooper, J. Bird, *The Burden: Fifty Years of Clinical and Experimental Neuroscience at The Burden Neurological Institute*, (White Tree, Bristol, 1989), p. 57.

of many of his less extrovert colleagues, Walter easily captured British public attention, and he rapidly became a recognisably modern celebrity scientist. Beside his own scientific talks, Walter was a frequent panellist on the hugely popular *Brains Trust* programme, broadcast weekly on both BBC TV and the Home Service until 1961. Here, alongside the likes of A. J. P. Taylor, Jacob Bronowski, Julian Huxley and Aldous Huxley, Walter made seven appearances from 1956 to 1959, answering the audience's scientific and philosophical questions.⁶⁴⁰ On 19 June 1961, Walter was castaway on *Desert Island Discs*. His celebrity continued across the sixties, and, notwithstanding his 1970 scooter accident, a little into the seventies.

Walter's fame irked a scientific establishment that was already vexed over the flamboyant claims from cybernetics about the electronic reproducibility of biological brains and minds; and, it further encouraged his less colourful peers to withhold the professional esteem that Walter craved. Even Walter's BNI colleagues and friends thought that his publications frequently sacrificed rigour for speed.⁶⁴¹ Less sympathetic contemporaries were damning in their disdain for Walter's scientific credibility. In 1953, Walter published *The Living Brain*, a popular science manifesto for cyberneticist neurophysiology.⁶⁴² In 1961, Penguin re-published it in Pelican, with reprints in 1963 and 1965. Despite, or perhaps because of, its trade success, *The Living Brain* was critically slammed. A *Spectator* reviewer scorned Walter's irresponsible debasement of the majesty of the human brain; condemning him as a psychologically damaged self-destructive narcissist.⁶⁴³ In 1956, Walter followed this

⁶⁴⁰ BBC/OPI, www.genome.ch.bbc.co.uk/search/0/20?order=first&filt=is_tv&q=W+Grey+Walter+&after=1950-01-01T00%3A00%3A00.000Z&before=1959-12-31T23%3A59%3A59.999Z-top, [22 Sept. 2022].

⁶⁴¹ Cooper, Bird, *Burden*, p. 54.

⁶⁴² W. G. Walter, *The Living Brain*, (Duckworth, London, 1953).

⁶⁴³ J. Howard, "EEG", *Spectator*, Vol. 192, Iss. 6553, 29 Jan. 1954, p. 131.

success with *Further Outlook*.⁶⁴⁴ However, this scrappy utopian novel about time travel to an anarcho-syndicalist sexually libertarian future, where cyberneticist rationalism prevailed over ideology, flopped. For the orthodox, its mere existence affirmed the frivolous pretensions of Walter, and cybernetics, to substitute romance for science.

Walter's public excursions beyond scientific probity began early, and were intertwined with cybernetics from the outset. His first BBC appearance on 28 February 1948, in which he discussed "Minds and Machines" in the Home Service series, *Strange World*, caused a stir. Somewhat sensationally, the *Radio Times* described his subject as devices that behaved like brains.⁶⁴⁵ Walter imagined mechanical tortoises that acted like organic animals: crying when cold, purring when happy, feeding when hungry, sulking when upset, and displaying an unexplained desire to rub against women's silk stocking clad legs.⁶⁴⁶ Journalistic attention was immediate.⁶⁴⁷ The following day, Walter hurriedly denied the existence of such robots, although he insisted upon their possibility, and promised their creation if time permitted.⁶⁴⁸ It was this panegyric to mechanical life that attracted the derision of Walter's fellow neurologist Jeffery Jefferson in his June 1949 Lister Oration. Jefferson's public mockery of Walter and his robots in his sneering laugh-line about a sexually confused biological tortoise initiated an abiding connection between ludicrously mechanistic analogues of life, cybernetics' reductionist materialist fallacies, and Walter's disreputability.

⁶⁴⁴ Published in America as *The Curve of the Snowflake*, (Norton, New York, NY., 1956).

⁶⁴⁵ *Radio Times*, Vol. 98, No. 1277, 2 April 1948, p. 10.

⁶⁴⁶ "Strange Worlds: Minds and Machines", BBC Home Svc., West of England, 25 Feb. 1948, 18:25, BBC/WAC/GB/898/BBC/R/RPAB/T519.

⁶⁴⁷ "The Lighter Side", *Nottingham Evening Post*, 26 Feb. 1948, p. 3.

⁶⁴⁸ "'Robot Tortoise' Denial", *Western Daily Press*, 26 Feb. 1948, p. 4.

Undeterred, or more likely spurred, by Jefferson's patrician disdain, Walter delivered his first mechanical tortoises, Elmer and Elsie, later that year. Walter assigned Elmer ('Electro-Mechanical Robot') as male, and Elsie ('Electro Light Sensitive with Internal and External Stability') as female. Taxonomized as *Machina Speculatrix*, they were ready to be shown to McCulloch in September 1949 when he visited the BNI during his British lecture tour.⁶⁴⁹ The *Mail* announced them in November 1949, and Chapman Pincher reported them to his *Express* readers in December.⁶⁵⁰ In February 1950, a BBC newsreel featured the tortoises and, following the other commentaries, Auntie also stressed their life-like behaviour.⁶⁵¹ In March, their nativity was covered in both the popular science monthly *Discovery*, and in a lengthy *Picture Post* BNI feature.⁶⁵² In January 1951, Walter took Elmer and Elsie to the Paris cybernetics conference to meet Wiener; their epistemological godfather. In February 1951, the Ratio Club met them in person; whilst cinema goers watched them in a British Pathé newsreel.⁶⁵³ Then, in summer 1951, Elmer, Elsie and Walter consolidated their national fame when the tortoises starred in the Science Museum's contribution to the Festival of Britain. Chloride, makers of the Exide batteries powering Elmer and Elsie, ran a full page *Economist* advertisement displaying their ability to electrically energise these simulacra with the spark of life. Presumably at Walter's direction, Chloride called him a cybernetician.⁶⁵⁴ Cybernetics was not respectable science, but it entertained; and sold batteries.

⁶⁴⁹ Letter, Walter to Wiener, 22 Sept. 1949, MIT/NWP/Box 7, Fldr. 104, <https://hdl.handle.net/1721.3/200281>, [6 Jan. 2024].

⁶⁵⁰ "And Now: Toys with Brains", *Mail*, 17 Nov. 1949, p. 5. C. Pincher, "Elmer and Elsie-They See, Feel, Move and Even Feed", *Express*, 13 Dec. 1949, p. 3.

⁶⁵¹ "Bristol's Robot Tortoises Have Minds of Their Own", BBC newsreel, BBC TV, 17 Feb. 1950, 20:00, www.bbc.co.uk/archive/bristols-robot-tortoises/zjf3hbk, [9 March 2023].

⁶⁵² W. G. Walter, "An Electro-Mechanical Animal", *Discovery: The Magazine of Scientific Progress*, Vol. 11, March 1950, pp. 90-93. D. W. Morley, "New Light on the Brain", *Picture Post*, Vol. 46, No. 12, 25 March 1950, pp. 18-23.

⁶⁵³ "Mechanical Tortoise", British Pathé newsreel, 26 March 1951, www.britishpathe.com/asset/79038/, [9 March 2023].

⁶⁵⁴ "Chloride", *Economist*, 15 Sept. 1956, p. 636.

Elmer and Elsie exemplified the crushing effect that public association with cybernetics, and celebrity cyberneticians, had on scientific credibility in fifties Britain. Walter built his tortoises with serious scholarly intent. As *The Living Brain* explained, the purpose of Machina Speculatrix was to mechanise an abstraction of life with sufficient fidelity so as to explain it.⁶⁵⁵ So, the tortoises embodied a simplified neurological model. Two thermionic valves simulated a single neuron apiece, and each regulated current to an electric motor. One motor activated the vertically mounted forward drive wheel, the other rotated this wheel through a 360° axial arc. There were two passive stabilising rear wheels. The valves were connected to a light sensor atop the front vertical swivel axle, and to an internal contact sensor that was triggered by pressure on the outer shell. The tortoise embodied opposing tropisms that were calibrated to induce the dynamic behaviours of autonomic homeostasis; negative tropism to bright light contested positive tropism to moderate light. Each tortoise had a fixed external light, so two or more proximate tortoises danced in repeated cycles of attraction and repulsion. Additionally, physical contact triggered the pressure sensor, cutting power to the drive wheel and edging the tortoise around obstacles. Battery depletion then re-calibrated the light tropisms, attracting the tortoise to the bright light in its charging station. Although they were ontologically deterministic, the tortoises' teleological dynamism emerged stochastically as indeterminate, yet homeostatic, behaviour arising from their self-adaptive environmental interaction. Behaviourally, Walter contended, they were alive.

⁶⁵⁵ Walter, Chapter 3, "Totems, Toys and Tools", *Living Brain*, pp. 104-18.

However, both Walter's sophisticated design, and his thoughtful intent, were submerged amidst the populist press he courted. Neither Walter's peers, nor his Ratio Club colleagues, ever regarded his tortoises as serious science. Nevertheless, they, and Walter, deserve far greater prominence in the history of robotics and AI than they have hitherto been afforded. Rodney Brooks, a pioneer of behavioural robotics and embodied AI, credited *Living Brain* with inspiring his life's work.⁶⁵⁶ Brooks co-founded iRobot, a company which manufactures modernised versions of Walter's tortoises as the Roomba series of domestic robots. Anybody using a robot vacuum cleaner or lawn mower today has Walter to thank. However, Brooks is an outlier, and both Walter, and his work, remain concealed under the cloak of invisibility cast over cybernetics by the mainstream of post-war British scientific computing. For Walter's scientific contemporaries, the tortoises' vulgar publicity further evidenced the foolishness of cybernetics; and their creator's folly. Walter helped neither himself, nor cybernetics, by habitually dismissing *Machina Speculatrix* as playthings. Perhaps he intended to disarm his critics through the archetypal self-deprecation which performative British anti-intellectualism demanded of the languidly effortless brilliance of its gentlemen amateur scholars. If so, he failed.

Cybernetics at the National Physical Laboratory

Fleetingly, following Womersley's recruitment of Turing to the NPL in 1945, the London borough of Teddington became one of the world's most important locales for computer development. Momentarily, just as this prowess flowered, there was a glimmering prospect that the NPL might host the first, and only, formalised venue for cybernetics anywhere within the ambit of the British state. In April 1948 the NPL separated the Electronics Section

⁶⁵⁶ R. Brooks, "Chronicle of Cybernetics Pioneers", *Nature*, Vol. 467, No. 7312, 9 Sept. 2010, pp. 156-57.

from its Radio Division, and tasked the new offshoot with delivering the Pilot ACE; a diminution of Turing's ambitious original computer design. In October 1949, Francis Colebrook, the newly appointed head of the Electronics Section, wrote to the NPL's director outlining his planned development of the newly cleaved department; he was expansionist.⁶⁵⁷ Remarking on an expanding intersection between the vital interests of his new Electronics Section, and the Metrology Division's existing Control Mechanisms Group, Colebrook argued that the overlap was rooted in the scientific realism of NPL research, rather than in a happenstance of arbitrary institutional configuration.

Colebrook suggested that the NPL already led the entirely new science which Wiener, a regrettably American mathematician, had just named and appropriated. Like Bates, Colebrook claimed priority for war-time British proto-cybernetics. For his part, Colebrook argued that Wiener described epistemologies of information, control and communication which the NPL already practiced. Moreover, and unlike the Ratio Club, Colebrook embraced the cyberneticist imperative towards a unified informational theory of biological, mechanical, telecommunications and sociological systems, and he acclaimed *Cybernetics'* exhortation to the interdisciplinarity predicated by such epistemological synthesis. For Colebrook, cyberneticist systemic and scientific unities explicitly framed servomechanisms as agents of feedback regulated autonomic control. He predicted that they would become as vital to governing the machines of peace as they had been in actuating the machines of war, and that they would thus become central to the NPL's new mission. Pointedly, Colebrook explicitly identified Turing's new electronic digital computer design as an embodiment of cybernetics.

⁶⁵⁷ "FMC/D1", untitled memo, F. M. Colebrook to Director NPL, 26 Oct. 1949, SMG/NCC/NPL/M11.

Colebrook's memo concluded by proposing that the NPL should consider constituting a new cybernetics section. The following month Colebrook went further. Appearing before the NPL's Executive Committee, he formally recommended merging the Electronics Section and the Control Mechanisms Group into a new Cybernetics Section.⁶⁵⁸ The chair brushed the proposal aside and warned Colebrook off the idea. Formally, the minutes recorded the thanks of the committee for the report on the work of the Electronics Section, and noted that the executive required time to consider the unsolicited proposal. The chair also officially remarked that as Colebrook was seemingly dissatisfied with his new department's current form, if the proposed merger occurred then Colebrook's new Cybernetics Section would relinquish the Electronics Section to the Electricity Division. Colebrook could surrender status to cybernetics, or disavow cybernetics and retain status. He could not have both. Whereupon, the idea vanished: behaviour is eloquent.

Colebrook's fleeting advocacy of cybernetics at the NPL was vaporised by a patrician Civil Service disapproval which mirrored that of respectable academic science. Jefferson had repeated his Lister Oration on the BBC the month before Colebrook's memo, and two months before his encounter with the NPL executives. Official NPL frostiness towards cybernetics was further chilled by management resentment of Turing, who was considered to have breached faith by not returning after his 1947 sabbatical. Nevertheless, Colebrook's proposal evidenced that *Cybernetics* could find favour amongst at least some government scientists. Moreover, whilst cybernetics was tainted by association with Turing amongst the NPL executives, some NPL scientists may have viewed their former colleague's relationship

⁶⁵⁸ NPL Executive Committee Minutes: Minutes of Meeting held on 15 Nov. 1949: "B: Technical, 7: Work of the Electronics Section, Mr. F. M. Colebrook", 5 Dec. 1949, ERD(43)", SMG/NCC//NPL/M15.

with Wiener's iconoclasm differently. Turing could be difficult, but he was also brilliant and exciting. For some, Wiener's 1947 visit to the NPL garnered kudos for both Turing and Teddington. Turing's NPL sojourn stimulated informal yet abiding intellectual resonances with epistemologies that were rooted in war-work on radar, automated control and instrumentation. Colebrook's proposal rightly situated the NPL as an important venue for British proto-cybernetics, and his failure notwithstanding, it also suggested the NPL as a venue where tacit receptivity to cybernetics might sustain an unofficial half-life, despite official deprecation.

There never was an NPL Cybernetics Section, but Colebrook got his merger. In 1954, a fusion of the Electronics Section and the Control Mechanisms Group (CMG) became the Control Mechanisms and Electronics Division. However, Colebrook's satisfaction was literally short lived: he died before completing the paperwork. Richard Tizard, his successor as Superintendent, had spent the war researching radar and automatic control, and had led the CMG before the merger.⁶⁵⁹ Like Colebrook, Tizard was drawn to cybernetics, and he left the NPL in May 1956 to investigate the application of control theory to economics at LSE. Tizard was replaced by Uttley, who transferred from TRE in January 1957 and remained at the NPL until his retirement in 1966. In 1960 Uttley became Superintendent of the Autonomics Division, his successor to the CME Division. As Clark intimated, at least in Uttley's mind, the CME and Autonomics divisions were cybernetically orientated. However, whilst Clark identified Uttley's cyberneticist intentions, he neglected the NPL's proto-cyberneticist practices, Wiener and Turing's meeting, and Colebrook's proposal.⁶⁶⁰

⁶⁵⁹ M. Yates, *Turing's Legacy: A History of Computing at the National Physical Laboratory 1945-1995*, (Science Museum, London, 1997), p. 310.

⁶⁶⁰ Clark, Chapter 4, "Autonomics", in *Enclosing*, pp. 103-30.

The NPL broke its normal pattern of internal promotion by coaxing Uttley from TRE, and as Clark discussed, his recruitment caused friction.⁶⁶¹ However, although an outsider, Uttley's computer knowledge was highly regarded at both the NPL, and across British computing generally.⁶⁶² Moreover, his design of the TRE Electronic Computer had garnered transatlantic recognition.⁶⁶³ Uttley had also supported the NPL's computer work across the decade before his appointment; receiving, for instance, an internal NPL report about early American computers.⁶⁶⁴ Elsewhere across government, his computing knowhow was called upon during the formation of the NRDC.⁶⁶⁵ In Uttley, the NPL acquired an internationally recognised and known quantity, with impeccable computing credentials, on a level grade Civil Service transfer. However, whilst Uttley's ability warranted his reputation, nevertheless he was one of only a tiny number of comparably competent British specialists. Although, given the nascent state of the field of electronic computing, such rarity was hardly

⁶⁶¹ Clark, *Enclosing*, p. 124.

⁶⁶² A. M. Uttley, Chapter 10, "The Telecommunications Research Establishment Parallel Electronic Digital Computer", in B. V. Bowden (ed.), *Faster Than Thought: A Symposium on Digital Computing Machines*, (Pittman, London, 1953), pp. 144-64.

⁶⁶³ C. E. Shannon, J. McCarthy (eds.), *Automata Studies: Annals of Mathematics Studies, No. 34*, (University Press, Princeton, 1956): A. M. Uttley, "Conditional Probability Machines and Conditioned Reflexes", pp. 253-76; A. M. Uttley, "Temporal and Spatial Patterns in a Conditional Probability Machine", pp. 277-85.

⁶⁶⁴ Distribution list dated 1 June 1949 for, "Extracts from the Office of Naval Research Quarterly Project Summary, 1 Jan. 1949", SMG/NCC/NPL/M11.

⁶⁶⁵ Memo, B. Lane, Board of Trade, "National Research Development Corporation, 9 March 1949", SMG/NCC/NPL/M11.

surprising.⁶⁶⁶ Whilst the NPL retained the knowledge initiated during Turing's tenure, Uttley's appointment suggested that its leadership sought to ameliorate an internal paucity of senior talent that was deemed capable of making a direct contribution to the fundamental design of this new technology. For his part, Uttley was perhaps encouraged by the cyberneticist undercurrents in Tizard's public announcement of the new division.⁶⁶⁷ Or perhaps he was heartened by the cyberneticist sympathies of his NPL predecessors; including Turing. Indeed, Uttley and Turing were closer than hitherto noted. In 1958 Uttley wrote to Sara Turing, acknowledging his indebtedness to Alan, and reporting his display of a large photograph of Alan at an NPL open day. He told Sara that he had credited the ACE to Alan at a press day with the unreported epithet: "Today, Turing's dream has come true".⁶⁶⁸

TRE had bound Uttley within military secrecy. Conversely, although it was a government research establishment, the NPL's remit was public mediation between academia, industry and the state. It commonly issued press releases, ran open days, and organised symposia, and perhaps it was this public orientation which also drew him. Uttley certainly made early use of the NPL's platform to advance a cyberneticist approach to non-human reasoning;

⁶⁶⁶ The NPL were recruiting for a senior level technocratic managerial post which, at the time and apart from Uttley, could realistically only have been filled by the likes of Maurice Wilkes, Tommy Flowers, F. C. Williams, Tom Kilburn, John Pinkerton, Andrew Booth or Kathleen Booth; all of whom were fully committed to their respective establishments. Whilst subtle, the note of gender here warrants amplification. Mar Hicks' concern was with "women as a class of labor in computing". Thus, she sought to examine the impact of the excision of women from entire categories of computer work in Britain, rather than to search for "exceptional women" and thereby risk replicating the "narrative structures and historiographical methods" which had hitherto "erased the impact of gender from the history of computing in the first place". Nevertheless, despite her manifest technical and administrative competence, Kathleen Booth would have been institutionally invisible to the senior men at the NPL who appointed Uttley. In the case of the professional strata from which the NPL drew Uttley, women were not removed by the gendered re-assignments of operational computer work; but only because they were not present in the first place. M. Hicks, *Programmed Inequality: How Britain Discarded Women Technologists and Lost its Edge in Computing*, (MIT Press, Cambridge, 2018), p. 233.

⁶⁶⁷ R. H. Tizard, "Automatic Control and Computing at the National Physical Laboratory", *Nature*, Vol. 174, No. 4420, 17 July 1954, p. 110.

⁶⁶⁸ Letter, Uttley to S. Turing, 19 Dec. 1958, TK/GBR/0272/AMT/A11.

inaugurating his epoch in November 1958 with the Mechanisation of Thought Processes Symposium. The event was oversubscribed.⁶⁶⁹ Most of the two hundred delegates were British and American; with the American contingent including Grace Hopper, Marvin Minsky and John McCarthy. Alongside a smattering from Africa, Israel and Europe, the USSR Academy of Sciences sent a party of five; chaperoned by a sixth with pointedly undeclared affiliation. Under Sputnik's shadow, Soviet academicians mingled with American and British government officials, intelligence officers, military scientists, and capitalists to discuss the mechanical reproducibility of human cognition.⁶⁷⁰ This was both a landmark event in the history of computing and AI, and a significant Cold War episode. However, alongside cybernetics, this symposium has suffered historiographical invisibility.

In 1979 Uttley described his life's work as an attempt to understand the brain by using an information theoretic epistemological scaffold to build computers as ontological neurological analogues.⁶⁷¹ This purpose infused Uttley's conception of the 1958 symposium. It was both nominatively manifest, and explicitly stated in the published proceedings.⁶⁷² Uttley's goal in 1958 was to develop a cross-disciplinary approach to the problem of understanding brain mechanism by building brain-like devices executing brain-like functions. Honouring the NPL's mission of mediating societal applications of science in pursuit of economic development, the symposium's further stated purpose was to explore replacing humans with brain-machines in natural language translation, clerical automation and industrial process design. For Uttley, this was a cyberneticist event in all but name.

⁶⁶⁹ *National Physical Laboratory: Symposium No. 10: Mechanisation of Thought Processes*, Vol. 1, (HMSO, London 1959), p. ii.

⁶⁷⁰ Table 17: International Delegates at British Events.

⁶⁷¹ A. M. Uttley, *Information Transmission in the Nervous System*, (Academic Press, London, 1979), p. vii.

⁶⁷² *Mechanisation of Thought*, Vol. 1, p. ii.

And, whilst the titular lacunae was replicated in the official language of the published proceedings, and in the titles of the papers; nevertheless, the depth of Uttley's tacit commitment to cybernetics was unmistakable to some contemporaries. Especially Wilkes, Kilburn and Williams who, unlike Strachey, did not attend, despite the event's manifest computing content.

The guardians of British scientific computing rectitude were not alone in discerning Uttley's cyberneticist transgression. By 1958, Jefferson's decade old Cartesian computational orthodoxy was hegemonic, and Uttley's symposium received a generally unsympathetic press. For the *Economist*, these scientists were the new Frankensteins, and electronic computers were their modern soulless monsters.⁶⁷³ The *Times* concurred; arguing that although the conference had opened with an electronic rendition of a computer generated score, this was not real music because computers required predetermination, and no mere machine could replicate human creativity. Significantly, the *Times* quoted McKay's conference paper on "Operational Aspects of Intellect" as support.⁶⁷⁴ For the *New Scientist*, talk of mechanising mind was a scientific harbinger of Orwellian techno-dystopia, and it sagely noted that even amongst their creators, brain-machines were emotive and Teddington had witnessed intemperate exchanges.⁶⁷⁵ *Wireless World* deviated from its typically staid technocratic reportage; remarking that the symposium profoundly discomfited both respectable science, and humanist exceptionalism. It described Uttley arguing that if machines could 'fly', then machines could 'think', with a reported stage whisper interjecting

⁶⁷³ "Computer Research: Franksteins of the Fifties", *Economist*, 29 Nov. 1958, p. 824.

⁶⁷⁴ Special Correspondent, "Computer As Composer", *Times*, 25 Nov. 1958, p. 7.

⁶⁷⁵ Geminus, "It Seems to Me", *New Scientist*, 4 Dec. 1958, p. 1447.

“calculating” alongside Uttley’s ‘machine’.⁶⁷⁶ NPL officialdom welcomed controversy less than publicity.

Despite his strong initial support from the NPL leadership, Uttley’s cyberneticist heterodoxy marked him as an NPL outlier, just as his recruitment had branded him an outsider. Perhaps Uttley’s unflinching advocacy of Turing’s post-conviction, and posthumous, legacy also contributed to a hardening of NPL cultural sentiment against both him and cybernetics. And, perhaps jealousy also played its part. Overall, during his time at the NPL, Uttley doubled the size of his section; he inherited a headcount of forty and he bequeathed one of eighty. In 1959, the NPL Executive Committee approved Uttley’s request for a new six story building, which opened in 1964.⁶⁷⁷ Uttley’s tenure was consequential for the NPL, and the 1958 symposium could have propelled British scientists to the vanguard of the then still nascent field of AI research. However, Uttley was excised from the NPL’s official memory, and he is absent from their website.⁶⁷⁸

The sub-textual testimony inadvertently offered by David Yates in his NPL court history, *Turings Legacy*, revealed deep personal and cultural antipathy towards Uttley from those who considered themselves the inhabitants or guardians of the normativities that should have constituted the collective mind and institutional practices at the NPL. The criticisms that Yates’ levelled at Uttley were often not delivered in his text directly; rather, they were frequently conveyed through inference and insinuation. Thus, Uttley is described from the

⁶⁷⁶ “Learning Machines: New Era of Control Systems Foreshadowed at N.P.L. Symposium”, *Wireless World*, Jan. 1959, pp. 8-9.

⁶⁷⁷ Yates, *Turing’s Legacy*, pp. 57-58.

⁶⁷⁸ www.npl.co.uk/famous-faces, [29 Sept. 2022].

outset as having brought “radical change” to the CME Division.⁶⁷⁹ Which, under his direction, was imbued with a new “ethos”; wherein, the pursuit of the “policies of Government” and the exploitation of the “opportunities for industrial development” were eschewed in favour of Uttley’s “passionate interest in the structure and function of the brain”.⁶⁸⁰ Even insofar as the practical applications of electronic computing were concerned, Uttley was uninterested unless he discerned some relevance to his own “chosen field”.⁶⁸¹

For Yates, and seemingly for many of his other colleagues also, Uttley was a “scientist at heart”, and his tenure at the NPL was characterised by a misguided desire to turn his division away from its proper purpose of enacting governmental policy and contributing to the prosperity of the nation.⁶⁸² Thus, whilst Uttley’s efforts to “foster a stimulating university-style atmosphere” were visionary, they were also alien to the NPL’s native pragmatism.⁶⁸³ Consequently, although there were some who found Uttley’s “idealism inspiring”; equally, there were others at the NPL for whom it could “provoke irritation”.⁶⁸⁴ Amongst those who felt Uttley’s ‘devotion’ to the investigation of the “natural world” to be an irritant, his commitment to “long-term” scientific enquiry was also a “politically naive” distraction from the “incremental” “approach to achieving progress” that they considered proper to the practical problem solving which should have consumed their time and resources.⁶⁸⁵

⁶⁷⁹ Yates, *Turing’s Legacy*, p. 56.

⁶⁸⁰ *ibid.*, p. 57.

⁶⁸¹ *ibid.*, p. 57.

⁶⁸² *ibid.*, p. 57. There was a four year overlap between Yates joining the NPL from LEO Computers Ltd in 1962, and Uttley’s retirement from the NPL in 1966. *Ibid.*, p. 312, 317.

⁶⁸³ *ibid.*, p. 57.

⁶⁸⁴ *ibid.*, p. 57.

⁶⁸⁵ *ibid.* p. 57.

For Yates, Uttley's injudicious and misapplied personal scientific enthusiasms were exemplified by the work which he initiated, alongside A. M. Andrew, on the "so called *conditional probability computer*"; which, Uttley's nomination notwithstanding, was considered by Yates to be a "learning device" rather than a computer in the proper sense of the word.⁶⁸⁶ This project had instigated a "complete change from the CME control tradition", and whilst "Dr Uttley had considerable faith" in his "simple concept", neither the world nor his NPL colleagues were ready for his radicalism. Uttley's machine had been beyond the "mainstream work" of his own division from the start.⁶⁸⁷ A point not lost on Uttley's own colleague, Percy Hammond; who, whilst attracted to the NPL from the RRE in March 1959 by Uttley's "enthusiastic plans and bold vision", soon realised that the "group had to show its relevance to current industrial needs if it was to prosper".⁶⁸⁸ As quoted by Yates, Hammond recalled his profound difficulty in attempting to reconcile the "'very sensible and logical'" attitudes of the "'indigenous'" NPL personnel on one hand, with the "'imaginative ... but essentially impractical ideas of Albert Uttley!'" on the other.⁶⁸⁹ Whilst Uttley, the incomer, had presided over "heady days" during the first years of his tenure, there was little to show in return for the early excitement and optimism. Despite glancing mentions of possible industrial applications in the NPL annual reports for 1957 and 1958; by 1960, Uttley's outlandish machine had entirely vanished.⁶⁹⁰

In Yates' view, Uttley's "faith" in his learning machine was predicated on his perception of the parallels between the working of his probability computer and the working of the human

⁶⁸⁶ *ibid.*, p. 73. The emphasis is Yates'.

⁶⁸⁷ *ibid.*, p. 73.

⁶⁸⁸ *ibid.*, p. 73.

⁶⁸⁹ *ibid.*, p. 74.

⁶⁹⁰ *ibid.*, p. 73. The two mooted possibilities were an oil refinery in 1957 and a distillation-column in 1958. Little memory of Uttley's machine inhabits the standard narratives of the history of British computing.

brain.⁶⁹¹ This biological element to Uttley's approach was a further source of his dissonance with the normativities of the NPL. For Yates, Uttley's neurological inclinations were "alien" to the NPL's "traditional culture of 'hard' science and technology"; just as his practice of accommodating "unpaid" "Guest Workers" or "Research Fellows" on "fixed-term contracts" was "too idealistic and long-term" for the salaried Civil Service establishment at the NPL.⁶⁹² In Yates' verdict, Uttley never grasped the realities of the world that the NPL inhabited; instead of overseeing the delivery of practical socio-economic impact, Uttley saw himself as a "professor", and he ran his division as though it were a "university research department".⁶⁹³ Ultimately, for Yates, an NPL insider who wrote on behalf of others of his ilk who had also been contemporaries of Uttley; Uttley was a misplaced academic whose politically naive intellectual idealism and outlandish ideas about mechanising minds invoked the soft science of biology (and cybernetics), and were Other to the hard scientific rigour of proper NPL practice. Yates' treatment of Uttley's tenure has the hallmarks of congruity with the NPL's culturally sanctioned orthodox narrative regarding its brief quasi-cyberneticist deviation. In 1960, Uttley re-named his division to Autonomics. His successor, Donald Davies, rapidly jettisoned the cyberneticist synonym and reversed Uttley's heterodoxy with the formation of the conspicuously respectable Computer Science Division.⁶⁹⁴

Although the NPL unpersoned Uttley, residual traces of the cyberneticist orientation and Ratio Club affiliations he imported survived. In the sixties, two of Uttley's former

⁶⁹¹ Despite Yates' evident disapproval of Uttley's tenure at NPL, he nevertheless reflected on the fact that the conditional probability computer did presage the late twentieth century use of artificial computational neural networks in industrial control systems. On this count at least, Uttley was proved right; albeit that he was too far ahead of his time for his ideas to have been right for the NPL during his tenure. *Ibid.*, p. 73.

⁶⁹² *ibid.*, p. 85

⁶⁹³ *ibid.*, p. 85.

⁶⁹⁴ *ibid.*, p. 117.

colleagues, Christopher Evans and Anthony Robertson edited two companion volumes of ‘key papers’. In 1966, the first publication, *Key Papers: Brain Physiology and Psychology*, reproduced Turing’s “Computing Machinery and Intelligence”.⁶⁹⁵ The second, *Key Papers: Cybernetics*, published in 1968, carried Turing’s “Intelligent Machinery”, alongside Craik’s two published papers, and work by McCulloch, Sluckin, Rushton, Barlow, and Cherry.⁶⁹⁶ Notably, in both volumes, the editors were openly affiliated to the NPL’s Autonomics Division. Equally noteworthy, Evans and Robertson were the first to publish Turing’s “Intelligent Machinery”; a previously unknown internal NPL report from his 1947 Cambridge sabbatical. Introducing Turing’s hitherto hidden work in their cybernetics volume, Evans and Robertson illuminated Turing’s pioneering NPL computer work, and argued that Turing’s “Computing Machinery and Intelligence”, collected in their previous brain volume, was vital to the intellectual history of cybernetics. Turing’s significance was never as ‘lost’ as his orthodox computing contemporaries wished. Neither were his reciprocally formative intersections with cybernetics as peripheral as later silences about them suggested.

