

R. V. Jones and the Birth of Scientific Intelligence

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I certify that all material in this thesis which is not my own has been identified accordingly, and that no material has previously been submitted and approved for the award of degree by any university.

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Abstract

The history of scientific intelligence – its birth, its importance during the Second World War, and its unique wartime qualities – has relied almost entirely on the memories of its pioneer, R. V. Jones. This thesis constitutes a critique of this history; through scrutiny of Jones's post-war literature (especially his war memoirs entitled *Most Secret War*), his archival papers and those of his colleagues and contemporaries, and other mediums he used to promote his account of scientific intelligence. This thesis examines chronologically all of the key events Jones became famous for – the Battle of the Beams, the Bruneval Raid, the Radio War, the Battle of the V-Weapons – and compares Jones's account of these (and many other) events with contemporary documentation. This thesis provides a rich understanding of the internal machinations within the British wartime air scientific intelligence organisation defined as ADI (Science), and their relationships with the many other political, military and intelligence sections that pursued similar and often closely-linked quests. This thesis importantly connects science and technology with the collection and collation of intelligence, is an analysis of wartime intelligence of a scientific and technical nature, and argues that scientific intelligence was much more than one man's accomplishments, involved many more individuals and organisations than is perceived, and is much more important to twentieth century history than has been permitted.

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Glossary

- AA** – Anti-Aircraft (also referred to as ‘ack-ack’)
- ACAS(I)** – Assistant Chief of Air Staff (Intelligence)
- ACAS(R)** – Assistant Chief of Air Staff (Research)
- ADRDE** – Air Defence Research & Development Establishment
- ADI** – Assistant Director of Intelligence
- ADI (Science)** – Assistant Directorate of Intelligence (Science)
- ADGB** – Air Defence of Great Britain
- ADRC** – CID’s Sub-Committee on Air Defence Research
- AEF** – Allied Expeditionary Force
- AEAF** – Allied Expeditionary Auxiliary Force
- AHB** – Air Historical Branch
- AI** – Air Interception
- AMES** - Air Ministry Experimental Stations
- AMRE** – Air Ministry Research Establishment
- APIS** - Army Photographic Interpretation Service
- ARL** – Admiralty Research Laboratory
- ASV** – Air-to-Surface Vessel
-
- BADU** – Blind Approach Development Unit
- BAFO** – British Air Force of Occupation
- BIOS** – British Intelligence Objectives Sub-Committee
- BMP** – Tactical Signals Intelligence Reports
-
- CH** – Chain Home
- C-in-C** – Commander in Chief
- CIA** – Central Intelligence Agency
- CID** – Committee for Imperial Defence
- CIU** – Central Interpretation Unit (Medmenham)
- CND** - *Confrérie de Notre-Dame*
- CombinedOps** – Combined Operations

COS – Chief of Staff/Chiefs of Staff
CSA – Chief Scientific Adviser
CSDIC – Combined Services Detailed Interrogation Centre
CSSAD – Committee for the Scientific Survey of Aerial Defence
CSSAO – Committee for the Scientific Survey for Air Offensive
CSSAW – Committee for the Scientific Survey of Air Warfare

DCAS – Deputy Chief of Air Staff
DDI – Deputy Director of Intelligence
DDI2 – Deputy Director of Technical Intelligence
DDI3 – Deputy Director of Operational and Organisational Intelligence
DDI4 – Deputy Director of Low Grade Signals Intelligence
DDR – Deputy Director of Research
DDSY – Deputy Director of Signals (Y), later defined as DDI4
D/F – Direction-Finding
DI(O) – Director of Intelligence (Operations)
DI(R) – Director of Intelligence (Research)
DI(S) – Director of Intelligence (Security)
DNI – Director of Naval Intelligence
DSIR – Department of Scientific and Industrial Research
DSR – Director of Scientific Research
DT – *Dezimeter Telegraphie* (German Radar)

EEC – English Electric Company
ELINT – Electronic Intelligence

F/Lt – Flight Lieutenant
FMG – *Flakmessgerät*
F/O – Flight Officer
FuGe – *Funk-Gerät*
FZG – *Flakzielgerät*

GAF – German Air Force
GASER – German Air Signals Experimental Regiment

GC&CS – Government Code and Cypher School

GCI – Ground Control Interception

GEC – General Electric Company

GPO – General Post Office

Gr/Cpt – Group Captain

HDU – Home Defence Units

HF – High Frequency

HDP – *Hochdruckpumpe (V3)*

HUMINT – Human Intelligence

HWA – German Army Ordnance Office

IFF – Identification: Friend or Foe

IIC – Industrial Intelligence Centre

ISK – Illicit Signals Knox

ISOS – Illicit Signals Oliver Strachey

JIC – Joint Intelligence Committee

KG - *Kampf Geschwader*

KGr - *Kampf Gruppe*

MAAF – Mediterranean Allied Air Force

MAP – Ministry of Aircraft Production

Mc/sec - Megacycles per second

MEW – Ministry of Economic Warfare

MHz – MegaHertz

MOD – Ministry of Defence

MOI – Ministry of Information

MOS – Ministry of Supply

MTB – Motor Torpedo Boat

NIB – Noise Investigation Bureau

NIC – Night Interception Committee

NID – Naval Intelligence Division

NPL – National Physics Laboratory

OIC – Operational Intelligence Centre

OPINT – Open Source Intelligence

OR – Operational Research

ORS – Operational Research Section

OSRD – Office of Scientific Research and Development

OSS – Office of Strategic Services

PCO – Passport Control Officer

PE – Photo-Electric

PI – Photographic Interpretation

PIU – Photographic Interpretation Unit

POW – Prisoner of War

PPI – Plan Position Indicator

PR – Photographic Reconnaissance

PRU – Photographic Reconnaissance Unit

PWE – Political Warfare Executive

RADAR – Radio Detection And Ranging

RAE – Royal Aircraft Establishment

RAF – Royal Air Force

RAFDEL – Royal Air Force Delegation

RCA - Radio Corporation of America

RCM – Radio Countermeasures

RDF – Radio Direction-Finding

REME – Regiment of Electrical and Mechanical Engineers

RE8 - Ministry of Home Security's Research and Experiments Department

RRE – Royal Radar Establishment

RSS – Radio Security Service

R/T – Radio Telegraphy

RUSI - Royal United Services Institution

SAM – Surface-to-air guided-missiles
SAS – Special Air Services
SBS – Special Boat Services
SHAEF – Supreme Headquarters of the Allied Expeditionary Forces
SIGINT – Signals Intelligence
SIR – Air Scientific Intelligence Report
SIS – Secret Intelligence Services
SLU – Special Liaison Units
SOE – Special Operations Executive
Sq/Ldr – Squadron Leader
STI – Scientific and Technical Intelligence
STC – Standard Telephone & Cables

TECHINT – Technical Intelligence
T-Force – Target Force
TRE – Telecommunications Research Establishment

USAF – United States Air Force

VHF - Very High Frequency

WAAF – Women’s Auxiliary Air Force
W/Cdr – Wing Commander
W/T – Wireless Telegraphy

Y-Service – low-grade signals intelligence organisation
Y-Station – Technical Military Listening Post

Introduction

There is little doubt that the reputation of Reginald Victor Jones (1911–1997) is surprisingly substantial for a man of his background and life career. The Second World War is the reason. Because of his newly-earned doctorate in Natural Philosophy, Jones was chosen for an unprecedented position as a scientist permanently attached to the Secret Intelligence Services (SIS – more well-known later as MI6) – the foreign section of British Intelligence. He obtained this position because of his relationship with Frederick Lindemann (later Lord Cherwell), who had been Jones's doctoral tutor, and who was great friends with the wartime Prime Minister, Winston Churchill. Once Jones was comfortably settled in the London offices of SIS within 54 Broadway, he moulded himself as the man responsible for the Air Ministry's scientific intelligence for the duration of the war. Thereafter, and for the rest of his working life, he returned to academic science as Professor of Natural Physics at the University of Aberdeen; a position not usually linked with fame. Nevertheless, Jones was (and still is) relatively famous, and this was solely because of his unique role during the Second World War.

Jones relished his unique wartime scientific intelligence responsibilities. He enthusiastically embraced all tasks which fell within his remit of helping the Allied powers gain the best understanding of the scientific and technological capabilities of the Axis powers, primarily German. After the war however, he was unable to fully receive public recognition for his war effort. All service personnel and intelligence operatives, who had been in contact in any way

with the communications decrypting centre known as the Government Code and Cypher School (GC&CS) at Bletchley Park (hereafter Bletchley) in Buckinghamshire, were sworn to secrecy during and after the war by the Official Secrets Act. Jones, like almost all others, took great care to comply with this expectation, believing non-compliance treasonable. Jones's story, therefore, was one that could not be relayed in its entirety until a lapse of more than thirty years allowed secrecy surrounding the decryption of German Enigma machine-codes to be lifted.¹ Jones's memoirs, entitled *Most Secret War: British Scientific Intelligence, 1939–1945*, were eventually published after the ULTRA secret was divulged (unofficially in 1974 by Frederick Winterbotham, Jones's direct superior during the war, and officially in 1977).²

Most Secret War became the historical authority on British scientific intelligence during the Second World War, and has remained so for decades.³ Other key texts produced by Jones contributed significantly to the construction of this thesis. Jones's 1947 Lecture to the Royal United Services Institution (RUSI) on scientific intelligence was published, and was the first official public acknowledgment of the work of ADI (Science), and as such is the seminal text

¹ See University of Bristol (hereafter UOB) DM1310/J.112, Review of *Most Secret War* by Sir Charles Frank for *Physics Bulletin*.

² Frederick Winterbotham, *The Ultra Secret* (London: Weidenfeld & Nicolson, 1974; Futura Publications Ltd., 1975). For a contemporary review, see Ronald Lewin, 'Churchill's secret ear', *The Listener*, 24 October 1974, 542. Peter Calvocoressi published an account shortly after Winterbotham: Peter Calvocoressi, 'The Ultra Secrets of Station X', *Sunday Times Weekly Review*, 24 November 1974, 33–4. For the furore surrounding the official release of the Ultra Secret see David Stafford, 'Ultra and the British Official Histories: A Documentary Note', *Military Affairs*, 42, 1 (February 1978), 29–31; see also Peter Hennessy, 'Will wartime reputations stand the Enigma test?', *The Times*, 13 October 1977, 16; Hennessy, 'History will be changed by Enigma disclosures', *The Times*, 13 October 1977, 1; Hennessy, 'Talks about Secrecy on Decoding', *The Times*, 12 November 1977, 3; and Hennessy, 'Restrictions eased on Codebreaking Secrets', *The Times*, 14 January 1987, 1.

³ Reginald Victor Jones, *Most Secret War: British Scientific Intelligence, 1939–1945* (London: Hamish Hamilton, 1978; Coronet Edition, 1979; Wordsworth Edition, 1998; Penguin Books, 2009); published in the USA as *The Wizard War: British Scientific Intelligence, 1939–1945* (New York: Coward, McCann & Geoghegan, 1978); published in France as: *La Guerre Ultra Secrète* (Paris: Plon, 1980). The British first edition is referred to throughout this thesis.

on the subject.⁴ Two eminent scientists who played key roles in Jones's career development were Lindemann and Sir Henry Tizard. As Jones wrote fairly extensively on both, the resulting publications are significant contributions to the scientific intelligence historiography which Jones created.⁵

In a 1969 letter Jones expressed hope of coaxing his secretary to stay with him for a while longer, for two years earlier he had begun to dictate to her some of the wartime stories in his memory. His secretary left his employ however, and his memories remained the unpolished 'rough accounts' she had typed. Jones thought that 'perhaps' he would 'one day have to start them all over again in order to retain' another secretary.⁶ Jones had a draft of *Most Secret War* in place by October 1976. He sent a copy to his old friend and scientific intelligence colleague Charles Frank for his perusal while the Cabinet Office was examining it.⁷ *Most Secret War* was eventually published

⁴ The National Archives (Hereafter TNA) AIR 20/1719, 'Scientific Intelligence I (Abridged)', and TNA AIR 20/1720, 'Scientific Intelligence II' (Abridged); published by the *Journal of the Royal United Services Institution*, 92 (1947), 352–69; and reproduced in *Studies in Intelligence*, 6: 3 (Summer 1962), 55–76 on the Central Intelligence Agency (CIA) website at www.cia.org, accessed 1 March 2010. This reproduction was arranged because it is 'a classic of the literature' by 'the father of scientific intelligence', and 'because it bears witness to the labors of the infant Hercules, contributes to the intelligence history of the war, and says some wise things about the nature of intelligence'. The origin of 'father of scientific intelligence' is: Robert M. Clark, 'Scientific and Technical Intelligence Analysis', *Studies in Intelligence*, 19: 1 (Spring 1975), 39–40.