Uniquely amongst Ratio Club members, Uttley attempted to instantiate a formal organisational venue for cybernetics. And, after Colebrook’s ill-fated proposal, Uttley’s Autonomics Division became the only credible effort to establish cybernetics institutionally

⁶⁹⁵ A. M. Turing, “Computing Machinery and Intelligence”, in C. R. Evans, A. D. J. Robertson (eds.), *Key Papers: Brain Physiology and Psychology*, (Butterworths, London, 1966), pp. 213-40.

⁶⁹⁶ In C. R. Evans, A. D. J. Robertson (eds.), *Key Papers: Cybernetics*, (Butterworths, London, 1968): A. M. Turing, “Intelligent Machinery”, pp. 26-52; R. Thomson, W. Sluckin, “Machines, Robots and Minds” pp. 78-89; W. S. McCulloch, “Machines that Think and Want”, pp. 104-18; K. J. W. Craik, “Theory of the Human Operator in Control Systems: I: The Operator as an Engineering System”, pp. 120-28; K. J. W. Craik, “Theory of the Human Operator in Control Systems: II: Man as an Example in a Control System”, pp. 130-39; W. A. H. Rushton, “A Theoretical Treatment of Fuortes’s Observations upon Eccentric Cell Activity in *Limulus*”, pp. 168-80; H. B. Barlow, “Sensory Mechanisms, the Reduction of Redundancy and Intelligence”, pp. 182-207; C. Cherry, “Two Ears-But One World”, pp. 268-87.

within the ambit of the British state. However, ultimately, Uttley failed. Marginalised and alienated at the NPL, he retired early and commenced a second career as research professor at Sussex University.⁶⁹⁷ Apart from a residual half-memory of the 1958 symposium, there is as little trace of Uttley's cybernetics at the NPL today, as there was evidence of cyberneticist transmissions from the NPL to the institutions and agencies of state and society then. Uttley's NPL experience exemplified the generalised institutional adherence to the precepts of scientific orthodoxy that countervailed cybernetics in fifties Britain. Cybernetics was a mutagenic intellectual pathogen, against which the host institutions of respectable humanist and scientific thought self-immunised. At the NPL, as elsewhere, resistance was typically indirect. The epistemological antigens to cybernetics were carried and concealed in tacit cultural and sociological practices, and were more effective for being camouflaged. Scientific knowledge can be sociologically destroyed as well as constructed.

The End of the Ratio Club

The Ratio Club's end came with a poignantly ironic whimper; not a bang. After a three year hiatus, the now moribund formation met at 19:30 on Thursday 27 November in the margins of the event inaugurating Uttley's doomed effort to establish cybernetics at the NPL. With poetic circularity, it ended where it had begun; at the National Hospital. As always, Bates was the activator. However, tonally, his invitational circular suggested that the initiative lay elsewhere, and Bates imbued the strictly prescribed character of their swan song with a marked reluctance.⁶⁹⁸ There would be eating and drinking, but no talks or guests; this was closeted conviviality, but without cybernetics. At the end, as at the beginning, the Ratio Club was sealed. The solitary item of postprandial business was the abiding question of the

⁶⁹⁷ Yates, *Turing's Legacy*, p. 62.

⁶⁹⁸ Draft invitation, 1958, WC/GC/179/B.19/Box 12.

Ratio Club's dissolution and formalised reconstitution as an open membership cybernetics society.

With sombre formality, Bates then circularised the Ratio Club with the outcomes of its valedictory dinner.⁶⁹⁹ His attendance register betrayed an uncharacteristic irascibility. First, he recorded those present.⁷⁰⁰ Next, he designated four categories of absence. Walter, Merton and Westcott were credited with expressing their regrets; whilst Gold and Shipton were exonerated emigres. Ashby and McLardy were rebuked for losing interest; and, Good, Little, Pringle and Rushton were chastised for their discourteous silence. As they all knew, Ashby and Walter had attended the NPL symposium the day the Ratio Club disbanded. Bates could have listed absences without categorisation, or simply recorded the attendances. His textual choice was performative. Maybe this atypical waspishness revealed his festering frustration that, as the Ratio Club's prime mover, ultimately, his endeavours were unreciprocated. Conversely, perhaps the poor turnout reflected the others' growing frustration with his unwillingness to relinquish control or allow the Ratio Club to adapt.

Bates' postprandial circular formalised the Ratio Club's demise and declared an absence of appetite for either regrouping its original members, or for reconstituting afresh along the same lines. However, it also suggested a potential collective desire to assemble an equally informal successor, which might convene an annual symposium under the aegis of a commercial, professional or government body. Bates' version of the outcome of the dinner conversation was perhaps heavily editorialised. Replying to Bates' invitation, Hick had already expressed a clear wish to resuscitate the Ratio Club in its original form by adding

⁶⁹⁹ "Ratio Club", circular, Nov. 1958, WC/GC/179/B.19/Box 12.

⁷⁰⁰ Namely: Barlow, Bates, Dawson, Hick, MacKay, Sholl, Slater, Uttley, Woodward.

new members to replace those who had resigned.⁷⁰¹ Indeed, the informal successor to the Ratio Club that Bates sketched out in his report could be read as a re-formulated description of the Ratio Club itself. Hick's prior response, this obvious commonality, and the sequence of subsequent events, suggested that Bates may have couched the sentiments of the final meeting in terms more suited to his inclinations than to the spirit of the conversation. Even before the farewell dinner, for Bates at least, the cybernetics episode was over.

Bates enclosed a stamped and addressed card with the final circular, asking Ratio Club members to reply with proposed candidates for the successor formation. He promised a subsequent meeting to discuss responses and develop the idea. Seven members replied, but Good used his card to rebut Bates' earlier rebuke, curtly explaining that he had been in America.⁷⁰² The other responses from Barlow, Pringle, Hick, Uttley, Walter, and Woodward generally remitted names which mirrored the abiding disciplinary and sociological insularity of the Ratio Club.⁷⁰³ So, for instance, Barlow and Uttley both offered Jack Allanson, an electrical engineer with biological and information theoretic leanings, and a one-time Ratio Club guest. Similarly, Hick suggested Dennis Gabor, another electrical engineer who had embraced information theory and who was also well known to the Ratio Club. However, predictably, Walter strayed a little and nominated Frank George, Stafford Beer and Gordon Pask. Barlow and Uttley also broke pattern by choosing Alex Andrew; unsurprisingly in Uttley's case given that he was Andrew's boss. George, Beer, Pask and Andrew were already known cyberneticians before their designation as putative heirs to the Ratio Club.

⁷⁰¹ Letter, Hick to Bates, 19 Nov. 1958, WC/GC/179/B.19/Box 12.

⁷⁰² Cards returned by Ratio Club members, WC/GC/179/B.20/Box 12.

⁷⁰³ Table 10: Post Ratio Club Cybernetics Symposia Suggestions.

Otherwise, most of the names that Bates received designated psychologists, physiologists or neurologists. Barlow, for instance, offered the physiologists Fergus Campbell and John Robson, as well as the psychologist Richard Gregory; while Pringle added the zoologists Colin Pennycuik and Adrian Horridge. This group would have assembled a stellar cast. Gabor received the Physics Nobel Prize; Beer architected a cyberneticist socio-economic system to implement socialism in Chile; and Gregory became a pioneer of cognitive psychology at Edinburgh, where he created the Bionics Research Laboratory and co-founded the Department of Machine Intelligence and Perception with Donald Michie and Christopher Longuet-Higgins.⁷⁰⁴ Alas, the outcome of this unrealised formation is unknowable.

Had Bates acted on these submissions, it is credible to imagine a viable Ratio Club successor. However, he did not, and neither did any of the other Ratio Club members shoulder the burden. There was no follow on meeting. Uttley's contemporaneous cyberneticist manifestation at the NPL symposium could have launched an ongoing series of cyberneticist events, or even initiated Ashby's cybernetics society. Yet, instead, both the Ratio Club and organised British cybernetics faded away. Despite its privately declared foundational epistemological allegiance, the Ratio Club was not convened to proselytise cybernetics. Unlike the politically and intellectually activist pre-war social relations of science movement inhabited by the likes of Solly Zuckerman, J. B. S. Haldane and J. D. Bernal, the Ratio Club had no pretensions to withstand the gaze of history. Nor did the Ratio Club share a desire for academic formalism with the Cambridge spawned Experimental Psychology Group, which also lamented Craik as an absent founder and included Hick as an inaugural

⁷⁰⁴ J. Howe, "Artificial Intelligence at Edinburgh University: A Perspective", www.inf.ed.ac.uk/about/AIhistory.html, [30 Sept. 2022].

member.⁷⁰⁵ Bates did not convene or constitute the Ratio Club to ignite a British cybernetics movement.

Perhaps Pringle also spoke for some others when he barbed his post Teddington suggestion of new names with the caveat that the Ratio Club's purpose was spent. For many of its members, the Ratio Club was more shield and succour than stage or platform. They gathered socially to play with a new science beyond the censorious eye of academic formalism; not to change the world. Their combative intellectualism evoked the heady excitement of their scientists' war, just as much as it conjured the anticipatory thrill of future professional glory. Moreover, for these hungry and ambitious minds, the Ratio Club offered both an intellectual refuge from post-war conservatism, and a bodily respite from pinching post-war austerity. Alongside its masculine mental jousting, eating and drinking were central to the Ratio Club's appeal; especially drinking. Bates kept accounts for the first eleven meetings on the back of an envelope; literally. For all but meeting eleven when it was even, expenditure on alcohol was between two and four times that on food.⁷⁰⁶ The Ratio Club existed to nourish and intoxicate its members, whilst equipping them with the epistemological equipment required for professional success. As intellectual novelty waned and careers waxed, and as affluence prevailed over austerity, the Ratio Club's allure faded.

⁷⁰⁵ "History of the EPS: Beginnings", www.eps.ac.uk/history-of-the-eps-beginnings/, [5 Jan. 2023].

⁷⁰⁶ "Dining Club Funds", envelope with manuscript notes, WC/GC/179/B.24/Box 12.

Chapter Four: Beyond the Ratio Club: Cybernetics in Fifties Britain

Auntie and the Penguin

The war had performatively embodied annihilation in advancingly complex technological forms at bewildering pace. In 1939 Britain retained biplanes in military service; by 1945 jet fighters chased pilotless missiles. Automated slaughter rendered technology existentially earthly, irreversibly demonstrative, and manifestly destructive. Whilst war had heroized weaponized science, peace now decanted the boffins from their back rooms and propelled them into a land where the conceit of a cloistered patrician elite condescending an occasional glance downward from dreaming spires vaporised. The post-war consensus demanded committal of power to re-construction; so science, and scientists, became agentic in the public discourse shaping the New Jerusalem's socio-technics. For the demos, who were now viscerally subject to the annihilative power of atomic science, discursive democratisation presaged restorative hope: science, and scientists, became public property. For the lionised soldier-scientists, this public mediation ameliorated the moral jeopardy of their intellectual violence. Science and civilisation would reclaim each other, and they would become the technocrats of a cathartic peace planned with slide-rules.

As swords became ploughshares, the polity willed that the belligerent technologies of motive power, electronics, synthetic materials, computers, automation and pharmacology should serve regeneration. Science augured new technologies and new industries. New factories would arise; buttressing full employment with better jobs, more leisure, and homes not slums. Even the feared atom promised limitless electricity. Popular sentiment required accessible science for prosperity, and visible scientists for comfort. It also draped a Union Flag over lab coats. Amidst swirling post-war uncertainties, boffins were a talisman of

abiding British greatness. America had might, money and mouth; but Britain had brains. As Macmillan divined about grand strategy, so also in science; Britain became Greece to Rome in a new American empire.⁷⁰⁷ Yet, as austerity transitioned to New Elizabethan affluence, science was increasingly constructed as both a cure and a cause for national anxieties. Britons relished the power and prestige of science. But, they also feared its abuse, and by the mid-fifties public sentiment was becoming increasingly anxious about the societal misuse of technology. Nevertheless, the immediate post-war public socio-technical discourse inclined more towards positivist optimism than determinist fear, and science and scientists were assimilated into popular British culture in hitherto unimaginable ways.

The BBC caught the mood early, and initiated what quickly became a rapidly accelerating post-war enfoldment of science within its Reithian embrace. In September 1945 the Services Educational Unit began its Forces Educational programmes, promising, *inter alia*, that science would deliver jobs to the demobilised in a land fit for heroes. That year, the BBC also recruited a young university chemist, Archibald Clow, to lead the production of its new scientific output.⁷⁰⁸ Like his mentor, the zoologist Lancelot Hogben, Clow believed both that science civilized, and that scientists were morally obliged to enlighten the uninitiated: science would slay Beveridge's giants.⁷⁰⁹ At a May 1946 AScW conference in Cambridge on Science and the Radio, Clow proposed transmitting societal progress through science broadcasting; possibly to future Ratio Club members.⁷¹⁰ Clow swiftly moulded BBC radio into a scientific broadcasting powerhouse. In 1947 he gained control of the fledgling weekly

⁷⁰⁷ R. Crossman, "The Making of Macmillan", *Sunday Telegraph*, 9 Feb. 1964, p. 4.

⁷⁰⁸ J. R. Keller, *A Scientific Impresario: Archie Clow, Science Communication and BBC Radio, 1945-1970*, (PhD thesis, Imperial College London, 2017).

⁷⁰⁹ L. Hogben, *Science for the Citizen: A Self-Educator Based on the Social Background of Scientific Discovery*, (Allen & Unwin, London, 1938). Keller, *Impresario*, pp. 40-2.

⁷¹⁰ Keller, *Impresario*, p. 58, 115.

Science Survey programme. Henceforth, instead of academic eminence and abstract theory, Clow's reformed *Science Survey* featured innovative junior scientists giving well-presented talks about the social application of their work. In 1954, *Nature* praised him for making serious science unpatronisingly accessible.⁷¹¹

Institutionally, in post-war Britain, cybernetics withered beneath disdain from a rapidly ossifying computational scientific orthodoxy, energetically wielded by an ambitious nascent professional academic elite. Publicly, however, it was disseminated widely across this generalised post-war popularisation of science. Clow's BBC became an especially significant venue for public mediations of cybernetics, and its epistemological cognates; robots, computers, information theory, automation, brains and minds featured in over 160 BBC broadcasts during the forties and fifties.⁷¹² The inscriptions of the resurrected Cartesian controversy in this output were prominent, especially in its treatments of electronic digital computers. As were the acute anxieties and optimisms aroused in many, including Wiener himself, by an impending cyberneticist automation which threatened to supplant human economic and social cognitive agency. However, whilst editorial framing of this output was knowingly shaped by *Cybernetics*, and although some programmes dealt directly with cybernetics itself, nevertheless, none used the word in their titles. Occasionally, a BBC continuity announcer used the word to introduce a programme, and sometimes the speakers themselves openly mentioned it, albeit infrequently. Yet, although tacitly pervasive, cybernetics was discursively obfuscated. The BBC was not insensate to hegemonic academic scientific respectability.

⁷¹¹ "The B.B.C. "Science Survey": Dr. Archie Clow", *Nature*, Vol. 173, No. 4396, 30 Jan. 1954, p. 192.

⁷¹² Table 20: BBC Broadcasts.

Across two decades, Clow produced over 700 episodes of *Science Survey*; of which, 550 featured a one-off speaker.⁷¹³ Here, as across contemporary BBC science programming generally, repeat appearances by the same scientist were unusual; typically, Clow preferred variety. Walter's regular broadcast presence was, therefore, atypical. As was MacKay's frequent airwave evangelism of his scientific Christian apologetics, and Turing's three BBC borne interventions in the Cartesian computational contest. Alongside these three repeat performers, several other Ratio Club members made singular contributions to Clow's post-war proselytization of science.⁷¹⁴ Ashby delivered a 1949 Third Programme talk on "Imitating the Brain", in which he explained how his Homeostat operationally replicated self-adaptive dynamic neurological equilibria.⁷¹⁵ Also that year, Slater joined a Third Programme series on *The Physical Basis of Mind*, and the book accompanying the talks credited Bates as a scientific advisor.⁷¹⁶ Sholl featured in "How the Brain Works", a BBC TV programme explaining the scientific underpinnings of J. Z. Young's contemporaneous 1950 Reith Lectures on "Doubt and Certainty in Science".⁷¹⁷ And, Uttley joined Young on a Third Programme panel discussing "Brains, Nerves and Models".⁷¹⁸ Individual Ratio Club members featured prominently on the BBC, and their contributions often carried cyberneticist themes into Britain's cultural air. However, there was no indication that these appearances derived directly from their Ratio Club membership.

⁷¹³ Keller, *Impresario*, p. 156.

⁷¹⁴ Table 20: BBC Broadcasts.

⁷¹⁵ W. R. Ashby, "Imitating the Brain", BBC Third Prog., 9 March 1949, 18:40.

⁷¹⁶ E. T. O. Slater, "Consciousness", *The Physical Basis of Mind*, BBC Third Prog., 21 May 1949, 21:30. P. Laslett (ed.), *The Physical Basis of Mind: A Series of Broadcast Talks by Sir Charles Sherrington, E. D. Adrian, W. E. Le Gros Clark, S. Zuckerman, E. T. O. Slater, W. Russell Brain, Wilder Penfield, Viscount Samuel, A. J. Ayer, Gilbert Ryle*, (Blackwell, Oxford, 1950), p.vi.

⁷¹⁷ J. Z. Young, J. T. Aitken, D. A. Sholl, "How the Brain Works", BBC TV, 13 Nov. 1950, 21:30. J. Z. Young, *Doubt and Certainty in Science: A Biologist's Reflections on the Brain: The B.B.C. Reith Lectures 1950*, (Clarendon Press, Oxford, 1951)

⁷¹⁸ J. Z. Young, A. M. Uttley, J. Brown, R. L. Gregory, W. K. Taylor, A. Watson, *Research: A Discussion Among Scientists: "Brains, Nerves, and Models"*, BBC Third Prog., 16 Oct. 1957, 21:20.

In MacKay's case, his sustained broadcast presence projected both his ancestral Free Church evangelism, and his adult Christian mission of scientific apologia. Rivalling Walter, across the forties and fifties he made seventeen BBC appearances.⁷¹⁹ However, MacKay eschewed Walter's middle-brow sensationalism in favour of a high-minded and professorial demeanour. MacKay's cybernetics freighted themes included the nullification of the Cartesian duality, the reconciliation of a mechanistic mind with Christian doctrines of humanity and free-will, and the potential complementarity between human and machine cognition. He also delivered occasional reports on developments in information theory. His 1950 talks on mechanical cognition, and his 1957 talks on determinism and free-will, exemplified his output.⁷²⁰ MacKay's ardent denial of the scientific banishment of religion or religious humanism evidently pleased T. S. Gregory, a Third Programme producer and Catholic convert from Methodism. Gregory had failed to prevent the 1955 broadcasts by the psychologist Margaret Knight in which she had privileging humanist science and atheism over religion as predicates for morality and education.⁷²¹ Thereinafter, as Gregory sought to sanctify the BBC's output, MacKay found himself in increasing editorial favour. In 1957,

⁷¹⁹ Table 20: BBC Broadcasts.

⁷²⁰ D. M. MacKay: "Mind Like Behaviour in Machines: 1", BBC Third Prog., 10 June 1950, 18:00; "Mind Like Behaviour in Machines: 2", BBC Third Prog., 16 June 1950, 20:20; "Brain and Will, 1: If the Brain Were a Machine Would the Will be Free?", BBC Third Prog., 1 May 1957, 19:30; "Brain and Will, 2: I-Language and It-Language", BBC Third Prog., 7 May 1957, 19:50.

⁷²¹ M. Knight: "Morals Without Religion 1", BBC Home Service, 5 Jan. 1955, 22:00; "Morals Without Religion 2", BBC Home Service, 12 Jan. 22:05. M. Knight, Rev. I. Pitt-Watson, Sir E. Villiers, Rev. H. C. Whitley, "Morals Without Religion", BBC TV, 22 Oct. 1957, 22:20. C. G. Brown, "'The Unholy Mrs Knight' and the BBC: Secular Humanism and the Threat to the 'Christian Nation'", *The English Historical Review*, Vol. 127, Iss. 525, April 2012, p. 357.

he was entrusted with delivering a series of Home Service talks for high school students about the relationships between cybernetics, humanism and theories of mind.⁷²²

Apart from Gregory's Christian mission, under Clow the conscious pursuit of cyberneticist themes resonated across the BBC's science output. Clearly, cyberneticians satisfied Clow's secular desire to broadcast novel, engaging and socially relevant science. Equally clearly, there was a social network connecting him and the BBC to British cyberneticians in and around the Ratio Club. The particularly vigorous BBC coverage of the Cartesian computational controversy was complemented by an equally enthusiastic engagement with the imbricated sociological questions around the replacement of human cognitive and perceptual control of industrial processes with computers: machines versus minds mattered to the post-war BBC. Furthermore, along with the vocabulary of cybernetics, Auntie's audiences also received information theory long before universities taught it. Overall, the BBC's extensive treatments of cybernetics, and its epistemological relatives, spanned both the vast popular audienceship of the Home Service and the Light Programme, and the fractional, yet elite, Third Programme listenership. Far more than liminal conference encounters, or indeed the sporadic gatherings of an insular dining club, it was this media coverage of cybernetics which propelled it into the countercultural sixties and the socio-technically pessimistic seventies. Cybernetics was floating in the airwaves of fifties Britain.

Penguin also detected the post-war appetite for accessible and salvatory science. And, like the BBC's broadcasts, its print publications were an important mechanism for the mediation

⁷²² *For the Schools: Talks for Sixth Formers* (repeated as *Out of Term*), BBC Home Service, 1957, D. M. MacKay, "Man and Machines": "1: Machines that Guide Themselves", 10 May, 11:00, (repeated 16 Sept., 09:00); "2: Machines that Calculate", 17 May, 11:00, (repeated 17 Sept., 09:00); "3: Models of the Brain", 24 May, 11:00, (repeated 18 Sept., 09:00); "4: Is Man a Machine?", 31 May, 11:00, (repeated 19 Sept., 09:00).

of cybernetics into the post-war socio-technical imaginary. In June 1946, Penguin launched *Science News*, which spanned fifty-four issues and became its longest ever running periodical. Declaratively, *Science News* conveyed sometimes uncertain, if not risky, knowledge from the frontiers of research, and readerly caution was advised.⁷²³ Venturing beyond academic respectability, *Science News* followed the BBC in favouring unstoried scientists. And, even more so than Auntie, Penguin espoused a positivist futurism where techno-scientific praxis secured societal progress. In May 1956, Penguin appointed Archie Clow and his wife Nan (also a chemist) as co-editors of *Science News*, and together they then brought the credible and accessible science that Archie had pioneered for the BBC's listeners to Penguin's readers.⁷²⁴ From these two towering post-war British cultural platforms, the Clows cast science, and cybernetics, widely and deeply across British society.

Whilst cybernetics did not permeate *Science News* as strongly as it did the BBC, nevertheless, its presence was significant. Although, like the BBC, *Science News* also eschewed nominative recognition of cybernetics; with one stark exception. In October 1949, *Science News* reviewed *Cybernetics* itself. The piece exemplified the condescension *Cybernetics* garnered from the British scientific establishment.⁷²⁵ Deriding Wiener's proposition of an informational isomorphism between electronic digital computers and neurological systems, the reviewer scorned both his fallacious mechanist and behaviourist portents of robots rivalling humans, and his crude operationalist analysis of ontological

⁷²³ *Science News*, Iss. 1, June 1946, pp. 7-8.

⁷²⁴ A. Clow, N. L. Clow, *The Chemical Revolution: A Contribution to Social Technology*, (Batchworth, London, 1952).

⁷²⁵ A. E. Blake, "Science Front: What is Cybernetics?", *Science News*, Iss. 13, Oct. 1949, pp. 124-27. Apart from this short piece, Blake made no further visible appearance in the post-war British cybernetics experience. He was not listed as an acknowledged contributor to Issue 13 (pp. 158-59), and this, combined with the magazine style of the "Science Front" section he authored (pp. 121-141), suggested that he might have been a *Science News* staff writer.

analogues of complex systems. Yet, the reviewer allowed, although physics had surpassed its need for mechanical toys, the methodological infantilism of physiology and neurology might find cybernetics sufficiently jejune. Echoing the already normalised scientific computational narrative, the review affirmed that computers were merely machines, entirely subject to the minds of their human masters. So, although *Cybernetics* was amusing, in reality, humanity was spared a robot revolution. Nevertheless, while cybernetics would likely perish, prudence indicated that a watchful eye should be kept on the inauspicious youth.

Alongside Turing's odd rehash of his 1936 paper on the decidability problem, two other Ratio Club members published in *Science News*.⁷²⁶ Rushton's 1947 proto-cybernetic exposition of the electro-conductive communicative commonality between neurological and telephone systems appeared alongside a story about mercury filled tubes operating as electronic memory for the NPL ACE; crosstalk was unavoidable.⁷²⁷ Pringle's 1950 article explained humans as information processing machines with calibrated and interlinked sub-systems, or anatomical organs, which instrumented systemic communicative control. He thanked Wiener and cybernetics for both erasing the inconsequential morphic differences between organic and inorganic systems, and establishing the essential unity of all communicative systems instantiating informational self-control.⁷²⁸ However, cybernetics was otherwise *sotto voce* in Pringle's information theoretic essay. Like many of his Ratio Club colleagues, he assimilated rather than activated cybernetics. Overall, the paucity of the

⁷²⁶ A. M. Turing, "Solvable and Unsolvable Problems", *Science News*, Iss. 31, Feb. 1954, pp. 7-23.

⁷²⁷ W. A. H. Rushton, "How Messages are Transmitted Along Nerves", *Science News*, Iss. 5, Nov. 1947, pp. 123-43. A. W. Haslett, "Physics Front: "Memory" in a Mercury Tube", *Science News*, Iss. 5, Nov. 1947, pp. 64-6.

⁷²⁸ J. W. S. Pringle, "The Instrumentation of the Living Body", *Science News*, Iss. 17, Sept. 1950, pp. 100-14.

Ratio Club's contributions to *Science News* again reflected its constitutional insularity. Here as elsewhere, most Ratio Club members either avoided public platforms entirely, or their sparse contributions gave scant overt sense of their cyberneticist commitments.

Accordingly, one of the strongest cyberneticist voices in *Science News* came from beyond the Ratio Club. In 1952, G. M. Weyburn, anatomy professor at Glasgow, published an essay praising cybernetics for impelling neurology away from the quasi-mystical imponderability of the mind, and towards mathematised empiricism.⁷²⁹ Weyburn recognised the affinity between cybernetics and the proto-cybernetic war-time development of servomechanisms. And, although unattributed, he supported Walter's idea of a cerebral neuronal scanning mechanism analogous to an electron beam in a cathode ray tube. He also expressed his gratitude to Wiener, and cited direct conversations with unnamed leading American cyberneticians. Weyburn was departmentally contiguous with Alex Andrew, whose post-war conversion to cybernetics stemmed from a lecture at Glasgow given by McCulloch. A personal encounter between McCulloch and Weyburn is clearly indicated. Like so many others, Weyburn met cybernetics through American, not British, vectors. And, although it was widespread, antipathy to cybernetics was evidently neither universal across British professional scientific practice, nor evenly distributed.

Like the BBC, *Science News* also became a venue for the Cartesian computational controversy. When the not yet infamous Margaret Knight wrote "Consciousness and the Brain" in 1952; she anticipated trouble.⁷³⁰ Lamenting the emotive degeneration of the re-energised Cartesian controversy into entrenched and polarised positions, Knight strove to

⁷²⁹ G. M. Weyburn, "Central Cerebral Processes", *Science News*, Iss. 23, Feb. 1952, pp. 61-78.

⁷³⁰ M. Knight, "Consciousness and the Brain", *Science News*, Iss. 25, Aug. 1952, pp. 97-104.

claim a philosophical middle ground where reductionist materialism and vitalist essentialism could be reconciled. She was a better prophet than peacemaker. First came the philosophers. The moralist Bernard Mayo believed that because metaphysics refuted materialism as absolutely as experimentalism avowed it, then philosophical and neurological theories of mind were incommensurable, and compromise was impossible. The phenomenologist Wolfe Mays supported Mayo's pessimism of the intellect. For Mays, the contemplation of the experiential subjectivity of mind was beyond crude neurophysiological empiricism: only philosophy could apprehend the epistemology of being.⁷³¹ An unaffiliated R. Hadekel common sensically asserted that the inexplicably immaterial mind was simply another impenetrable universal imponderable.⁷³² After the spiritualist position was put by a yogi from the Sri Aurobindo Ashram in Pondicherry, French India, *Science News* closed the correspondence.⁷³³ Whilst vigorous, this intellectual censure paled beside the misogynistic vituperation Knight received from the British press after her 1955 BBC talks.

Machines Not Minds

For centuries, the mind-body problem had inhabited the metaphysical realms of theology and philosophy. Where, even as abstract speculation, mechanism had shaken the deepest foundations of both secular humanism and Abrahamic theology. Then, the clockwork automata of the sixteenth and seventeenth centuries ontologically amplified these epistemic perturbations and spurred Descartes' conjuration of the rational soul to defend human exceptionalism. Now, for Wiener's contemporaries, as post-war electronic digital computers performatively instrumentalised manifestly brain like functions in brain like

⁷³¹ B. Mayo and W. Mays, "Correspondence: Consciousness", *Science News*, Iss. 27, Feb. 1953, pp. 118-20.

⁷³² R. Hadekel, "Correspondence: Consciousness", *Science News*, Iss. 29, Aug. 1953, pp. 120-22.

⁷³³ K. D. Sethna, "Correspondence: Consciousness", *Science News*, Iss. 30, Nov. 1953, pp. 119-22.

ways, in Britain particularly, the mind-body problem became corporeally charged with cosmologically cataclysmic potential. Post-war British popular sentiment was riven with concerns about decline and moral purpose, and the nation's cultural and political elites were driven to the redemptive codification of categorically imperative human rights which were simultaneously universal and exceptionalist. Unsurprisingly therefore, Mountbatten's October 1946 intervention sparked an instant resuscitation of Descartes' immaterial, yet rational, soul. Equally unsurprisingly, *Cybernetics* became immediately agentic in the ensuing Cartesian computational controversy. Nevertheless, both the force and the popularity of this controversy were remarkable. The BBC was especially willing to confront the jeopardy that thinking computers offered vitalist humanism, and Aunties' philosophical enthusiasm was not lost on Margaret Knight. Citing the 1949 *Physical Basis of Mind* talks, Knight's *Science News* essay credited the BBC with making the Cartesian duality, and its computational intersections, as familiar to the general public as to Third Programme listeners.⁷³⁴

Again, the BBC had an early finger on the national epistemic pulse. Perhaps sensing the anxiety about dehumanising Nazi roboticisation, it broadcast a radio adaptation of Karel Čapek's *R.U.R.* in February 1946.⁷³⁵ Then, in February 1948, Cyril Joad gave a Forces Educational Broadcast on the Cartesian Duality, followed by a TV version of *R.U.R.* in March.⁷³⁶ Also that month, Ashby's BBC broadcast compared his electro-mechanical Homeostat to the human brain.⁷³⁷ In May and June of the following year, the BBC burst the

⁷³⁴ Knight, "Consciousness", *Science News*, p. 97.

⁷³⁵ "'R.U.R.' ('Rossum's Universal Robots')", BBC Home Svc., 16 Feb. 1946, 21:20.

⁷³⁶ C. E. M. Joad, *Forces Educational Broadcast*: "Introduction to Philosophy: Mind and Body-One Thing or Two?", BBC Light Programme, 12 Feb. 1948, 10:00. "R.U.R. (Rossum's Universal Robots)", BBC TV, 4 March, 1948, 20:30.