⁵ R. V. Jones, 'The Right Hon. Viscount Cherwell, P.C.C.H. F.R.S.', *Nature*, 180 (21 September 1957), 579–81; 'Lord Cherwell's Judgment in World War II', *The Oxford Magazine*, 9 May 1963, 279–86 (this article was also published in *RUSI*, 108: 632 (November 1963), 321–27); 'Lindemann beyond the Laboratory', *Notes and Records of the Royal Society of London*, 41: 2 (June 1987), 191–210; 'Corrigendum: Lindemann beyond the Laboratory', *Notes and Records of the Royal Society of London*, 47: 1 (January 1993), 161; (with William S. Farren) 'Henry Thomas Tizard, 1885–1959', *Biographical Memoirs of the Fellows of the Royal Society*, 7 (November 1961), 313–41; 'Sir Henry Tizard (1885–1959)', *Nature*, 4975 (6 March 1965), 943–52; 'Scientists and Statesmen: The Example of Henry Tizard', *Minerva*, 4 (1966), 202–14; 'Tizard's Great Lessons of the Last War', *Chemistry and Industry*, 13 June 1979, 400–5.

⁶ Churchill College Archives, Cambridge (hereafter CCAC) RVJO B.207, Jones to Colonel James Langley, 18 September 1969.

⁷ UOB DM1310/J.100, Jones to Frank, 1 October 1976. Jones informed Frank that he was unsure of the manner of its publication, as it ran 'to nearly a quarter of a million words, starting from 1911'. His concern was that such a large word count 'would make it pretty expensive', as even if he cut it down to start at 1935 it would still be around one hundred and seventy thousand words'.

in February 1978. Based on Jones's pre-1970s publications, three books were written that served as useful forerunners to *Most Secret War* and useful companions to it thereafter.⁸ Perhaps because of Jones's air of factual certainty and often self-confessed arrogance within *Most Secret War*, no dedicated history of scientific intelligence followed. Nor has there been a biography of Jones.⁹

The eventual publication of *Most Secret War* was generally well-received, and has since been defined as a 'classic book'.¹⁰ One reviewer remarked that it contained all 'the excitement of wartime intelligence' and that Jones had 'the flair of a fine fiction writer'.¹¹ It was later referred to as one of 'the most

⁸ Ronald W. Clark, *The Rise of the Boffins* (London: Phoenix House, 1962); Alfred Price, *The Instruments of Darkness: The Struggle for Radar Supremacy* (London: William Kimber, 1967); George Millar, *The Bruneval Raid: Flashpoint of the Radar War* (London: The Bodley Head, 1974).

⁹ The controversial (and dubious) historian David Irving offered to write Jones's biography in 1964, and again in 1969. He imagined an 'official biography', bringing Jones's 'life up to date and concentrating particularly on the war years', and expected to obtain MOD clearance for such a project. Irving did not receive a reply from Jones to his appeals: CCAC RVJO B.345, Jones to David Irving, 26 October 1965; CCAC RVJO B.350, Irving to Jones, 27 January 1969. Irving's 1964 approach to write Jones's biography was inspired by Jones's remark that he was 'afraid' that writing an autobiography would open him to 'criticism from his wartime colleagues', but also in the hope that such a task would allow Irving to obtain access to Jones's wartime files. Irving wrote to Jones again on 17 April 1969 hoping that perhaps his original request had 'got mislaid'. There was no reply to the second request either. Irving's publisher also independently approached Jones, to thank him for the 'invaluable help' he had given to Irving, and to suggest that Jones's 'unique role in the whole affair' would provide a 'fascinating subject for autobiographical treatment': CCAC RVJO B.345, William Kimber to Jones, 24 November 1964. Jones replied that if he had the time he would consider an autobiography 'if only because' some of the official accounts were 'inadequate or incorrect': CCAC RVJO B.345, Jones to Kimber, 3 December 1964.

¹⁰ Chapman Pincher, 'Reflections on a Lifetime of Reporting on Intelligence Affairs' in Robert Dover and Michael Goodman (eds.), *Spinning Intelligence: Why Intelligence Needs the Media, Why the Media Needs Intelligence* (London: Hurst & Company, 2009), p. 156.

¹¹ Richard G. Head, 'The Wizard War: British Scientific Intelligence, 1939–1945', *Foreign Affairs*, 57: 1 (Fall 1978), 217. Alongside this review of the American publication of *Most Secret War* were reviews of memoirs written by two of Jones's contemporaries: Solly Zuckerman, *From Apes to Warlords: The Autobiography (1904–1946) of Solly Zuckerman* (London: Hamish Hamilton, 1978) and F. W. Winterbotham, *The Nazi Connection* (London: William Kimber, 1978). Edward Bullard (another of Jones's wartime contemporaries who worked for the Admiralty) wrote that *Most Secret War* was 'the grand panjandrum of the arcane of scientific intelligence': Edward Bullard, 'Processes of Scientific Intelligence', *Nature*, 274 (13 July 1978), 191. For favourable reviews, see Hugh Trevor-Roper, 'Keeping up with Dr Jones', *The Listener*, 9 March 1978, 314; Peter Hennessy, 'The Boffin who managed to bend the beam', *The Times*, 13 March 1978.

remarkable books on intelligence ever written'.¹² Two of Jones's scientific contemporaries however, Solly Zuckerman and Robert Cockburn, were aghast at some of Jones's claims. Following discussion on the matter, Zuckerman drafted a letter to Lord Chalfont who had shown an interest in 'writing a piece about the overlooked scientific heroes of the Second World War'.¹³ Zuckerman produced a particularly damning twelve-page assessment of Jones's version of events. Zuckerman applied Cockburn's comments as valid alternative recollections to some of the events discussed in *Most Secret War* – valid because Cockburn was involved in many of the scientific intelligence issues, but from a responsive countermeasure perspective.

This document serves as a reminder that Jones's version of events in many of the scientific issues of the Second World War was from his personal perspective, written in hindsight, and not necessarily accurate in all respects. Although Zuckerman believed that wartime scientific intelligence was very useful, Jones was not in as unique a position as he proclaimed, nor was he as popular in Whitehall and within the scientific community as he led his readers to believe. Cockburn believed that 'Jones's fascination with his wartime experiences' always 'remained his main preoccupation', and added that Jones 'did some good work' but it was 'a pity' that he 'so excessively gilded the lily'.¹⁴

¹² Lord Thomas of Swynnerton, 'Preface' to R. V. Jones, *New Light on Star Wars; a contribution to the SDI debate*, Centre for Policy Studies, Policy Study No. 71, 1985, p. 4.

¹³ University of East Anglia (hereafter UOEA) SZ/2/GEN, 'Draft letter to Lord Chalfont' written by Solly Zuckerman, no date, p. 1. The letter was not sent.

¹⁴ UOEA SZ/2/GEN, Robert Cockburn cited in 'Draft letter to Lord Chalfont' written by Solly Zuckerman, no date, p. 4. Jones was indeed preoccupied with the war, as a letter to Frank confirms in which Jones explained with amusement that his subconscious kept making him write dates in the wartime mode (18.6.40 instead of 18.6.60): UOB DM1310/J.96, Jones to Frank, 18 June 1960.

Two years after the publication of *Most Secret War*, Frank put pen to paper to apologise to a fellow academic because the latter found *Most Secret War* was spoilt by Jones's egotistic personality. Stanley Hooker had explained to Frank that it was 'a fascinating story somewhat marred' by Jones's egotism, and asked Frank whether Jones was 'really as good' as he claimed in the book.¹⁵ Another of Frank's friends believed *Most Secret War* 'showed Jones as having a chip on his shoulder'. Frank had 'suggested small changes here and there', but believed it right that Jones's character should show through, and that 'a bit of Cockney cockiness was a necessary, or at least very helpful element of character to do the job'. Frank explained to Hooker that he believed *Most Secret War* to be 'a very good attempt to tell as truly as possible, with sound judgement, the history of that very interesting and important part of the war' which Jones was 'in a position to observe as no-one else was'. Ultimately *Most Secret War* was 'a large slice' of Jones's autobiography. In answer to the question as to whether Jones 'was really as good as he makes out', Frank stated that those in scientific intelligence were 'bloody good' at their job, and 'worked with some bloody good colleagues'. Moreover, those in scientific intelligence 'were better than anyone else who tried to muscle in', and worked 'very well together' with colleagues except for those they 'had to fight'.¹⁶

Jones supplied George Millar with much of the information contained within the latter's 1974 book, *The Bruneval Raid*. Zuckerman had much to say about

¹⁵ UOB DM1310/A.16, Stanley Hooker to Frank, 9 August 1981.

¹⁶ UOB DM1310/A.16, Charles Frank to Stanley Hooker, 13 August 1981.

Jones's regular divulgence of information to authors before *Most Secret War* was published. He remarked that Jones 'sang his song to everyone' who was 'writing about radar and counter-measures', and that his pomposity was 'well disclosed' in Millar's book. This was through the declaration that frequently 'Jones was to lay before his Ministry, the War Cabinet, the defence scientists, disagreeable evidence that they had first refused to credit', to which Millar added Jones's words: "The path of truthful duty is not easy; there were several attempts to get me removed from my post because of my insistence of unpalatable facts being faced. I survived – but I might not have done had the situation not been so serious." For this statement alone Zuckerman defined Jones as a 'silly man'.¹⁷

Given Jones's extensive wartime involvement in intelligence work (in relation to radar, rockets and respective countermeasures) it is not surprising that Jones's work has featured in most accounts of British intelligence in the Second World War.¹⁸ Similarly, Jones's efforts can be found in most accounts of the scientific and technological contribution to the 1939–45 war.¹⁹ Given the successful conclusions to Jones's scientific applications, it is surprising that only fleeting mention is provided in a small number of generic accounts of the

¹⁷ UOEA SZ/2/GEN, 'Draft letter to Lord Chalfont' written by Solly Zuckerman, no date, p. 6; Millar, *The Bruneval Raid*, p. 65.

¹⁸ See as prime examples F. H. Hinsley, E. E. Thomas, C. F. G. Ransom, R. C. Knight, *British Intelligence in the Second World War: Its Influence on Strategy and Operations, Volume I* (London: HMSO, 1979), *Volume II* (London: HMSO, 1981), *Volume III, Part I* (London: HMSO, 1984), *Volume III, Part II* (London: HMSO, 1988); Basil Collier, *Hidden Weapons: Allied Secret or Undercover Services in World War II* (London: Hamish Hamilton, 1982); Ralph Bennett, *Behind the Battle: Intelligence in the War with Germany, 1939–45* (London: Sinclair-Stevenson, 1994); David Stafford, *Churchill and the Secret Service* (London: Abacus, 2000).

¹⁹ See as examples Guy Hartcup, *The Challenge of War: Scientific and Engineering Contributions to World War Two* (Newton Abbot: David & Charles, 1970); Brian Johnson, *The Secret War* (London: BBC, 1978); Brian J. Ford, *Secret Weapons: Technology, Science & the Race to Win World War II* (Oxford: Osprey Publishing, 2011); David Edgerton, *Britain's War Machine: Weapons, Resources and Experts in the Second World War* (London: Allen Lane, 2011).

war as a whole, while others deem radar countermeasures and scientific intelligence as insignificant to the broader picture.²⁰ It is not surprising that Winston Churchill's accounts of Jones's involvement in wartime events were both respectful and amiable (albeit somewhat slight), for Jones intermittently assisted the literary syndicate created to compile Churchill's war memoirs.

No secondary source, before or after publication of *Most Secret War*, has, however, matched Jones's memoirs for definition and clarity in representing the role he played during the war in assisting Allied victory. As his version of events this source has great and continuing value. Nevertheless, it is remarkable that since publication of Jones's memoirs no historian has challenged Jones's account of events or, for that matter, even assessed his wartime role as head of Air Ministry Scientific Intelligence. This position, upgraded in the late-1941 British Air Intelligence reforms to Assistant Directorate of Intelligence (Science), and designated ADI (Science) – an upgrade which firmly confirmed Jones's position and his organisation's role within the British intelligence organisation – proved integral to almost all aspects of science and technology harnessed to air warfare. Radio, Radio Direction-Finding (RDF – or Radar), rockets, aircraft (propeller, jet, and pilotless), as well as chemical, biological, and even atomic research, among many other matters were investigated by Jones and his team during the

²⁰ For examples of the few generic histories of the Second World War that mention Jones and scientific intelligence, see Martin Gilbert, *Second World War* (London: Weidenfeld & Nicolson, 1989); Gerhard L. Weinberg, *A World at Arms: A Global History of World War II* (Cambridge: CUP, 1994).

war.²¹ The organisation Jones controlled became an essential mechanism within Britain's war machine.

This, however, contrasts with another more obvious reason why Jones has a larger reputation than his lifetime career should allow. For Jones it was not the scientific intelligence organisation he headed that was 'a rather vital cog in the defence machine', but he himself.²² Through post-war lectures, journal articles, radio and television broadcasts, memoirs and other related publications Jones cleverly exaggerated his own wartime role. He ensured that the importance of his wartime role was enhanced to the extent that, when it came to writing his memoirs in the mid-1970s, he purveyed the myth that everything he and his organisation did during the war was crucial to Allied victory. Such memory fabrication has been defined as 'composure', something that almost everyone experiences at one time or other in their lives. Composure 'explains how storytelling is an inter-subjective performance in which narrators tell the most suitable version of their memories', anticipating that the audience will recognise it as 'meaningful and valid'. This inter-subjective performance 'makes the audience a constitutive factor in the story told'. Composure further explains that 'we compose memories about our lives to project a cohesive sense of self to others and ourselves'.²³

²¹ The British first applied the word 'radiolocation' for the process of using radio waves to find metal objects. This word was abbreviated to 'RDF' in the belief that it would serve well as a cover name to protect the secret of the technology. The United States Army Signals Corps had applied the term 'RPF' for 'radio position finding, but later altered this to 'radar' which stood for 'radio detection and ranging'. The British adopted this convenient term with common consent as late as 1943; see Office of Scientific Research and Development (OSRD), *Radar: A Report on Science and War* (London: HMSO, 1945), p. 8. In all references to British radar technology, this thesis will apply the term 'RDF' before 1943, and 'radar' during and after 1943.

²² Jones, *Most Secret War*, p. 144.

²³ Andrea Weis, 'On Behalf of My Comrades: Transnational Private Memories of German Prisoners of War in U.S. Captivity', Unpublished PhD Thesis, University of Kansas, 2008.

Such composure plays an integral role in the construction of memoirs— Jones’s memoir construction was no different. He did indeed tell the most suitable version of his memories in the hope that his audiences would find his role in the war not just valid, but crucial. Jones did indeed imagine himself central within his own stories in relation to events, interactions, organisations, and individuals he chose to recall. Upon critical analysis of his memoirs for this thesis, it became very evident that Jones had carefully selected certain elements, and excluded others, in order to accentuate his own importance in establishing scientific intelligence during the Second World War. However, as this thesis demonstrates, many more people and organisations played crucial roles as well. It is important to add that this thesis, while critiquing *Most Secret War*, is not entirely critical of Jones and his work. In many instances, Jones’s contributory war effort was exemplary, and credit is emphasised where due.

Perhaps Jones’s memory composure was due to the fact that, during the Cold War, many of the scientific and technological developments that he had discovered, uncovered and/or hunted in his wartime capacity as ADI (Science) had advanced exponentially. In this instance he could arguably be forgiven for some exaggeration of the importance of his wartime role as scientific intelligence watchdog. Memoirs are almost always self-serving in any case, and a degree of self-importance is to be expected. However, upon reading Jones’s *Most Secret War*, a reader gains the impression that Jones

won the war almost single-handedly.²⁴ This led one commentator to applaud him as one of the ‘heroes of World War II’.²⁵ One historian recently wrote that *Most Secret War* was ‘magnificently boastful’, but that Jones proved ‘the most reliable of narrators’, and in turn became a ‘global celebrity’.²⁶

If historians have not questioned Jones’s role, it means that all have taken his memoirs at face value – a truly remarkable occurrence, one that is quite possibly unique considering the amount of times *Most Secret War* has been cited in Second World War histories. In sum, Jones’s memoirs have been regarded for far too long as the authority on the subject of scientific intelligence. Defined as the ‘father of scientific intelligence’, Jones is most famous for ‘bending the beams’ in 1940. Once it had been publicly ascertained that Jones’s scientific intelligence deductions had potentially saved many homes and many lives, Jones became accepted in certain circles of the scientific and intelligence communities and, more importantly, acknowledged in Whitehall. As a consequence Jones firmly established his position in the history of Scientific and Technical Intelligence (STI). And yet, in application of this accolade and, in rightly defining Jones as the paradigm for the ‘how, why and wherefore’ of scientific intelligence, Michael Goodman

²⁴ The impression of Jones’s imagined central importance is staged from the outset of his memoirs, for on page three, in discussion of accepting the position as head of Scientific Intelligence, Jones stated ‘A man in that position could lose the war – I’ll take it!’: Jones, *Most Secret War*, p. 3.

²⁵ This was specifically for Jones’s contribution to electronic warfare: see Tom Bower, *Heroes of World War II: The Men and Women Who Won the War* (London: Boxtree, 1995), p. 114. This perception was perpetuated by statements like ‘Churchill declared that Jones did more to save Britain than many who glittered with metal trinkets on their chest’: John Mendelsohn, *Scientific and Technical Intelligence Gathering, including the ALSOS Mission* (New York: Garland, 1987), p. xi.

²⁶ Christy Campbell, *Target London: Under Attack from the V-Weapons during World War II* (London: Little, Brown, 2012), pp. 441 & 450.

raised many unanswered questions on the true conception of deployment of science and technology for intelligence purposes.²⁷

During the Second World War, however, scientific intelligence was an entirely separate pursuit from technical intelligence. Indeed, the differentiation between the two was unique to this particular world war. Both relatively new intelligence pursuits had incidences of liaison as well as friction as this thesis shows, and owing to wartime practical experience, were combined after the war to form a unified STI construct. This thesis forms a Second World War foundation to the ever-increasing historiography on Cold War STI.²⁸

Scientific intelligence is concerned with research projects, scientific ideas, or capabilities (potential future weaponry), whereas technical intelligence is

²⁷ Michael S. Goodman, 'Jones' Paradigm: the How, Why and Wherefore of Scientific Intelligence', *Intelligence and National Security*, 24: 2 (April 2009), 236–256.

²⁸ For the growing historiography on STI see Charles A. Ziegler and David Jacobson, *Spying without Spies: Origins of America's Secret Nuclear Surveillance System* (Westport: Praeger Publishers, 1995); Jeffrey T. Richelson, 'The Wizards of Langley: The CIA's Directorate of Science and Technology', *Intelligence and National Security*, 12: 1 (January 1997), 82–103; *The Wizards of Langley: Inside the CIA's Directorate of Science and Technology* (Cambridge MA: Westview Press, 2001); 'The technical collection of intelligence' in Loch K. Johnson (ed.), *Handbook of Intelligence Studies* (London: Routledge, 2009); Paul Maddrell, 'British-American scientific intelligence collaboration during the occupation of Germany', *Intelligence and National Security*, 15: 2 (2000), 74–94; 'The Scientist Who Came in from the Cold: Heinz Barwich's Flight from the GDR', *Intelligence and National Security*, 20: 4 (December 2005), 608–30; *Spying on Science: Western Intelligence in Divided Germany, 1945–1961* (Oxford: OUP, 2006); Michael S. Goodman, 'British Intelligence and the Soviet Nuclear Bomb, 1945–1950', *Journal of Strategic Studies*, 26: 2 (June 2003), 120–51; 'Grandfather of the Hydrogen Bomb? Klaus Fuchs and Anglo-American Intelligence', *Historical Studies in the Physical and Biological Sciences*, 34: 1 (2004), 1–22; "'Who is Trying to Keep What Secret from Whom and Why?'" MI5–FBI Relations and the Klaus Fuchs Case', *Journal of Cold War Studies*, 7: 3 (Summer 2005), 124–146; 'Sibling Rivalry: The Birth of the Post-War American Atomic Intelligence Community', *International Journal of Intelligence and CounterIntelligence*, 19: 2 (2006), 289–301; 'With a Little Help from my Friends: The Anglo-American Atomic Intelligence Partnership, 1945–1958', *Diplomacy & Statecraft*, 18: 1 (2007), 155–83; *Spying on the Nuclear Bear: Anglo-American Intelligence and the Soviet Bomb* (Stanford: Stanford University Press, 2007); Huw Dylan, 'The Joint Intelligence Bureau: Economic, Topographic, and Scientific Intelligence for Britain's Cold War, 1946–1964', unpublished PhD thesis, University of Aberystwyth, 2010; 'The Joint Intelligence Bureau: (Not So) Secret Intelligence for the Post-War World', *Intelligence and National Security*, 27: 1 (February 2012), 27–45; Michael Warner, 'Reflections on Technology and Intelligence Systems', *Intelligence and National Security*, 27: 1 (February 2012), 133–53. In the latter article, Warner was concerned about the 'gap in the scholarship' due to few works on technology and intelligence examining or understanding 'how technology affects intelligence systems'.

concerned with weapons in being, whether at the planning stage or in production.²⁹ After the Second World War the two combined became less defined within the STI acronym.³⁰ In an attempt to ‘demystify’ STI, Goodman declared it to be ‘essentially the fundamental ingredient of twentieth century intelligence’, the history of which is an ‘undernourished subject’.³¹ This thesis further develops the STI demystification process through archival research into the very origins of scientific intelligence, charts the importance of scientific intelligence throughout the Second World War, defines how scientific intelligence connected with technical intelligence during the war, and how the two were amalgamated thereafter.

Jones left behind an extensive paper trail. Before the war, he published five research papers.³² It is fair to speculate that had it not have been for the war, Jones’s publications would almost all have been of a scientific nature. However, the war had a lasting effect on Jones’s path in life. On various occasions during his lifetime Jones embarked upon memoirs, and two

²⁹ Maddrell, *Spying on Science*, p. 1; Maddrell, ‘British-American scientific intelligence collaboration during the occupation of Germany’, 90. Samuel Goudsmit, an early American scientific intelligence officer, defined the pursuit as ‘knowledge about the scientific standing and scientific potentialities of a country’, and remarked that it was ‘hard to draw a sharp distinction’ between scientific and technical intelligence: Goudsmit, Samuel A., ‘Scientific Intelligence’, *Proceedings of the American Philosophical Society*, 100: 1 (February 1956), 100.

³⁰ A recent definition elucidated that STI ‘assesses technical developments and characteristics, and the capabilities and performance of foreign technologies including weapon systems’, and that technical analysis ‘usually relates to defense planning, military operations, or arms-control negotiations’: John Hollister Hedley, ‘Analysis for strategic intelligence’ in Johnson (ed.), *Handbook of Intelligence Studies*, p. 214. STI is conspicuous by its absence in this volume of contemporary intelligence studies, for Hedley’s reference is solitary.

³¹ Goodman, ‘Jones’ Paradigm’, 237. See also Michael Goodman, ‘British Intelligence Estimates of the Soviet Nuclear Weapons Programme and their Impact on Strategic Planning, 1945–1958’, PhD thesis, University of Nottingham, 2004.

³² R. V. Jones, ‘The design and construction of thermoelectric cells’, *Journal of Scientific Instruments*, 11 (1934), 247–57; R. V. Jones, ‘A simple method of attaching a photoelectric cell relay to a moll galvanometer’, *Journal of Scientific Instruments*, 11 (1934), 302–303; R. V. Jones, ‘Photoelectric relays for galvanometers’, *Nature*, 133 (9 June 1934), 872; R. V. Jones, ‘The production of metallic films’, *Journal of Scientific Instruments*, 13 (September 1936), 282–8; R. V. Jones, ‘Radiation thermopiles of quick response’, *Journal of Scientific Instruments*, 14 (1937), 83–9.

reached publication. *Most Secret War* and *Reflections on Intelligence* were based on his experiences, recollections, and collected memories and anecdotes during his time working for British Intelligence, the Air Ministry, and later the Ministry of Defence.³³ Jones did have another book published, entitled *Instruments and Experiences*, although this was a collection of selected journal articles written during his academic scientific career.³⁴ Jones also wrote two monographs, *Future Conflict and New Technology* and *New Light on Star Wars* respectively.³⁵ What is notable about these publications is that (aside from the scientific article collection) they are all war-related. Perhaps not surprising for a scientist, the extent of Jones's journal article publications is remarkable. His fertile period for original scientific research was during the 1950s, 1960s and 1970s, when he produced well over 200 papers, only 31 of which can be found in *Instruments and Experiences*.