⁷³⁷ W. R. Ashby, "Imitating the Brain", BBC Third Prog., 9 March 1949, 18:40

mechanist-vitalist mind storm with the *Physical Basis of Mind* series. The *Listener*'s contemporaneous publication of the talks, and the reproduction of the scripts in book form the following year articulated the resonant strength of the public appetite nourished by these programmes.⁷³⁸ Cartesian anxieties swelled far beyond the narrow highbrow confines of the Third Programme. There is more cause than coincidence in the proximity between these talks and the publication of *Cybernetics* in late 1948. Although its British readership was fractional compared to America, nevertheless, indirectly *Cybernetics* radiated its intellectual shock waves into British minds through the BBC's transmitters.

The *Physical Basis of Mind* pitted science against metaphysics in a contest where science had the editorialised advantage. Nominatively, the singularising force of the definite article privileged materialism. Structurally, the seven anatomists, neurologists and physicians had a programme each, whereas the three philosophers shared one in reply. The mechanists were further advantaged by the selection of philosophers. Only Herbert Samuel staunchly resisted the scientised physicalism of mind. A. J. Ayer, torn between humanism and logical positivism, repudiated Cartesian dualism but balked at the reductionism he feared to be immanent in mechanism. Gilbert Ryle rehearsed the natural language assault he was shortly to unleash on Descartes in *The Concept of Mind*; wryly quipping that so strong was the dualist fallacy that even some of the materialist scientists succumbed to the tacit linguistic separability of a substantive mind.⁷³⁹ The staging of these talks suggested that antipathy to

⁷³⁸ C. O. M. Sherrington, "The Physical Basis of Mind", *Listener*, Vol. 41, No. 1058, 5 May 1949, p. 755. E. D. Adrian, "What Happens When We Think", *Listener*, Vol. 41, No. 1060, 19 May 1949, pp. 840-41. W. E. Le Gros Clark, "Anatomical Background of Mental Processes", *Listener*, Vol. 41, No. 1061, 26 May 1949, pp. 881-82 & 895. A Physician [E. T. O. Slater], "Consciousness and Emotion", *Listener*, Vol. 41, No. 1063, 9 June 1949, pp. 974-76. A Neurologist [W. R. Brain], "Speech and Thought", *Listener*, Vol. 41, No. 1064, 16 June 1949, pp. 1020-21 & 1024. W. Penfield, "Evidence of Brain Operations", *Listener*, Vol. 41, No. 1065, 23 June 1949, pp. 1063-64. Viscount Samuel, A. J. Ayer, G. Ryle, "A Philosophers' Symposium", *Listener*, Vol. 41, No. 1066, 30 June 1949, p. 1109-1111.

⁷³⁹ G. Ryle, "A Philosopher's Symposium, Part III", in Laslett, *Physical Basis of Mind*, p. 75.

Cybernetics was weaker in the editorial imaginary of the BBC than in the social mind of Britain's scientific and computing elite. Nevertheless, deep tensions between Gregory and his less theologically fervent colleagues, including Clow, are easily imagined.

The one overtly cyberneticist intervention in the *Physical Basis of Mind* series came from the zoologist Solly Zuckerman; a pre-war founder of the social relations of science movement, and a war-time pioneer of OR. His broadcast on "Self-Organisation" was published as "The Mechanism of Thought: The Mind and the Calculating Machine" in the accompanying book.⁷⁴⁰ It cited Ashby on self-adaptive neurological homeostasis, and promoted electronic computers as cerebral analogues that obviated the otherwise insuperable subject-object problem of brains apprehending the mechanics of thought. Peppering his talk with feedback, equilibrium, prediction, and communication and control, Zuckerman credited Wiener's paternity of this new, radical, American science.

Zuckerman's talk proposed an electronic brain, which when sensorily equipped with photoelectric cells, thermometers, microphones and radar, would emulate, if not rival, human adaptive mental faculties. Not quite a 'mechanical man'; but close. Zuckerman's talk was broadcast on 19 May 1949 and Jefferson delivered his Lister Oration on 9 June. This was not happenstance. Jefferson's prior commitment to Cartesian dualism was manifest in his 1944 address to the Manchester Literary and Philosophical Society.⁷⁴¹ The title, text and tone of his Lister Oration suggested that Jefferson was galvanised into his interventionist

⁷⁴⁰ S. Zuckerman, "The Mechanism of Thought: The Mind and the Calculating Machine", in Laslett, *Physical Basis of Mind*, pp. 25-35.

⁷⁴¹ "Localisation Of The "Soul": Prof. Jefferson's Address", *Guardian*, 19 Jan. 1944, p. 7.

vitalist polemic by Mountbatten's evangelism of ENIAC, Wiener's *Cybernetics*, Walter's putative electro-mechanical tortoises, and Zuckerman's cyberneticist advocacy.

The next public protagonist in the fight for mind on the BBC's quasi-institutional stage was Ryle. After the *Physical Basis of Mind*, Ryle appeared twice more on the Third Programme, again trailing his arguments in *The Concept of Mind*.⁷⁴² Two days after his second talk on 16 August 1949, Ryle's publisher advertised his forthcoming book in the *Listener*.⁷⁴³ On 14 September, Jefferson responded to Ryle by broadcasting his Lister Oration on the Third Programme.⁷⁴⁴ Two days later, a *TLS* advertisement announced the imminent arrival of *The Concept of Mind*.⁷⁴⁵ By the middle of November 1949, Ryle's book was on sale.⁷⁴⁶ Ryle's publisher had been quick to embrace the commercial potency of performative philosophical iconoclasm amidst a tumultuous public intellectual controversy. Neither Ryle's talks, nor his book, mentioned cybernetics. Nevertheless, he would have recognised the conjoined imbrication of electronic computers and *Cybernetics* in the argument he so emphatically joined, and known which side favoured his exorcism of Descartes's ghost from the human machine. Whilst not a cybernetician, nor strictly a materialist, nevertheless Ryle philosophically and performatively allied with those Jefferson attacked; including Turing.

Although Turing had been publicly implicated in the Cartesian computational dispute since 1946, before 1950 his interventions were ad-hoc journalistic episodes of sensationalist

⁷⁴² G. Ryle: "Minds or Human Beings" [1/2], BBC Third Prog., 15 Aug. 1949, 21:30; "Consciousness and the Inner Life" [2/2], BBC Third Prog., 16 Aug. 1949, 19:05.

⁷⁴³ "Ready Mid-September: *The Concept of Mind*, G. Ryle", *Listener*, Vol. 42, No. 1073, 18 Aug. 1949, p. 285.

⁷⁴⁴ G. Jefferson, "The Mind of Mechanical Man", BBC Third Prog., 14 Sept. 1949, 21:15.

⁷⁴⁵ "To be Published Shortly: *The Concept of Mind*, G. Ryle", *TLS*, 16 Sept. 1949, p. 593.

⁷⁴⁶ "Now Available: *The Concept of Mind*, G. Ryle", *TLS*, 11 Nov. 1949, p. 725.

reportage. However, the conjunction of the BBC's philosophical editorial arc, and Turing's personal entanglement with Jefferson, became a fulcrum for his pivot into deliberate public intellectualism. Following Ryle's BBC defenestration of Descartes, and Jefferson's retaliatory broadcast, Dorothy Emmet, philosophy professor at Manchester, held a departmental seminar on Mind and the Computing Machine on 27 October 1949. Alongside Emmet, attendance included Michael Polanyi, Max Newman, Wolfe Mays, J. Z. Young, Turing and Jefferson; but, not Williams or Kilburn.

Emmet explicitly framed the seminar with the cyberneticist brain-machine analogy. Optimistically, Young predicted that cybernetics would elevate neurophysiology from observation to experimentation. Conversely, Jefferson refuted the reductionist instrumentalization of brain medicine from craft to science wrought by EEG, and decried its dehumanising mechanisation of mind. Young countered that the replacement of artisanship with science was precisely the point of EEG. Turing spurned Jefferson's vitalism entirely.⁷⁴⁷ Shortly before Christmas that year there was an informal reprise of Emmet's seminar when Turing, Williams, Newman, Polanyi, Jefferson, Young, and James Yule Bogue, a biologist then working for ICI, gathered in Manchester for an evening of argumentative discussion. Reporting the session to McCulloch, Bogue joked that using EEG equipment and a universal electronic computer might have improved the quality of some of the arguments. Williams was as notable for his attendance as Kilburn was for his absence.⁷⁴⁸

⁷⁴⁷ The singular record of the 1949 Manchester seminar is an anonymous contemporary participant's note, in P. R. Blum, "Michael Polanyi: Can The Mind Be Represented By A Machine?: Documents of the Discussion in 1949", *Polanyiana*, Vol. 19, 2010, Nos. 1-2, pp. 35-60, www.polanyiana.org/articles/polanyiana-2010-1-2-19_paul-richard-blum-michael-polanyi-can-the-mind-be-represented-by-a-machine.pdf, [7 Oct. 2022].

⁷⁴⁸ Christmas greeting note on ICI headed paper, Bogue to McCulloch, Christmas 1949, W. S. McCulloch Papers, Mss.B.M139, Box 3, <https://diglib.amphilsoc.org/islandora/object/text:232312#page/4/mode/1up>, [20 Oct. 2022].

Henceforth, the intellectual antagonisms between Turing on one side, and Jefferson and Mays on the other, were manifest; whereas, Turing and Ryle entered an expedient and epistemologically interventionist alliance. Ryle became editor of *Mind*, the venerable philosophical journal, in 1947; and, it was with Ryle, and *Mind*, that Turing published “Computing Machinery and Intelligence” in October 1950.⁷⁴⁹ In 2001, Mays revisited his 1952 riposte to Turing’s 1950 paper, and claimed that Ryle had rejected his 1952 paper for *Mind*, despite inviting it, because Mays had contradicted Turing.⁷⁵⁰

Turing and Ryle’s intellectual affinity was predicated on their shared rejection of Jefferson’s Cartesian vitalism. Turing’s introduction to “Computing Machinery” advertised his alliance at the outset by denying the reification of both ‘machine’, and ‘think’. As arbitrary linguistic categories, their synchronic subjectivity was divorced from the existence, or supposed distinctiveness, of actual phenomenon. Whilst Ryleian philosophy tacitly infused Turing’s categorical unification of mentality and physicality in intelligent behaviour, it became explicit when Turing openly charged Jefferson with solipsism. For Turing, and Ryle, asserting that the inability to directly apprehend the subjective phenomenology of another consciousness affirms the immateriality of mind was a logical fallacy.

Although there was considerable commonality between Turing’s 1950 paper and his unpublished 1948 valedictory NPL report, this philosophical turn was new.⁷⁵¹ Turing’s 1950 paper was a studiously accessible act of public intellectualism: a deliberate intervention in

⁷⁴⁹ A. M. Turing, “Computing Machinery and Intelligence”, *Mind*, Vol. LIX, Iss. 236, Oct. 1950, pp. 433-60.

⁷⁵⁰ W. Mays, “Can Machines Think?” *Philosophy*, Vol. 27, Iss. 101, April 1952, pp. 48-162. W. Mays, “My Reply To Turing: Fiftieth Anniversary”, *Journal of the British Society for Phenomenology*, Vol. 32, No. I, Jan. 2001, pp. 4-23.

⁷⁵¹ A. M. Turing, “Intelligent Machinery”, in Evans, Robertson (eds.), *Cybernetics*, pp. 26-52.

the Cartesian computational conflict by the mind from which the computer had emanated. It propelled Turing, along with his mechanistic commitments and his cyberneticist affinities, onto the BBC. This shy, awkward, slightly stammering man expelled himself from the shelter of academia onto the most public broadcast stage imaginable. Turing was neither biddable, nor desperate for external validation. But, he was driven to unflinching intellectual honesty. His uncomfortable choice signified a deep obligation.

British Cartesian fulminations were further energised with the arrival of Wiener's *The Human Use of Human Beings* in late May 1951. Although largely disregarded and rarely cited by the contemporary cyberneticist initiate, it registered in the popular press far more so than had *Cybernetics*. Notably, it was also considerably more popular with the British mid-century technocratic apostles of computerised automation discussed later in this Chapter, than with cyberneticians. Wiener's second book stridently proclaimed the Second Industrial Revolution that would arise when cyberneticist automata replaced human minds.

In May and June 1951, the BBC broadcast a series of talks on *Automatic Calculating Machines*.⁷⁵² The intentional intersection with the ongoing Cartesian debate was advertised by the titular subjunction of computers as “thinking mechanisms”; and by the casting. Turing was opposed by Hartree, Newman, Williams and Wilkes who collectively espoused the scientific computing orthodoxy. Turing embraced his solitary heterodoxy, and declared himself a lone scientific outlier. The contest between him and Wilkes was particularly ardent. Both supplemented the series' general title with their own interventionist declarations. Turing asked, “Can Computers Think?”, whilst Wilkes asserted “The Use of

⁷⁵² Table 20: BBC Broadcasts.

Automatic Calculating Machines for Scientific Calculation”. Turing’s broadcast rendition of his *Mind* paper denied his listeners the vitalist consolation of essentialist humanism. Minds were machines, and computers could emulate biological mentality in its entirety and without exception. Wilkes’ retort drew an explicit connection between Turing’s heterodoxy and Wiener’s dubious American ideas, and scorned Turing’s romantic conceit of computers someday rivalling humans. Presumably, it would have horrified Wilkes that his broadcast transcript was, like Turing’s, post-hoc annotated as “Cybernetics”.⁷⁵³ In August 1951, Wilkes pressed his ‘common-sense’ case against Turing in a *Spectator* article, forcibly arguing that the apparently wondrous capabilities of computers depended entirely on brilliant human programmers; like him.⁷⁵⁴

Sometime in 1951, Turing made another radio appearance when the BBC broadcast his talk to the Manchester Fifty-One Society; an artifice the BBC fabricated to mimic a nineteenth century civic learned society. Although Turing’s script survives, the broadcast date is unknown. Turing’s Fifty-One Society lecture openly declared his heresy.⁷⁵⁵ More so than in his *Automatic Calculating Machines* talk, here Turing advanced a view of mechanistic cognition wherein computers would so easily and completely outmatch humans that Butler’s Erewhonian fable might materialise. This surfaced the fears that *Cybernetics* had instilled in so many. Although Turing was immune to the Erewhonian’s terror, few in his audience, and fewer still of his colleagues, shared his welcome of inhuman minds. Epistemologically as well as sociologically, Turing and cybernetics both existed in the spaces beyond

⁷⁵³ A. M. Turing, *Automatic Calculating Machines* [3/4]: “Can Computers Think?”, BBC Third Prog., 15 May 1951, 19:30, script, BBC/WAC/GB/898/BBC/R/RPAB/T614. M. Wilkes, *Automatic Calculating Machines* [5/4]: “The Use of Automatic Calculating Machines for Scientific Calculation”, BBC Third Prog., 5 June 1951, 19:05, script, BBC/WAC/GB/898/BBC/R/RPAB/T650.

⁷⁵⁴ M. V. Wilkes, “Can Machines Think?”, *Spectator*, 10 Aug. 1951, pp. 177-8.

⁷⁵⁵ A. M. Turing, “Intelligent Machinery: A Heretical Theory”, typescript, TK/GBR/0272/AMT/B/4 & 20.

orthodoxy. The cyberneticist predicate to his heresy was contemporaneously explicit. In July 1951, the Philosophy of Science Group of the British Society for the History of Science invited him to lecture them on Wiener's dangerous new science.⁷⁵⁶ Even hegemony is permeable.

Turing's final BBC appearance was in a panel discussion with Newman, Jefferson, and the Christian moral philosopher Richard Braithwaite, recorded on 10 January 1952 and broadcast four days later.⁷⁵⁷ Again, it was Turing against the others. Turing was publicly interrogated for his scientific heresy by an eminent religious philosopher, a famous brain surgeon, and a fellow mathematician and world renowned computing expert. The affectedly jocular tone disguised neither the patrician derision, nor the intellectual antipathy, directed at Turing by Braithwaite and Jefferson. However, whilst not sharing Turing's ideas about cognitive computers, Newman nevertheless at least sought to defend his friend. Jefferson claimed the last word; characteristically goading Turing with the mocking reflection that it would be amusing to hear a BBC Fourth Programme broadcast in a mythical future where two computers speculated about why humans thought themselves capable of thought: the last laugh may yet be on Jefferson. The programme was made around the time of Turing's affair with Arnold Murray. Turing's conviction on 31 March 1952 abruptly terminated his public intellectualism. Suicide silenced him prematurely. Yet, albeit fleetingly, Turing had openly championed a cyberneticist counter to the expedient alliance between scientific computing orthodoxy and Cartesian computational dualism.

⁷⁵⁶ Letter, Crombie to Turing, 25 July 1951, NAHC/TUR/ADD/25.

⁷⁵⁷ M. H. Newman, A. M. Turing, G. Jefferson, R. B. Braithwaite, "Can Automatic Calculating Machines Be Said To Think?", BBC Third Prog., 14 Jan. 1952, 21:35, script, BBC/WAC/GB/898/BBC/R/RPAB/T54.

In December 1956, the Third Programme staged yet another open clash between cybernetics and Cartesian dualism. First, Wolfe Mays, a known Turing antagonist, presented his phenomenological speculations on “Machine Process and Thought Process”.⁷⁵⁸ Then, Colin Cherry offered some information theoretic reflections “On the Present State of Brain Models”.⁷⁵⁹ Finally, in an open advocacy of cybernetics, Frank George discussed “Machines and Human Behaviour”.⁷⁶⁰ George had announced his epistemological allegiances in July with a paper defending cybernetics against Mays’ 1952 rebuttal of Turing’s intelligent machines. Notably, George had perceived the cyberneticist character of Turing’s thinking.⁷⁶¹ Equally notably, the *Listener* described Mays’ December 1956 talk as the first in a series about cybernetics.⁷⁶² Mays’ talk recounted that whilst attending the recent international cybernetics conference in Namur he had received a badge depicting a goose-stepping robot. Whilst unmistakably a cybernetician’s in-joke, for Mays there was more at stake than *cognoscenti* humour or Cartesian philosophy. For him, and many listeners, mechanist mental materialism portended brutalising robotization: cybernetics marched with fascism. Wiener’s ideas were not philosophical whimsies or scientific playthings, they were dangerous and dehumanising.

Amongst the Ratio Club, only Turing publicly avowed this mechanistic cyberneticist sacrilege in open defiance of Jefferson’s secular yet spiritual vitalism. He was also a lonely heretic in his opposition to the reductionist scientific computing normativity championed by

⁷⁵⁸ W. Mays, “Machine Process and Thought Process [1/3]”, BBC Third Prog., 5 Dec. 1956, 20:00.

⁷⁵⁹ C. Cherry, “On the Present State of Brain Models [2/3]”, BBC Third Prog., 10 Dec. 1956, 21:05.

⁷⁶⁰ F. H. George, “Machines and Human Behaviour [3/3]”, BBC Third Prog., 21 Dec. 1956, 19:00.

⁷⁶¹ F. H. George, “Could Machines Be Made to Think?”, *Philosophy*, Vol. 31, Iss. 118, July 1956, pp. 244-52.

⁷⁶² W. Mays, “Minds and Machines: W. Mays Gives the First of Three Talks on the Science of Cybernetics”, *Listener*, Vol. 56, No. 1448, 27 Dec. 1956, pp. 1065.

Jefferson's allies; Wilkes, Kilburn and Williams. Walter's flamboyant BBC voice studiously celebrated the uniquely wondrous complexity of living brains: mechanical analogues furnished simplifying scientific abstractions, but mere machines could never equivalence biology. Even before Turing's broadcasts, Walter had already cursed Frankenstein's fate on those tempted by hubris to Promethean sin.⁷⁶³ Ashby remained silent. Conspicuously, MacKay also avoided direct involvement in the Cartesian computational controversy, and publicly he neither opposed nor supported Turing's ideas. MacKay's BBC ventures remained public attempts to reconcile his personal scientific commitments to a cyberneticist materiality of mind, with his theological compulsions to a divine soul and free-will.⁷⁶⁴ With Gregory's blessing, MacKay used the BBC as a pulpit for evangelism, not exorcism. Nevertheless, his material mind proved God's intelligent design and this, in turn, proved that human made machines could never better Creation because humans were not God and only His spirit was divine.⁷⁶⁵ Even amongst cyberneticians Turing was an outlier.

The Spectre of Automation

Wiener was so concerned about the prospect of the misuse of his ideas, that he considered withholding them from publication. Fearing that *Cybernetics* might spawn computer controlled automatic factories that would devastate and decimate their human workforce, Wiener wrote to Walter Reuther, President of the United Automobile Workers, to warn him of the impending catastrophe and offer him assistance in averting it.⁷⁶⁶ In *The Human Use*

⁷⁶³ W. G. Walter, *Science Survey*: "Brains: Electronic and Human", BBC Home Svc., 4 May 1950, 22:30, script, BBC/WAC/GB/898/BBC/R/RPAB/T464.

⁷⁶⁴ Table 20: BBC Broadcasts.

⁷⁶⁵ D. M. MacKay, "Mindlike Behaviour in Artefacts", *Brit. J. Philosophy of Science*, Vol. 2, No. 6, Aug. 1951, pp. 105-21. D. M. MacKay, "On Comparing The Brain With Machines", *American Scientist*, Vol. 42, No. 2, April 1954, pp. 261-68.

⁷⁶⁶ Letter, Wiener to Reuther, 13 Aug. 1949, www.libcom.org/history/father-cybernetics-norbert-wieners-letter-uaw-president-walter-reuther, [11 Oct. 2022].

of *Human Beings*, a direct continuation of *Cybernetics*, Wiener announced this warning to the world at large. For Wiener, society, like its constituent sub-systems, was a machine that was both constituted and controlled by information and communication. Within this societal machine, humans and electronic computers were systemically fungible and informationally isomorphic. Thus, whoever controlled the production and communication of information controlled society as a whole, along with its electronic and biological information processing sub-parts. Wiener's second cybernetics book exhorted humans to use his ideas responsibly.

Wiener foresaw a Second Industrial Revolution where cyberneticist fabrications replaced brains, nerves and sense organs; just as steam engines had once replaced muscles and bones.⁷⁶⁷ He imagined a new age of cognitive and perceptual automation where cybernetic factories were entirely devoid of humans and free of their fallibility and frailty. Yet, he was profoundly ambivalent about automation's civilizational consequences. Cybernetics would render human brains economically redundant. Used responsibly, it promised a golden age of liberation from drudgery and deprivation. However, used recklessly, cybernetics would precipitate mass unemployment on a scale which would eclipse that of the Great Depression. Therefore, in Wiener's view, scientists, politicians and industrialists were jointly responsible for averting calamitous dehumanisation and societal collapse. Walter agreed; telling the Bristol Round Tablers in September 1949 that cybernetics was the only credible alternative to Marxism, and the only truly scientific way to preserve civilisation.⁷⁶⁸

⁷⁶⁷ N. Wiener, "The First and Second Industrial Revolution", Chapter IX, *Human Use*, 2nd edn., pp. 136-62.

⁷⁶⁸ "Alternative to Marxism", *Western Daily Press*, 28 Sept. 1949, p. 6.

In April 1949, Walter told Wiener that he had attempted to alert Clement Attlee, the Labour Prime Minister and Shipton's father-in-law, to the impending cyberneticist transformation.⁷⁶⁹ However, foreshadowing the rebuttal that *Cybernetics* was to receive across the British state, both Attlee and his advisors reportedly considered cybernetics to be more akin to ideology than to science, and summarily dismissed it. The FBI agreed with the ideological interpretation of cybernetics, at least insofar as Wiener's behaviour was concerned. Following his incendiary 1947 letter to the *Atlantic* abjuring military research, they investigated him as a potential communist.⁷⁷⁰ During his January 1951 visit to Britain, Wiener was surveilled by MI5; at the express request of the US Embassy.⁷⁷¹ Later that year, days before the *Automatic Calculating Machines* talks, Wiener prophesied "The New Industrial Revolution" to the same BBC audience that would shortly hear Turing's cyberneticist heresy.⁷⁷²

Initially, Wiener's warnings went unheeded. Then, in the mid-fifties, British concerns about automation surfaced rapidly in a dramatic moral panic about 'push-button society' that was broadly contoured around four themes. First, there was a pragmatic positivism where automation predicated national strength and international competitiveness. Next, there was a futurist utopianism where automation set the arrow of deterministic progress on a new arc. Then, a capitalist dystopia where machines utterly alienated labour. Finally, the spectre of the de-humanised Erewhonian nightmare where machines enslaved humans. Thematic inhabitation was ideologically and sociologically predictable. Thus, in 1956, Michael

⁷⁶⁹ Letter, Walter to Wiener, 21 April 1949, MIT/NWP/Box 6, Fldr. 96, <https://hdl.handle.net/1721.3/200273>, [6 Jan. 2024].

⁷⁷⁰ N. Wiener, "A Scientist Rebels", *Atlantic*, Jan. 1947, p. 46.

⁷⁷¹ Conway, Siegelman, *Dark Hero*, pp. 261-62.

⁷⁷² N. Wiener, "The New Industrial Revolution", BBC Third Prog., 30 April 1951, 20:05, script, BBC/WAC/GB/898/BBC/R/RPAB/T649.

Kidron demanded Marxist resistance to automation, unless it was introduced under worker's control.⁷⁷³ And, in April that year, communist agitators were duly blamed for subverting the Amalgamated Engineering Union into its militant opposition to rational efficiency.⁷⁷⁴ Also that month, the Standard Motor Company saw the first major British strike against redundancies threatened by automation.⁷⁷⁵ By May, the Conservative government was reportedly poised to flood workplaces with a pamphlet propagandising the "Mechanical Man Friday" to counter irresponsible communist fearmongering.⁷⁷⁶ Apparently, Eden himself stood ready to scold Khrushchev personally.⁷⁷⁷ Unlike America, Britain's response to automation was shaped by both declinist anxieties, and apprehensions about the precarity of post-war prosperity.

The mid-fifties eruption of British industrial and political anxieties about automation coincided with an upsurge in wider concerns about its social and human consequences. As with cybernetics and computers, the BBC was a major site for the staging of the automation anxiety discourse. However, here the BBC agitated, rather than reflected, public sentiment and its editorial tone favoured the technocratic modernisers over the anti-mechanist naysayers. Its coverage stressed automation's generally positive implications for politicians, industrialists, trade unionists, factory and office workers, schoolchildren, and even gardeners.⁷⁷⁸ Two pro-automation series broadcast in 1955 spawned popular books the following year. In one, Robert Macmillan, a young Cambridge engineering lecturer,

⁷⁷³ M. Kidron, *Automation: The Socialist Answer*, (London, 1956).

⁷⁷⁴ "Fishing In Troubled Waters: Communist Victory at Eastbourne", *Automation Age*, Vol. 1, No. 10, June 1956, p. 7.

⁷⁷⁵ "Trouble At Coventry", *Automation Age*, Vol. 1, No. 10, June 1956, p. 3.

⁷⁷⁶ G. Wakeford, "The Robot: Factories To Get The Truth", *Mail*, 30 May 1956, p. 1.

⁷⁷⁷ "Fighting the Communists", *Automation Age*, Vol. 1, No. 11, July 1956, p. 1.

⁷⁷⁸ Table 20: BBC Broadcasts.

published his talks on “Automatic Control” as *Automation Friend or Foe?*.⁷⁷⁹ In the other, Magnus Pyke, then a young industrial chemist, reworked his *Science Review* talks as *Automation: Its Purpose and Future*.⁷⁸⁰ Notably Macmillan thanked his BBC producer; Archie Clow.⁷⁸¹ Again, Penguin and the BBC were in zeitgeist lockstep. In 1957 Penguin published *Man and Automation* by Leonard Goodman, an engineer and early automation expert, as a Pelican.⁷⁸² These young technocrats unhesitatingly embraced automation’s necessary transformation. Although they were aware of its potential harms, for them automation was disinterested progress; resistance was irresponsibly futile.

This positivist techno-optimism was not universal. In 1955, Philip Cleator published *The Robot Era*, and Rolf Strehl’s *The Robots Are Among Us* was translated from German.⁷⁸³ Both foretold a near future dystopia where electronic computers, automatic factories, push-button war, and technologized mass communication alienated, corrupted and enslaved humanity. Strehl’s sensationalist chapters predicted “The Invasion of the Brain Machines”, “The Dictatorship of the Automaton”, and “The Civilization of the Electronic Brain”. In Strehl’s technological tyranny, assuming that humanity escaped obliteration by thinking machines, it would be shackled by robots and cowed by computerised mind control. Strehl cited both Wiener’s forecast that the third world war would precipitate full automation to release humans for slaughter, and Omond Solandt’s prediction that future war would be waged entirely by robots.⁷⁸⁴ Solandt had established the MRC research group where Bates

⁷⁷⁹ R. H. Macmillan, *Automation Friend or Foe?*, (CUP, Cambridge, 1956).

⁷⁸⁰ M. Pyke, *Automation: Its Purpose and Future*, (Hutchinson’s, London, 1956).

⁷⁸¹ Macmillan, *Automation*, p. 5.

⁷⁸² L. L. Goodman, *Man and Automation*, (Penguin/Pelican, London, 1957).

⁷⁸³ P. E. Cleator, *The Robot Era*, (Allen & Unwin, London, 1955). R. Strehl, H. Scott (trans.), *The Robots Are Among Us*, (Arco, London, 1955).

⁷⁸⁴ Strehl, *Robots*, pp 25-65, 178-225, 245-92, 292-93.

spent the war, and he and Porter became friends in Canada where Solandt led the Defence Research Board.⁷⁸⁵ Cleator was less melodramatic, but equally stark. Once computerised automation had entirely replaced meat brains, robots would systematically eradicate vestigial humanity. Emotionless and eternal machine minds would methodically shut breeding plants, and sterilise any residual humans.⁷⁸⁶ Orthodox scientific intellects would have rejoiced that Cleator, a science fiction author, invoked Turing to validate the absurdity of thinking computers.

Within successive and imbricated discursive and socio-technical encounters across the second half of the first full decade after the war, cybernetics, roboticization, automation and annihilation were increasingly tightly interwoven. And, in these narratives, for opponents and supporters alike, *Cybernetics* furnished a scientific basis for both industrial automation, and the mechanisation of humans within sociological machines. For automation's opponents, when it was framed within popular post-war British anti-Americanism, *Cybernetics* was an easy target for the transference of socio-technical and declinist anxieties. To contemporary minds, *Cybernetics* was as American as its author; a point habitually made when Britons wrote about either of them. And, if across the ideological and sociological spectrum, some British eyes saw in *Cybernetics* the positivist objectification of the toxic reality beneath the chrome of the American dream; they were not alone. Kurt Vonnegut's 1952 debut novel, *Player Piano*, depicted an explicitly cyberneticist American dystopia of corporatist automation. It appeared in Britain in 1953, to favourable reviews.⁷⁸⁷ Vonnegut's

⁷⁸⁵ Porter, *Hills*, p. 159.

⁷⁸⁶ Cleator, *Robot*, pp 156-7, 153.

⁷⁸⁷ K. Vonnegut, *Player Piano*, (Scribner, New York, 1952), (Macmillan, London, 1953). "New Fiction: Fantasy and Foibles", *Times*, 14 March 1953, p. 9. A. L. Duggan, A. Duggan, "Fiction: The Writing on the Wall", *TLS*, 3 April 1953, p. 217.

book named Wiener as the creator of the science of dystopia and the architect of this catastrophic Second Industrial revolution where machines replaced minds.⁷⁸⁸ Even a fellow American foresaw the danger portended in *Cybernetics*. Usurpingly, Wiener took umbrage and wrote a thunderous letter to Vonnegut's publisher.⁷⁸⁹

The British discursive tumescence about automation summonsed *Automation Age*; a monthly news digest and opinion periodical, published from 1955 to 1961.⁷⁹⁰ The masthead declared its putative readership to be both women and men, as workers and executives, in both offices and factories. Its editorial aims were to calm emotions, and promote automation as a rational global civilisational necessity, and a predicate of British prosperity. It assured readers of both its political neutrality, and its freedom from vested interests; automation was as positivist as the science sustaining it.⁷⁹¹ The inaugural edition reported on the first British automation conference, staged by the Institution of Production Engineers at Margate that June.⁷⁹² Conspicuously, in his presidential address, Sir Walter Puckey explicitly thanked Wiener and Walter for the new science that had enabled the prospect of machines replacing humans as controllers of economic production. That edition also welcomed the new NPL CME Division as evidence that government was taking automation seriously.⁷⁹³ The second edition covered Wiener's Fawley Foundation Lecture at Southampton University on 2 June 1955; anointing Wiener, and cybernetics, as automation's own.⁷⁹⁴ In May 1956, *Automation*

⁷⁸⁸ K. Vonnegut, *Player Piano*, (Panther, St Albans, 1973), p. 19.