It is not Jones's publications however – impressive as they are – that will maintain the endurance of his legacy, but his archives. For a man who was not a diplomat, statesman or politician, Jones's personal papers are phenomenal. Again this is predominantly because of the Second World War. Total war 'prompted an expansion of what constituted compelling historical evidence and reoriented the history of the war into social-historical streams'; wars triggered archives 'in 1806 and again in 1918', and much the same in

³³ Jones, *Most Secret War*; R. V. Jones, *Reflections on Intelligence* (London: Heinemann, 1989). Both of these publications were sanctioned by the respective British governments. Of importance to future biographers are the manuscripts of Jones's abandoned memoirs regarding his academic career entitled 'No Easy Chair': For the manuscript of 'No Easy Chair', see CCAC RVJO J.477 through to J.543.

³⁴ R. V. Jones, *Instruments and Experiences: Papers on Measurement and Instrument Design* (Chichester: John Wiley & Sons, 1988).

³⁵ R. V. Jones, *Future Conflict and New Technology* (London: Sage Publications, 1981); R. V. Jones, *New Light on Star Wars: a contribution to the SDI debate* (London: Centre for Policy Studies, 1985).

1945.³⁶ Many other wartime scientists can be compared with Jones.³⁷ From the scientific intelligence perspective, Frank has an archive at Bristol University, but it is dwarfed by Jones's, and contains much more post-war academic research matter than wartime papers. No archive exists for any of the other wartime ADI (Science) personnel. Winterbotham has no archive, as is fitting for a British intelligence operative. Comparatively then, Jones's archive is disproportionate, both to his position – during and after the war – and his lifetime achievements.

If a balanced, comparative history is to be written, that is as true to the past as possible, then it is very important that intent behind archive construction is appreciated. What is interesting about Jones's archive is that it contains a great deal of documents that he had no legal right to have in his possession after the war. In fact the wartime papers in his collection are far superior to those in the National Archives. Indeed, for the research of this thesis, the documentation in the National Archives (among others) supplemented the Jones papers. Often it is the reverse. To obtain a full and true picture of Second World War scientific intelligence, the papers of Jones and Frank need to be analysed and compared with *Most Secret War*, and with all the other post-war publications and productions that stemmed from Jones's story, as well as with other memoirs and papers of all those involved.

³⁶ Peter Fritsche, 'The Archive', *History and Memory*, 17: 1–2 (Spring-Winter 2005), 22–4.

³⁷ Archive collections exist for Henry Tizard, Frederick Lindemann, Solly Zuckerman, Patrick Blackett, J. D. Bernal, Bernard Lovell, Robert Cockburn, and A. V. Hill. All of these archive collections have been engaged with during the research for this thesis. Other scientists who feature in this thesis for whom no archive exists are A. P. Rowe, Robert Watson Watt, Robert Hanbury Brown, and E. G. Bowen, although each of these men wrote memoirs that were referred to as source.

The Jones papers are a treasure trove of documents pertaining to his personal involvement in some of the key issues of twentieth century British history. The introduction to the catalogue of the Jones papers, written three years after Jones's death, also provides details of material relating to Jones at other locations. The first papers mentioned are the Ministry of Defence (DEFE) 40 files at the National Archives, which consist predominantly of scientific intelligence related matter (most post-war). There are many others, some which have come to light after construction of the Jones archive, in the National Archives and elsewhere.³⁸ Some material found in other archival collections can be said to be complementary to Jones's collection, and some supplementary to Jones's legacy. That is not where its importance lies, however, for much of the material collected by other people who came into contact with Jones during his life is either critical of Jones (both professionally and personally), or contradictory to Jones's version of events. The Jones papers held by Churchill College consist of a total of 5063 dossiers of documents contained in 229 box files.³⁹ One of Jones's contemporaries noted that Jones was the 'only man [who] kept everything'.⁴⁰ Evidently Jones had his legacy on his mind at all times throughout his life.

In writing his war memoirs in 1978, Jones attempted to fill the blanks created by the restrictions of the Official Secrets Act with his own memories of what

³⁸ Within the National Archives, Jones-related material can be found in the Cabinet Papers, Ministry of Defence papers, Admiralty papers (Infra-Red Research), the Foreign Office papers (regarding the late-war scientific intelligence gathering organisation 'Target Force' (T-Force) and the British Intelligence Objectives Sub-Committee (BIOS)), and the Air Ministry papers (radar and radar countermeasures).

³⁹ The catalogue of the Jones papers also highlights the fact that Jones's son, Mr Robert Jones, holds an extensive collection of personal papers.

⁴⁰ CCAC DEKE 5, Lecture notes written by Denis Kelly entitled 'Churchill as Historian'. The lecture was presented to the Middle Temple History Society on 13 January 1982.

had occurred and, more importantly, how he had contributed to Allied victory. To avoid re-telling the story of the birth of scientific intelligence according to Jones, the objects in question – and which must be questioned – are his archives and his memoirs. Jones’s archives and memoirs are therefore both the objects and subject of research within this thesis. Throughout the critique it has been vital to factor in the ‘cultural cloak’ that has existed since the end of the Second World War, which has enthusiastically (and perhaps even lovingly) been fuelled through many varied media by Jones himself.

Churchill’s memoirs were, according to David Reynolds, ‘not just an exercise in self-defence and self-promotion’, because ‘at times they became an attempt at self-knowledge’, for the wartime documents ‘forced’ Churchill into ‘some real heart-searching about his wartime career’.⁴¹ Although to a lesser degree, much the same can be said for Jones’s *Most Secret War* – his ‘elaborated memoirs’. Jones intentionally presented his recollections of the wartime events he himself participated in, yet unintentionally presented primary evidence about himself completely: his character, his beliefs, his foibles. Applying Reynolds’s methodology to the memoirs of other Second World War participants should therefore produce similar enlightening results about many other characters, occurrences, organisations, events, and other aspects of the Second World War.

Through his auto-biographical practice, Jones crafted his own history of events. Conversely, he also created the evidence to corroborate his history of

⁴¹ David Reynolds, *In Command of History: Churchill Fighting and Writing the Second World War* (London: Penguin Books, 2005), p. xxiv.

events (during the war through his SIRs, and after the war through construction of his archive). Because of the secrecy surrounding his war-time experiences and the sensitive nature of the actual evidence, he was in an ideal position to produce such a unique history. As the large majority of sensitive material is now accessible however, there is no longer any excuse for the history of events to remain so incomplete. Further historical research needs to be undertaken in order for normal historical practice to be restored. By placing the autobiographical history Jones created into the category of 'evidence' (as all memoirs should be) this thesis makes a significant contribution to such a restoration.

Just as Jones's archives are disproportionate to the man, so have his memoirs been disproportionately treated by history. Many histories of the Second World War have cited *Most Secret War* without question. Only two publications – one a memoir itself – have taken Jones's recollection of events to task, and both discuss the intelligence fields of photographic reconnaissance (PR) and photographic interpretation (PI). The memoir was from Ursula Powys-Lybbe, one of the wartime Women's Auxiliary Air Force (WAAF) PIs at Medmenham. Powys-Lybbe recalled how in 1978 she settled down to enjoy a television programme on the secret war, and was then disappointed because 'the scientist taking the major role' (Jones) displayed 'a marked lack of objectivity in his approach to the subject'. She also criticised later published accounts (*Most Secret War*), due to the competence of the Medmenham interpreters being questioned. This was 'sufficient to galvanise' Powys-Lybbe into rectifying the matter and giving 'RAF Medmenham its

proper status as a branch of Military Intelligence'.⁴² Perhaps Powys-Lybbe's personal aims and satisfaction were accomplished upon publication, although neither goal has been satisfied so far as history is concerned.

The second publication that critiqued Jones's recollection of PR/PI issues was written by a Cold War PI, Colonel Roy Stanley, of the United States Air Force (USAF). Although quick to praise *Most Secret War* as 'another "must read" from a brilliant man central to a number of "intelligence coups"', Stanley specifically stated that he did not agree with everything Jones said or did.⁴³ Close examination of these 'intelligence coups' is a primary reason behind the importance of this thesis. Laying foundations towards fuller appreciation of Jones's personal role and the ADI (Science) role in Allied victory during the Second World War is another. Powys-Lybbe's and Stanley's contributions to the history of British intelligence during the Second World War are rare for their professed determination to disagree with Jones's accounts of events, yet are exclusive to PR/PI. This thesis questions Jones's account of events in all scientific and technological spheres in which ADI (Science) played their part.

The memoirs of Aileen Clayton, who worked for the low-grade signals intelligence organisation (Y-Service) for Air Intelligence, also deserve special mention.⁴⁴ Clayton made reference to Jones even though Jones had chosen

⁴² Ursula Powys-Lybbe, *The Eye of Intelligence* (London: William Kimber & Co. Ltd., 1983), p. 13.

⁴³ Roy M. Stanley II, *V-Weapons Hunt: Defeating German Secret Weapons* (Barnsley: Pen & Sword Military, 2010), p. 247.

⁴⁴ Aileen Clayton, *The Enemy is Listening: The Story of the Y-Service* (London: Hutchinson, 1980). Clayton's story deserves much more attention than it has been afforded, not only because she worked in a rarely-discussed section of service intelligence, but also because she was a woman doing what was perceived to be a masculine role. See also Sinclair McKay, *The Secret Listeners: How the Y Service Intercepted German Codes for Bletchley Park* (London: Aarum Press, 2012).

not to mention Clayton at all, despite her contribution being integral to Jones's early scientific intelligence work.⁴⁵ Regarding high-grade signals, much has been written about the limitations to the history of British cryptanalysis during the Second World War owing to the remarkably impressive compliance to the Official Secrets Act.⁴⁶ Many memories have been lost forever. Close to 10,000 cryptanalysts, operatives, clerks, and service personnel (three quarters female) worked at Bletchley during 1939–1945.⁴⁷ Only a fraction of memoirs have been written by them, although the process of retrieval still continues.⁴⁸

On many occasions Jones used audio and visual media to further enhance his legacy. In the 1960s and early 1970s Jones used radio as a platform to tell his version of his wartime exploits.⁴⁹ All programmes were aired on BBC

⁴⁵ In reference to Jones's personal contact with the Y-Service, Jones always refers to Rowley Scott-Farnie, who was head of the Section in which Clayton operated.

⁴⁶ While in discussion of memoirs from wartime intelligence personnel, it is worth mentioning that Winterbotham's *The Ultra Secret* has repeatedly been proven to be unreliable as source; not because it has been critiqued meticulously, but because some of his recollections were so outrageously fabricated regarding ULTRA intelligence that his memoirs are well-known to be doubtful evidence of past events. Winterbotham attempted to pre-empt the Ultra Secret becoming public and rushed the compilation and publication of his recollections. For more information on the publication of Winterbotham's memoirs, see Robin Denniston, 'Three Kinds of Hero: Publishing the Memoirs of Secret Intelligence People', *Intelligence and National Security*, 7: 2 (April 1992), 112–25.

⁴⁷ See Christopher Grey, 'Britain's Wartime Intelligence Factory', *BBC History Magazine*, 13: 4 (April 2012), 57.