⁷⁸⁹ Conway, Siegelman, *Dark Hero*, pp. 287-8.

⁷⁹⁰ As *Automation and Equipment News* from 1956.

⁷⁹¹ *Automation Age*, Vol. 1, No. 1, Aug. 1955, p. 1.

⁷⁹² "This was the Conference that Caused the Fuss: 1984 at Margate", *Automation Age*, Vol. 1, No. 1, Aug. 1955, p. 3.

⁷⁹³ "Question Asked In The House", *Automation Age*, Vol. 1, No. 1, Aug. 1955, p. 1.

⁷⁹⁴ "Time and Organisation", *Automation Age*, Vol. 1, No. 2, Sept. & Oct. 1955, p. 4. N. Wiener, *Time and Organisation: 2nd Fawley Lecture, University of Southampton, 2nd June 1955*, (University of Southampton, 1955).

News advertised the First International Cybernetics Congress in Namur.⁷⁹⁵ For good or ill, cybernetics and automation were inseparably interlaced in the British public discourse about the socio-technic near future.

For those opposed to machine minds controlling machines, the cyberneticist technologies of automation also suggested an easy exercise of despotism over biological human minds. Fascism had already disastrously roboticized weapons and humans with old science and the conventional mechanisms of mass communication. Now, the novel roboticizations of cybernetics and automation threatened worse to come. If Wiener and Turing were right, and computers and minds worked alike, then each could programme, and direct, the other. Freedom would perish when computers controlled biological minds just as they would themselves, or any another machine. Speaking at the Margate conference, Puckey mockingly dismissed the fictive terrors of *Erewhon*, *1984*, and *R.U.R.* as he sought to dispel pervasive contemporary fears about automation, and its cyberneticist foundations. His attempted exorcism of Orwell was timely. A recent BBC TV dramatization had generated national controversy and stirred Parliamentary questions.⁷⁹⁶ However, associating cybernetics with techno-dystopia to promote automation was unwise. Orwell had taught Britain to fear a state wielding the technologized control of information and communication to monitor and manipulate thought. Cyberneticist automation threatened to materialise Orwellian fear into reality.

⁷⁹⁵ "International Congress On Cybernetics, Namur", *Automation Age*, Vol. 1, No. 9, May 1956, p. 10.

⁷⁹⁶ *Nineteen Eighty-Four*, BBC TV, 12 Dec. 1954, 20:30. "Political Notes: Controversy Over "1984"", *Times*, 15 Dec. 1954, p. 5.

Recognition of the constitutive intersectionality between cybernetics and automation was not confined to *Automation Age* or *Player Piano*. Pyke and Macmillan both recognised their dependence on Wiener.⁷⁹⁷ Notably, Macmillan recommended three popular cyberneticist books: Sluckin's *Minds and Machines*, Walter's *The Living Brain*, and Tustin's *The Mechanism of Economic Systems*.⁷⁹⁸ Less happily for British cyberneticians, Strehl implicated Wiener, Walter, and cybernetics generally, in his socio-technical catastrophism. His Chapter on "The Civilisation of the Electronic Brain" spoke of "The Age of Cybernetics", and "The Artificial Tortoise" as dire portents of automated perils to come.⁷⁹⁹ In the Cartesian computational controversy, cybernetics had stood accused of a dehumanising denial of a vitalist mind. Now, in the freighted public discourse about automation, cybernetics was implicated in a portended civilizational collapse. Far from curing the societal madness of war with scientific rationality, for many Britons cybernetics now spoke of new insanities of mind machines and subjugation.

By 1956, these agitations about the perils and promises of a push-button society had prompted Frank George to take to the pages of *John Bull*, a richly illustrated popular weekly which chronicled the emerging contours of post-war British society alongside short stories by the likes of H. E. Bates, Agatha Christie and J. B. Priestley. Although George led with Walter's famous tortoises, and an anecdote signifying his friendship with their equally famous creator, the burden of his depiction of the 'march of the robots' was cybernetics and

⁷⁹⁷ Pyke, *Automation*, p. 16. Macmillan, *Automation*, p. 80, 94.

⁷⁹⁸ W. Sluckin, *Minds and Machines*, (Pelican, London, 1954). W. G. Walter, *The Living Brain*, (Duckworth, London, 1953). A. Tustin, *The Mechanism of Economic Systems: An Approach to The Problem of Economic Stabilisation From the Point of View of Control-System Engineering*, (Heinemann, London, 1953).

⁷⁹⁹ Strehl, *Robots*; "The Civilization of the Electronic Brain", pp. 245-91; "The Age of Cybernetics", pp. 250-53; "The Artificial Tortoise", pp. 268-72.

automation.⁸⁰⁰ George explained that Walter's tortoises were simply experimental forerunners of vastly more complex electronic machines which would reproduce, and surpass, the entire spectrum of human capabilities; including the mind. Whilst recognising Shannon and Turing as important pre-war primogenitors of the theory that had enabled the creation of these machine-brains, George also granted Wiener primacy in the discoveries behind their predicted instrumentation as electronic imitations of humans. In George's estimation, Wiener's war-work on computationally predictive automated anti-aircraft fire had laid the foundations upon which the cyberneticist future was now being built.

Citing von Neumann, and noting his association with Wiener, George explained that these new robots could easily be imbued with the capacity for self-reproduction. He also stated that whereas conventional machines were limited to enacting the instructions that instrumented and expanded the agency of humans, these new robots could, through negative feedback, act autonomously. Such machines could self-regulate, self-adapt, self-instruct, learn and remember. Deepening the biological analogy, George likened the instructions scripted into von Neumann's self-replicating automata to genetic coding, and compared electronic computer circuitry to the nervous system. And, alluding to contemporaneous research into artificial neural networks, George predicted the existence of indeterminate computers that would both replicate human neuro-plasticity, and possess the stochastic systemic predicate for emergent behaviour. Within the decade, he predicted, robots would drive trains, mine coal and mend roads. He stridently warned against the dire consequences of a failure to grasp the imperative of automation; noting the recent Russian formation of a Soviet Ministry of Automation. However, he also raised the spectre of an automated war

⁸⁰⁰ F. H. George, "Robots on the March", *John Bull*, 5 March 1956, pp. 25-7, 54.

waged by self-replicating robots, and he called for international statutory regulation of this powerful yet potentially destructive new science. Remarkably, not once did he mention ‘cybernetics’.

However, in 1959, George returned to automation with a book which, from the title on, made the connections to cybernetics explicit. The contents list alone of *Automation, Cybernetics and Society* displayed George’s counter-Cartesian materialism, the epistemological anatomy of his narrative construction, and his grasp of the intellectual history of his subject.⁸⁰¹ Part Two dealt with “Cybernetics and Automation” and contained chapters on “Servo-Systems”, “The Philosophical Problem of the Machine”, “Organisms, Models, and Feedback”, and “Programming a Computer to Learn”.⁸⁰² Part Three discussed “Operational Research and Automation”, with chapters on “Methods of the Psychologist in the Age of Automation”, “Social Control and Communication”, and “Operational Research and Scientific Method”.⁸⁰³ Automation was, for George, “applied cybernetics”, and although he recognised that this brought the potential for earthly damnation; nevertheless, its successful application was necessary for the survival of humanity.⁸⁰⁴ In George’s view, cybernetics was a uniquely integrative science which promised to unlock the biological and social secrets of the human condition.⁸⁰⁵ With its responsible use, society could plan its progress to a leisured rationalist utopia of material plenty. However, the abuse of cybernetics to exercise malicious control over minds, machines and societies was not the only obstacle to realising a planned and

⁸⁰¹ F. H. George, *Automation, Cybernetics and Society*, (Leonard Hill, London, 1959).

⁸⁰² George, *Automation*, pp. 45-206, 115-31, 166-72, 173-91, 192-206.

⁸⁰³ *ibid.*, pp. 207-80, 221-36, 237-47, 248-354.

⁸⁰⁴ *ibid.*, pp. 1-2.

⁸⁰⁵ *ibid.*, p. 2.

prosperous peace.⁸⁰⁶ Automation was also opposed by irrational and primitive conservatism. This, George lamented, was especially so in Britain, where inertia was anchored to ancient glory; and, where his book was soundly ignored.⁸⁰⁷

Whilst the early post-war assertion of electronic mind-brains had jeopardised the vitalist exceptionalism of an essentialist and insubstantial mind upon which humanism was predicated; it had not presaged humanity's destruction. However, computerised automation concretised humanist anxieties in economic actuality; extending cybernetics' threat from abstract phenomenological subversion to material civilizational collapse. For those guarding the epistemic borders of British scientific respectability and scientific computing orthodoxy, this was further cause to spurn the brash American upstart. Likewise, it stiffened the resolve of the creatures of Whitehall and Westminster to resist automation. As an intellectual frivolity peddling the absurdity of cognitive computers, *Cybernetics* was governmentally inconsequential. However, whilst prophecies of civilisational collapse prompted patrician condescension, and although public politics required rhetorical advocacy of technological productivity, the socio-economic reality of computerised automation imperilled the New Jerusalem's shibboleth of full employment; and that was unacceptable. Technocratic proselytizers confronted purported irrationality and emotion with logic and calculation, but conservatism and the social contract prevailed.

Automation, and cybernetics along with it, failed to gain significant socio-economic traction in fifties Britain. Whilst the young technocrats divined its Sibylline auguries; the inhabitants of shop-floors, boardrooms, and Westminster's labyrinthine corridors all closed their minds

⁸⁰⁶ *ibid.*, p.1.

⁸⁰⁷ *ibid.*, p. 13.

to its Siren song. As military officers, many captains of post-war industry had, like Air Marshall Harris, endured the tyranny of the slide rule. Now, they enacted Churchill's other dictum that "scientists should be on tap, but not on top" and they returned these upstarts to their rightful subordination.⁸⁰⁸ Managerial conservatism, entrenched authority, and defence of the labour intensive practices of the full employment that sustained the post-war consensus, triumphed. By the end of the fifties, the only British industrial cybernetics formation was Beer's creation at United Steel. Which also doubled as one of the largest of a small number of British industrial OR formations; and, which was second in size in this regard to only the National Coal Board's group.⁸⁰⁹ In 1957, the British and American OR societies jointly convened an international OR conference in Oxford, which was also supported by the Institute of Management Sciences. The delegates received a report on the condition of British OR; written by a member of Beer's United Steel team. Despite valiant endeavours to highlight success, the picture was one of tenuous and fragile activity that was largely confined to small enclaves by organisational antipathy to expert management. The report itself acknowledged that many OR practitioners did not confess their affiliation professionally.⁸¹⁰ Neither cybernetics nor automation could prosper where OR faltered.

Overall, the denizens of Whitehall shared this conservative antipathy towards technocratic managerialism and computerised automation, and resisted the advances of both within the machinery of government itself. Beyond the narrow enclaves of the Home Office's Establishment and Organisation Division, and the Treasury's Organisation and Methods

⁸⁰⁸ R. S. Churchill, *Twenty-One Years*, (Weidenfeld & Nicolson, London, 1965), p. 127.

⁸⁰⁹ R. S. Gander, "The State of Operational Research in the United Kingdom", in M. Davies, R. T. Eddison, T. Page (eds.), *Proceedings of the First International Conference on Operational Research (Oxford 1957)*, (English Universities Press, London, 1957), p. 509.

⁸¹⁰ *ibid.*, p. 500.

Division, both of which sent small delegations to the 1958 NPL symposium, OR withered in the post-war state. However, vestiges of proto-cybernetics and OR persisted, especially in military research. The Dowding System became the conceptual and architectural core of Cold War command and control doctrine and practice. The developmental trajectories of sensorily enabled, computer controlled and servomechanically equipped automated fire systems, and those of self-guided ordnance, were extrapolated. Computers were invisibly embraced by government cryptologists and nuclear scientists. And, more openly by avionics engineers who also used automation to augment human control of new supersonic aircraft.

Notably, Woodward and Uttley also paved the way for the post-war use of computers in military research in a series of in-house TRE lectures which they delivered in 1947.⁸¹¹ Yet, it was the existential imperatives of the Cold War, not the enthusiasms of expert individuals or groups, that spurred the early use of computers within the secret state, and which gifted proto-cybernetics and OR their military half-life. Neither was the residual military practice of OR long-lived. In 1964, the control of military OR was centralised under the Army Operational Research Establishment which then morphed into the Defence Operational Research Establishment in 1965.⁸¹² Thereinafter, British military OR atrophied.

In 1957, Elliott Brothers, an electronics and instruments firm, and an early British computer builder, morphed into Elliott Automation in an optimistic anticipation of a booming market for cyberneticist computerised automation. In 1964, Sir Leon Bagrit, Managing Director of

⁸¹¹ Dr. A. Uttley, Mr. P. W. Woodward, “T.R.E. Physics Department Lecture Series: Electronic Digital Computers”, NAHC/MISC/BOX 1/D.3).

⁸¹² G. N. Gadsby, “The Army Operational Research Establishment, *OR*, Vol. 16, No. 1, March 1965, p. 13. National Archives, “Catalogue Description: Records of Research Establishments”, <https://discovery.nationalarchives.gov.uk/details/r/C539>, [25 April 2023].

Elliott Automation, delivered the Reith Lectures on the *Age of Automation*; but, as a plea, not as a celebration.⁸¹³ Unless British industry overcame its irrational resistance to cybernetics and automation, Bagrit lamented, national impoverishment and global Malthusian crisis loomed. In 1967 Elliott Brothers was absorbed by English Electric. In 1968 both companies vanished within International Computers Ltd; itself formed through the multiple forced mergers of several other failing companies compelled by Harold Wilson's technological white heat initiative.

International Feedback Loops

British cybernetics was never exclusively British. American cyberneticians visited Britain, and attended the seven British gatherings; and British cyberneticians reciprocated.⁸¹⁴ British and American delegates attended European conferences, and European delegates joined British events.⁸¹⁵ The small international community of cyberneticians and fellow travellers was tightly bound around the shared sense of their belonging to an intellectual elect. Many British cyberneticians endured the isolation of transgression to pursue their new truth. And even American cyberneticians could cast the daunting aura of a scientific cabal possessing great, yet secret, revealed wisdom.

British, American and European scholarly and technical gatherings were relatively safe havens for nurturing national and international cyberneticist sociologies, and they functioned as quasi-institutional sites for the construction of cybernetic knowledge; even if only tacitly and marginally in Britain. Cloistered within shared esotericism, deep affinities were easily

⁸¹³ Leon Bagrit, *The Age of Automation: The BBC Reith Lectures 1964*, (Weidenfeld, London, 1965).

⁸¹⁴ Table 17: International Delegates at British Events.

⁸¹⁵ Table 17: International Delegates at British Events. Table 18: British Delegates at Namur: 1956, 1958 and 1961. Table 19: British Delegates at Paris, 1951.

formed amongst the chosen. Hence, McCulloch's prodigious friendships; notably with Beer, Ashby, Walter and MacKay. And, hence also, Beer's deep friendships with Ashby, Pask and Walter. The affinities of cybernetics even reconciled McCulloch's infamously freewheeling Bacchic proclivities to both MacKay's staunch Presbyterianism, and Ashby's notoriously punctilious personality.

British and American cybernetics were foundationally interactive. Wiener and Walter met in Boston in 1946, and Wiener's two 1947 British sojourns fertilised *Cybernetics*. Westcott met Wiener in 1948 (or 1949), read *Cybernetics* in draft, and visited McCulloch. McLardy worked with McCulloch in 1950, and attended Macy seven; the last of the series graced by Wiener. MacKay joined Macy eight in 1951, whilst he was researching under McCulloch on a Rockefeller scholarship at Illinois University's medical college. This work produced a joint paper, whereon McCulloch graciously ceded MacKay lead authorship.⁸¹⁶ Ashby and Young attended Macy nine in 1952, and Walter witnessed the end of the seminal cybernetics conferences in 1953, when McCulloch name checked MacKay, Sholl and Uttley.⁸¹⁷ However, McCulloch's attempt, via MacKay, to persuade Turing to attend failed; ostensibly, because of anti-Americanism. As Turing wrote to MacKay, although the conferences sounded good, nevertheless, he loathed America.⁸¹⁸ Whilst this may have been a superficial excuse on Turing's part, nonetheless, it derived its legitimacy and efficacy alike from the ambient sense of post-war British anti-Americanism.

⁸¹⁶ D. M. MacKay & W. S. McCulloch, "The Limiting Information Capacity of a Neuronal Link", *Bull. Mathematical Biophysics*, Vol. 14, June 1952, pp. 127-35

⁸¹⁷ W. S. McCulloch, "Introductory Remarks", in H. von Foerster, M. Mead, H. L. Teuber (eds.), *Cybernetics: Circular Causal and Feedback Mechanisms in Biological and Social Systems: Transactions of the Tenth Conference, April 22, 23, and 24, 1953, Princeton N. J.*, in Pias, *Cybernetics*, p. 688.

⁸¹⁸ Letter, MacKay to Turing, 3 Feb. 1953. Letter, Turing to MacKay, 20 Feb. 1953, NAHC/TUR/ADD/1107.

Variously, the British Macy guests met: Claude Shannon, the pioneer of information theory; J. C. R. Licklider, a progenitor of the Internet; John von Neumann, the architect of classical computational processing; and, Margaret Mead and Gregory Bateson, pioneers of second order cybernetics. However, the Macy conferences were more receptive to the Ratio Club than vice versa. McCulloch was the only Macy participant to address the Ratio Club, and the only other Macy guest was Licklider at the Ratio Club meeting in the margins of the 1955 London information theory symposium. Although the Ratio Club was uniquely imbricated with the generative American nucleus of cybernetics, its self-limiting constitutional insularity prevented it from exploiting this privileged access.

From 1948 onwards, the intersectionality of British and American cybernetics pivoted around McCulloch who, as chair, controlled invitations to the Macy conferences. However, McCulloch broke through the Ratio Club's insularity more through personality than bureaucracy. He was a generous, gregarious, and charmingly ubiquitous figure who roamed freely across international cybernetics.⁸¹⁹ After inaugurating the Ratio Club, McCulloch attended meeting thirty-one on 2 July 1953; and, poignantly, he joined the Ratio Club's terminal meeting in 1958. McCulloch later reported to Beer that, at their swansong, the Ratio Club members had praised Beer's paper at the NPL symposium.⁸²⁰

Conversely, Wiener was entirely absent from the Ratio Club. However, this was neither through his ignorance nor, in this instance, their insularity. Bates first invited Wiener in November 1949, when he used Walter's name, and compared his new dining club to the

⁸¹⁹ P. Husbands, O. Holland, "Warren McCulloch and the British Cyberneticians", *Interdisciplinary Science Reviews*, Vol. 37, No. 3, Sept. 2012, pp. 237-53.

⁸²⁰ Letter, McCulloch to Beer, 30 Jan. 1959, UIA/WM, Box 3, www.digital.library.illinois.edu/items/8a40d1b0-29aa-0136-4d81-0050569601ca-9, [14 Oct. 2022].

Macy events.⁸²¹ Wiener declined, pleading cancellation of the trip he had already announced to Walter.⁸²² In December 1950, Walter again encouraged Bates to entice Wiener, this time by exploiting the Paris cybernetics conference the following year.⁸²³ Again, Bates stressed informality.⁸²⁴ Although he blessed the Ratio Club in his reply, Wiener again declined.⁸²⁵ In June 1951, Bates made his final pitch.⁸²⁶ Once again, Wiener declined.⁸²⁷ Perhaps, for Wiener, the Ratio Club was tainted by association. Wiener and McCulloch had first argued in 1947. Although they were partially reconciled, neither their friendship nor their professional relationship ever fully recovered. Then, there was an explosive personal rift in 1951 which extinguished any residual hope of rapprochement.⁸²⁸

Whilst the Macy conferences did not exhaust the totality of the British attendances at American events relating to cybernetics or computing, neither were these wider delegations extensive. Only Hartree and Wilkes joined the 1946 lectures on electronic digital computers at Pennsylvania University's Moore School. Turing alone attended the 1947 Harvard computer symposium, and William Elliott from Elliott Brothers' Borehamwood laboratories was a solitary British presence at the second Harvard symposium in 1949. However, there was a larger British presence at the 1959 MIT sensory communication symposium; which comprised, Cherry, MacKay, Rushton and Barlow. Nevertheless, although the British presence was limited, these American events were significant channels for knowledge

⁸²¹ Letter, Bates to Wiener, 18 Nov. 1949, WC/GC/179/B.03/Box 12.

⁸²² Letter, Wiener to Bates, 13 Dec. 1949, WC/GC/179/B.04/Box 12.

⁸²³ Letter, Walter to Bates, 21 June 1950, WC/GC/179/B.07/Box 12.

⁸²⁴ Letter, Bates to Wiener, 25 Jan. 1951, WC/GC/179/B.08/Box 12.

⁸²⁵ Letter, Wiener to Bates, 31 Jan. 1951, WC/GC/179/B.08/Box 12.

⁸²⁶ Letter, Bates to Wiener, 14 June 1951, WC/GC/179/B.10/Box 12.

⁸²⁷ Letter, Wiener to Bates, 4 July 1951, WC/GC/179/B.10/Box 12.

⁸²⁸ Conway, Siegelman, *Dark Hero*, pp. 195-212, 213-34.

transfer. ENIAC designer John Mauchly attended the 1947 conference with Turing; and Presper Eckert, another ENIAC architect, attended the 1949 event with Elliott. The British delegation to the 1959 MIT event encountered Licklider. Although slightly beyond the chronology of this thesis, the 1961 Illinois University Principles of Self Organisation symposium furnished an especially noteworthy convergence of Ashby, Beer, Pask, Ludwig von Bertalanffy (a founder of general systems theory), and Friedrich Hayek (whose *Road to Serfdom* famously inspired the then Oxford undergraduate Margaret Thatcher in 1944).⁸²⁹

Delegations from the richer America to the seven British events were more extensive; especially to the three London information theory symposia and the 1958 NPL Mechanisation of Thought event.⁸³⁰ Overall, across these transatlantic events, the founders and pioneers of computing, information theory and cybernetics mixed and moved freely. And, it was this small anglophone community that laid the deep epistemological foundations for the systemic architectures of the Information Age; including the Internet and AI.

In 1956 Ashby, MacKay and Uttley contributed essays to *Automata Studies*, a collection edited by Shannon and, the then unknown, American mathematician John McCarthy.⁸³¹ Turing was invited to contribute but declined; explaining that he had relinquished cybernetics to focus on morphogenesis.⁸³² Ashby accepted, but refused permission for a peer

⁸²⁹ F. H. Hayek, *The Road to Serfdom*, (Routledge, Abingdon, 1944). “Thatcher, Hayek and Friedman”, <https://www.margarethatcher.org/archive/Hayek>, [22 June 2024].

⁸³⁰ Table 17: International Delegates at British Events.

⁸³¹ C. E. Shannon, J. McCarthy (eds.), *Automata Studies: Annals of Mathematics Studies, No. 34*, (Princeton University Press, Princeton, 1956); W. R. Ashby, “Design for an Intelligence-Amplifier”, pp. 215-34; D. M. MacKay, “The Epistemological Problem for Automata”, pp. 235-52; A. M. Uttley, “Conditional Probability Machines and Conditioned Reflexes”, pp. 253-76; A. M. Uttley, “Temporal and Spatial Patterns In a Conditional Probability Machine”, pp. 254-77.

⁸³² Letters, Shannon, McCarthy to Turing, 18 May 1953; Turing to Shannon, 3 June 1954, NAHC/TUR/ADD/123.

review of his paper; asserting that he alone possessed sufficient expertise to assess its quality. As Kline noted, this did little to endear Ashby, or cybernetics, to the irascible McCarthy.⁸³³ Although Shannon and McCarthy's invitation letter struck a deceptively cyberneticist note around self-learning mechanistic analogues of human neurology, the preface to *Automata Studies* deprecated faddish comparisons between computers and brains; suggesting that, like earlier mechanistic metaphors of clockwork for bodies and telephone switchboards for synapses, such transient subjectivities exhibited merely superficial explicatory power. It also dismissed Turing's ideas on intelligent machinery; solipsistically decreeing that behaviourist conceptions of intelligence left differences between rote learning and real thought unexplained. Occluding its tacit philosophical predicate, the preface announced the editors' inductivist goal of discovering the essential mathematical truth of intelligence. Although jointly attributed, the preface reads as McCarthy's work. His dissatisfaction with cybernetics was not shared by Shannon.⁸³⁴

In 1955, McCarthy was concurrently editing *Automata Studies* and writing the proposal for a summer research project at Dartmouth College, New Hampshire.⁸³⁵ This became the 1956 Dartmouth Summer Workshop on Artificial Intelligence; and, the basis upon which McCarthy laid his stridently defended lifelong claim to the invention of the neologism now known as AI. The Dartmouth proposal certainly contained the first recorded use of the term 'Artificial Intelligence', although McCarthy's vigorous assertion of nominative paternity

⁸³³ Kline, *Cybernetics Moment*, pp. 155-6.

⁸³⁴ Kline, *Cybernetics Moment*, pp. 156-7.

⁸³⁵ J. McCarthy, M. L. Minsky, N. Rochester, C. E. Shannon, *A Proposal for the Dartmouth Summer Research Project on Artificial Intelligence: 31 Aug., 1955*, www.jmc.stanford.edu/articles/dartmouth/dartmouth.pdf, [19 Oct. 2022].

was disputed by Woodward.⁸³⁶ The sense of a prior terminological emergence predating the Dartmouth proposal was also suggested by Oliver Selfridge; McCarthy's contemporary and Wiener's graduate student.⁸³⁷ Coinage notwithstanding, McCarthy's AI was a nominative and epistemological attack on cybernetics: in both its British and American manifestations. As McCarthy later recalled, the thinly veiled antipathies prefacing *Automata Studies* reflected his deep personal disapproval of its contents, and his yet deeper hostility to both cybernetics and Wiener.⁸³⁸ These antagonisms spurred McCarthy's Dartmouth proposal, his terminological construction (or appropriation) of AI, and his enactment of the ensuing workshop.

In 1955, McCarthy asserted that cognition was reducible to logical sequencing. Thus, the mechanics of thought were mathematically describable, algorithmically expressible and computationally programmable. Therefore, whereas cybernetics had postulated intelligence as an emergent behavioural manifestation of embodied systemic self-adaption imbued with reciprocating feedback and memory; McCarthy now proposed a rigidly deterministic model where the passive machine received pre-scripted, symbolically encoded, and sequential *a priori* instructions. Natural language constituted, rather than expressed, thought; and intelligence was the logical manipulation of disembodied abstract symbols, not the operation of contingent, circuitous, physically instantiated information networks. Mathematics was likewise symbolic and logical. It was the language of computation, and thus the language of mechanised cognition. Therefore, intelligence was computationally replicable though the

⁸³⁶ P. Woodward, "I Invented AI", *New Scientist*, Iss. 2501, 28 May 2005, www.newscientist.com/letter/mg18625011-700-i-invented-ai/, [1 March 2023].

⁸³⁷ "An Interview With Oliver Selfridge", in Husbands, Holland, Wheeler (eds.), *Mechanical Mind*, p. 406.

⁸³⁸ P. McCorduck, *Machines Who Think: A Personal Inquiry into the History and Prospects of Artificial Intelligence*, 2nd edn., (CRC Press, Boca Raton, 2018), p. 115.

logically sequential manipulation of syntactic symbols. Indeed, inasmuch as McCarthy's approach loaded such symbols with both innate representationality, and necessarily correlative semantic burdens, it repudiated the basic tenet of Shannon and Wiener's statistical information theory. This was the genesis of symbolic AI, now known as good old fashioned AI or GOFAI.⁸³⁹

McCarthy constructed AI to wrest epistemological control of machine cognition away from cybernetics. In America, before the Dartmouth workshop, cyberneticist ideas about electronic neurological systems were advancing. The pre-cyberneticist mathematical describability of connectionist neurological networks had first been proposed in 1943 by Walter Pitts and Warren McCulloch.⁸⁴⁰ In 1958, the Cornell psychologist Frank Rosenblatt built the Perceptron; a self-learning, perceptual, computational machine that embodied cyberneticist neural networks.⁸⁴¹ However, from 1956 onwards, both the new Soviet embrace of cybernetics, and Wiener's politics, began to cool the earlier American cyberneticist enthusiasms. Especially amongst the military-industrial complex, with its structural and cultural predispositions to deterministic, hierarchical and linear command and control. So, when Paul Baran, a young RAND researcher, proposed self-adaptive digital packet switching as an architecture for resilient military communications networks capable

⁸³⁹ Andrew Pickering had correctly identified the "paradigmatic divergence" of symbolic AI and cybernetics in his 2002 paper on post-war British cybernetics. But, without the requisite empirical historical contextualisation, he was restricted to using the manifest difference to exemplify the philosophical divergence between a representational scientific idiom (symbolic AI); and a performative scientific idiom (cybernetics). Although, he did recognise that by the late 1950s symbolic AI had effectively marginalised cybernetics as a scientific paradigm for research into non-human cognition. Pickering, "Cybernetics and the Mangle", p. 420.

⁸⁴⁰ W. S. McCulloch, W. Pitts, "A Logical Calculus of the Ideas Immanent In Nervous Activity", *Bull. Mathematical Biophysics*, Vol. 5, Dec. 1943, pp. 115-33.

⁸⁴¹ F. Rosenblatt, "The Design of an Intelligent Automaton: Introducing the Perceptron-A Machine Which Senses, Recognizes, Remembers and Responds Like the Human Mind", *Research Trends: Cornell Aeronautical Lab.*, Vol. VI, No. 2, Summer 1958. F. Rosenblatt, "The Perceptron: A Probabilistic Model for Information Storage and Organization in the Brain", *Psychological Review*, Vol 65, No. 6, Nov. 1958, pp. 386-408.

of surviving a Soviet nuclear strike in the early sixties; he was ridiculed for his radicalism.⁸⁴²

Notably, Baran had been inspired to model a self-adaptive and self-healing computational grid of contingent information circuits on human neurology after conversations with McCulloch.⁸⁴³

Following Dartmouth, McCarthy's algorithmic determinism found increasing favour, and funding, and McCarthy and his cohort used their influence to quash the competition. They had a particularly strong dislike of self-learning neural networks. When Marvin Minsky and Seymour Papert authored a damning 1969 critique of Rosenblatt's Perceptron, it precipitated the demise of research into neural networks; as they had intended it should.⁸⁴⁴ By the end of the sixties, AI had exiled cybernetics.

Although the repudiation of cybernetics was central to McCarthy's AI project, he masked his motives for decades. In a hostile review of a 1987 essay collection which suggested, *inter alia*, that cybernetics might overcome AI's limitations, McCarthy disclosed that he had intentionally constructed AI as a branch of applied mathematics in deliberate disregard of the neurological mechanics of cognition.⁸⁴⁵ Furthermore, McCarthy stated that he had invented AI to break, nominatively and epistemologically, from cybernetics. Not only had he rejected Wiener's ideas, he said, but he had also sought to evade an open scientific debate

⁸⁴² Baran's ideas were originally developed in a sequence of internal RAND memoranda circulated between 1960 and 1962 and then consolidated across eleven papers published in 1964 as the *On Distributed Communications* series listed here in the bibliography.

⁸⁴³ M. Bay, "Conversations With a Pioneer: Paul Baran in His Own Words", *Internet Histories*, Vol. 1, Iss. 3, Sept. 2017, pp. 278.

⁸⁴⁴ M. Minsky, S. A. Papert, *Perceptrons: An Introduction to Computational Geometry*, (MIT, Cambridge, 1969). M. Olazaran, "A Sociological Study of the Official History of the Perceptrons Controversy", *Social Studies of Science*, Vol. 26, Iss. 3, Aug. 1996, pp. 611-59.

⁸⁴⁵ B. P. Bloomfield (ed.), *The Question of Artificial Intelligence: Philosophical and Sociological Perspectives*, (Croom Helm, London, 1987).

with him, and avoid conceding his priority. McCarthy rightly believed that Dartmouth had inaugurated the idea that thought was algorithmically reproducible, and he correctly noted that neither von Neumann, Wiener, McCulloch, Ashby or MacKay agreed with him.⁸⁴⁶ Originally posted on an internal MIT network, McCarthy's confessional review remained unpublished until 1996. AI was McCarthy's covert personal project to suppress cybernetics, and schism research into machine cognition away from neurologically inspired and embodied approaches. Notably, in 1986, Frank George had inferred the covert historical schism between McCarthyite AI and cybernetics, and he predicted that Wiener and McCulloch's ideas would overcome the now manifest limitations of GOFAI.⁸⁴⁷

Following *Automata Studies*, there was a Ratio Club presence at the Dartmouth workshop. Although no formal records exist, Grace Solomonoff, wife of participant Ray Solomonoff, compiled an account using contemporaneous notes and subsequent interviews.⁸⁴⁸ Grace cited attendances logged by both Ray, and Trenchard More. In Trenchard's list, Ashby, MacKay and Uttley joined. However, Ray's list showed only Ashby who was visiting at Stanford at the time. Both notes agreed that on 23 July Ashby presented the Homeostat and plugged his book, *An Introduction to Cybernetics*.⁸⁴⁹ Although MacKay had initially accepted his Dartmouth invitation, he then chose to attend the birth of his first child instead.⁸⁵⁰ On his return, Ashby would doubtless have communicated the sense of antipathy to cybernetics he had encountered at Dartmouth to others. Notwithstanding the then

⁸⁴⁶ J. McCarthy, *CSLI Lecture Notes No. 49: Defending AI Research: A Collection of Essays and Reviews*, (CSLI, Stanford, 1996), pp. 73-4.

⁸⁴⁷ F. H. George, *Artificial Intelligence: Its Philosophy and Neural Context*, (Gordon, New York, 1986), p. ix-11.

⁸⁴⁸ G. Solomonoff, *Ray Solomonoff and the Dartmouth Summer Research Project in Artificial Intelligence, 1956*, <http://raysolomonoff.com/dartmouth/dartray.pdf>, pp. 1-28, [19 Oct. 2022].

⁸⁴⁹ G. Solomonoff, "Dartmouth", pp. 9-10, 11.

⁸⁵⁰ *ibid.*, pp. 8. Kline, *Cybernetics Moment*, p. 163.

dormancy of the Ratio Club, its members remained in contact, and Ashby was a frequent visitor at the BNI. Moreover, although Wiener and McCulloch's presence at Dartmouth was ambiguous, Oliver Selfridge certainly attended. He and McCulloch were friends, and McCulloch corresponded regularly with his British network. These intersections between members of the Ratio Club and McCarthy's invention of AI have hitherto been occluded from the historical gaze.

Uttley's 1958 NPL Mechanisation of Thought Symposium can now be framed, at least in part, as a response from British cybernetics to the antagonism that was already radiating from Dartmouth. Alone amongst the British events, Uttley's NPL symposium nominatively stressed the synthetic replicability of the neuronal dynamics of mind. The title conspicuously echoed Wiener's phrase; "mechanisation of processes of thought", which he used in *Cybernetics* to describe the common historical intellectual impetus uniting the emergence of mathematical logic and the automation of cognition.⁸⁵¹ Uttley's implied cyberneticist commitment, and the tacit juxtaposition of his neurological foundation to McCarthy's algorithmic predicate were evident to the initiate.

Then, there was the programme; and the commensurate attendance it attracted. Uttley's symposium drew the strongest American cohort of all the British gatherings. It included McCarthy, and his collaborator, Marvin Minsky; as well as McCulloch, Rosenblatt and Selfridge. Notably, this was the only one of the British events that McCarthy or Minsky attended. By 1958, the intellectual divergence between McCarthy and Minsky on one hand, and McCulloch, Rosenblatt and Selfridge on the other, was visible. Uttley set the agenda

⁸⁵¹ Wiener, *Cybernetics*, p. 20.

for the symposium. The first session on “General Principles”, which he chaired, was a showdown between AI and cybernetics. First, Minsky rejected behaviourism in favour of programming. Then, MacKay countered with an information theoretic approach to mental mechanisms. McCarthy’s riposte advocated predicate calculus as the basis for logical problem solving. Ashby retorted with a proposal to mechanise the physiological systems of neurological self-adaptation. Uttley concluded by arguing that the nervous system was a biological computer which processed conditional probabilities. McCulloch chaired the discussion session after Minsky’s paper.⁸⁵² The rancorous exchanges at Teddington reported in the *New Scientist* may well have arisen from this direct clash between AI and cybernetics.

The opening of Uttley’s event afforded AI a partial, albeit contested, platform. Substantively however, the NPL symposium was performatively orientated towards information theory and cybernetics. Session Two dealt with “Automatic Programming” and “Mechanical Language Translation”.⁸⁵³ Session Three examined “Speech Recognition” and “Learning in Machines”.⁸⁵⁴ Session Four A explored the “Implications for Biology”.⁸⁵⁵ Whilst Four B concluded with the “Implications for Industry”.⁸⁵⁶ Rosenblatt’s Perceptron opened the machine learning section of Session Three; and, he was followed by Andrew describing Uttley’s electronic conditional probability computer. Selfridge then concluded this section

⁸⁵² *Mechanisation of Thought*, Vol. 1: Session 1: “General Principles”, pp. 1-152: M. L. Minsky, “Some Methods of Artificial Intelligence and Heuristic Programming”, pp. 3-36; D. M. MacKay, “Operational Aspects of Intellect”, pp. 37-74; J. McCarthy, “Programs With Common Sense”, pp. 75-92; W. R. Ashby, “The Mechanism of Habituation”, pp. 93-118; A. M. Uttley, “Conditional Probability Computing in the Nervous System”, pp. 119-52.

⁸⁵³ *Mechanisation of Thought*, Vol. 1: Session 2: “Automatic Programming” & “Mechanical Language Translation”, pp. 153-354.

⁸⁵⁴ *Mechanisation of Thought*, Vol. 1: Session 3: “Speech Recognition” & “Learning in Machines”, pp. 355-531.

⁸⁵⁵ *Mechanisation of Thought*, Vol. 2: Session 4A: “Implications for Biology”, pp. 533-752.

⁸⁵⁶ *Mechanisation of Thought*, Vol. 2: Session 4B: “Implications for Industry”, pp. 753-928.

with his seminal paper on unsupervised self-learning pattern recognition.⁸⁵⁷ In its turn, Part A of Session Four, chaired by J. Z. Young, exemplified Uttley's cyberneticist intent by unifying electronic and biological computation. Barlow discussed the neurological discrimination of information redundancy as a feature of intelligence. And, he was followed by McCulloch, who then explored the connectionist resilience that neurological networks obtained through the redundancy inherent in the dynamic reconfiguration of synapsial pathways. One discussant notably spotted that McCulloch had described a biologically inspired mathematical architecture for a resilient electronic computer.⁸⁵⁸

However, if the intent behind the 1958 symposium was for cybernetics to decisively contest AI; it failed. Dartmouth is memorialised; Teddington is forgotten: McCarthy is venerated; and Wiener, the Ratio Club and cybernetics are all but invisible. Few modern researchers into machine learning or neural networks know that many of their ostensibly fresh ideas originated in cybernetics. Fewer still know that some lie dormant in the proceedings of a forgotten conference in a London suburb. Likewise, few historians have recognised that here, on the eve of the sixties, an argument between British and American scientists about how to make machines think was witnessed by an official delegation of Soviet cyberneticians. The 1958 NPL symposium was the only one of these British or American events which the USSR attended; an exception yet more remarkable by Sputnik's shadow. Yet, in the Cold War's superheated geo-politics, such a visible communist affinity for cybernetics would have done little to endear an already problematic science to Establishment

⁸⁵⁷ Session 3: "Learning in Machines", *Mechanisation of Thought*, Vol. 1: F. Rosenblatt, "Two Theorems of Statistical Separability in the Perceptron", pp. 419-72; A. M. Andrew, "Learning Machines", pp. 473-510; O. G. Selfridge, "Pandemonium: A Paradigm for Learning", pp. 511-31.

⁸⁵⁸ Session 4A: "Implications for Biology", *Mechanisation of Thought*, Vol. 2: H. B. Barlow, "Sensory Mechanisms, The Reduction of Redundancy and Intelligence", pp. 535-74; W. S. McCulloch, "Agatha Tyche: Of Nervous Nets-The Lucky Reckoners", pp. 611-33; E. A. Newman, "Discussion on the Paper by Dr. W. S. McCulloch", p. 627.

minds on either side of the Atlantic.⁸⁵⁹ However, the mere fact of a Soviet delegation to a conference held at a British government research facility the year after Soviet space technology had terrified and humiliated the military-industrial complex was as remarkable then as its historical invisibility is now.

Looking beyond the transatlantic arc, there were four European cybernetics events in the period covered here which drew a British presence. Namely: the 1951 *Colloque International: Les Machines a Calculer et la Pensee Humaine* at the Centre National de la Recherche Scientifique in Paris from 8-13 January; the *First International Congress on Cybernetics* at Namur in Belgium from 26-29 June 1956; and the second and third iterations of the Namur gathering from 3-10 September 1958 and 11-15 September 1961 respectively. British attendance at these European cybernetics meetings was generally scarce; whereas, European attendance at the seven British events was comparatively populous.⁸⁶⁰ Although some of these European delegates to the British conferences were Cold War military actors, most were civil and commercial agents engaged in post-war reconstruction. France and Holland were prominent; West Germany, Italy, Sweden and Switzerland were noticeable. Attendance from state owned telecommunications and applied research organisations was strong, as was that from electronics manufacturers. Whilst Britain was a major early post-war venue for university based scientific computing, computer engineering and information theory; these European delegations suggested a stronger contemporary Continental appetite for a broad socio-economic deployment of these new ideas and technologies. For those

⁸⁵⁹ Gerovitch, *Newspeak to Cyberspeak*. V. Shilov, “Reefs of Myths: Towards the History of Cybernetics in the Soviet Union”, in *Third International Conference on Computer Technology in Russia and in the Former Soviet Union, Kazan, Russia, 2014*, pp. 177-182, [www.ieeexplore.ieee.org/document/7032982/similar - similar](http://www.ieeexplore.ieee.org/document/7032982/similar-similar), [13 March 2023].

⁸⁶⁰ Table 17: International Delegates at British Events.

rebuilding from occupation and liberation, computers and information theory offered reconstructive epistemological and ontological scaffolds. And, whereas peace ossified Britain in deep conservatism, it energised Europe with reconstructive receptivity.

The pattern at the Namur international cybernetics conferences was similar. European delegates were generally orientated to the societal utilisation of cybernetics and automation, whilst British attendance was sparse, even from Ratio Club members. Overall: nine Britons attended the first Namur conference in 1956; eight in 1958; and six in 1961.⁸⁶¹ Regarding the Ratio Club, both Uttley and Walter went in 1956, but only Ashby attended in 1958 and 1961. Beer also represented British cybernetics in 1956 and 1958. Pask joined him in 1958, and George joined Pask in 1961. Undaunted by his exclusion from the Ratio Club, Jack Allanson also attended in 1956; as did Wolfe Mays, who was perhaps drawn to survey his mechanist adversary. Apart from Uttley, and a sole RRE delegate, there were no British government or military delegates at any of these European cybernetics conferences, and Beer was the only delegate from a British industrial cybernetics department. The Loughborough Ergonomics and Cybernetics Department sent a solitary delegate to Namur in 1961; the only representation from a British academic instantiation of cybernetics at any event, in any location, in this period. Including Pask, four British commercial cybernetics and automation consultancies attended across these three events. However, they were all were small or lone operators and none of them thrived. None of the British computer builders, academic or commercial, attended any of these international cybernetics conferences.

⁸⁶¹ Table 18: British Delegates at Namur.

However, the situation at the Paris event in January 1951 had been markedly different. The unambiguously cyberneticist conference on “Les Machines à Calculer et la Pensée Humaine” (Calculating Machines and Human Thought) occurred in the eye of the British Cartesian computational storm, and the British press loudly reported that Walter, and his tortoises, were there.⁸⁶² Perhaps aroused by the controversy, after the French, the British were the largest cohort at Paris.⁸⁶³ The British embassy delegated three, Ferranti sent eight, and the *Daily Express* despatched Chapman Pincher. Ferranti’s delegation included their chief sales person, Bertram Bowden, who subsequently collated *Faster Than Thought*; an essay collection surveying the state of contemporary British computing. Recognising the dangers of counter orthodoxy amidst the Cartesian furore, Bowden’s editorial interventions in the book would deprecate the term ‘Electronic Brain’: his job was selling, not philosophising.⁸⁶⁴ Nevertheless, he, and his fellow British delegates, had witnessed this controversy first hand, as the Paris event had staged a unique direct encounter between McCulloch and Wiener on one hand, and Hartree, Kilburn, Williams and Wilkes on the other. Perhaps a Parisian setting licensed cybernetics’ hazardous exoticism. Perhaps Wilkes, Williams and Kilburn wanted to see their adversaries in person. Or, perhaps they were there defensively. Andrew Booth, their rival at Birkbeck, also attended. Notably, both Uttley who was still at TRE, and Colebrook who had retained his interest in cybernetics despite the NPL’s rebuttal of his proposed cybernetics division, also went to Paris. Equally notably, only Ashby and Walter joined Uttley from the Ratio Club. Not even the prospect of meeting Wiener broke the Ratio Club’s insularity.

⁸⁶² “Trip for Toby the Tortoise: His Brain is Electric”, *Mail*, 18 Dec. 1950, p. 3. “Items from Far and Near: The North Pole; Paris Robots; and a Baby Penguin at London’s Zoo: One of the Attractions at the International Congress of Cybernetics in Paris: A Mechanical Tortoise With Dr. Grey Walter, Its Inventor”, *Illustrated London News*, 20 Jan. 1951, p. 95.

⁸⁶³ Table 19: British Delegates at Paris.

⁸⁶⁴ Bowden, *Faster Than Thought*, p. vii.

Nominatively, the 1951 Paris conference trumpeted cybernetics' central claim of the equivalence between electronic and biological computational systems. If that was insufficiently Wienerian, then there was the Third Section, organised by Walter, on "Les Grosses Machines, la Logique et la Physiologie du Système Nerveux" (Large [Computing] Machines, Logic and Physiology of the Nervous System). This featured: Ashby's Homeostat; Walter's tortoises; Wiener's prediction that computers would outdo humans in pattern recognition; Uttley's argument that computers could perform deductive reasoning and take intelligence tests; and McCulloch's comparison between computers and brains. By contrast, Williams and Kilburn's paper summarised computer engineering work at Manchester, and Wilkes spoke about operationalising and programming EDSAC.⁸⁶⁵ Williams, Kilburn and Wilkes' contributions were not entirely out of place in Paris, there were other papers on the mechanics and electronics of computation. Nevertheless, they were conspicuously pedestrian amidst the fruits of more imaginative intellects.

Whatever brought Wilkes, Williams and Kilburn to Paris, whilst there they encountered an overt and scholarly intersection between cybernetics and electronic computers. Afterwards, the British gatekeepers of scientific computing orthodoxy could not dismiss the idea of thinking machines as fictive caprice without also knowing that this censorious delegitimization defied the science which they had witnessed being constructed in Paris.

⁸⁶⁵ *Les Machines à Calculer et la Pensée Humaine: Paris 8 au 13 Janvier 1951*: W. R. Ashby, "Presentation of the Homeostat"; W. G. Walter, "Mechanical Realization of Brain Structure Models: Introducing Artificial Animals"; N. Wiener, "The Computing Machine and Form (Gestalt)"; A. Uttley, "The Performance of Logical Processes by Means of Calculating Machines"; W. S. McCulloch, "A Comparison Between Calculating Machines And The Brain (Presented by W. S. McCulloch: in collaboration with : J. Y. Lettvin, W. H. Pitts, P. C. Dell)"; F. C. Williams, T. Kilburn, "Summary of Computer Research At Manchester University"; M. V. Wilkes, "Operational Experience of The E.D.S.A.C.", [no page numbers], www.archive.computerhistory.org/resources/access/text/2021/01/102805935-05-01-acc.pdf, [19 Jan. 2023].

Nor could they claim that this science was not serious. The event was too prestigious for that. Henceforth, if not before, declarations of scientific computing orthodoxy, at least by Hartree, Wilkes, Williams, Kilburn and Bowden, were necessarily also conscious contestations of cybernetics. Their sustained assertion of the incommensurability between computing and cybernetics was a performative sociological intervention which, whilst a product of intellectual conviction, was nevertheless not driven by epistemological imperative.

Paris also taught the custodians of British scientific computing orthodoxy that cybernetics in Britain was neither as populous, nor as powerful, as in America or Europe. Amidst the sizeable British delegation stirred by the domestic Cartesian storm, the trio of Ashby, Walter and Uttley at an avowedly cyberneticist event attended by Wiener and McCulloch was a poor showing from British cybernetics. Although they were clearly highly regarded internationally, British cyberneticians had visibly shallow domestic scientific roots and they posed little threat to the hegemonic ambitions of the British scientific computing pioneers.

Outward Trajectories: The Ratio Club

Six Ratio Club members joined the post-war transatlantic brain drain. A seventh, MacKay, did not emigrate but his evident affinity for America brought him honours and numerous named lectureships. Of the emigres; Gold and Shipton left in 1957, Barlow in 1964, McLardy in 1965, and Good in 1967. Ashby followed in 1960, but his departure was a flight into exile. The BNI had appointed him as its Director in 1958; despite strident internal opposition. His short but disastrous tenure then ended with a threatened mass resignation;

including Walter's.⁸⁶⁶ Ashby ran the BNI as a martinet; intercepting staff mail, and compelling senior clinicians and researchers to sit grading examinations. He also hired a private investigator to spy on Walter's libertine lifestyle. All of the emigres found America more conducive to their cyberneticist leanings; and, more rewarding, professionally and personally. However, only Ashby devoted his American professional practice entirely to cybernetics, and he joined Heinz von Foerster, the pioneer of second order cybernetics, as Professor of Biophysics and Electrical Engineering in von Foerster's Illinois University Biological Computing Laboratory. Of the others: Gold became an astronomer; Shipton a professor of biomedical engineering; Barlow a professor of optical physiology; and Good a research professor of statistics. McLardy continued in psychiatry.

Clearly, early encounters with cybernetics and information theory had shaped the subsequent intellectual practices of some of these emigres. Barlow's work on the neuronal mechanics of vision was indivisible from information theory; just as Shipton's biomedical practices pivoted around cyberneticist instrumentations of EEG. However, Ashby excepted, these formative influences did not re-construct any of them as cyberneticians. This pattern, of being formed but not transformed by cybernetics, held across the Ratio Club as a whole. With the visible exception of Walter, and the less obvious exceptions of MacKay, Westcott and Uttley, the rest of the Ratio Club sublimated their internalised mediations of cybernetics and information theory, without openly declaring their cyberneticist affiliations. Turing, as always, was a case entirely unto himself. Even amongst the exceptions, there was a marked tendency to privilege their primary disciplinary commitments over cybernetics. At the final Macy Conference in 1953, Walter announced himself a "British neurophysiologist" whose

⁸⁶⁶ Cooper, Bird, *Burden*, pp. 17-18.

scientific horizons had been expanded by cybernetics, rather than as a cybernetician.⁸⁶⁷ In 1979, Uttley thanked the other members of the Ratio Club by name, and used the 1952 Cambridge group photograph as a frontispiece to *Information Transmission in the Nervous System*.⁸⁶⁸ He was one of the very few who ever mentioned the Ratio Club in later life.

Ultimately, the only member of the Ratio Club who abjured their previous incarnation and became a professional cybernetician, rather than a cybernetics inspired practitioner of another discipline, was Ashby. He alone devoted himself to the development of cybernetics as a universalising trans-disciplinary science. And, ironically, whilst the others suspected Ashby of using the Ratio Club as a private seminar to advance his own intellectual development, he was the only one of them devoted to constructing extensions, rather than mediations, of cyberneticist theory. However, Ashby was also considerably more focused and direct than his colleagues, and conspicuously far less empathetic or socially adroit. Perhaps McLardy was merely more honest than most when he declined Bates' invitation to the terminal 1958 reunion by explaining that as his only interest in cybernetics had been to develop his ideas about brain morphology; the Ratio Club was now personally irrelevant.⁸⁶⁹ For many, if not most, of its members, the Ratio Club existed to furnish them with novel intellectual equipment as a means of career progression within their existing disciplinary commitments. Notably, beyond McLardy's candour, the general sense that the Ratio Club existed to serve the private needs of its members, rather than to collectively proselytise the

⁸⁶⁷ W. G. Walter, "Studies on Activity of the Brain", in H. von Foerster, M. Mead, H. L. Teuber (eds.), *Cybernetics: Circular Causal and Feedback Mechanisms in Biological and Social Systems: Transactions of the Tenth Conference, April 22, 23, and 24, 1953, Princeton N. J.*, in Pias, *Cybernetics*, p. 689.

⁸⁶⁸ A. M. Uttley, *Information Transmission in the Nervous System*, (Academic Press, London, 1979), p. vii.

⁸⁶⁹ Letter, McLardy to Bates, 24 Nov. 1958, WC/GC/179/B.32/Box 12.

epistemological cause of cybernetics, infused the correspondence between Bates and the others.

Even then, cybernetics did not mark all of the Ratio Club's members equally. Neither Slater's psychiatry, nor Gold's astronomy were discernibly cyberneticist. For Slater, a eugenicist and an advocate of psychosurgical Heroic interventions, the neuro-materiality of mind might have bolstered his commitments to heritable intelligence and leucotomy. Whilst Gold, for his part, was genuinely intellectually curious. Little was only ever a token member, and his work on high intensity lasers lacked any cyberneticist specificity. Retaining the pattern of the Ratio Club's insularity, none of McLardy, Hick, Barlow, Rushton, Merton, MacKay or Pringle strayed beyond the boundaries of psychology, neurology or physiology. Cybernetics and information theory are inscribed in their subsequent work; the later often more deeply than the former. But it takes a guided eye to see it.

For Bates, Walter and Dawson, cybernetics scientised the materiality of mind, and affirmed the capacity of EEG to instrumentalize its empirical validation. None of them considered cybernetics as anything other than a contribution to neurophysiology. Even Walter's cyberneticist tortoises were essays in brain science. Turing brought his cybernetics and his computers with him to the Ratio Club; just as Good brought (and departed with) computers and the mathematics of sequential conditional probability which he and Turing had developed at Bletchley. Indeed, most of Good's later work owed more to cryptanalysis than cybernetics. Although, in 1966, he did publish a paper which predicted a computational super-intelligence, predicated on artificial neural networks, that would precipitate the

civilisational transformation now called the technological singularity.⁸⁷⁰ Lamentably, though unsurprisingly, this remarkably prescient paper is absent from the contemporary AI canon.

Many of the Ratio Club's members pursued highly successful careers. Several were renowned, and a few became famous. Of the twenty-one, seven were elected to the Royal Society.⁸⁷¹ However, not all of them shone equally brightly. Even within EEG practice, Bates and Dawson faded after the Ratio Club. Woodward and Uttley were simultaneously highly regarded and tightly constrained within military and government research. Little of their work, and less of their presence, entered the public domain. Similarly, before he emigrated, Good was sequestered at GCHQ and the Admiralty. And, although he was a prolific writer, and Stanley Kubrick's advisor about HAL 900 during the British production of *2001: A Space Odyssey*, Good nevertheless subsequently vanished into anonymity. Likewise, Ashby fell into obscurity after 1960, notwithstanding his renown within the marginal international cybernetics community. Shipton, beyond his wedding to Janet, was invisible.

For some Ratio Club members, their successful careers became trajectories for the mediation of cybernetics and information theory more widely across their disciplines. This was especially the case with both Barlow and Rushton's information theoretic approach to the neurophysiology of vision, and with Merton's deployment of servomechanism theory in skeleto-muscular mechanics. And also with Hick's application of information theory to the

⁸⁷⁰ I. J. Good, "Speculations Concerning the First Ultrainelligent Machine", *Advances in Computers*, Vol. 6, 1966, pp. 31-88.

⁸⁷¹ Barlow, Gold, Merton, Pringle, Rushton, Turing and Westcott.

psychology of decision making, which came to spawn an eponymous law.⁸⁷² However, even these successful transmissions were tacit. They had all seen Walter pay a high professional price for his showy assimilation of cybernetics into neuroscience, and witnessed the vilification meted out to Turing for his unwavering commitment to thinking computers.

Given that life scientists constituted the Ratio Club's core, it is tempting to ascribe it agency in Crick and Watson's discovery of the double helix. Watson certainly knew about cybernetics and information theory. The week before his seminal publication with Crick in April 1953, Watson had drunkenly co-authored a joke letter to *Nature* citing the potential importance of cybernetics and information in explaining bacterial self-replication.⁸⁷³ However, there is no indication that this knowledge was mediated into genetics research through British cybernetics.⁸⁷⁴ Rather, genetics met cybernetics and information theory through American intersections such as the annual symposia on quantitative biology at the Cold Spring Harbour Laboratory. Notably, at the 1948 Hixon Symposium on "Cerebral Mechanisms in Behavior" at the California Institute of Technology, von Neumann had told an audience of biologists about his idea that the information inscribed on the paper tape in Turing's 1936 universal computer thought experiment could instruct the computer that was reading it to self-replicate. Moreover, he said, this self-encoding replication might constitute

⁸⁷² Hick's Law: decision time increases logarithmically with the number of choices. W. E. Hick, "On the Rate of Gain of Information", *Quarterly Journal of Experimental Psychology*, Vol 4, Iss. 1, 1952, pp. 11-26.

⁸⁷³ B. Ephrussi, U. Leopold, J. D. Watson, J. J. Weigle, "Terminology in Bacterial Genetics", *Nature*, Vol. 171, No. 4355, 18 April 1953, p. 701. J. D. Watson, F. H. C. Crick, "Molecular Structure of Nucleic Acids: A Structure for Deoxyribose Nucleic Acid", *Nature*, Vol 171, Iss. 4356, 25 April 1953, pp. 737-38.

⁸⁷⁴ M. Cobb, "1953: When Genes Became "Information"", *Cell*, Vol. 153, Iss. 3, 25 April 2013, pp. 503-6.

the mathematical model that would explain genes as biological analogues of Turing's paper tape.⁸⁷⁵ McCulloch followed with an exposition of the cranial materiality of mind.⁸⁷⁶

In his rebuttal of Ashby's attempted reconstitution of the Ratio Club as a learned society in 1952, Bates had argued that because the initial academic resistance to cybernetics had been overcome, the need imagined by Ashby had abated.⁸⁷⁷ For his evidence, Bates cited Edgar Adrian's 1951 Royal Society Presidential Address.⁸⁷⁸ Bates also invoked the same sense of professional accomplishment when he closed the Ratio Club in 1958.⁸⁷⁹ However, Adrian's claimed endorsement of cybernetics was merely a tentative welcome of ideas about information and feedback into neurology, and a cautious indication that analogies between electronic computers and nervous systems might be scientifically productive; Adrian mentioned neither Wiener nor cybernetics. Rather than evidencing the formal intellectual success of cybernetics, Adrian's circumspect and coded oration underscored its consignment to institutional and epistemological liminality. Bates' further counter-argument against Ashby in 1952, that cybernetics was academically normalised because Ratio Club members could mention it in scholarly papers without fearing editorial rejection, set a risibly low bar of success. Only in the most farfetched of interpretations was Bates' suggestion that cybernetics was safely ensconced in British intellectual life valid. Still less, the claim that the Ratio Club had made it so.

⁸⁷⁵ von Neumann, "The General and Logical Theory of Automata", in Jeffress, *Cerebral Mechanisms in Behavior*, pp. 1-41.

⁸⁷⁶ W. S. McCulloch, "Why the Mind is in the Head", in Jeffress, *Cerebral Mechanisms*, pp. 42-81.

⁸⁷⁷ Letter, Bates to Ashby, 18 Jan. 1952, WC/GC/179/B.12/Box 12.

⁸⁷⁸ E. D. Adrian, "Address of the President at the Anniversary Meeting, 30 Nov. 1951," *Proc. Royal Soc. of London. Series B, Biological Sciences*, Vol. 139, Iss. 896, 24 April 1952, pp. 289-99.

⁸⁷⁹ "Ratio Club", circular following Nov. 1958 meeting, WC/GC/179/B.19/Box 12.

Westcott's career exemplified the tenuous British academic presence of cybernetics. Uniquely within the Ratio Club, Westcott developed an academic practice around the industrial applications of control theory and automation. Equally uniquely, he combined teaching and research with commercial consultancy and electronic equipment manufacture. Westcott was a rare personification of the sectorally fluid cyberneticist technocrat that Bagrit's automation age required. Westcott's businesses prospered, and his academic career advanced. However, he flourished as a singularly preeminent specialist within a tiny niche. The academic and economic appetite for cyberneticist industrial control systems and automation was sufficient unto Westcott's brilliance; but Bagrit's vision remained elusive and Westcott's practices remained contemporaneously peripheral. Westcott was also the only Ratio Club member who contributed directly to the doctoral self-replication of British cybernetics; accentuating Pickering's point that dining clubs do not confer degrees.⁸⁸⁰ Westcott was Kevin Warwick's PhD supervisor at Imperial. Warwick became Professor of Cybernetics at Reading in 1988, where he acquired the media sobriquet of 'Captain Cyborg'. Predictably, after his move to Coventry in 2014, cybernetics atrophied at Reading.

Outward Trajectories: The Fellow Travellers

Of all the Fellow Travellers, Arthur Porter was the most institutionally and geographically mobile, and the least noticed; then as now. Nevertheless, after his deep immersion in British proto-cybernetics, he became a significant vector for the international post-war mediation of cybernetics itself. From 1946 to 1949 he was a professor at the Military College of Science in Shrivenham, where he helped to prepare the Army's Technical Staff Officers for promotion. During his tenure, he taught servomechanism and control theory, and promoted

⁸⁸⁰ Pickering, *Cybernetic Brain*, p. 59.

early military awareness about computers.⁸⁸¹ Porter met Mountbatten several times whilst he was at Shrivenham, and perhaps it was he who helped to prime the explosive 1946 ENIAC speech.⁸⁸² Certainly, during his three year term, Porter shaped some of the military minds that went on to fashion the ontologies and epistemologies of the Cold War; especially those of command and control systems, and self-guiding weapons. However, although Porter attended the 1949 BNI cybernetics meeting, and knew several Ratio Club members personally; he was neither a guest at any of their meetings, nor one of Bates' initial membership candidates. Partly this was professorial disqualification, and partly it was timing. Porter moved to Canada 1949, and when he returned in 1955 the Ratio Club was moribund.

Upon his return to Britain, Porter became the first Professor of Light Electrical Engineering at Imperial. His inaugural lecture, attended by the General Secretary of the TUC, predicted that transistorised computers would soon displace humans, and assume control over automated production; he spoke just as the British moral panic over automation was erupting.⁸⁸³ Porter's detailed autobiography mentioned his Imperial colleagues Tustin, Gabor and Cherry; but not Wescott, who joined Imperial in 1950 and became a reader in Porter's department in 1956.⁸⁸⁴ This silence perhaps offers a further clue about the explanation for Porter's Ratio Club absence; even as a later guest. In 1958 he emigrated to Canada as the Dean of Engineering at Saskatchewan University. Later, in Toronto, he befriended Marshall McLuhan.⁸⁸⁵ In 1969, he expressed his continuing commitments to

⁸⁸¹ A. Porter, *Introduction to Servomechanisms*, (Methuen, London, 1950).

⁸⁸² Porter, *Hills*, p. 155.

⁸⁸³ *ibid.*, p. 195.

⁸⁸⁴ *ibid.*, pp. 191-192.