⁴⁸ See Gordon Welchman, *The Hut Six Story: Breaking the Enigma Codes* (New York: McGraw-Hill Book Company, 1982); Peter Calvocaressi, *Top Secret Ultra* (London: Cassell, 1980); Doreen Luke, *My Road to Bletchley* (Kidderminster: M & M Baldwin, 2002); James Thirsk, *Bletchley Park: An Inmate's Story* (London: Galago, 2008); Mavis Batey, *From Bletchley with Love*, (Milton Keynes: Bletchley Park Trust, 2008). Some compilations of Bletchley Park memories have been published: see F. H. Hinsley and Alan Stripp, *Codebreakers: The Inside Story of Bletchley Park* (Oxford: OUP, 1993); Michael Smith and Ralph Erskine, *Action This Day: Bletchley Park from the breaking of the Enigma Code to the birth of the modern computer* (London: Bantam Press, 2001); Marion Hill, *Bletchley Park People: Churchill's Geese that Never Cackled* (Stroud: The History Press, 2004); Sinclair McKay, *The Secret Life of Bletchley Park: The WWII Codebreaking Centre and the Men and Women Who Worked There* (London: Aurum Press Ltd., 2010).

⁴⁹ Jones was pre-recorded in BBC Manchester Studios reading a script written by the historian Norman Longmate on 8 January 1974. This tape recording was enhanced on 13 January 1974 with intermittent narration by David Mahlowe of the 'Time of My Life' show, and was eventually aired on BBC Radio 4 on 20 July 1974. For the transcript of 'Dr. Jones's War: The Man Who Could have Lost the War', see CCAC RVJO K.451. For 'Dr Jones' War: The Darkness is No Darkness', which was broadcast on 25

Radio Four, one in November 1964 entitled 'Emotion, Science, and the Bomber Offensive',⁵⁰ and a series aired in 1974 detailing his secret war. Entitled 'Dr Jones's War', this series comprised of three programmes, two in July 1974, with the other on 1 August 1974. The first programme was 'The Man who could have lost the War', the second 'The Darkness is no Darkness', and the third was 'The Rocket's Red Glare'.⁵¹ Perhaps stimulated by his radio broadcasts and growing celebrity status, Jones was invited by two television companies to recount his war experiences.⁵² These programmes precipitated Jones into writing *Most Secret War* earlier than he had planned.⁵³

The BBC's *The Secret War* truly evoked the British-ness of boffinry. As Jones was interviewed regarding the so-called 'Battle of the Beams', the radio war, and 'Battle of the V-Weapons', he was the boffin aired most. The first episode of *The Secret War* was called 'The Battle of the Beams' and was first aired on 5 January 1977.⁵⁴ Editing did not hide the fact that Jones was in his element narrating the events as they unfurled in the latter months of 1940. The second episode, entitled 'To See a Hundred Miles' and aired the following week, allowed Jones to tell the tale of the hunt for German radar and the Bruneval Raid. 'Terror Weapons', aired on 19 January, allowed Jones to take centre

July 1974 and covered the hunt for German radar which led up to the Bruneval Raid, see CCAC RVJO K.459. However, the Jones papers do not tell the full picture regarding his radio broadcasts.

⁵⁰ See R. V. Jones, 'Emotion, Science, and the Bomber', *The Listener*, 30 November 1961, 907–909.

See also CCAC RVJO A.121 for a fascinating 'Audience Research Report'.

⁵¹ The Cole Tapes at C.909/21 preserved in the British Library Sound and Moving Collection.

⁵² For a fascinating contemporary review of this BBC television series, see Joseph Hone, 'Biplanes and Bombers', *The Listener*, 13 January 1977, 55.

⁵³ Jones, *Reflections on Intelligence*, 213; Barry Fox, 'Review: Detecting the watchers – 'Reflections on Intelligence' by R. V. Jones', *New Scientist*, (14 April 1990). Jones added that he would not have considered writing his memoirs until he retired in 1981 'at the earliest'.

⁵⁴ Gerald Hughes remarked that, following the 1977 BBC broadcast of *The Secret War*, British intelligence 'was able to bask in good publicity once again'; see R. Gerald Hughes, 'Truth Telling and the Defence of the Realm: History and the History of the British Secret Intelligence Service', *Intelligence and National Security*, 26: 5 (October 2011), 715.

stage once again. Arguably in this episode Jones was permitted to hog the limelight to the detriment of other people's contributions to the Allies V-Weapon hunt. Jones was also a studio guest for the final episode in the series entitled 'Still Secret', which narrated the Bletchley story for the first time on British television. *The Secret War* consisted of only six fifty-minute episodes, and, as stated, Jones played a part in four.⁵⁵ These programmes were aired around the same time as Yorkshire Television ran a similar programme, which Jones also accepted fees for.⁵⁶

Reynolds stated that historians have become fascinated with the theme of war and memory, that such research has been largely explored as cultural and social history, and yet the influence of political memoirs on public memory has been profound.⁵⁷ This thesis expands upon the cultural, social, and political by addressing the scientific. It further extends the growing trend for memoir critique to assist in understanding the past through the eyes of one witness. Throughout, this thesis considers the cultures (and cultural mediums) of past and present and how these have, over time, affected the collective memory and historical consciousness of the birth of scientific intelligence.

⁵⁵ For the transcripts of these programmes, see CCAC RVJO K.475 through to K.478.

⁵⁶ See CCAC RVJO K.479 for some awkward correspondence between Jones and Philip Daly of the BBC concerning Jones being interviewed for the BBC and Yorkshire Television at the same time.

⁵⁷ Reynolds, *In Command of History*, p. xxiv.

Contextualising Scientific Intelligence

Keith Jeffery defined privileged access to intelligence primary source as ‘the Holy Grail of British archives.’⁵⁸ It was, however, the revelatory writings of Harold ‘Kim’ Philby, Hugh Trevor-Roper, Graham Greene, and Malcolm Muggeridge that encouraged the British Government to proceed with the official publication of *British Intelligence in the Second World War*.⁵⁹ Memoirs from Winterbotham and Jones consequently contributed to ‘the climate of opinion’ in which the official histories were sanctioned, and in which ‘contemporaries felt they were free to speak’.⁶⁰ The official history was not entirely warmly received.⁶¹ The former Chief of SIS, Sir Maurice Oldfield, commented that the first volume was ‘a book written by a committee, about committees, for committees’.⁶² Nevertheless, the official histories have been defined as ‘revolutionary’, not only for highlighting the successes and failures of British intelligence, but also for revealing the myriad agencies that existed.⁶³ They were also written by men with extensive knowledge of British intelligence in the Second World War.⁶⁴ Jeffery has since written the official

⁵⁸ Keith Jeffery, ‘A Secret History: Unravelling MI6’s Past’, *Daily Telegraph*, 22 September 2010, cited in Gerald Hughes, ‘Truth Telling and the Defence of the Realm’, 711.

⁵⁹ Gerald Hughes, ‘Truth Telling and the Defence of the Realm’, 714. See as examples, Kim Philby, *My Silent War: The Autobiography of a Spy* (London: MacGibbon & Kee, 1968; Arrow Books, 2003); Hugh Trevor-Roper, *The Philby Affair: Espionage, Treason, and Secret Services* (London: William Kimber, 1968); Graham Greene, *Our Man in Havana* (London: Heinemann, 1958); Malcolm Muggeridge, *Chronicles of Wasted Time, Part II: The Infernal Grove* (London: Collins, 1973).

⁶⁰ Len Scott, ‘Sources and Methods in the Study of Intelligence: A British View’, *Intelligence and National Security*, 22: 2 (April 2007), 187; Rodney M. Brunt, ‘Special Documentation Systems at the Government Code and Cypher School, Bletchley Park, during the Second World War’, *Intelligence and National Security*, 21: 1 (February 2006), 129.

⁶¹ See for example, Ronald Lewin, ‘Ghost in the Machine’, *RUSI*, 124: 3 (September 1979), 72. Lewin was critical of the lack of personality within the first volume of the official history.

⁶² Cited in Phillip Knightley, *The Second Oldest Profession: The Spy as Patriot, Bureaucrat, Fantasist and Whore* (London: Pan Books, 1987), p. 111; Scott, ‘Sources and Methods in the Study of Intelligence’, 190.

⁶³ Robert Dover and Michael Goodman, ‘Introduction: Intelligence in the Information Age’ in Dover and Goodman (eds.), *Spinning Intelligence*, p. 6.

⁶⁴ Harry Hinsley and Edward Thomas worked at Bletchley during the war. For their individual recollections, see Edward E. Thomas, ‘A Sidelong Glance at Alan Turing’ in Hayden B. Peake and

history of MI6.⁶⁵ All of these official histories serve as useful contributions to the historiography of scientific intelligence, and yet do little to enhance understanding of scientific intelligence as a wartime human enterprise.

Scientific intelligence in the Official History of *British Intelligence in the Second World War* follows Jones's account closely. Sources used by Hinsley *et al* throughout their narrative of British understanding of German science and technology mostly constituted those created by ADI (Science) during the war, as well as *Most Secret War* and Jones's 1947 *RUSI* Lecture. Other secondary sources used sparsely are Price's *Instruments of Darkness* which also follows Jones's story, Constance Babington Smith's *Evidence in Camera*, and Millar's *The Bruneval Raid*.⁶⁶ Primary sources used by Hinsley *et al*, other than the relevant Air Scientific Intelligence Reports (SIR), consist almost entirely of official histories.⁶⁷ Despite its bland and impersonal nature, the official history provided a strong account of events involving scientific intelligence, one which Jones would have appreciated. But that is the point;

Samuel Halpern (eds.), *In the Name of Intelligence: Essays in Honor of Walter Pforzheimer* (Washington DC: NIBC Press, 1994), 461 & 464–5; 'A Naval Officer in Hut 3' in F.H. Hinsley and A. Stripp (eds.), *Codebreakers: The Inside Story of Bletchley Park* (Oxford: OUP, 2001), p. 41. Hinsley was not a mathematician or a technical expert, but was recruited as an assistant to Max Neumann and Alan Turing: see Harry Hinsley, 'The Influence of ULTRA in the Second World War', www.cl.cam.ac.uk/research, accessed 7 March 2012, 1; Edward W. Bennett, 'Intelligence and History from the Other Side of the Hill', *The Journal of Modern History*, 60: 2 (June 1998), 315.

⁶⁵ Keith Jeffery, *MI6: The History of the Secret Intelligence Service, 1909–1949* (London: Bloomsbury, 2010).

⁶⁶ Constance Babington Smith, *Evidence in Camera: The Story of Photographic Intelligence in the Second World War* (London: Chatto & Windus, 1958). See footnote 8 above for full details of Price, *Instruments of Darkness* and Millar, *The Bruneval Raid*.

⁶⁷ TNA AIR 41/49, *The Air Defence of Great Britain*; TNA AIR 41/10, *The Rise and Fall of the German Air Force*; TNA AIR 41/6, *Photographic Reconnaissance*; TNA AIR 41/42, *The RAF in the Bombing Offensive against Germany*; Air Historical Branch (hereafter AHB), 'Air Ministry Intelligence'; Basil Collier, *The Defence of the United Kingdom* (London: HMSO, 1957); Charles Webster and Noble Frankland, *The Strategic Air Offensive against Germany, Volumes I–IV* (London: HMSO, 1961). Within the AHB official history of 'Air Ministry Intelligence' is the official history of ADI (Science) entitled 'Air Scientific Intelligence in War, 1939–45', and dated 1 April 1946. This document is also at CCAC RVJO B.83, CCAC CHUR 4/398E/326 & TNA AIR 40/1532.

the official history omits individuality and, more importantly, the problems incurred from personality. The official history also fails to define scientific intelligence both as pursuit and organisational structure, and fails to emphasise the importance of such a construct within British intelligence.

Close examination of the history of Second World War scientific intelligence inevitably raises questions regarding the awkward integration of science and governance during the twentieth century. An essential component of high-level government is intelligence in the service of national security. Yet there is a fundamental friction between the pursuits of intelligence and science. The hallmark of intelligence is secrecy and careful control of information; the hallmark of science is openness. Intelligence is tantamount to power; science, or at least the scientific ideal, should be free from any considerations of political ideology or national need.⁶⁸ Integration of modern science, scientists, and scientific thought into the more traditional profession of British intelligence was rarely smooth and often difficult as this thesis demonstrates throughout.

Summary of Chapters

The first chapter of this thesis provides a summary of British intelligence between the two world wars. This serves as an introduction to the structure and organisation of British intelligence leading into the Second World War, and provides solid foundation for the primary focus of this thesis. Chapter I analyses the British interwar realisation that scientific understanding of enemy

⁶⁸ Ronald E. Doel and Allen A. Needell, 'Science, Scientists, and the CIA: Balancing International Ideals, National Needs, and Professional Opportunities', *Intelligence and National Security*, 12: 1(1997), 59.

science and technology was crucial to Britain's immediate and future defence (crucial also to Britain's offensive ability across the globe, although this was not realised until well into the war). Chapter I also charts the early days of British scientific intelligence, and introduces the individuals and organisations involved in its creation.