⁸⁸⁵ T. Robinson, "Oral History of Arthur Porter", interview transcript, 8 March 2008, CHM, <http://archive.computerhistory.org/resources/access/text/2015/06/102658245-05-01-acc.pdf>, [20 June 2022].

cybernetics in his popular science book, *Cybernetics Simplified*, which was graced with a forward by the now famous McLuhan.⁸⁸⁶ As Wiener had anticipated, the comprehension of society was becoming inseparable from the comprehension of its constitutive information and communications systems.⁸⁸⁷

Like Porter, the war had immersed Arnold Tustin in engineering proto-cybernetics; especially servomechanisms. In 1946, Tustin began to consider the application of servomechanism and control theory to economics; but, his early encounter with *Cybernetics* changed the shape of his thinking. The product, in 1953, was his book on *The Mechanism of Economic Systems: An Approach to the Problem of Economic Stabilisation from the Point of View of Control-System Engineering*.⁸⁸⁸ Tustin's application of cybernetics to equilibrium economics contended that a dynamic physical analogue of economic behaviour could obviate the stochastic unknowability of the living social system. This cyberneticist excursion was especially well received at LSE.⁸⁸⁹ Particularly by Richard Tizard, who had briefly preceded Uttley as superintendent of the NPL's CME Division before moving to LSE to develop a synthesis between cybernetics, control theory and economics. Tizard's warm review explicitly recognised the cyberneticist nature of Tustin's book.⁸⁹⁰

Even before Tizzard's arrival, the ground at LSE had already been well prepared for Tustin's ideas. In 1949, Bill Philips, an undergraduate, had built MONIAC, an analogue computer

⁸⁸⁶ A. Porter, *Cybernetics Simplified*, (English Universities Press, London, 1969).

⁸⁸⁷ Wiener, *Human Use*, 2nd edn., p. 16.

⁸⁸⁸ Tustin, *Mechanism Of Economic Systems*, p. v.

⁸⁸⁹ A. W. Phillips, *Economic Journal*, Vol. 64, No. 256, Dec. 1954, pp. 805-7. R. G. D. Allen, "The Engineer's Approach to Economic Models", *Economica*, Vol. 22, No. 86, May 1955, pp. 158-68. P. Streeten, *Brit. J. Sociology*, Vol. 7, No. 2, June 1956, p. 167.

⁸⁹⁰ R. H. Tizard, "A Cybernetic Interpretation of Economics", *Brit. J. Philosophy of Science*, Vol. 8, No. 30, Aug. 1957, pp. 161-4.

which modelled economic variables with water volumes and processes with flows, as a student project.⁸⁹¹ However, elsewhere, Tustin's book suffered the silent censure incurred by disciplinary transgression and it vanished. Nevertheless, alongside MONIAC, it perhaps helped establish LSE as a major site for both econometrics, and economic modelling and simulation. Tustin became Imperial's Professor of Heavy Electrical Engineering in 1955. Whereupon, he promptly relinquished cybernetics, and confined his applications of control theory to engineering. Moreover, whilst Tustin had readily applied cybernetics to economic modelling, he had never subscribed to its mechanistic mind thesis. His 1953 lecture to the Midlands branch of the British Psychological society had spurned the idea of mechanical minds, whether biological or synthetic; just as it had repudiated the authority of biologists to claim that engineered artefacts could be imbued with perception and awareness.⁸⁹²

What Tustin had endeavoured for economics; Wladyslaw Sluckin then essayed for psychology. In 1954, his book, *Minds and Machines*, was published by Penguin under the Pelican imprint.⁸⁹³ However, although this was an explicit application of cybernetics to psychology, apart from a rehearsal in a paper the year before, there was no manifest connection between Sluckin and proto-cybernetics.⁸⁹⁴ His war-work in commercial electricity generation was unconnected with servomechanisms, radar, PR or OR. Likewise, he attended none of the British events, and he was unknown within their wider intersectional sociologies: during his authorship of *Minds and Machines*, Sluckin had taught psychology

⁸⁹¹ C. C. Bissell, "Historical Perspectives-The Moniac A Hydromechanical Analog Computer of the 1950s", *IEEE Control Systems Magazine*, Vol. 27, No. 1, 2007, pp. 59-64. MONIAC, (The Monetary National Income Analogue Computer), also a portmantua of 'money' and 'ENIAC'.

⁸⁹² A. Tustin, "Do Modern Mechanisms Help Us to Understand the Mind?", *Brit. J. Psychology*, Vol. 44, Iss. 1, Feb. 1953, pp. 24-37.

⁸⁹³ W. Sluckin, *Minds and Machines*, (Pelican, London, 1954).

⁸⁹⁴ R. Thomson, W. Sluckin, "Cybernetics and Mental Functioning", *Brit. J. Philosophy of Science*, Vol. 4, No. 14, Aug. 1953, pp. 130-46.

at Durham. However, despite his isolation from proto-cybernetics, and as his mentor, the industrial psychologist Cecil Mace noted, Sluckin's engineering hinterland had combined with his psychological training to equip him to produce his popularisation of the obscurities of cybernetics and information theory.⁸⁹⁵ Inasmuch as Sluckin autonomously discovered cybernetics through its independent intellectual appeal alone, and without immersion in proto-cybernetics or encountering British cyberneticians socially, he exemplified the candidate constituency for Ashby's cybernetics society.

Despite the Ratio Club's invisibility, Sluckin's evident receipt of its member's epistemological transmissions was textually inscribed in *Minds and Machines*. His book also explicitly recognised that cybernetics unified the work of Ashby, MacKay, Pringle, Walter, Turing and Uttley on one hand, with that of McCulloch, Shannon and Wiener on the other. And, he also clearly discerned Craik's proto-cybernetics. Sluckin's recommendations for further reading included works by them all.⁸⁹⁶ His absences notwithstanding, Sluckin also referenced the Macy conferences, and the London information theory symposia.⁸⁹⁷ Moreover, affirming both the radiative force of the BBC's staging of the Cartesian computational controversy, and its ineluctable imbrication with cybernetics, Sluckin also cited the publication of "The Physical Basis of Mind" talks.⁸⁹⁸ Indeed, Sluckin acknowledged Ryle as a protagonist in the Cartesian contest, which Sluckin himself now entered with a broadly epiphenomenalist position.⁸⁹⁹

⁸⁹⁵ C. A. Mace, "Editorial Foreword", in Sluckin, *Minds*, pp. 9-10.

⁸⁹⁶ Sluckin, *Minds*, p. 120, 141, 143.

⁸⁹⁷ *ibid.*, p. 68, 127.

⁸⁹⁸ *ibid.*, p. 143.

⁸⁹⁹ *ibid.*, p. 180, 195, 207.

Sluckin's cyberneticist psychological mediation was critically less favoured than Tustin's economics excursion. Steven Vajda, an OR practitioner, considered it merely tolerable.⁹⁰⁰ While his fellow psychologist, R. M. Mowbray, only grudgingly welcomed Sluckin's abjuration of the typical cyberneticist hyperbole.⁹⁰¹ In the now familiar defence of his epistemological territory, Wolf Mayes asserted the triumph of philosophy over psychology as the exclusive episteme of mind.⁹⁰² However, despite its tepid scholarly reception, Sluckin's book exemplified the informal cultural infusions of cybernetics into British intellectual life that occurred despite the antipathy of scientific orthodoxy, or the Ratio Club's insularity; and, once again, Penguin was the vector.

If Sluckin was a Ratio Club outlier, J. Z. Young was virtually a shadow member. When Ashby deployed Young's proposed membership in his power struggle with Bates, he chose wisely.⁹⁰³ Young was a professor, and his admittance would have broken Bates' authority. Yet, otherwise, the case was unassailable. Young had attended the 1949 BNI cybernetics meeting, as well as both Emmett's 1949 Manchester philosophy seminar, and its informal December evening reprise. He had also been a guest at two Ratio Club meetings. Young's exclusion belied both his social proximity to the Ratio Club, and his intellectual commitments to cybernetics; which were stronger than many of its members. Conspicuously, cybernetics and information theory infused his 1950 Reith Lectures.⁹⁰⁴ Equally notably, amongst the intellectual eminences the BBC consulted whilst selecting their

⁹⁰⁰ S. Vajda, *Mathematical Gazette*, Vol. 40, No. 331, Feb. 1956, p. 74.

⁹⁰¹ R. M. Mowbray, *Brit. J. Medical Psychology*, Vol. 29, Iss. 1, March 1956, pp. 67-72.

⁹⁰² W. Mays, *Philosophy*, Vol. 31, No. 118, July 1956, pp. 266-67.

⁹⁰³ Meeting notice from Bates, WC/GC/179/B.14/Box 12.

⁹⁰⁴ Table 20: BBC Broadcasts.

third Reithian orator, Young's candidacy was controversial.⁹⁰⁵ For some, he was a refreshing novelty. For others, he was a brash, controversialist, upstart youth. Archie Clow's voice may have been decisive. Young's Reith performances vindicated both camps.

In his first lecture, Young argued that because communication defined humanity, and because the brain created communication, then brains and computers were analogues. His second lecture then characterised brains as information processing machines. In his third talk, he proceeded to describe brains as biological electronic computers. Next, he explained memory as the physical enactments of homeostatically regulated and feedback adjusted neurological connective patterning. In lecture five, he asserted the commonality of communicative control mechanisms in biological and social systems. Lecture six then described science as a constitutive communications system within which changes to scientific language changed the world it supposedly described. The seventh talk was a mechanistic rebuttal of vitalism in which organismic emergent behaviourism replaced reductionist materialism. Lecture eight dramatically predicted that electronic machines would enable direct communication between brains. Young published his Reith lectures as *Doubt and Certainty in Science*; in which he cited Ryle, and connected Turing and Wiener to the mathematisation of neurology.⁹⁰⁶

Inasmuch as he avowed a cyberneticist materiality of mind, Young was clearly implicated in the mid-century Cartesian controversy. However, he was less concerned with asserting

⁹⁰⁵ "Confidential memorandum: Professor J. Z. Young", Ronald Lewin, Organiser Third Programme Talks, to D. S. W., 17 Feb. 1950. "Reith Lecturer 1950", letter, Sir Robert Robinson to G. R. Barnes, Director of the Spoken Word, 2 Nov. 1949. "Suggestions for Reith Lecturer 1950", letter, B. H. Sumner to G. R. Barnes, Director of the Spoken Word, 20 Oct. 1949. All in file, "Talks Reith Lectures Advisory Panel", BBC/WAC/GB/898/BBC/R/PRR/R51/455

⁹⁰⁶ J. Z. Young, *Doubt and Certainty in Science: A Biologist's Reflections on the Brain: The B.B.C. Reith Lectures 1950*, (Clarendon Press, Oxford, 1951), pp. iv-v.

electronic and neurological computational equivalence philosophically, than with applying cybernetics as a new experimentalist scientific paradigm for biology generally, and neurophysiology particularly. Like many of the Ratio Club's members, he was more interested in deploying cybernetics than in developing it. Nevertheless, as a long standing anatomy professor at UCL, he also trained many generations of medical practitioners and biologists. His 1957 book, *The Life of Mammals*, became a standard text for all British students of medicine and biology. It acknowledged Cherry, MacKay and Sholl, and it was as deeply inscribed with cybernetics and information theory as his Reith Lectures had been.⁹⁰⁷ Young's cyberneticist inclinations were explicitly recognised, although not entirely approved of, in Julian Huxley's *Sunday Times* review of *The Life of Mammals*.⁹⁰⁸ Few, if any, of the Ratio Club's members matched the range or depth of Young's mediations of cybernetics and information theory into the knowledge corpus of life science.

Similarly, whilst Imperial was the substantive post-war British venue for the mediations of cybernetics and information theory into the teaching and researching of electronics and communications engineering, this was more because of Cherry and Gabor than Wescott. Perhaps Westcott expended his energy commercially, or, perhaps he discriminated between control and information theory. And, maybe, Porter's biographical lacuna suggested personality collisions. Nevertheless, and whatever the cause, although Imperial was the major venue for the British school of information theory, Westcott played scant part in it.

The fulcrum of Cherry and Gabor's agency in the construction of British information theory was their convocation of the three London symposia. Although they were staged extra-

⁹⁰⁷ J. Z. Young, *The Life of Mammals*, (Clarendon Press, Oxford, 1957), p. vii.

⁹⁰⁸ Huxley, J., "Mammalian Marvels", *Sunday Times*, 23 June 1957, p. 7.

institutionally because of their novelty and the paucity of internal resource, these symposia were, nevertheless, overt extensions of Imperial's electrical engineering department. Functionally, and uniquely, they had broadly the same relationships to information theory as the Macy conferences had to cybernetics. Most of the international attendance at the seven British events was here, not at the computer conferences, and the American attendance was especially significant; Shannon, Licklider, McCulloch, Selfridge and Pitts all attended one of three. BBC delegates also joined these symposia, but not the computer conferences. Wescott attended only one of the three, the first, which was conspicuously colonised by the Ratio Club.

Cybernetics and information theory were monozygotic epistemological twins. And, much of Gabor and Cherry's work was a praxical synthesis of the two. Nevertheless, the three London symposia expressed, and enacted, a rift between the probabilistic and neurologically focused information theoretic cybernetics prevalent within the Ratio Club, and the technologically generative fusion of quantitative information theory and cybernetics practiced at Imperial. The first London symposium in September 1950 was staged under the shadow of Jefferson's BBC broadcast of his 1949 Lister Oration, and it occurred just as the Cartesian computational controversy was approaching its performative crescendo. The Ratio Club dominated the event; epistemologically and constitutively. Markedly, only Little and McLardy were absent. Moreover, apart from this meeting, the only other event that Bates attended was Uttley's 1958 Teddington conference. Of the twenty talks at the symposium, members of the Ratio Club gave eleven.⁹⁰⁹ In the residuum, Shannon gave

⁹⁰⁹ Table 13: Papers at British Events.

three, and Gabor and Cherry one each. Unsurprisingly, the talks by the Ratio Club's members struck a predominantly neurophysiological note.

However, the second London symposium pivoted dramatically away from neurology and the Ratio Club, and veered sharply towards the electronic encoding of speech in telecommunication and broadcast technology. The third event further developed the information theoretic approach to electronically systematising language, and extended it to mechanised translation. Ratio Club attendance also pivoted. Only Good, MacKay and Woodward went in 1952; and only Hick, MacKay and Merton joined in 1955.⁹¹⁰

The technological orientation of British information theory after 1950 was as much a pivot towards the professional concerns of the principal protagonists and sponsors of the symposia, as it was an obvious evasion of association with the cyberneticist heterodoxy of electronic brains. The events were run by, and after 1950, for engineers, and the first two were directly supported by the BBC and the MoS. Moreover, the post-war British schism between computing and cybernetics was paralleled by an equally consequential, and connected, division between computing and information theory; albeit without the philosophical angst. Neither Wilkes, Williams, nor Kilburn, attended any of the information theory symposia. Indeed, the only one of the pioneers of British computing who did so was Andrew Booth at Birkbeck, and he had always stood apart from his colleagues, as they had from him. With negligible exceptions, Computers and computing in fifties Britain were epistemologically, spatially and sociologically compartmentalised within the scientised computational orthodoxy that was vigorously policed by their institutional gatekeepers.

⁹¹⁰ Table 15: Ratio Club & Other British Protagonists at British Events.

For the early British academic computational elite, the forbiddance of cognitive agency to computers was initially also extended to the denial of their communicative and informational agency. In fifties Britain, the socio-technical fusions of information theory, electronic telecommunications, computing, and cybernetics which constitute our contemporary cyber phenomenon were unthinkable to most conventional techno-scientific minds; although not entirely so to Gabor and Cherry.⁹¹¹ From the fifties through to the seventies, they each authored important scientific popularisations which explored the societal implications of information technology, computers and cybernetics. Although neither of them were cyberneticians, they were both influenced by *Cybernetics*, and more than any Ratio Club member, they mediated both its profound optimisms, and anxieties, into the popular British socio-technical imaginary.

For Cherry, the amelioration of burgeoning societal complexity required the development of increasingly sophisticated telecommunications technologies. His 1957 book, *On Human Communication*, both framed information theory humanistically, and posited communication and society as circular predicates, in order to argue that the electronic systems suggested by information theory were sociologically imperative.⁹¹² Relatedly, his 1959 inaugural professorial lecture at Imperial, both proposed telecommunications as a social science, and framed information theory as a branch of epistemology ripe for fusion

⁹¹¹ Nor to American minds untrammelled by British computational orthodoxy and untroubled by declinist angst. The modern idea of information technology (IT), as a fusion between cybernetics and information theory, and contra to computing as automated mathematics, originated in, H. J. Leavitt, T. L. Whisler, "Management in the 1980's", *Harvard Business Review*, Vol. 36, Iss. 6, Nov./Dec. 1958, pp. 41-48.

⁹¹² C. Cherry, *On Human Communication: A Review, a Survey, and a Criticism*, (Technology Press, MIT, 1957).

with semiotics.⁹¹³ However, in an obvious attempt to forestall accusations of cyberneticist scientific heresy, he also said that whilst biological and electronic information systems might seem analogous, nevertheless, thought, and the language expressing it, were exclusively human. Moreover, he believed, there were dangers. Socio-economic power outweighed technological determinism, and global electronic telecommunications were a necessary, but not sufficient, condition for progress. In 1971, he used his popular science book, *World Communication: Threat or Promise?*, to denounce technological determinism, utopianism and catastrophism alike.⁹¹⁴ By the seventies, Cherry was actively feeding strengthening British fears about societal techno-precarity and computerised oppression.

Gabor cried doom earlier, and more stridently, than Cherry. His 1959 inaugural professorial lecture at Imperial warned that advancing technology might as easily destroy civilisation, as usher a golden age of freedom, peace and plenty.⁹¹⁵ This cautionary oration received favourable notice from Wiener in the second edition of *Cybernetics*.⁹¹⁶ In 1960, *Encounter* published Gabor's lecture, which he then extended into the 1963 book *Inventing the Future*. Penguin re-published Gabor's book in Pelican in 1964, and re-printed it under the same imprint in 1972.⁹¹⁷ *Inventing the Future* gave even greater expression to Gabor's driven moral imperative than had his lecture, and in it he set out three technological paths; each of which he proclaimed could lead to either to salvation or destruction. Firstly, nuclear power

⁹¹³ C. Cherry, *Telecommunication as a Social Science: Inaugural Lecture November 3rd 1959*, (Imperial College/Modern Book Co, London, 1959).

⁹¹⁴ C. Cherry, *World Communication: Threat or Promise? A Socio-Technical Approach*, (Wiley, New York, 1971).

⁹¹⁵ D. Gabor, *Electronic Inventions and their Impact on Civilization: Inaugural Lecture March 3rd 1959*, (Imperial College/Modern Book Co, London, 1959). Tustin chaired both lectures.

⁹¹⁶ Wiener, *Cybernetics*, 2nd edn. 1961, (MIT Press, Cambridge, 1965), pp. xi, xii, 178, 180.

⁹¹⁷ D. Gabor, *Inventing the Future*, (Secker & Warburg, London, 1963), (Pelican, London, 1964, 1972).

would deliver limitless power; or extinction.⁹¹⁸ Secondly, computerised automation would bring cornucopia; or Malthusian collapse. Thirdly, even if automation abolished want, it would then herald either Classical leisure; or torpid decadence. Gabor happily aligned with Lewis Mumford in echoing that variety of optimistic humanism which spurned both the fatalistic descent of capitalism to barbarism, and the illusory ideological certitude of Marxism. Gabor also returned Wiener's favour, agreeing that the cyberneticist Second Industrial Revolution would, if ungoverned, render humanity an alienated irrelevance. Gabor dedicated the Pelican of *Inventing the Future* to Aldous Huxley, using both *Brave New World* and *1984* to illuminate his dystopic forebodings.⁹¹⁹ For Gabor's readers, cybernetics proclaimed Big Brother, not Prometheus.

Such anxieties did not trouble Giles Brindley. After joining the Ratio Club's Cambridge meeting in 1952, he then vanished from the scenes of British cybernetics, computing and information theory. He was neither proposed for Ratio Club membership, nor was he a recorded delegate at any of the international or domestic events examined here. However, whilst his sociological brush with cybernetics was glancing, his epistemological encounter with it was profound. In 1968, the MRC appointed him to lead its new Neurological Prosthesis Unit which went on to pioneer radical techniques for bypassing irremediable neurological damage by anatomically integrating electronic implants that enabled direct autonomic operation of computer controlled external prosthesis by living nerves.⁹²⁰

⁹¹⁸ Gabor was an early advocate of fusion over fission.

⁹¹⁹ Gabor, Chapter 8, "Men and Machines", *Inventing the Future*, (Pelican, 1972), pp. 14, 16, 89-110.

⁹²⁰ P. E. K. Donaldson, "Twenty Years of Neurological Prosthesis-Making", *Journal of Biomedical Engineering*, Vol. 9, Iss. 4, Oct. 1987, pp. 291-98.

By the late seventies, dramatic news was emerging from Brindley's unit. In 1978, the *Sunday Telegraph* reported on computer controlled prosthetic cameras that were wired directly into the brain.⁹²¹ In 1987, the *Telegraph* noted further developments of this cybernetic visual sensor.⁹²² In 1996, the *Times* reported on the case of Peter Gannicott. His tetraplegia had been remediated by his direct thought control of assistive devices via a computer wired to his brain.⁹²³ BBC TV's *Tomorrow's World* ran the same story.⁹²⁴ That year, the *Sunday Times Magazine* featured Julie; a patient whose lower limb paralysis was partially overcome by a computer controlled electronic neurological bypass which was activated wirelessly by a wheelchair mounted button. When Julie pushed the button she stood up.⁹²⁵ In 2000, the *Telegraph* reported that, in America, the Dobelle Institute's work on Internet connected computerised visual prosthesis had been inspired by Brindley's research.⁹²⁶ Future cyborgs will be as indebted to Brindley's fusions of humans and cybernetics as humanists may be repelled by it.

Like many others, Christopher Strachey's war-time radar research work had imbued him with an initial receptivity to *Cybernetics*, which, serendipitously, he had read shortly before hearing Turing's contribution to the BBC's *Automatic Calculating Machines* series of radio talks in 1951. Strachey wrote to Turing, enthusiastically declaring his support for cybernetics on 15 May, the very day of the broadcast itself.⁹²⁷ Within the year, Strachey was

⁹²¹ S. McClelland, "Building Sight in the Laboratory", *Sunday Telegraph*, 15 Jan. 1978, p. 37.

⁹²² R. Highfield, "Probing the Mind's Eye, Artificial Sight on the Horizon", *Telegraph*, 2 Feb. 1987, p. 3.

⁹²³ A. Ahuja, "The Power of Thought: Will the Paralysed be able to Communicate with Computers Merely by Thinking?", *Times*, 2 Sept. 1996, p. 14.

⁹²⁴ *Tomorrow's World*, BBC One, 4 Sept. 1996, 19:30, BBC Programme Index, https://genome.ch.bbc.co.uk/schedules/service_bbc_one_london/1996-09-04, [26 Nov. 2023].

⁹²⁵ R. Eggar, "This Woman is Paralysed from the Waist Down: A Small Step for Julie, A Huge Leap for Medical Science", *Sunday Times Magazine*, 21 Jan. 1996, pp. 26, 29.

⁹²⁶ R. Highfield, "Blind Man Learns How to 'See' Again with Artificial Eye", *Telegraph*, 18 Jan. 2000, p. 2.

⁹²⁷ Letter, Strachey to Turing, 15 May 1951, TK/GBR/0272/AMT/D/5.

also on the BBC, giving two Home Service talks on “Control Without Men”, both produced by Clow.⁹²⁸ These were introduced by Strachey, and announced by the BBC, as explanations of cybernetics.⁹²⁹ Strachey’s first script was also annotated as “Cybernetics”; in the same hand as Turing and Wilkes’ contributions to the *Automatic Calculating Machines* series had been.⁹³⁰ Strachey’s talks discussed the commonalities between mechanical and biological control and communications systems, and the correspondences between brains and electronic computers. And, although he equivocated their cognitive equivalence, he nevertheless accepted both their functional systemic similarity, and the behaviourist comparisons between computers and biological intelligence. Recognising that computers outperformed brains, he predicted profound sociological transformations. However, by 1954, Strachey had ceased to even equivocate about thinking computers. Writing in *Encounter*, he decried cognitive equivalence, and asserted mechanistic passivity.⁹³¹ He now said that computers depended upon uniquely creative humans for the programmes upon which their activation depended. However, his foreboding of cyberneticist societal upheaval had strengthened.

Strachey’s *Encounter* essay overlapped with the outbreak of the mid-century moral panic about automation, and with the second edition of Wiener’s *The Human Use of Human Beings*, the sociological sequel to *Cybernetics*.⁹³² Like H. D. Turner, a Sheffield science lecturer who was compelled to write to the *Times* on the subject, Strachey mobilised

⁹²⁸ C. Strachey, *Science Survey*: “Control Without Men”, BBC Home Svc., [1/2], 1 May 1952, 22:30, [2/2], 8 May 1952, 22:30.

⁹²⁹ C. Strachey, “Control Without Men: Calculating Machines and the Brain”, [2/2], BBC/WAC/GB/898/BBC/R/RPAB/T464.

⁹³⁰ C. Strachey, “Control Without Men: Controlling Machines”, [1/2], BBC/WAC/GB/898/BBC/R/RPAB/T464.

⁹³¹ C. Strachey, “The “Thinking” Machine”, *Encounter*, Oct. 1954, pp. 25-31.

⁹³² N. Wiener, *Human Use*, 2nd edn., (Eyre & Spottiswoode, London, 1954).

Wiener's prophesy of computerised automatons replacing minds in a second Industrial Revolution.⁹³³ However, whereas Turner and Wiener merely foresaw automated factories, Strachey also predicted automated offices in which electronic computers replaced human clerks. For Strachey, office work was already the mindlessly rote human enactment of prescriptive rules. Systemically, therefore, offices were already information factories. Consequently, because such programmatised human behaviour was logically describable, computers could be programmed to replace these human machines.

Harmonising with the technocrats of industrial automation, Strachey preached a positivist and ineluctable technological determinism; computers were indubitably Progress. Nevertheless, he professed awareness of the unfortunate, yet necessary, price that such advancement exacted. Strachey anticipated that within the decade, clerical computerisation would erase around a million jobs. However, he also predicted that the inevitable productivity gains from office automation would be sufficient compensation. Moreover, he said, as most of the lost jobs would atrophy as computers replaced the women who married out of the labour market, no real harm would occur; men would remain breadwinners. Also, computers could only repeat mindless tasks. So those elite male professions and occupations that required higher mental functions were reassuringly invulnerable to computerisation. Strachey anointed university academics, and computer engineers and programmers, to this irreplicable male elect.

In June 1952, shortly after his cyberneticist BBC talks, Strachey became a technical computer specialist at the NRDC. Although the NRDC was a government organisation, and

⁹³³ H. D. Turner, "The Automatic Factory: A New Industrial Revolution", *Times*, 8 Nov. 1954, p. 7.

Strachey was a civil servant not an academic, nevertheless he was assimilated within the sociological influence field of scientific computing orthodoxy. His living, and his professional identity, now came from programming computers. The renunciation of machine cognition in *Encounter* had evidenced the operation of sociologically administered epistemological antibodies to cybernetics. However, in the same essay, Strachey had also recognised that his projected clerical deployment of computers departed from their prevailing institutional and epistemological locations as laboratory mathematics machines. This divergence had originated in his fleeting cyberneticist enthusiasm. The idea of computers processing information in socio-economic settings derived from Wiener; not from Wilkes, Williams and Kilburn. Strachey's computational heterodoxy was also framed by the NRDC's mission to boost economic growth and productivity through technology transfers from government research to commerce. Strachey's early cybernetics inspired ideas about office automation helped prepare for later public and private sector clerical computerisations.

Outward Trajectories: The Other Cyberneticians

Gordon Pask, Alex Andrew, Stafford Beer and Frank George emerged and developed as cyberneticians without, and beyond, the Ratio Club; although, they were all eventually offered as candidates for membership of its abortive successor. Moreover, only Beer encountered war-time proto-cybernetics directly, and then only glancingly. Andrew's post-war radar work post-dated *Cybernetics*; Pask was at school until 1949; and George served as an RAF pilot and administrator. However, more than any Ratio Club member, except Ashby, cybernetics transformed all of their professional, intellectual and personal identities.

For these four, cybernetics surpassed career enhancement or intellectual amusement; it became a cause. For Pask and Beer especially; it became their life. Friendships amongst the four were deep and enduring, far more so than those that typically formed within the Ratio Club itself, and after 1958 this tiny group constituted the only sociologically and epistemologically transmissive locus of British cybernetics. Nevertheless, they were a loosely bound formation whose nebulous collectivity mirrored their individual sociological and institutional liminalities.

Pask was especially enthusiastic in his embrace of this marginality, and he integrating it with his exquisitely crafted persona of romantic eccentricity to curate the identity of a visionary, driven by genius, to rapture. His membership of the Cambridge Footlights had nurtured his theatricality, and he performatively advertised his lifelong flamboyance with his exaggeratedly formal dress, which he regularly accented with a cape. His anaesthetist brother procured him the drugs to which he became habituated, and copious intakes of amphetamine fuelled his famed capacity for frenetically sleepless work. In a frame where cybernetics attracted misfits who eschewed intellectual and cultural normativity, Pask was an ideal type; cybernetics legitimised his idiosyncrasies by formalising his otherwise dilettante eclecticism. There was certainly no epistemological immanence in cybernetics towards liminal or counter cultural practice; hence its Soviet adoption as an ideologically sanctioned state science. However, equally clearly, cybernetics easily drew those who sought to credentialise personal or political philosophies of dissent.

The union of Pask's undergraduate surrealist sensibilities with cybernetics and war-surplus electronics produced MusiColour; a sound to light machine that instantiated a performative feedback loop with the musician. Amateurish early fifties commercial tours of MusiColour

to pubs and nightclubs flopped. As did the attempted sale of MusiColour to Billy Butlin as a holiday camp attraction. Thereinafter, Pask became a globe-trotting itinerant; a perpetually peripatetic free-lance cybernetician consultant, researcher, inventor, lecturer and theoretician. In later life, Pask was a cherished member of the international cybernetics movement; chairing the British Cybernetics Society from 1976 to 1979, and receiving the Norbert Wiener Gold Medal from the American Cybernetics Society in 1984. However, by then, this international fraternity was atrophying in obscurity. The cyberneticist sociologies within which Pask became acclaimed were communions of consolation and refuge, which were sustained by a devout yet dwindling conclave of true-believers.

Pask's first public appearance as a cybernetician was in September 1958, at the second international cybernetics conference in Namur, directly after which he spoke and exhibited at Uttley's NPL event in November. In June 1961, he joined the Illinois Self-Organisation symposium, alongside Ashby, Beer, McCulloch, Rosenblatt, von Bertalanffy, and Hayek; after which he journeyed to the third Namur gathering in September.⁹³⁴ By the early sixties, he and cybernetics were surfacing within the nascent British counterculture. Around 1963, theatre director Joan Littlewood, and architect Cedric Price, invited Pask into their Fun Palace; a project to construct a public architecture within which both occupants and building would adaptively interact. Pask accepted the invitation, and convened the Fun Palace Cybernetics Committee.⁹³⁵ Alas, the Fun Palace never was. However, architecture left its mark, and Pask became a regular lay teacher at the Architectural Association in London.⁹³⁶

⁹³⁴ H. von Foerster, G. W. Zopf (eds.), *Principles of Self-organization: Transactions of the Illinois Archives Symposium on Self-organization, Robert Allerton Park, 8 and 9 June 1961*, (Pergamon, Oxford, 1962).

⁹³⁵ S. Mathews, “Where Does the Idea Come From? In the Beginning There was Joan and Cedric ...”, *Fun Palaces*, www.funpalaces.co.uk/about-fun-palaces/where-does-the-idea-come-from/ - :~:text=In 1961 Joan Littlewood and,or great centres of learning, [27 Jan. 2023].

⁹³⁶ J. H. Frazer, "The Architectural Relevance of Cybernetics", *Systems Research*, Vol. 10, No. 3, 1993, pp. 43-48.

In 1969, he published an influential paper in which he called for the assimilation of cybernetics into architectural practices.⁹³⁷ Pask was not a unique vector for this idea; Nicholas Negroponte's MIT Architecture Machine Group and his Media Lab were more than spatially proximate to Wienerian influences. Nevertheless, Pask became an important cyberneticist influence on architectural theory.⁹³⁸ However, as with cybernetics generally, Pask's architectural sojourn is largely forgotten.

In 1968, Pask and cybernetics jointly gravitated further toward the British countercultural artistic centre. Jasia Reichardt, a leading art curator and critic, invited him to exhibit at her *Cybernetic Serendipity* exhibition at London's Institute of Contemporary Arts.⁹³⁹ In his "Colloquy of Mobiles", an immersively interactive large mobile installation, human occupants simultaneously altered, and were acted upon by, the sculpture's behaviour. Reichardt's landmark *Cybernetic Serendipity* built on *This Is Tomorrow*; a 1956 Whitechapel Art Gallery exhibition staged by the Independent Group of young British artists.⁹⁴⁰ During two meetings at the ICA, one in 1952 another in 1954, the Independent Group wove cybernetics and information theory into its American inspired, dissident, techno-modernist imaginary.⁹⁴¹ *This Is Tomorrow* trailblazed for British Pop Art.⁹⁴² Reichardt's 1968 *Cybernetic Serendipity* followed where it had led, and her show

⁹³⁷ G. Pask, "The Architectural Relevance of Cybernetics", *Architectural Design*, Iss. 7, No. 6, Sept. 1969, pp. 494-96.

⁹³⁸ F. Torisson, "The Cybernetic Hypothesis and Architecture", *Histories of Postwar Architecture*, Vol. 1, Iss. 1, Jan. 2017, doi.org/10.6092/issn.2611-0075/7208, [27 Jan. 2023].

⁹³⁹ R. Usselman, "The Dilemma of Media Art: Cybernetic Serendipity at the ICA London", *Leonardo*, Vol. 36, No. 5, 2003, pp. 389-96.

⁹⁴⁰ T. Crosby (ed.), *This Is Tomorrow*, (Whitechapel Art Gallery, London, 1956).

⁹⁴¹ A. Massey, *The Independent Group: Modernism and Mass Culture in Britain, 1945-59*, (University Press, Manchester, 1995).

⁹⁴² D. Robbins (ed.), *The Independent Group: Postwar Britain and the Aesthetics of Plenty*, (MIT Press, Cambridge, 1990).

foregrounded machine made art to both deconstruct the binary distinctions between humans and computers, and to subvert the exclusionary claims of exceptionalist human creativity. The brochure acknowledged advice from Gabor, McCulloch and Strachey, and recognised direct contributions from Beer, Good and Pask. It also featured an excerpt from *The Human Use of Human Beings*, alongside Wiener's digitised and computer generated portrait. The bibliography listed Ashby, Cherry, McCulloch, Pask, Sluckin, Walter and Wiener.⁹⁴³ As with architecture, Pask was neither singular nor pivotal to the artistic mediation of cybernetics. However, here he was both integral to, and illustrative of, a far larger picture.

Although Pask was an extreme illustration of cyberneticist heterodoxy and liminality, he was not unique. Alex Andrew's 1957 move to Uttley's NPL department could have inaugurated a lifelong government research career. However, his personality and cybernetics conspired otherwise. Andrew's intemperate impatience had already piqued his initial departure from Glasgow for Teddington. Then, by 1962, his rising anti-authoritarian indignation dramatically sundered him from the NPL. Civil Service restrictions had already chafed Andrew, even before his formal reprimand for extending an official trip to America to pay an unofficial visit to McCulloch without prior authorisation. Next, he was censured by the NPL for negotiating an unauthorised overseas scholarship. An argument, and his resignation, ensued. Thereinafter, Andrew's employment opportunities narrowed considerably. He was manifestly unbiddable to corporatist conformity, and in 1962, Britain afforded vanishingly few opportunities to practice cybernetics professionally. There was a lone ergonomics and cybernetics department at Loughborough University, but this was then

⁹⁴³ J. Reichardt (ed.), *Cybernetic Serendipity: The Computer and the Arts: A Studio International Special Issue*, 2nd edn., (Studio International, London, Sept. 1968), pp. 5-7, 9, 16.

barely two years old and little known even to British cyberneticians.⁹⁴⁴ However, even had Andrew known of this, its subordination of cybernetics to ergonomics would have been unappealing. Wienerian cybernetics set Andrew on a tight occupational path.

After the NPL, Andrew joined SIGMA in Croydon where Beer, his friend, was the managing director.⁹⁴⁵ SIGMA grew, for a while, but Andrew did not thrive commercially. He spent the academic year of 1964 to 1965 in the Illinois Biological Computing Laboratory with Ashby and Heinz von Foerster on US Air Force funding. Returning to Britain, Andrew joined the newly formed cybernetics department at Reading. However, Reading's cybernetics degree was orientated towards mathematics and the electronic instrumentation of control theory, and it was not to Andrew's taste. His teaching there was endured not enjoyed. However, apart from Loughborough, there were only two other academic possibilities. One was a computing, cybernetics and management department at Brighton Technology College created in 1965.⁹⁴⁶ The other was a cybernetics department at Brunel which had been salvaged from the wreckage of Beer's grand attempt to found a cybernetics institute there in 1968. Andrew knew about the Brunel department but decided not to join it. He stayed at Reading until he was retired early in a Thatcherite cost-cutting exercise.

Andrew then followed a similar path to Pask, and he became a freelancing cybernetician immersed in the sociologies of sanctuary harboured within the introspected, contracting, and dissipated international cybernetics movement. Significantly, he was the Director General

⁹⁴⁴ "Prestigious Role for University Ergonomist", 15 April 2014, www.lboro.ac.uk/internal/news/2014/april/prestigious-role-for-university-ergonomist.html, [28 Oct. 2022].

⁹⁴⁵ S. Beer, "SIGMA", *Operational Research*, Vol. 16, No. 3, Sept. 1965, pp. 275-85.

⁹⁴⁶ "Technology College to Aid Industry", *Telegraph*, 31 May 1965, p. 22. "Classified Advertising, Educational Courses", "Brighton Education Committee: Brighton College of Technology, Department of Computing, Cybernetics and Management: Diploma in Management Studies", *Financial Times*, 3 Feb. 1967, p. 22.

of the World Organisation of Systems and Cybernetics (WOSC) from 2004 to 2011.⁹⁴⁷ And, symptomatically, the WOSC had coalesced in 1969 as an attempt to cohere the already isolated fragments of the international cyberneticist diaspora. Ultimately, Andrew accomplished a functional reconciliation between the independence of mind which cybernetics required of its adherents on the one hand, and the salaried confinements of academic discipline and demarcation on the other; but at a price. Reluctantly, he tolerated institutional formalism rather than risk the uncertainties of a Paskian hand to mouth existence; at least for the long middle of his career. However, the bored lecturer was but a faint shadow of the young researcher on the frontier of a new science who had told the elite Cold War gathering at Teddington in 1958 that electronic computers would finally reveal the secret workings of the human mind.

Stafford Beer's shallow encounter with proto-cybernetics came when his war-time Army commission accidentally and briefly brushed him against OR and PR. Nevertheless, even before reading *Cybernetics* as a trainee production manager at United Steel in Sheffield, Beer had already established an OR group at Samuel Fox, the United subsidiary where he served his apprenticeship under Sidney Howes' tutelage. In 1956, buoyed by Howes' support and inspired by Wiener, Beer established the Department of Operational Research and Cybernetics in Cybor House, with a remit spanning the entire United Steel group.⁹⁴⁸ He also bought a Ferranti Pegasus computer for his department, and became a pioneer in both the computerised simulation of linear industrial processes and computer controlled automation. He debuted as a cybernetician at the first international cybernetics conference in September 1956, which he had probably seen advertised in *Automation News*. Beer gave

⁹⁴⁷ <http://wosc.co/history/>, [28 Oct. 2022].

⁹⁴⁸ 'Cybor' was Stafford's portmanteau of 'cybernetics' and 'OR'.

three papers at Namur, one in the first section on the principles of cybernetics, and two in the third section on automation.⁹⁴⁹ And, he met Walter, one of the event's organisers.

By March 1957, Beer had also separately befriended Ashby and Pask. He invited them both to attend his George Bray Memorial Lecture in Sheffield; partly for moral support, and partly to bring them together for the first time.⁹⁵⁰ As was normal for Beer, these two friendships were both deeply cherished; although, he was also especially fond of his long and lubricated nocturnal discussions with Pask, whom he credited with introducing him to McCulloch.⁹⁵¹ Beer probably met Frank George, who taught at Bristol until the late sixties, through Walter. Beer's diary of his first trip to America in 1960 was published in 1994.⁹⁵² In his introduction to the belated publication, Beer recalled that he was already friends with George, Walter and MacKay well before his 1960 trip, and that he already knew McCulloch sufficiently well for him to have been his house guest in Sheffield.⁹⁵³ The diary itself recorded Beer's first meeting with Wiener. Reportedly, Wiener greeted Beer with great warmth and proclaimed him as the prime mover in European cybernetics.⁹⁵⁴ Evidently, Beer's ego was sufficient to bear his larger than life personality. However, Wiener's accolade was not unwarranted.

⁹⁴⁹ *Proceedings of the First International Congress on Cybernetics: Namur 26th-29th 1956*, (International Association for Cybernetics, Namur, 1958): S. Beer, "Operational Research and Cybernetics", pp. 29-45; S. Beer, "A Technical Consideration of the Cybernetic Analogue for Planning and Programming", pp. 512-34; S. Beer, "The Impact of Cybernetics on the Concept of Industrial Organization", pp. 535-54.

⁹⁵⁰ S. Beer, "The 1956 George Bray Memorial Lecture: The Scope for Operational Research in Industry: Presented to the Institution in the Sheffield City Memorial Hall, 18 March 1957", *Institution of Production Engineers Journal*, Vol. 36, Iss. 5, May 1957, pp. 298-320. S. Beer, "A Filigree Friendship", *Kybernetes*, Vol. 30, No. 5/6, July 2001, pp. 551-60.

⁹⁵¹ S. Beer, "Requisite Ross", typescript obituary marked "For Publication in a Special Edition of *Forum*, a Journal of the American Society for Cybernetics", LJMU/SB/1/130. S. Beer, "A Filigree Friendship", *Kybernetes*, Vol. 30, No. 5/6, pp. 551-60.

⁹⁵² S. Beer, "Retrospect-American Diary, 1960", in R. Harnden, A. Leonard (eds.), *How Many Grapes Went Into the Wine: Stafford Beer on the Art and Science of Holistic Management*, (Wiley, New York, 1994), pp. 229-309.

⁹⁵³ *ibid.*, p. 229.

⁹⁵⁴ *ibid.*, p. 281.

As had been the case with Andrew at the NPL, Beer's United Steel appointment could have been a job for life. And, again likewise, character and cybernetics colluded to ensure otherwise. Both Beer's expansive personality and his exuberantly independent mind were unsuited to the corporate conservatism and inert industrial hierarchy of fifties Britain. So, as it had done for Pask, cybernetics then furnished Beer with an externalised and scientised epistemology that articulated and legitimised his personal intellectual and sociological heterodoxies. Beer's embrace of cybernetics became increasingly fervent. Within four years of its creation, he had expanded his United Steel OR and cybernetics group to a staff of seventy, and it had become the second largest corporate OR practice and the only avowed industrial cybernetics group in fifties Britain. Beer's remarkable achievement required unrelenting drive and formidable force of mind, and the end came abruptly when Beer overreached himself by attempting to entirely remake his employer in his own, cyberneticist, image. In January 1960, Beer co-authored an internal report on *The Cybernetic Factory*.⁹⁵⁵ This explosive text proposed the wholesale transformation of United Steel into an environmentally interconnected, homeostatic, self-adaptive and self-regulating organism, governed by a computational neurological system. Shortly thereafter, Beer and United Steel parted company.

In 1961, Beer formed SIGMA; a Croydon based company that materialised a joint venture between the French firm Societe d'Economie et de Mathématique Appliquées and the British

⁹⁵⁵ S. Beer, T. P. Conway, H. J. Hirst, D. A. Hopkins, M. Scott, "The United Steel Companies, Department of Operational Research and Cybernetics: Report No. 66/TRM/1/4. The Cybernetic Factory", LJMU/SB/Box 4, United Steel.

owned Martech Consultants.⁹⁵⁶ Beer was appointed as SIGMA's Managing Director, and its unique blend of management consultancy, OR, and cybernetics expressed his equally singular constructions of mind and personality. For a time, SIGMA prospered. It secured a succession of one-off exploratory domestic contracts with clients such as British Rail and the Gas Council, and some small government engagements in countries such as Yugoslavia and Israel. However, by 1966, Beer felt that the direction and control desired by SIGMA's French majority owners was becoming increasingly irksome. He left SIGMA and joined the International Publishing Corporation (IPC), a SIGMA client, as their development director. Beer left the IPC in 1969. Thereinafter, like Pask and Andrew, he went freelance. He also became a Catholic apostate, embraced Buddhism, pivoted to the radical left, and divorced.

SIGMA ceased trading in 1970, and it left no discernible traces in the contemporary British practices of management consultancy.⁹⁵⁷ However, crucially, SIGMA had worked in Chile, where it had advised the government on a restructuring of the railways and steel production. SIGMA hired Fernando Flores, a young Chilean engineer with OR training, to assist them.⁹⁵⁸ Flores then became the Technical General Manager of Chile's State Development Corporation in Salvador Allende's socialist government. In July 1971, Flores invited Beer to become a scientific advisor to Allende's government. Beer accepted, and under the CIA's veiled yet vigilant eye he undertook an application of cybernetics, complete with automated computerised control, to the socio-economics of an entire nation state in pursuit of

⁹⁵⁶ S. Beer, "SIGMA", *Operational Research*, Vol. 16, No. 3, Sept. 1965, pp. 275-85. SIGMA stood for Science in General Management.

⁹⁵⁷ S. Beer, "Roger Tatham Eddison: An Appreciation", *Journal of the Operational Research Society*, Vol. 51, Iss. 8, 2000, pp. 1004-07.

⁹⁵⁸ E. Medina, *Cybernetic Revolutionaries: Technology and Politics in Allende's Chile*, (MIT Press, Cambridge, 2014), pp. 30-31.

socialism.⁹⁵⁹ This endeavour became known by its English name as Project Cybersyn; a portmanteau of ‘cybernetics’ and ‘synergy’. In Chile it was known as *Sistema de Información y Control*, or *Synco*.

According to Beer, Wiener himself affirmed his paternity of management cybernetics. And, Beer’s alacritous self-promotion notwithstanding, his parenthood is unquestionable. After leaving United Steel, Beer devoted his prodigious energy to forging a theoretical synthesis of OR, systems theory and cybernetics, which he then applied to the structure, operation and management of economic activity. Intellectually, this was productive. Beer had published *Cybernetics and Management*, his first essay on the subject, shortly before departing from Sheffield.⁹⁶⁰ Subsequently, Beer then titularly unified his two most important books with the serial prefix, *The Managerial Cybernetics of Organisation*. The first of these, *Brain of the Firm*, appeared in 1972.⁹⁶¹ And the second, *The Heart of Enterprise*, followed in 1979.⁹⁶² Beer infused the second edition of *Brain of the Firm* with lessons from his Cybersyn experiences.⁹⁶³

The central thesis of Beer’s management cybernetics was his idea of the Viable System Model (VSM). This proposed a five layered modular organisational architecture of extensible, system-theoretic, functional units that were scaffolded by biological and computational metaphors, and unified by both first and second order cybernetic theories.

⁹⁵⁹ *ibid.*, p. 43.

⁹⁶⁰ S. Beer, *Cybernetics and Management*, (English Universities Press, London, 1959).

⁹⁶¹ S. Beer, *The Managerial Cybernetics of Organization: Brain of the Firm*, 1st edn., (Allen Lane, London, 1972).

⁹⁶² S. Beer, *The Managerial Cybernetics of Organization: The Heart of Enterprise*, (Wiley, Chichester, 1979).

⁹⁶³ S. Beer, *The Managerial Cybernetics of Organization: Brain of the Firm*, 2nd edn., (Allen Lane, London, 1981).

However, Beer's intellectual novelty left mainstream management theory unperturbed, and any residual knowledge about the VSM soon faded within the tightening circles of the dwindling cyberneticist *cognoscenti*. Nevertheless, as the stochastic complexities of the cyber domain continue to proliferate across our contemporary socio-technics, it may prove worthwhile to revisit Beer's long neglected ideas.

Like many of the youthful managerialist technocrats of the New Jerusalem, Beer was energised by rational planning. Cybernetics, a science rooted in the same epistemological and ontological ground as OR, found him and uncountable others instantly receptive. Many of these technocrats read *Cybernetics*, and some would also have read *Automation News* and *Science News*. Many more of them would have heard Wiener, Turing, Young, Walter, MacKay and Strachey on the BBC. However, they lacked any manifest pathways into the limited and liminal sociologies of post-war British cybernetics. These extra-institutional formations and venues were exclusionary sealed units which were overwhelmingly inhabited by the already networked veterans of war-time proto-cybernetics. Almost uniquely, Beer gained entry to these sancta through the sheer force of his personality and intellect. However, the innumerable and unknowable others missed the very cybernetics society that had been proposed by Ashby, and refused by Bates and the other members of the Ratio Club.

Like those immeasurable others, Beer had encountered *Cybernetics* beyond the southern, metropolitan, quasi-academic venues of British cybernetics, computing and information theory. And, initially, without meeting Wiener or McCulloch; although, Sheffield did have books and radios capable of receiving the BBC's transmissions. Remarkably, unlike those lost others, Beer inserted himself into these esoteric sociologies as a cybernetician on his own terms. And then, exceptionally, he also devised a new form of cybernetics itself.

The unfinished Cybersyn system was obliterated, along with Chilean democracy, in Pinochet's CIA backed coup. However, before Cybersyn descended into the unlight mausoleum shrouding the victims of American Cold War covert operations, the British press found out about it. In January 1973, the *Observer* ran a story that framed Cybersyn as a hitherto clandestine attempt at computer controlled Marxism.⁹⁶⁴ The Orwellian cadences were made explicit. In seventies Britain, for left and right alike, the toxic socio-technics that were conjured when cybernetics and computers fused belonged to Big Brother.

Already deeply disillusioned with corporate conformity, after the destruction of Cybersyn Beer retreated even further from societal normativity. He renounced consumerism, bought a remote stone cottage in Wales, made his own furniture and drew his water from a well.⁹⁶⁵ Like Pask, Beer then generated his income from peripatetic academic practice, and he held positions at Manchester University, Liverpool John Mores University and the Open University. And, like Pask and Andrew, Beer was honoured amongst cyberneticians. The American Cybernetics Society awarded him their 1970 McCulloch Plaque, and he received the 1984 Norbert Wiener Memorial Gold Medal from the WOSC, an organisation which he then presided over from 1987 to 2002. He also served as the president of both the General Systems Research and OR societies. However, in his own words, he was also a "British dissident", driven to self-imposed "exile" through his increasingly ardent socialism.⁹⁶⁶ Ultimately, despite his commercial success, his innovative theories, and his consequential

⁹⁶⁴ N. Hawkes, "Chile Run by Computer", *Observer*, 7 Jan. 1973, p. 4.

⁹⁶⁵ Stafford Beer CV, LJMU/SB/Box 80.

⁹⁶⁶ S. Beer, "I Am the Emperor-and I Want Dumplings", *Systems Practice*, Vol. 2, No. 3, 1989, p. 284.

entanglement with Cold War geo-politics, Beer exemplified the expulsion of cybernetics from the British intellectual, commercial, industrial and social mainstreams.

By comparison with Pask and Beer, Frank George was remarkably unremarkable.⁹⁶⁷ From 1949 to 1964, he taught in the psychology department at Bristol University. Then, for four years, he sold cyberneticist training as the Managing Director of the short-lived Educational and Scientific Developments company. In 1968, he returned to academia as the inaugural professor of cybernetics at Brunel, where he remained until his retirement in the eighties. Along the way he advised NATO about computers, worked for Imperial Tobacco, and attained Fellowship of both the Royal Statistical and the British Computer societies.

George found it relatively easy to root himself in the sociologies of British and American cybernetics. Unlike Beer in distant Sheffield, George's post-war employment in Bristol had delivered him directly into Walter's circle. And, in his 1959 book *Automation, Cybernetics and Society*, he thanked Beer, Walter, Ashby, Uttley, Cherry, MacKay, Tustin, Porter and Wiener in terms that connoted both personal and intellectual familiarity.⁹⁶⁸ However, he was not one of Walters 'conference scientists' and he attended only the 1961 Namur event.

Whilst George was neither expansively extrovert, flamboyant, incontinently idiosyncratic, temperamental, professionally liminal, or drug addicted; nevertheless, his lifepath as a practicing cybernetician was inevitably trammelled by the same constrictions as those who were. British cybernetics was too shallow rooted and too marginalised for this to be

⁹⁶⁷ Apart from biographical snippets in his books and articles, George's only biography is, M. Elstob, "Frank George: A Personal Appreciation", *Kybernetes*, Vol. 27, No. 1, Feb. 1998, pp. 23-5.

⁹⁶⁸ George, *Automation*, frontmatter.

otherwise. Ultimately, the fates of the four British cyberneticians were anchored to the circumscription of British cybernetics, rather than to their individual constructions of self.

According to Beer, by the mid-sixties Pask, George and he had despaired of ever feeling Harold Wilson's vaunted technological 'white heat'. By 1968, George and Pask were poised to emigrate to America. An incensed Beer sought to galvanise government support for his own national computing strategy. Although his appeal to the state fell on deaf ears, the indignant but undaunted Beer persuaded both the IPC board and Brunel's inaugural vice-chancellor to support his idea for a National Cybernetics Centre at the new university. However, on the eve of a lavish fundraising dinner for the venture, hosted by Lord Mountbatten, the IPC underwent a board room coup which instantly defenestrated Beer and his allies.⁹⁶⁹ The Savoy dinner plummeted into chaos. Mountbatten's patronage had drawn the gaze of the Establishment to a cybernetics inspired initiative which had descended into public farce.

The cybernetics centre, which was to have employed Pask, George and Ashby, evaporated. All that could be salvaged was the money that had already been irrevocably committed to Brunel by the IPC; which was just sufficient to establish George's professorship, and Pask's visiting lectureship. Brunel's cybernetics department limped on until the early eighties when the Conservative government's education cuts finally forced its merger with the departments of electrical engineering and electronics. George accepted his redundancy. He then became an associate editor of *Kybernetes*, the official journal of the world cybernetics movement,

⁹⁶⁹ S. Beer, "A Filigree Friendship", *Kybernetes*, Vol. 30, No. 5/6, pp. 551-60.

and he joined the other British cyberneticians as he retreated into the same decaying international cyberneticist residuum.

Like cybernetics, George vanished into obscurity. And, also like his subject, his invisibility is a poor reflection of historical importance. After his initial forays into the tumults of electronic brains and automation, and following some less adventurous academic papers on cybernetics and psychology, George started penning public and popular science. In 1961, just as cybernetics was surfacing across the counterculture, he made his breakthrough with *The Brain as a Computer*; a book that delivered a serious yet accessible application of cybernetics to the neurophysiology and psychology of behaviour.⁹⁷⁰ As George continued to proselytise cybernetics and computers across the sixties, his books became increasingly political and interventionist.

By 1970, in both *Computers, Science and Society* and *Science And The Crisis In Society*, he was articulating the burgeoning fear that the ongoing misuse of science and technology was broadening and deepening the already unacceptable iniquities of wealth and power.⁹⁷¹ By 1977, in *Machine Takeover: The Growing Threat to Human Freedom in a Computer-Controlled Society*; he was predicting computerised totalitarianism.⁹⁷² George had always believed that cybernetics promised humanity freedom and prosperity. Like Wiener, his concern was not with the power of computerised automation; but, rather, with its corruption and misuse. However, those who saw the sensationalist Paladin paperback cover of *Man*

⁹⁷⁰ F. H. George, *The Brain as a Computer*, (Pergamon, Oxford, 1961).

⁹⁷¹ F. H. George, *Computers, Science and Society*, (Pemberton, London, 1970). F. H. George, *Science And The Crisis In Society*, (Wiley, London & New York, 1970).

⁹⁷² F. H. George, *Machine Takeover: The Growing Threat to Human Freedom in a Computer-Controlled Society*, (Pergamon, Oxford, 1971).

The Machine on the shelves in 1979 would have heard the assimilative stomp of the Cybermen and the deathly cry of the Daleks; not the clarion call of a cyborg golden age.⁹⁷³

⁹⁷³ F. H. George, *Man the Machine*, (Paladin, St Albans, 1979).

Conclusion

Existing scholarship has conceptualised British cybernetics with the Ratio Club at the nucleus of an undrawn periphery. Insofar as the Ratio Club has attracted scholarly notice beyond Husbands and Holland's work, its designation as the 'hub' of British cybernetics has been uncritically assimilated. Moreover, since there has been little effort to situate the Ratio Club within the broader institutional and intellectual contexts which it inhabited, it, and British cybernetics as a whole, have been tacitly conflated.

However, my archival investigations have served as the basis for a richer, more complex, and more nuanced picture of post-war British cybernetics than has previously been suggested. It is now evident that the early British cybernetics experience was vitally important to the history of our contemporary socio-technics. My thesis changes our understanding of post-war British computing, the invention of AI, the nature of Turing's thinking and his intellectual legacy, and of course, the origins of cybernetics itself. Manifestly, the substance of this significance lay beyond the Ratio Club.

Characterising the Ratio Club as the 'hub' of post-war British cybernetics is problematic in three directions. Firstly, it suggests that the cybernetics within this experience can be characterised via a simplistic two-dimensional abstraction of an inner and outer layer. Secondly, it accepts the prima face claim that the Ratio Club was itself cyberneticist. Thirdly, it tacitly denotes a uniquely British epistemological construction of cybernetics. None of these claims are baseless, but unqualified, they lack the granularity required by the texture of historical actuality.

Cybernetics in post-war Britain was socially and institutionally disembodied, and it was disbarred from boardrooms, Whitehall and academia alike. No bastion of intellectual normativity or rectitudinous common-sense countenanced its transgressive radicalism. Academically, *Cybernetics*' interdisciplinarity imperilled the patterns of power and prestige that were inscribed within the arbitrary institutional departmentalisations of knowledge colonised by the gowned elite. Nationally, there was a precipitous peacetime re-tightening of the sociological strictures and stratifications that had been forcibly relaxed by the war's existential imperatives. In peace, the denial of hierarchical deference by intellectual meritocracy quickly became intolerable and the rule of experts ended. To Establishment minds, *Cybernetics* was tainted by association with the scientised managerialism of OR. Rationalism belonged to planners, and planners were re-learning their place.

A cocktail of nascent anti-Americanism, nationalistic chauvinism, burgeoning anti-Soviet sentiment, and deep-rooted anti-intellectualism soon catalysed initially aloof conservative indifference into antipathy. Cybernetics was an American export; popular in France, and, after 1956, embraced across the USSR as official state science. Its mathematised intellectualisation of human nature deeply disturbed minds that were seeking a restoration of the natural order of things amidst a shattered society, an impoverished peace, and a disintegrating empire. Unlike America, in Britain the economic and political Establishment had neither need nor appetite for a science to serve an ascendant geo-political hegemony fuelled by explosively consumerist domestic economic growth. Nationally, unlike the peoples of Europe, Britain denied itself the grand project of transformative cooperation, modernisation and unification. Although active and explicit hostility to cybernetics was rare, nevertheless, across British society it withered into deep disreputability and then invisibility in the face of implacable indifference and steadfast ignorance. As Walter

discovered when he attempted to introduce cybernetics to Shipton's father-in-law, the then Labour Prime Minister Clement Attlee.

Within Britain's post-war geo-political and socio-economic contexts, and under its prevailing intellectual, cultural and political normativities, Cybernetics was at best an amusing foreign exoticism, and at worst an alien menace. Beyond defensive nationalism, economic precarity and imperial decline, *Cybernetics*' indecent claims about the cognitive potential of electronic brains threatened human and humanist exceptionalism with mortal danger. Especially so amidst the recoil from the moral and economic consequences of defeating Nazism, and amongst the raw horrors of the concentration camps and the Bomb. Post-war Britain craved a reaffirmation of humanity's divine spirit more than the rationalist scientisation of its mechanist being.

Whilst Christians condemned *Cybernetics*' blasphemous repudiation of vitalism, one could easily decry Wiener's dehumanisation without God; the defence of a secular New Jerusalem sufficed. As Macmillan recognised; when it eventually came, the relative prosperity of Britain's post-war settlement was manifestly friable.⁹⁷⁴ If the totem of full employment fell, as cyberneticist automation portended, the spectres of Depression and catastrophic war would return. War and fascism had taught Britons to fear technologically empowered and informationally adroit government machines, and the fragile post-war British consensus easily rejected the entreaties of the rationalist young technocrats who promised an arc of progress that would deliver a push-button cornucopia tomorrow.

⁹⁷⁴ The anti-inflation warning in Macmillan's famous "Never Had It So Good" speech was as lost on its contemporary audiences as it has been to many subsequent commentators, including historians.

Not only was *Cybernetics* confronted by orthodox and Establishment repudiation, but it also failed to emulate its phenomenal American sales, and cybernetics entered British intellectual life more through amorphous diffusion than direct transmission. Some, like Stafford Beer, did meet *Cybernetics* itself. And, many of these few who did shared his epistemological epiphany. However, unlike Beer, their intellectual and social isolation generally cooled their zeal as quickly as their conversion had ignited it. Even amongst the minority wielding *Cybernetics* conversationally, more knew of it than had read it. The rare British textual encounters with *Cybernetics* were typically private or foreshortened, and its readers had scant reason to protect their purchase from acquisitively curious acquaintances. Insofar as the word itself gained currency beyond the *cognoscenti*, it was generally deployed awkwardly, apologetically and reductively.

Denied formal institutional instantiation, *Cybernetics*' epistemological contents were textually decoupled, disaggregated, anonymised, and disseminated memetically. Many amidst the multitudinous audiences for the BBC's staging of the Cartesian computational controversy would not have registered the cyberneticist undercurrents in the recasting of the ancient mind-body dualism. Similarly, generations of biology, neurology and engineering students, especially at Cambridge, UCL and Imperial assimilated conceptions of feedback, and information and control theory, unaware of their infusion with Wiener's epistemic radicalism. However, although informal, cybernetics' dispersal was powerful. When the Cybermen first invaded Earth on British TV screens in 1966, Wiener's nominative neologism was already a free-floating signifier triggering instant, albeit terrifying, cultural

resonances.⁹⁷⁵ Thus, cybernetics became the epistemological dark matter of the Information Age in Britain as in America. However, whereas cybernetics was an easy ally of American techno-futurist optimism, in Britain it readily inhabited popular cultural tropes of dystopic techno-totalitarianism.

Cybernetics arrived in Britain at the moment of inception for mass-media popular science journalism, and its contents were enthusiastically disbursed by a new generation of Reithians who were driven to proselytise the New Jerusalem's epistemological foundations. As the airwaves infused the BBC's percolations of cybernetics directly into the tacit common sense of British intellectualism, they entered British minds without the endorsement of the academic scientific establishment. Whilst burnishing cybernetics' modernist credentials for some; for others, including the circumvented elite, this confirmed the scientific unsuitability of a gauche whimsey that had been invented by an eccentric American crank with dubious politics. To the methodologically and historiographically informed eye, cybernetics presents a new dimension for the application of constructivist theories of scientific knowledge. Wherein, insofar as it existed at all, a new science emerged across society itself rather than within the sub-cultural sociologies of institutional and official practice.