Chapter II begins a long-awaited and much needed close examination of the episode that made Jones famous, colloquially known as the Battle of the Beams. Throughout the war, scientific intelligence was significantly influenced by ULTRA, for Jones was one of few who were security cleared for ULTRA. Jones was a frequent recipient of GC&CS reports, and received full advantage of cryptanalytic intelligence by establishing a special collegiality with a small research party inside Bletchley's Hut 3, and maintaining frequent (almost daily) contact with personnel of that party.⁶⁹ Among other key scientific intelligence sources were POW interrogation reports, the products of PR/PI, and low-level SIGINT collected by the British Y-Service. The organisations involved in the gathering of these intelligence sources and their early interaction with Jones is discussed through the operational analysis of the Battle of the Beams. Chapter III continues this theme through to the end of the Blitz in May 1941, by which time scientific intelligence had grown from a single man into a small air scientific intelligence organisation. Three differing navigation/bombing beam systems were tackled by the slowly evolving scientific intelligence nucleus during the Battle of the Beams, and each posed their own intelligence, scientific, and technological problems.

⁶⁹ Józef Garliński, *Intercept: The Enigma War* (London: J.M. Dent & Sons, 1979), p. 51; Michael Smith, *Station X: The Codebreakers of Bletchley Park* (London: Channel 4 Books, 1998), p. 40.

Following Operation *Barbarossa* in June 1941, scientific intelligence experienced a brief lull in activity. This allowed Jones's small but growing organisation to consider offensive possibilities for scientific intelligence, the beginnings of which are charted in Chapter IV. This chapter extends scientific intelligence activity up to February 1942, by which time SIS had experienced reorganisation. British intelligence expansion meant an increase in staff for air scientific intelligence, and its establishment as a permanent Directorate in the SIS structure. Perhaps because of Jones's growing wartime importance the abrasiveness of his character produced certain frictions during this period that would persist and fester, sometimes to the detriment of harmonious relations between organisations important to scientific intelligence.

With an appreciation of the shift in the mentality of the Allies from defence to offense, Chapter V proceeds with Jones's war following his successes in the Battle of the Beams. With the burgeoning Allied strategic air offensive in mind, Jones's small but growing team of scientific intelligence officers were requested to understand as fully as possible the day and night defences of the German Air Force (GAF) protecting the Greater Reich. This immense undertaking continued through to the end of the war, and constituted ADI (Science)'s greatest accomplishment. Using a variety of sources available to them, including German equipment captured in the famous Bruneval Raid, ADI (Science) became the Allied authority on German radar capability. It is for these reasons that this subject matter extends into Chapter VI, which also draws upon many of the operational issues and controversies that occurred

throughout the war involving ADI (Science). This chapter also examines the significant contribution made by ADI (Science) to the Allied strategic air offensive. ADI (Science) were also drawn into other aspects of scientific and technical intelligence throughout the war, atomic and naval issues for example. Chapter VI covers these matters also.

Chapter VII breaks from war-related operational analysis, and closely examines the individual personalities within ADI (Science) and their organisational position inside the wartime superstructures of both the Air Ministry and SIS. No history to date has scrutinised the individuality within ADI (Science). Even Jones was vague regarding most of his wartime colleagues throughout all of his post-war literature. While structural examination of SIS has been undertaken, notably by Philip Davies, ADI (Science)'s position within the SIS structure and its relatively parallel position within the Air Ministry organisation has remained ambiguous.⁷⁰ This chapter therefore constitutes a major contribution to the history of British intelligence.

Chapter VIII is an isolated examination, through the lens of air scientific intelligence, of the Allied intelligence campaign against the German rocket and flying bomb programmes, colloquially known as *Vergeltungswaffen*, or Vengeance Weapons. Due to the complexity of the issues under examination throughout this thesis, it was necessary to separate the wartime technologies which resulted from German scientific research wherever possible. The V-Weapons stood entirely alone in this regard. Many difficulties arose from the

⁷⁰ Philip H. J. Davies, *MI6 and the Machinery of Spying* (Abingdon: Frank Cass Publishers, 2004).

political misunderstandings of the V-Weapons which resulted directly from too many experts being called upon to assist. ADI (Science) were always on the periphery of these difficulties from December 1942 through to the end of the war, and felt shunned when not asked to lead the intelligence attack.

Jones, and by token, his wartime scientific intelligence organisation were one of the Second World War's great success stories. They are well known to history because of *Most Secret War*, and the authority it has been afforded due to its status as a first-hand account. ADI (Science) also made mistakes, and frequently ignited controversies. These are naturally less well known, and need to be placed into context. This thesis does just that. Much more importantly, as this thesis shows throughout, Jones's important organisation was only one small part of a much larger scientific intelligence establishment, which has been unjustly neglected and is greatly deserving of further study. This thesis therefore constitutes a significant contribution to the history of the Second World War, for it builds upon the foundations laid by Jones in his memoirs and post-war literature, extends upon the limited wartime scientific intelligence historiography, and provides a fuller picture of the ADI (Science) contribution to the Second World War.

Chapter I: A Scientific Intelligence Service

It was evident at the beginning of the twentieth century that espionage and scientific invention were to be inextricably intertwined. A 1910 journal article questioned the legitimacy of the word 'spy' when applied to messages sent by pigeon, balloon, aircraft, or wireless telegraphy unless either the sender or the message was somehow disguised. The author emphasised that larger facilities afforded by modern invention 'for obtaining and communicating information of the enemy's movements or plans' rendered it desirable that 'the extreme penalty should not be inflicted upon a person captured in the course of such acts, unless there were special circumstances to justify the harshness'. Instead, in view of the fact that 'conquest of the air' provided 'for taking observations from a position of vantage', the author proposed that nation states ought to consider interdiction of 'passage of balloons and airships over their forts and arsenals and dockyards, lest valuable information should be secured by the secret agent of foreign powers'.¹

Air power relied on two fundamental assumptions following the First World War. The first was that if war came again it was highly likely to be total, eradicating the distinction between civilians and combatant. The second was

¹ Norman Bentwich, 'Espionage and Scientific Invention', *Journal of the Society of Comparative Legislation*, 10: 2 (1910), 243–49. See also Franz Boas, 'Scientists as Spies', *The Nation*, 109: 2842 (20 December 1919), republished in *Anthropology Today*, 21: 3 (June 2005), 27. The latter article addressed the fundamental principle announced by President Woodrow Wilson that 'only autocracies maintain spies', for spies were 'not needed in democracies'.

that science and technology would play dominant roles.² It became essential, therefore, to understand the enemies' capabilities of scientific research and technological capacity; not just as a signifier of what to expect in the respective theatres of battle, but also to appreciate the enemies' ability to sustain modern warfare. The complexities of obtaining this type of intelligence became acute as science (pure and applied) became much more nationalistic and thereby secret. Universal appreciation of this fact however, failed to inspire any forms of scientific or technical intelligence.

Many historians agree that British intelligence in the Second World War was on the whole successful. Christopher Andrew stated that, although British intelligence was 'far from infallible', its 'record remains an astonishing one'.³ Reynolds wrote that it is 'an incontrovertible fact that intelligence was a vital part of the British war effort'.⁴ Richard Aldrich argued that 'MI5 enjoyed a successful Second World War and was well managed', for 'German spies in Britain were quickly rounded up in 1939', with 'many being 'played back' as double agents for the purpose of deception'.⁵ Added to this was the important fact that British Signal codes were not broken by Axis at all during the war.⁶ As for SIS, during 1939 and 1940, its resources were stretched 'almost to

² Richard Overy, 'Air Power and the Origins of Deterrence Theory before 1939', *The Journal of Strategic Studies*, 15: 1 (March 1992), 74.

³ Christopher Andrew, 'Governments and Secret Services: A Historical Perspective', *International Journal*, 34: 2 (Spring 1979), 181.

⁴ Reynolds, *In Command of History*, p. 163.

⁵ Richard J. Aldrich, 'The Secret State', in Paul Addison and Harriet Jones (eds.), *A Companion to Contemporary Britain, 1939–2000* (Oxford: Blackwell Publishing, 2005), p. 334. See also Jennifer Grant, 'The Role of MI5 in the Internment of British Fascists during the Second World War', *Intelligence and National Security*, 24: 4 (August 2009), 499–528.

⁶ John Ferris, 'The British "Enigma": Britain, signals security and cipher machines, 1906–1953' in John Robert Ferris, *Intelligence and Strategy, Selected Essays* (Abingdon: Routledge, 2005), pp. 138–80. Ferris wrote that 'ULTRA was not enough for victory; Britain won not just by breaking German codes but by defending its own'.

breaking point', but after a difficult start 'established itself as an integral and valued part of the British war machine, not least (but also not only) because of the increasingly valuable signals intelligence emanating from Bletchley Park'.⁷

The latter part of this statement is important. Hinsley was modest in his claims of wartime GC&CS successes, and specifically rejected the view that 'Bletchley won the war'; rightly so, according to John Keegan.⁸ Hinsley instead posited that ULTRA intelligence certainly shortened the war.⁹ In autumn 1985, Hinsley gave a paper in which he emphasised not just the inferiority of German intelligence, but also the importance of intelligence sources (in addition to ULTRA) the British organised so effectively.¹⁰ This is vital to any examination of British intelligence during the Second World War. Signals intelligence (SIGINT) alone did not win the war; that much has been historically assessed through many publications.¹¹ However, SIGINT was an

⁷ Jeffery, *MI6*, pp. 411 & 726.

⁸ John Keegan, *Intelligence in War: Knowledge of the Enemy from Napoleon to Al-Qaeda* (London: Hutchinson, 2003), p. 293.

⁹ F.H. Hinsley, 'The Influence of Ultra in the Second World War', in F.H. Hinsley and Alan Stripp (eds.), *Codebreakers: The Inside Story of Bletchley Park* (Oxford: OUP, 1993), p. 11. John Keegan reiterated Hinsley's comments in his historiographical study entitled *The Battle for History: Re-fighting World War II* (London: Pimlico, 1997), pp. 87–8. Keegan reaffirmed Hinsley's stance by suggesting that his conclusions were 'not to be argued with'; for as a 'master player of the game' Hinsley was able to 'make judgements not open to the rest of us'. Keegan added that perhaps Hinsley had underplayed the significance of the confidence that possession of the ULTRA secret gave to the Allied High Command. For a comparative overview of Second World War cipher interception, see R. A. Ratcliff, *Delusions of Intelligence: Enigma, Ultra, and the End of Secure Ciphers* (Cambridge: CUP, 2006).

¹⁰ See F.H. Hinsley, 'British Intelligence in the Second World War' in Christopher Andrew and Jeremy Noakes (eds.), *Intelligence and International Relations, 1900–1945* (Exeter: Exeter University Publications, 1987), pp. 209–18; F. H. Hinsley, 'British Intelligence in the Second World War: An Overview', *Cryptologia*, 16: 1 (1990), 1–10; F. H. Hinsley, 'The Counterfactual History of No Ultra', *Cryptologia*, 20: 4 (October 1996), 308–24; F. H. Hinsley, 'The Enigma of Ultra', *History Today*, 43: 9 (September 1993), 15–20; F. H. Hinsley, 'The Influence of Ultra in the Second World War', available at www.cl.cam.ac.uk/research/security/Historical/hinsley/html, accessed 7 March 2012.

¹¹ For the most influential supplements to Hinsley's thesis, see Harold C. Deutsch, 'The Historical Impact of Revealing the Ultra Secret', *Parameters*, 7: 3 (1977), 16–32; 'The Influence of Ultra on World War Two', *Parameters*, 8: 4 (1978), 2–15; David Kahn, 'Codebreaking in World Wars I and II: The Major Successes and Failures, Their Causes and their Effects' in Christopher Andrew and David Dilks, *The Missing Dimension: Governments and Intelligence Communities in the Twentieth Century* (London: Macmillan Publishers, 1984), p. 158; Keegan, *The Second World War*, p. 423. For a counter-

integral component of a highly effective (and pragmatic) British intelligence organisation. SIGINT was combined with, and contributed to, a remarkable Secret (and Security) Service structure that was a crucial element of Britain's war machine.¹² Such intelligence organisation was without precedent.