⁹⁷⁵ The Cybermen debuted in the four part *Doctor Who* episode "The Tenth Planet", Season 4, Serial 2, BBC TV, Saturdays, 8 to 29 Oct. 1966, BBC/OPI, <https://genome.ch.bbc.co.uk/search/0/20?order=first&q=The+Tenth+Planet>, [15 Jan. 24]. The episode's writer and the creator of the Cybermen, Kit Pedlar, was an ophthalmologist and pathologist who pioneered electron microscopy in ocular medicine. His professional locus was the University of London, especially the Institute of Ophthalmology in the Brain Science Faculty. His knowledge of cybernetics came through his scientific practice. Undoubtedly he read papers by Barlow and Rushton, and possibly also those from Bates and Walter. Pedlar's first BBC job was as a computer expert advising on the earlier *Doctor Who* four part episode "The War Machines" Season 3, Serial 10, BBC TV, Saturdays, 25 June to 16 July 1966, BBC/OPI, <https://genome.ch.bbc.co.uk/search/0/20?order=first&q=The+War+Machines&after=1966-01-01T00%3A00%3A00.000Z&before=1966-12-31T23%3A59%3A59.999Z#top>, [15 Jan. 24]. This dealt with WOTAN, a super-intelligent computer built by an irresponsible scientist. WOTAN became self-aware and decided to conquer humanity. Pedlar also co-created *Doomwatch*, aired on BBC TV from 1970 to 1971. Each episode delivered a differently focused variation of the theme that unrestrained scientists would unleash devastation, if not destruction, upon humanity. Its plotlines echoed many of the themes pursued by Frank George in his contemporaneous popular science books. For an account of Pedlar's life and work, see M. Seely, *The Quest for Pedlar: The Life and Ideas of Kit Pedlar*, (Miwk, Tadworth, 2014).

There was no British equivalent of the American cybernetics movement in whose centre the Ratio Club could reside. Nor did the Ratio Club exhibit any characteristics or behaviours suggestive of either the capacity or the inclination to even attempt such a movement's ignition. From its inception to its demise, the Ratio Club was stubbornly insular and impermeable. Nevertheless, and notwithstanding the conservatism inuring the British Establishment against cybernetics, there were sufficient sparks of cyberneticist interest amongst elite British intellectuals to suggest that Ashby's urge to create a publicly facing cyberneticist association could have rooted. Solly Zuckerman, J. D. Bernal and J. Z. Young were all potential members; if not figureheads. Patrick Blackett and C. P. Snow were also reachable. However, here also cybernetics suffered taint by association, this time with left-wing politics. With the notable exception of Walter's anarcho-syndicalism, none of the Ratio Club displayed any overt politics, radical or otherwise. Moreover, they were all respectable men following established careers and, apart from Walter and Turing, pursuing apparently orthodox lifestyles. Some inhabited the secret state. They were unlikely to have welcomed public, intellectual, or professional association with known communists, whatever their personal politics.

In some senses therefore, and despite prevailing conditions, the Ratio Club's isolationism occurred more through choice than by necessity. However, in another sense, it was a structural product of its own innate intellectual limitation, albeit that this itself arose from self-imposed disciplinary parochialism. Whilst pervaded with powerful intellects, the Ratio Club's considerable communal powers were narrowly focussed. Collectively, it lacked the intellectual depth or sophistication to have permitted public interventionism. With rare exceptions, Ratio Club members remained firmly within their scientific specialisms and

beyond the public gaze. Notably, despite the vigour and reach of the Cartesian computational controversy, or the intensity of the economic automation debate, neither of these public entanglements with cybernetics made any discernible mark on the Ratio Club's conduct; nor did the Ratio Club register its presence as a protagonist in either. Had it embraced the genuine cyberneticist interests of philosophers such as J. O. Wisdom, or R. H. Tizard's sustained inclination to assimilate cybernetics into economics, the Ratio Club would have been at least constitutively capable of an overt and visible cyberneticist posture.

Beyond the contingent conditionality of proximate choices, the Ratio Club was overwhelmingly comprised of middle-class aspirants for whom cerebral and professional pursuits were pathways to personal economic security or the satisfaction of scientific curiosity, not platforms for public intellectualism or political activism. With, again, the singular exception of Walter, none of the Ratio Club's members inhabited familial or cultural milieux marked by interventionist practices of any kind. Moreover, many of the Ratio Club advanced into professional science as emanations from families driven to propel their progeny's social betterment. This constitution was reflected in the forms of cybernetics individually practiced by many Ratio Club members, and in the absence of any collective cyberneticist identity across the epistemological practices of the group as a whole.

Regarding its members' individual practices, Bates had convened the Ratio Club to continue the war-work that he, and a legion of others, had undertaken on synthesising new science from the praxical amalgamation of neurology, electronics and control theory. For him, and many amidst his cohort, the relationship between their post-war endeavours and *Cybernetics* was co-incidence not cause. Wiener's book gifted Bates' group both notional and

nominative purpose, but it neither defined nor circumscribed their personal intellectual trajectories.

With the singular exception of Ashby, Ratio Club members strove to enrich their individual scientific and professional practices, rather than develop cybernetics itself; assimilating and subsequently sublimating abstracted elements of cybernetics within their extant and abiding disciplinary commitments, rather than becoming cyberneticians per se. Thereafter, beyond the Ratio Club's brief life, it and cybernetics became biographically and epistemologically invisible. This applies equally to Westcott, Uttley and Walter, as to Bates and the others. Uttley deployed cybernetics to build brain machines, Walter built cybernetic neurological analogues to analyse brains, and Westcott dispersed cybernetics in industrial and commercial exploitations of control theory.

Apart from Ashby, no Ratio Club member directly contributed to theoretical cybernetics. Nor, apart from him, were any of them properly describable as cyberneticians. Even Uttley and Walter, both closer to avowed cyberneticism than the rest, failed in close comparison with Beer, George, Pask and Andrew. MacKay's atypical retention of visible cyberneticist associations was theologically expedient. He appropriated cybernetics' stochastic counter to the Cartesian duality to exemplify a realist complementarity commensurate with his scientific apologetics. Turing was no more reductively classifiable as a cybernetician than as a mathematician. Ultimately, Ashby was the Ratio Club's only fully fledged cybernetician, and both he and his cyberneticism were spurned by his fellows.

Regarding the Ratio Club's group identity, its initial cyberneticist self-characterisation was transitory and superficial. Given *Cybernetics'* proximate publication, its contextual and

epistemological commonality with the recent lived experiences of Bates and his circle, and their prior exposure to Wiener's work; Bates' initial Ratio Club invitations persuasively nominated the project as a cybernetics discussion group to its prospective members. Likewise, Bates' epistolary attempts at cajoling Wiener to visit the Ratio Club sensibly stressed his group's professed intellectual affinity; albeit unsuccessfully. However, beyond its initiation, the Ratio Club displayed scant sense of even nominative cyberneticist communality, or indeed of any other unifying or galvanising purpose. These colleagues attended meetings, more than they joined a group. And, just as most participants did not consider themselves to be individual cyberneticians, so neither was there any collective inculcation of a cohesive cyberneticist identity. Whilst it hosted many individual disciplinary ingestions of cybernetics, the Ratio Club was neither a site for the construction of significant new cyberneticist knowledge, nor a venue for the emergence of any distinctive British form or school of cybernetics.

If there were particular forms of cybernetics in Britain, as opposed to various inward disciplinary mediations, they occurred in the separate practices of only a few individuals, most of whom were denied Ratio Club membership. And, if there were British specificities to these practices, they were conditioned by the contingent experiential hinterlands of their authors, and by the immediacies of the post-war British socio-economic and geo-political contexts, rather than by deeper historical British cultural and intellectual currents. This might have been otherwise had cybernetics gained admission to the institutional repositories of accumulated British ways of thinking and doing. However, in reality, cybernetics was academically inhibited, and excluded rather than nurtured and assimilated. Even amidst the epistemologically proximate quasi-institutional venues of the conferences and events that were manufacturing new knowledge about computers and information theory, cybernetics

was deprecated and disregarded. To the limited extent that overt cyberneticians attended these new venues, their propagation and acquisition of liminal cyberneticist knowledge was marginalised. Tellingly, the only overtly cyberneticist events held outside America in this period were European.

Following Hayward, Husbands, Holland and Pickering, it has become commonplace to characterise cybernetics in Britain as being preoccupied with neurology and brain science. This certainly holds somewhat true amidst the Ratio Club's confines. And, inasmuch as it does, it also partly tempers the sense that cybernetics in Britain had shallow epistemological roots. Most of the Ratio Club's nucleic life scientists attended Cambridge and entered Edgar Adrian's electrophysiological neurological orbit, which was itself aligned with Sherrington's earlier synapsial Oxford trajectory. Assertions about mind as mechanism and mechanised minds landed easily with Adrian's disciples.

However, this characterisation decoheres under the observation that the Ratio Club's life scientists were consumers, not practitioners or producers, of cybernetics. And it dissipates entirely when the lens necessarily extends empirically and conceptually beyond the Ratio Club and its nomination as the epicentre of British cybernetics. Here, Walter's flamboyant celebrity and the journalistic fascination with his tortoise robots are distractions. The substantive core of Walter's science, if such existed, was EEG, and it was only incidentally influenced by cybernetics. As for the tortoises, they were neither singularly Walterian nor uniquely British. Electro-mechanical and electronic neurological analogues were explicit in

Cybernetics; and, by 1949, Wiener himself had built a cybernetic robot sharing many attributes with Walter's tortoises. Priority remains unclear.⁹⁷⁶

None of Woodward, Westcott or Good were interested in delving the synapsial depths of mind or brain science. Turing and Uttley sought such knowledge in pursuit of their common goal of building electronic thinking machines, not in order to advance their understanding of the biological human subject. MacKay was more interested in God's mind than that of his fellow humans. Although a Ratio Club member, and whilst a neuropathologist by training and initial practice, Ashby's intellectual trajectory was singular and all but untouched by his unfulfilling encounter with Bates' group. Ashby's proto-cybernetics had emerged beyond the war-time sociologies and epistemologies occupied by other Ratio Club members. And, similarly, as his cybernetics matured, he departed from neurological specificity, and gravitated towards more generalised mathematical and conceptual abstractions of dynamic systemic stability. Ashby, the Ratio Club's only fully fledged cybernetician, started as a British brain scientist, but ended as an American systems and complexity theorist.

⁹⁷⁶ Walter's tortoise robots were ready to show McCulloch in Sept. 1949; Letter, Walter to Wiener, 22 Sept. 1949, MIT/NWP/Box 7, Fldr. 104, <https://hdl.handle.net/1721.3/200281>, [6 Jan. 2024]. Wiener's robot, variously called the 'moth' or the 'bedbug', was built by Wiener and two electrical engineers, Henry Singleton and Jerome Wiesner. There is a photograph in the MIT archives of Wiener and Wiesner (the latter wearing a distinctive sweater) taken by Alfred Eisenstaedt on May 10, 1949; (MIT Museum, <https://webmuseum.mit.edu/media.php?module=people&type=popular&kv=12187&media=81>, [23 Jan. 2024]). There is another photograph, undated and unattributed, showing Wiener, Wiesner and the robot, with Wiesner wearing the same distinctive sweater; (<https://cyberneticzoo.com/cyberneticanimals/1949-wieners-moth-wiener-wiesner-singleton/>, [23 Jan. 2024]). If, as is likely, both photographs were taken on the same day, Wiener's robot probably preceded Walter's. Wiener demonstrated his robot, under the stage name Palomilla, during his prologue to a 1950 resurrection of Čapek's *R.U.R.* by MIT's Dramashop am-dram society cast with engineering students. The robot received better reviews than the players who forgot their lines as the scenery collapsed around them: see, P. W. Mandel, "Cabbages and Kings: Deus ex Machina", *The Harvard Crimson*, 10 May 1950, <https://www.thecrimson.com/article/1950/5/10/cabbages-kings-plast-friday-and/>, [23 Jan. 2024]; W. K., "Revival of *R.U.R.* With New Prologue", *New York Times*, 7 May 1950, p. 163.

Beyond the Ratio Club, overt cyberneticist practice was confined to Pask, Andrew, George and Beer. If there was a discernibly discrete manifestation of British cybernetics; it was here. And here, the conflation between cybernetics in Britain and brain or mind science evaporated entirely, along with any sense that such cybernetics was imbued with a discernibly national character by prior British epistemological or cultural specificities.

In the early fifties, Pask and Andrew were budding cyberneticians. The end of the decade saw Andrew lodged at Uttley's NPL and Pask enduring a rare period of stable salaried employment pending his transition to permanent peripateticism. Although he was a Cambridge natural sciences graduate, Pask's intellect nevertheless bore scant sign of conditioning from his typically idiosyncratic university encounter. And, from the outset, his cyberneticist practices were as eclectic and picaresque as his lifestyle. Pask's oeuvre did encompass an interest in psychology; but, only as an adjunct to electronics, computers, art, architecture, pedagogy and management theory. Like cybernetics, he was uncategorisable. Andrew, however, was a deeply conventional counterpoint to Pask's multifarious oddity; distant, geographically and culturally, from the Cambridge milieux moulding the minds of the Ratio Club's core membership. After his initial training in mathematics and physics at Glasgow, and a brief postgraduate physiological sojourn under McCulloch's spell, Andrew became a computer scientist with a cybernetics-inclined interest in AI and robotics. Neither he nor Pask could credibly be called brain or mind scientists.

George and Beer were older than Pask and Andrew, and more advanced in their maturation as practicing cyberneticians in this period than their younger counterparts. Moreover, and notwithstanding the deep affection that Pask commanded amongst the cyberneticist initiate, both George and Beer became more important contemporary British cyberneticians than the

other two. They, together with Ashby, constituted the epistemological centre of overt cybernetics in post-war Britain. Neither were ever even Ratio Club guests, although both were nominated, by Walter, for membership of the Ratio Club's abortive successor.

Both George and Beer sustained consistent, and career long, patterns of cyberneticist activism and interventionism. After creating the only formalised British industrial cybernetics group at United Steel, Beer went on to forge a novel theoretical expression of cybernetics itself. His new management cybernetics mounted the geo-political stage in Project Cybersyn, an unfinished deployment of computerised cybernetic economic management in Allende's socialist Chile. George lacked Beer's expansive personality or global reach, and hitherto he has been historically invisible. Yet, he was a vocal cyberneticist belligerent in the Cartesian computational controversy, and a staunch public advocate of technocratic rationalism amidst mid-century automation anxiety. Thanks to Beer's machinations, George became Britain's first professor of cybernetics; deploying extensive popular science mediations of cybernetics across a range of seventies paperbacks from his academic bases at first Bristol and then Brunel. Our contemporary socio-technical anxieties about alienating computerisation, dehumanising AI, and iniquitous informational power echo George's warnings about the abuse of cybernetics which he sounded stridently across his later, mass-market, writing. His is one of the many powerful stories about British cybernetics yet untold.

Like most of the Ratio Club, most of the Fellow Travellers consumed rather than created cyberneticist knowledge. Tustin and Sluckin essayed its assimilation, into economics and psychology respectively, as singular and transitory episodes; whereas, J. Z. Young sublimated it within the core of his scientific and educative practices. Notwithstanding his

vital proto-cyberneticist importance, Porter was an early post-war brain drain departure from Britain, and so also absent from further attention here. Strachey's direct encounter with *Cybernetics* was both explosively life changing, and formative of his later attitudes towards the socio-economic utility of computing. It was also ephemeral. After Brindley's initial inhabitation of the Ratio Club's immediate periphery, his cyberneticism lay apparently dormant until the late seventies when his research into computerised neurological prosthesis broke into public consciousness. The shared paternity of Brindley's laboratory creations and Doctor Who's metallicized mortal enemies was invisible to their contemporary audiences.

Cybernetics and information theory were conjoined epistemological twins. In ascendant America, they amalgamated with electronic computation to form what we now call IT, or information technology. In declinist Britain, they were surgically separated through the emergence of a discernibly distinct school of information theory. This British bifurcation of cybernetics and information theory was driven by Gabor and Cherry, and instrumented, especially by Gabor, through the staging of the three London information theory symposia. Notwithstanding the reluctance of either to admit cybernetics to the canon of scientific respectability, both Gabor and Cherry were socially and epistemologically equipped to coalesce the British variant of information theory, and its deployments in broadcasting and telecommunications technology, as much by Wiener's *Cybernetics* as by Shannon's more sober applied mathematics. Here, as elsewhere across the surface of emergence of cybernetics in Britain, the significances lurk in the silences, the lacunae, and the exclusions of Wiener's science; not in its embrace. The strongest constitutive force of cybernetics in Britain was its power to repel adoption. The development of British information theory, under and beyond the influence of *Cybernetics*, and its intersectionality with early ground-

breaking applied research at the BBC and GPO, is another of the stories about British cybernetics awaiting its telling.

The British denial of cybernetics was especially pronounced amongst the nascent elite of budding British computer science. Wilkes in Cambridge, and Williams and Kilburn in Manchester, guarded the reductionist purity of their self-created computational orthodoxy with particular zeal. Unlike the cybernetics they opposed, this deprecation of computational cognition was distinctively British. Thinking computers defied the foundational precepts of empiricist common sense that were deeply rooted in the historicism of British national identity. The offence that *Cybernetics* gave to British anti-intellectualism was particularly pungent for the practical and pugilistic minds striving to appropriate computers as their exclusive domain. To their putative mathematical and engineering masters, electronic computers, regardless of their complexity, were merely passive scientific instruments. Their power was the mechanisation of the mundanity of calculation, not their ability to replace or surpass the vitalist creative minds of their makers.

For these early computational technocrats, the subjects of their expertise belonged in their laboratories, not in the salons of philosophers. Moreover, whilst the guardians of computational orthodoxy did not entirely eschew the industrialisation or commercialisation of their scientific instruments or engineering exercises, neither was their embrace of applied computing particularly enthusiastic. Wilkes welcomed the financial support from Lyons that the initial development of LEO brought to his laboratory but, as he made clear in his memoirs, he saw little scientific worth in using computers for the automation of the

“mundane forms of business accountancy such as payroll operation”.⁹⁷⁷ The relationship between the Manchester University laboratory and Ferranti was certainly closer and more sustained than that between Cambridge and Lyons, but even here the arrangement had the hallmarks of a marriage of financial convenience. Ferranti were able to manufacture and commercialise the Manchester computers, but the central direction of the research trajectory remained under the control of Williams and Kilburn. The possibility that this vigorously promoted and constricting scientisation of computing retarded the wider socio-economic British deployment of computers and stunted the viability of the early British computer industry warrants further investigation.

Publicly passive and professionally quiescent dissenters to the narrow conceptualisation of computational orthodoxy, including Andrew Booth and Kathleen Britten at Birkbeck, and Uttley at the NPL, were generally ignored by the protectors of its purity. Active antagonists, principally Turing, were energetically and aggressively targeted. Pursuant to his self-appointment and self-promotion as a computer pioneer, Wilkes especially crafted a victor’s version of British computing history wherein Booth, Britten, Uttley, Turing, and others, were actively concealed. Turing’s excision from the history of computing prior to his rescue by Brian Randell in the early seventies was not because of the shroud of secrecy over Bletchley,

⁹⁷⁷ Wilke’s account of LEO amounted to little more than an extended thank you note for their grant of £3,000 and their loan of E. G. Lennaerts as a laboratory assistant. Wilkes, *Computer Pioneer*, pp. 132-34.

nor was it an aftereffect of Turing's trial, conviction and suicide.⁹⁷⁸ Rather, it was an intended consequence of Wilkes' *damnatio memoriae*, and the complicit silence of Turing's colleagues at Teddington and Manchester. Evidently, enough was known and understood of Turing's work before and after the war, and to a sufficiency of his contemporaries, for them to have ensured that his vital importance to the history of computing was understood and communicated. Turing's unforgivable crime, in their eyes, was his wilful public conviction that machines could think.

Turing's authorship of the ACE design was widely reported in the press following Mountbatten's incendiary British revelation of ENIAC in October 1946. This often sensationalist reportage precipitated a hasty NPL press release which, as well as officially acknowledging Turing as the architect of the ACE, also recognised his 1936/37 paper as the intellectual wellspring of both the American and the British computers.⁹⁷⁹ Maurice Wilkes had previously been directly confronted with Turing's prior technical authority when Wilkes had attempted to secure a contract from the NPL to build the ACE at Cambridge. As was known to Wilkes at the time, Turing had successfully blocked him. The correspondence

⁹⁷⁸ Brian Randell became actively interested in the history of computing shortly after becoming professor of computer science at Newcastle University. Whilst researching an early lecture on the origins of his primary subject he became intrigued by odd inconsistencies and gaps in the account of how electronic digital computers emerged with such apparent spontaneity directly after the Second World War. Investigating these gaps led him to uncover the Bletchley codebreaking computers and to recover Alan Turing to the historical gaze. Randell first surfaced his discoveries across a range of scholarly and popular publications. See: B. Randell, "On Alan Turing and the Origins of Digital Computers", in B. Meltzer, D. Michie (eds.), *Machine Intelligence 7: Proceedings of the Seventh Annual Machine Intelligence Workshop, Edinburgh, 1971*, (Edinburgh University Press, Edinburgh, 1972), pp. 3-20; B. Randell, "On Alan Turing and the Origins of Digital Computers", Computing Laboratory Technical Report Series, No. 33, May 1972, Computing Laboratory, University of Newcastle upon Tyne, SMG/NPL/K.8; B. Randell, "COLOSSUS: Godfather of the Computer", *New Scientist*, Vol. 74, No. 1038, 10 Feb. 1977, pp. 346-48. Randell recounted the story of his discoveries in several interviews and lectures. See: B. Randell, "Uncovering COLOSSUS: or From Ludgate to Los Alamos", National Museum of Computing, Bletchley Park, 7 Feb. 2013, *YouTube*, (11 March 2013), <https://www.youtube.com/watch?v=Y16pK1Z7B5Q&t=551s>, [28 Jan. 2024]; R. Solomon, "The Computer Pioneers: Interview footage of Michael Woodger and Brian Randell", *YouTube*, (4 Feb. 2014), https://www.youtube.com/watch?v=TxC_ziacMKs, [28 Jan. 2024].

⁹⁷⁹ "Calculations and Electronics: Automatic Computator Designed by the N.P.L.", *Electrician*, Vol. 137, No. 19 (3571), pp. 1279.

relating to this unhappy episode ran from August 1945 to April 1947. It was retained by Mike Woodger, Turing's NPL assistant, who collated it into a separate document in February 1977, following Brian Randell's revelations.⁹⁸⁰ One of the essays in Bowden's 1953 survey of British computing opened by explicitly recognising that Turing's 1936/37 paper had laid the foundations for post-war electronic digital computers.⁹⁸¹ Max Newman's combined 1955 obituary and Royal Society biography for Turing also recognised "On Computable Numbers" as the theoretical basis for post-war electronic computation, and acknowledged Turing as both the originator of the ACE's design and a pioneer in the art of programming subroutines.⁹⁸²

Whilst the early British computer scientists were disinclined to make an active philosophical defence of Cartesian dualism, they nevertheless entered into a willing alliance with those who were. The consequences of the Cartesian computational controversy, and of the knowing expulsion of cybernetics from British computing, are further dimensions of British cybernetics awaiting exploration. Clearly, British computer makers made their computers in their own epistemic images, and, within obvious limits, their forms and functions were products of elective contingency, not technological determinism. As Turing and Wiener both believed, the assertion that electronic computers could be made to think did not depend

⁹⁸⁰ M. Woodger (ed.), "A Little Light on the Prehistory of ACE and EDSAC: Extracts from Correspondence on File at NPL", SMG/NPL/K10.

⁹⁸¹ Anon., "Automatic Computation at the National Physical Laboratory", in Bowden, *Faster Than Thought*, p. 135.

⁹⁸² M. A. H. Newman, "Alan Mathison Turing", *Biographical Memoirs of Fellows of the Royal Society*, Vol. 1, Iss. 1, Nov. 1955, p. 254.

on whether this was true of the machines currently under construction.⁹⁸³ The parochial intellectual myopia of the early British computer scientists ensured that, in their domain, the very possibility of computational cognition was forbidden. Equally clearly, our contemporary discourse about computing, and AI, remains freighted with a reductionist hegemonic orthodoxy fashioned three quarters of a century ago. Every contention that computers can only perform rote tasks according to pre-scripted algorithmic instructions, and every assertion that computers can never truly emulate human attributes, are restatements of the anti-cybernetics narrative fashioned by these early computer scientists, and their Cartesian allies, to consolidate their emerging discursive and professional power.

Upon exploring the nature and origins of British cybernetics, it is apparent that American pre-cybernetics and British proto-cybernetics both emerged within an epistemological and ontological setting that was similarly contoured by the prosecution of mechanised total war. In Britain, the directly existential threat of the proximate Nazi menace intensified the belligerent imperatives towards substituting mechanical for human perceptual, cognitive and control agency. Porter's previously overlooked quasi-official Servo Panel drew Bates and several other Ratio Club members deeply into the theoretical heart of combative proto-cybernetics. It was also a directly transmissive trans-Atlantic intellectual arc across which Wiener's formative cyberneticist ideas flowed relatively freely. Reciprocally, the intellectual currents of British proto-cybernetics flowed westwards. American scientific

⁹⁸³ Wiener's conviction that sensorily equipped electronic digital computers could, in principle, emulate and surpass human perception and cognition infused *Cybernetics*. In *Human Use*, Wiener went further, openly stating that a sufficiently complex mechanical simulacra of a human would replicate the full spectrum of its creator's intellect (p. 57). Turing's belief in the cognitive potential of electronic computation was powerfully expressed thematically and explicitly in his three BBC broadcasts: A. M. Turing, "Intelligent Machinery, A Heretical Theory", *The Fifty-One Society*, Home Svc., 1951, TK/GBR/0272/AMT/B/4/1; A. M. Turing, "Can Digital Computers Think?", Third Prog., 15 May 1951, BBC/WAC/GB/898/BBC/R/RPAB/T614; M. H. A. Newman, A. M. Turing, G. Jefferson, "Can Automatic Calculating Machines be Said to Think?", Third Prog., 14 Jan. 1952, BBC/WAC/GB/898/BBC/R/RPAB/T54.

liaison missions spanned the gamut of British war-time military scientific research and development, including the cryptologic inner sanctum inhabited by Turing and Good. Whilst not directly in receipt of these British transmissions, Wiener was tightly bound within the circles of those who were, including the American pioneers of electronic digital computation, information theory, and control engineering.

When Wiener visited Britain enroute to his momentous Parisian meeting with Enrique Freymann, affirmation for his scientific radicalism was easily found. Even before his 1947 meetings with Turing and the others whose support he declared in *Cybernetics*, Wiener had received direct British proto-cyberneticist impetus. In another previously neglected episode, Wiener met Walter at the 1946 Boston EEG conference, where an unbearded Walter presented his EEG automatic frequency analyser, and the venerable Wiener lectured on the statistical analysis of neuronal activity. Earlier still, Turing's 1943 New York encounter with Shannon suggested an Anglo-American intellectual reciprocity at a seminal moment in the formation of information theory.⁹⁸⁴ Wiener's resolve to write *Cybernetics* did not depend on the validation furnished by the protagonists of British proto-cybernetics. However, neither was this corroboration merely incidental. Wiener was notoriously insecure, and he continually craved his peer's approval. Moreover, Wiener's contextually conditioned conception of cybernetics was strikingly similar to Craik's independently formulated, yet similarly contextually conditioned, theories. Whilst Wiener was the undisputed creator of a manifestly American episteme, my thesis shows that both author and text bore a stronger British imprimatur than has been previously thought. Had Craik lived, we may have spoken

⁹⁸⁴ Hodges, *Turing*, pp. 250-53.

of Wiener-Craik cybernetics alongside Shannon-Wiener information. Craik's story is yet another woeful historiographical omission.

Of all the previously occluded episodes uncovered here, one of the most historically significant was John McCarthy's deliberate sundering of AI and cybernetics. The profound effects of which continue to shape our contemporary discourse about non-human cognition in societally significant ways. McCarthy's foundational predicate was his assertion of the algorithmic replicability of human cognition. However confusedly, this crude mathematical reductionism bolstered an equally reductionist conceptualisation of electronic computers. Although programmes could mimic thought like an eighteenth-century clockwork automaton mimicked writing, computers remained merely electronic calculators, incapable of human creativity despite their speed, power and complexity. For McCarthy and his influential acolytes, computational cognition was a product of instruction not adaptation, and their linear algorithmic constructions were strictly deterministic. The characterization of computationally based cognition within the linearly reductionist frame which McCarthy proselytised remains commonplace to this day. Notions of pre-scripted algorithms and reassurances about the inviolable phenomenological sterility of their electronic enactments infuse our contemporary discourse. Disturbingly, the current debate about the safety and trustworthiness of non-human cognition harbours the fallacy that its normative behaviour should be recursively comprehensible. As Wiener observed in 1948, the stochastic nature of the emergent properties of cybernetic systems negates the temporal bi-directionality such analysis requires.

Only latterly has AI decisively relaxed McCarthy's stranglehold and begun to seriously embrace the approaches proposed by the cyberneticians whom McCarthy covertly

deprecated. Generative pre-trained transformer neural networks only hint at the unrealised potential residing in the fruitful history of early cybernetics. And, significant elements of this history were located in British venues and emergences. Specifically, as this research has newly uncovered, the British cybernetics experience, and British cyberneticians, encouraged McCarthy's initiation of the AI-cybernetics schism. Just as Uttley's 1958 NPL symposium staged a decisive contest between AI and cybernetics, similarly his probabilistic self-learning computer and his contributions to *Automata Studies* intensified McCarthy's veiled disdain for Wienerian cybernetics. Likewise, Ashby's *Automata Studies* essay, and his freshly revealed presence at the 1956 Dartmouth summer school, consolidated McCarthy's ambition to create and colonise his secessionist episteme.

Like that of AI, Turing's history acquires new dimensionality within the deeper British history of cybernetics. Knowledge of Turing's Ratio Club membership, and his wider cyberneticist encounters, was readily available in Hodges' ground-breaking biography. However, Hodges and those he inspired have minimised, or ignored, Turing's cyberneticist imbrications. Like *Cybernetics*, Turing's intellectual contents defied definitional delineation. Nevertheless, whilst Turing was not a cyberneticist, it is a mistake to neglect the constitutive reciprocity between his mind and cybernetics. Indeed, Wiener himself testified to their conceptual commonality. Specifically cyberneticist conceptions of mental materiality and direct intersectionality with the sociology of British cybernetics, both materially influenced the trajectory of Turing's post-war mind. Much that was previously puzzling about Turing's post-war behaviour, particularly his BBC performances and his manifestation as a public intellectual, becomes less so once his cyberneticist experiences are accounted for.

Contemporaneously with his broadcast advocacy of thinking machines, Turing's post-war claim to paternity of electronic digital computation was publicly and professionally recognised. Whilst suicide silenced the former, the taint of cybernetics caused his colleagues to extinguish the latter. Turing's commitments to the realisability of computational cognition, which he essayed in his 1948 NPL report and published in his 1950, paper acquire new perspectives when aligned with his 1947 meeting with Wiener, the textual encounter with *Cybernetics*, his Ratio Club membership, and his belligerency in the Cartesian computational controversy. Framed by cybernetics, even Turing's choice of Ryle's *Mind* as the vehicle in which to publish "Computing Machinery and Intelligence" is differently illuminated. Just as the release of Bletchley's secrets changed the history of the Second World War, so cybernetics necessitates both a revaluation of Turing's account, and a revision of the history of post-war British computing as a whole.

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Archive Acronyms

BBC/WAC: BBC Written Archives Centre

BPI: BBC Programme Index

GPA: North American Gordon Pask Archive

JWP: John Westcott Papers

LJMU: Liverpool John Moores University, Special Collections and Archives

MIT: MIT, Library, Archives Space, Department of Distinctive Collections Repository

NAHC: University of Manchester, John Rylands Research Institute and Library, History of Computing Collection

OP: University of Oxford, Bodleian Libraries, Special Collections: Scientific Manuscripts and Archives

RADA: W. Ross Ashby Digital Archive

SMG/NCC: Science Museum Group, National Collections Centre, Swindon

TDA: Turing Digital Archive, King's College, Cambridge

TK: University of Cambridge, King's College, Archive Centre, Modern Archives

UIA: University of Illinois Archives, The Cybernetics Thought Collective (Digital Surrogates)

WC: Wellcome Collection, Archives and Manuscripts

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⁹⁸⁶ Scanned copies via email.

⁹⁸⁷ Retained by Westcott's wife. Photocopies courtesy of Professor Philip Husbands.

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