Three important developments contributed significantly to the success of this British intelligence organisation. First, the 1936 formation of the Joint Intelligence Committee (JIC) proved crucial to Allied victory. Established to serve the three armed forces by co-ordinating and assessing intelligence as a whole, during the Second World War as a sub-committee of the newly-formed War Cabinet that replaced the Committee of Imperial Defence (CID) it became a central component of government machinery.¹³ Considered synonymous with the definition of 'Central Intelligence Machinery', the JIC markedly came of age during world war as the major filter for integrating intelligence into strategy and operations, and as a direct interface between intelligence and policy.¹⁴

Secondly, many branches within this extensive British intelligence organisation allowed for the smooth and relatively warm welcome of American intelligence officers during the mid-war period. In many respects post-war US

argument, see Kenneth Macksey, *Without Enigma: The Ultra and Fellgiebel Riddles* (Shepperton: Ian Allen Publishing, 2000).

¹² It is surprising that Edgerton's examination of *Britain's War Machine* has negligible discussion on the immense British intelligence organisation. Science and technology were crucial factors in Second World War intelligence-gathering systems and processes as this thesis demonstrates throughout.

¹³ Percy Cradock, *Know Your Enemy: How the Joint Intelligence Committee Saw the World* (London: John Murray Publishers, 2002), pp. 1 & 7. The Official History of the JIC is currently being written by Michael S. Goodman.

¹⁴ Aldrich, 'The Secret State', p. 339; Cradock, *Know Your Enemy*, p. 11. See also Edward Thomas, 'The Evolution of the JIC System Up to and During World War II' in Andrew and Noakes (eds.), *Intelligence and International Relations*, pp. 219–34.

intelligence organisations owed much to the methods they had learnt and adopted from British intelligence organisation.¹⁵ Anglo-American (and Anglo-Canadian) scientific and technological liaison and integration as direct consequence of war also require consideration, particularly in the fields of cryptanalysis, aerial photography, and atomic research.¹⁶

This neatly leads to the less discussed, yet just as important third contribution to such expansive intelligence organisation—the rapid development of science and technology in the early years of the twentieth century. Common themes of technological application can be seen in the list of British intelligence branches provided in Appendix I, such as photography, radio,

¹⁵ Andrew, ‘Governments and Secret Services’, 181; Christopher Andrew, ‘The Making of the Anglo-American SIGINT Alliance’ in Peake and Halpern, *In the Name of Intelligence*, pp. 95–109; Lee A. Gladwin, ‘Cautious Collaborators: The Struggle for Anglo-American Cryptanalytic Co-operation 1940–43’ in David Alvarez (ed.), *Allied and Axis Signals Intelligence in World War II* (London: Frank Cass, 1999); C. J. Jenner, ‘Turning the Hinge of Fate: Good Source and the UK-U.S. Intelligence Alliance, 1940–1942’, *Diplomatic History*, 32: 2 (April 2008), 165–205; Jon Robb-Webb, ‘Anglo-American Naval Intelligence Co-operation in the Pacific, 1944–45’, *Intelligence and National Security*, 22: 5 (October 2007), 767–86. For First World War collaborative precedents, see Jim Beach, ‘Origins of the Special Relationship? Anglo-American Intelligence Co-operation on the Western Front, 1917–18’, *Intelligence and National Security*, 22: 2 (April 2007), 229–49; See Roy Macleod, ‘Secrets among Friends: The Research Information Service and the “Special Relationship” in Allied Scientific Information and Intelligence, 1916–1918’, *Minerva*, 37 (1999), 201–33.

¹⁶ The celebrated Tizard Mission was perhaps the most important Anglo-American scientific exchange: see Imperial War Museum (hereafter IWM) HTT 252, ‘Tizard Mission to the USA: Minutes and Letters Prior to Departure’, August 1940; IWM HTT 254, ‘Miscellaneous Papers regarding Tizard Mission’, September 1940–July 1941. The Tizard Mission was the brainchild of A. V. Hill while attached to the British Air Attaché in Washington: see IWM HTT 251, ‘RDF and USA’, April–May 1940; CCAC AVHL I 3/5, ‘Preparing for New War’, June 1940; IWM HTT 58, Hill to Archibald Sinclair, Secretary of State for Air; CCAC 920/HIL, A. V. Hill, unpublished memoirs ‘Memories and Reflections’, pp. 559–71; Bernard Katz, ‘Archibald Vivian Hill: 26 September 1886–3 June 1977’, *Biographical Memoirs of Fellows of the Royal Society*, 24 (November 1978), 117–8. Hill was not deemed suitable for the job himself, and as Tizard was available, he instead undertook (as Blackett wrote) the task of ‘bringing American scientists into the war before their Government’: A. V. Hill, ‘Science and Defence: Anglo-American Partnership in Research’, *The Times*, 17 June 1941, 5; P. M. S. Blackett, ‘Tizard and the Science of War’, *Nature*, 4714 (5 March 1960), 649. See also J. R. M. Butler, *Grand Strategy, Volume II: September 1939–June 1941* (London: HMSO, 1957), p. 423; Ronald Clark, *Tizard* (London: Methuen & Co., 1965), pp. 248–71; Hartcup, *Challenge of War*, pp. 27–9; Mendelsohn, *Scientific and Technical Intelligence Gathering*, p. xi; Donald Avery, ‘Allied Scientific Co-Operation and Soviet Espionage in Canada, 1941–45’, *Intelligence and National Security*, 8: 3 (July 1993), 101–3; David Zimmerman, *Top Secret Exchange: The Tizard Mission and the Scientific War* (Stroud: Phoenix Mill, 1996); Stephen Phelps, *Tizard Mission: The Top-Secret Operation that Changed the Course of World War 2* (Yardley: Westholme Publishing, 2010).

communications, and code-breaking machinery. Up to 1940, intelligence had little interest in scientific pursuits yet during the Second World War the physical, biological, and even psychological sciences became necessary (sometimes critical) to the belligerents' respective war efforts.

Preparing for War

Legions of histories have declared that Britain was unprepared for war in 1939.¹⁷ Fresh perspectives on the Second World War suggest otherwise.¹⁸ Seldom discussed in Second World War narratives, however, is the state of readiness within the British intelligence organisation—defined as 'disturbing' and 'ramshackle'.¹⁹ In many respects, British intelligence unpreparedness suggests that care be taken regarding fresh perspectives of British readiness for war in 1939. For example, GC&CS were desperately short of receivers for wireless interception, despite frequent warnings to this effect since 1932.²⁰ Until 1939, SIS had even been unable to afford wireless sets for its agents, which obliged them to continue to rely on the traditional method of communication—letters written in secret ink to post office boxes!²¹ There was no service-based aerial PR at all – a remarkable oversight given (albeit

¹⁷ Classic examples are Arthur Bryant, *The Turn of the Tide, 1939–1943* (London: Collins, 1957), pp. 47–88; Winston S. Churchill, *The Second World War, Volume One: The Gathering Storm* (London: Reprint Society Ltd. 1950), pp. 118–44 & 192–202; A. J. P. Taylor, *English History, 1914–1939* (Oxford: OUP, 1967), pp. 456–66; Basil H. Liddell Hart, *History of the Second World War* (London: BCA, 1970), 16–24.

¹⁸ D. E. H. Edgerton, 'State Intervention in British Manufacturing Industry, 1931–1951: A Comparative Study of Policy for the Military Aircraft and Cotton Textile Industries', unpublished PhD thesis, Imperial College London, 1986; David Edgerton, *England & the Aeroplane: An Essay on a Militant and Technological Nation* (London: Macmillan, 1991); David Edgerton, *Warfare State: Britain, 1920–1970* (Cambridge: CUP, 2006); Edgerton, *Britain's War Machine*; G. C. Peden, *Arms, Economics, and British Strategy: From Dreadnoughts to Hydrogen Bombs* (Cambridge: CUP, 2007).

¹⁹ Bennett, *Behind the Battle*, p. 8. Collier, *Hidden Weapons*, p. 53.

²⁰ Hinsley *et al*, *British Intelligence in the Second World War, Volume I*, p. 51. See also pp. 488–95.

²¹ Christopher Andrew, *Secret Service: The Making of the British Intelligence Community* (London: Heinemann, 1985), p. 377; Nigel West, *GCHQ: The Secret Wireless War, 1900–86* (London: Weidenfeld & Nicolson, 1986), p. 113; Hinsley, *et al*, *British Intelligence in the Second World War, Volume I*, p. 57.

rudimentary) PR success during the First World War. Interception of low-grade SIGINT was incredibly amateur while the equipment was either tailored together from First World War receiver components, or, if could be afforded, imported from the USA. British intelligence required professionalising.²²

Nevertheless, there is no better catalyst for intelligence activity than that of the threat of imminent national danger. In January 1936, the CID's Defence Requirements Sub-Committee found that German naval re-armament had highlighted a major issue in which British intelligence 'proved defective', and endorsed the need for greater intelligence spending. Without debate in Parliament, the Secret Service Vote (covering both MI5 and SIS) was raised from £180,000 in 1935, to £250,000 in 1936, £350,000 in 1937, £450,000 in 1938, and £500,000 in 1939.²³ Secret Service grants and expenditure up to 1938 show that almost all allotted funds were spent, thereby demonstrating the dramatic rise in espionage activity during this time of crisis.²⁴

In 1937, the Treasury approved the sum of £400,000 to be spent on establishing a test area for a searchlight project called 'Silhouette'. This was the brainchild of the physiologist A.V. Hill in his capacity as a member of the Committee for the Scientific Survey of Aerial Defence (CSSAD – also known as the Tizard Committee, after its chairman). The project's purpose was to construct powerful searchlights to illuminate the clouds and 'light up the sky', to provide good visibility for nightfighter aircraft. That Silhouette was only

²² John Pether, *Funkers and Sparkers; Origins and Formation of the Y Service*, The Bletchley Park Reports, 17 (September 2000), p. 11.

²³ See TNA T160/787, 'Secret Service Blue Notes'; see also Andrew, *Secret Service*, p. 377; and Jeffery, *MI6*, p. 247.

²⁴ TNA T160/787, 'Secret Service 1939, Grants and expenditure in recent years', April 1939.

expected to be effective for 111 nights of the year, and a full system could potentially cost over 7.5 million pounds, were insufficient grounds to deter trials of Silhouette from proceeding.²⁵ Even more remarkable is that larger funds were set aside by the Treasury for this untested technology than were spent on the entire 1937 Secret Service Vote.

Silhouette symbolised the 1930s desperation to apply technology to the defence of Great Britain. There is no doubt that military technological application was as hard-hit by financial restraint as intelligence had been. Edgerton has written convincingly of Britain possessing an 'interwar military-industrial complex' which had at its heart a 'research corps' employed by both state and industry.²⁶ For Edgerton, the problem was not lack of war preparation, for Britain went into the Second World War 'believing in victory, and did so because it believed in its economic power and the power of its new scientific weapons'.²⁷ Clearly the entire British technical infrastructure had enormous effect on Britain's readiness for yet another war. Yet arguments of structural readiness should not be taken too far, for in many respects, and in several instances, not least by intelligence, Britain was surprised by Germany's scientific and technical ingenuity (and for a while superiority).

²⁵ Phillip Edward Judkins, 'Making Vision into Power: Britain's acquisition of the world's first radar-based integrated air defence system', unpublished PhD thesis, Cranfield University, November 2007, pp. 277–79, 299–301 & 312–13; the latter pages for Judkins's plausible justification for the Silhouette technology; see also Edgerton, *Britain's War Machine*, p. 41. This idea of illuminating the clouds had been tabled for Cabinet approval as early as March 1928 by the War Office's Committee of Imperial Defence, Anti-Aircraft Sub-Committee; see TNA CAB 24/194. In light of this report from the committee, the Cabinet approved the sum of £5000 for the construction of the concrete sound mirrors which can still be found along the east coast of England.

²⁶ Edgerton, *Warfare State*, pp. 108–44.

²⁷ Edgerton, *Britain's War Machine*, p. 46.

The threat of mass air attack from the European continent had been on the British government's agenda since the First World War, despite cuts in military spending. Two factors are significant: the development of the Chain Home (CH) RDF umbrella, and the 1930s intelligence assessment of German air strength. The latter is well-known and has a rich historiography.²⁸ How science and technology were mobilised to assist with Britain's defence is much more relevant here. The Tizard Committee was ultimately responsible for the timely beginnings of Chain Home, while Tizard's personal role in the integration of RDF into Britain's Fighter Command system was immense. British RDF became the final bark of the watchdog before the intruder encroached – the very last gasp of British operational intelligence – and for this reason (among many others) the Air Ministry and SIS worked very closely with each other before, and during the war.²⁹

²⁸ For perhaps the most influential accounts, see Air Ministry (ACAS(I) T. W. Elmhirst), *The Rise and Fall of the German Air Force (1933 to 1945)*, 1948 (this publication can be accessed at TNA AIR 41/10); Churchill, *The Gathering Storm*; Charles Webster and Noble Frankland, *The Strategic Air Offensive against Germany, 1939–1945, Volume I* (London: HMSO, 1961), pp. 33–85; Derek Wood & Derek Dempster, *The Narrow Margin: The Battle of Britain and the Rise of Air Power, 1930–1940* (London: Hutchinson, 1961), pp. 35–64; Williamson Murray, 'German Air Power and the Munich Crisis', in Brian Bond and Ian Roy (eds.), *War and Society: A Yearbook of Military History, Volume 2* (London: Croom Helm, 1977); Hinsley *et al.*, *British Intelligence in the Second World War, Volume I*, pp. 45–88; Uri Bailer, *The Shadow of the Bomber: Fear of Air Attack and British Politics, 1932–1939* (London: Royal Historical Society, 1980); Richard Overy, 'The German Pre-war Aircraft Production Plans: November 1936–April 1939', *English History Review*, 90 (1975), 778–97; *The Air War, 1939–1945* (London: Europa Publications, 1980); 'German Air Strength, 1933 to 1939: A Note', *Historical Journal*, 27 (1984), 465–71; 'Strategic Intelligence and the Outbreak of the Second World War', *War in History*, 5: 4 (1998), 451–80; Barton Whaley, 'Covert Rearmament in Germany 1919–1939: Deception and Misperception', *The Journal of Strategic Studies*, 5: 1 (March 1982); Wesley K. Wark, 'British Intelligence on the German Air Force and Aircraft Industry, 1933–1939', *The Historical Journal*, 25: 3 (September 1982), 627; *The Ultimate Enemy: British Intelligence and Nazi Germany, 1933–1939* (Oxford: OUP, 1986).

²⁹ See TNA AIR 40/2659 for co-ordination of SIS and RAF during the Second World War and expenditure specifics of 'Special Duties' in Europe.

Much has been written on the 'backroom' scientific research which formed the foundation to the British RDF programme.³⁰ Harry Egerton Wimperis of the Department of Scientific and Industrial Research (DSIR) was requested to investigate the feasibility of a death-ray, and delegated the matter to the Radio Research Station.³¹ Rather than being a vibrant enterprise, it was the epitome of a 'backroom boys' project. This at a time when there was still airship pioneers.³² The Air Ministry supported further investigation to the tune of a not insignificant £10,000, and a Radio Research Station sub-section was moved to the RAF base at Orfordness on the Suffolk coast to enable further development. A few months later this team of scientists, led by Watson-Watt, moved to Bawdsey Manor, some twenty miles south of Orfordness.³³

Crucially, Bawdsey Manor became a 'mecca for scientists of all three Services'; such unique service integration inspired the evolution of what were

³⁰ See as examples, Robert Watson-Watt, *Three Steps to Victory: A Personal Account by Radar's Greatest Pioneer* (London: Odhams Press, 1957), p. 60; David Zimmerman, *Britain's Shield: Radar and the Defeat of the Luftwaffe* (Stroud: Sutton Publishing, 2001); Alexander Rose, 'Radar and Air Defence in the 1930s', *Twentieth Century British History*, 9: 2 (1998), 219–45. See also J. A. Ratcliffe, 'Robert Watson-Watt. 13 April 1892–5 December 1973', *Biographical Memoirs of Fellows of the Royal Society*, 21 (November 1975), 549–68. Watson-Watt later confirmed in his collaborative Post Office Report No.233 in June 1932 that aircraft did indeed interfere with radio signals and that they also re-radiated them; taking this further he postulated that aircraft were likely to act as radiators and thus reflect radio signals back in the opposite direction. But there had been no urgency then. See also J. A. Ratcliffe, 'Edward Victor Appleton, 1892–1965', *Biographical Memoirs of Fellows of the Royal Society*, 12 (November 1966), 1–21. For Russian RDF development, see John Erickson, 'Radio-Location and the Air Defence Problem: The Design and Development of Soviet Radar 1934–40', *Science Studies*, 2: 3 (July 1972), 241–63.

³¹ The Radio Research Station was a sub-branch of the National Physics Laboratory (NPL) situated at Datchet (near Slough), and was a fine example of how Edgerton's 'research corps' was so readily available to be utilised whenever required, although it is important to place the Radio Research Station into context. It was housed in a modest collection of huts, in which an enthusiastic group of young scientists tinkered with a range of radio equipment: Edgerton, *Warfare State*, pp. 108–44.

³² Henry Tizard, 'Is the Airship Obsolete?' *The Listener*, 438 (2 June 1937), 1070. An early task for the Radio Research Station in 1933 was to build cathode-ray direction-finding (D/F) equipment for airships R34, R100 and R101 for thunderstorm avoidance: Watson-Watt, *Three Steps to Victory*, p. 72.

³³ Arnold Wilkins in Gordon Kinsey, *Bawdsey – Birth of the Beam: The History of R.A.F. Stations Bawdsey and Woodbridge* (Lavenham: Terence Dalton Limited, 1983), p. 9. For an excellent history of the Orfordness military research establishment, see Paddy Heazell, *Most Secret: The Hidden History of Orfordness* (Stroud: The History Press, 2010).

dubbed 'Sunday Soviets' – meetings on Sundays, which encouraged free discussion between civil servants, scientists, technicians and service personnel on the necessary operational requirements.³⁴ For security reasons this scientific cadre left Bawdsey for Dundee in 1939, and became the Air Ministry Research Establishment (AMRE), and later (November 1940) the Telecommunications Research Establishment (TRE) when it moved to Worth Matravers near Swanage in Dorset. Headed by Rowe throughout the war, TRE proved to be of invaluable assistance to British intelligence, not just in developing countermeasures to German scientific and technological application to war, but also in technical intelligence assessment, and in producing equipment for field agents.³⁵

The Central Register ensured that many scientists, engineers, and technicians would be mobilised where and when their nation required their special skills for its war machine. As war loomed ever closer, the Central Register itself expanded, drawing many other experts into the heart of Government.³⁶ British intelligence also required experts, and with the increase in the Secret Service allocation did not (and could not) wait for war. The cryptanalytic and intelligence personnel at GC&CS rose from 80 to 200 between 1934 and 1939, although of the 180 recorded in 1938, only thirty

³⁴ A. P. Rowe, *One Story of Radar* (Cambridge: CUP, 1948), pp. 83–6; A. P. Rowe, 'From Scientific Idea to Practical Use', *Minerva*, 2 (1964), 309; Hartcup, *The Challenge of War*, p. 24.

³⁵ Rowe took over from Watson Watt as Bawdsey Superintendent in May 1938 when the latter became the first Air Ministry Director of Communications Development. Bawdsey was the embryo from which TRE was born. Initially an Air Ministry establishment, TRE was later transferred to the Ministry of Aircraft Production, and by the end of the war, TRE employed some 3000 men and women. Almost every radar device designed for the RAF during the war was conceived in the laboratories at TRE; Rowe, *One Story of Radar*, pp. ix, 9, 24 & 91.

³⁶ For details on the Central Register branch of the Ministry of Labour and National Service, see CCAC 920/HIL, A. V. Hill, unpublished memoirs 'Memories and Reflections', pp. 332–6; Peter Hennessy, *Whitehall* (London: Pimlico, 2001), pp. 88 & 94–6. Hennessy wrote that Britain had learnt its lesson from the Great War not to waste the nation's brilliant scientists on the battlefield in the event of war.

were code-breakers.³⁷ European refugees also filtered into British intelligence organisations thereby enlarging the pool of linguists, mathematicians, and analysts.³⁸ For security reasons intelligence organisations were able to legitimately sidestep the Central Register – for personnel with ‘rather special requirements’ (Foreign Office language for SIS agents), and for personnel of the ‘professor type’ for GC&CS.³⁹ The first wave of professorial types included mostly linguists, classicists, and historians; only two mathematicians – Alan Turing and Gordon Welchman – were required, vividly demonstrating that pre-war codebreaking was deemed art rather than science.⁴⁰ Evidently the late-1930s intelligence operatives were a blend of youthful technical ‘wizards’ and wizened war-weathered veterans, who were to form a new technological breed of intelligence handlers and producers.⁴¹

It would take time, however, and much trial by error, before reaching efficiency. Much of the SIGINT and communications networks were as rudimentary as RDF in the pre-war years. Indeed, much of the specialist equipment required for interception, decryption, and communication was not

³⁷ Ferris, *Intelligence and Strategy*, p. 126; McKay, *The Secret Life of Bletchley Park*, p. 15; Stephen Budiansky, *Battle of Wits: The Complete Story of Codebreaking in World War II* (Harmondsworth: Viking, 2000), p. 89.

³⁸ Allan R. Millett, ‘Patterns of Military Innovation in the Interwar Period’ in Williamson Murray and Allan Millett (eds.), *Military Innovation in the Interwar Period* (Cambridge: CUP, 1996), p. 266.

³⁹ Hennessy, *Whitehall*, p. 97; Ladislav Farago, *Burn After Reading: The Espionage History of World War Two* (Annapolis: Naval Institute Press, 2003), p. 30.

⁴⁰ Christopher Andrew, ‘Bletchley Park in Pre-War Perspective’, in Smith & Ralph Erskine (eds.), *Action This Day*, p. 9.

⁴¹ David Syrett captured this well: ‘Gone were the days when intelligence was produced by essentially amateur staffs who sifted through agents’ and travellers’ reports, newspapers, naval attachés, dispatches and the like. These were replaced by super-secret organizations employing worldwide electronic systems of collection and communications. In this new world of intelligence, human sources of information, with the exception of prisoners-of-war, would be replaced by the electronic intercept station. Information collected electronically would be despatched to centralized staffs who employed machines and electronic devices to analyse raw information and produce usable intelligence that was sent electronically to users’; David Syrett (ed.), *The Battle of the Atlantic and Signals Intelligence: U-Boat Situations and Trends, 1941–1945* (Aldershot: Ashgate Publishing Limited, 1998), p. x.

yet commercially available.⁴² Highly valuable links had to be made throughout the course of the war with reputable electronic and electrical engineering companies, such as EMI, Marconi, Pye Ltd., English Electric Company (EEC), General Electric Company (GEC), Western Electric, Ferranti, Cossor, Decca, Standard Telephone and Cables (STC), Metropolitan Vickers (MetroVick), among others.⁴³ Standard Cable & Wireless were also an integral part of Britain's worldwide SIGINT system.⁴⁴ The General Post Office (GPO) also proved an essential cog in Britain's war machine (the history of which has yet to be researched and relayed).⁴⁵

Clearly in the pre-war period there was much to do, although there is no question that the struggle against Hitler revolutionised the importance of intelligence from enciphered messages, because the sheer speed of war placed an onus on 'real time' intercepted enemy signals.⁴⁶ And just as importantly, wartime scientific organisation of all primary belligerents became hidden from sight and scrutiny.⁴⁷ Scientific secrets became gold, while scientists themselves became 'in the know'.⁴⁸

⁴² Pether, *Funkers and Sparkers*, p. 11.

⁴³ See Phillip Judkins's PhD thesis 'Making Vision into Power' throughout for deep analysis of how integral private enterprise was to the largely effective electronic production and logistics. Judkins made significant headway into the research of these almost entirely forgotten matters of Second World War history. There is still much more research to do in this field.

⁴⁴ Richard J. Aldrich, *GCHQ: The Uncensored Story of Britain's Most Secret Intelligence Agency* (London: HarperPress, 2010), p. 17.

⁴⁵ A. G. Denniston, 'The Government Code and Cypher School Between the Wars', *Intelligence and National Security*, 1: 1 (January 1986), 68; See also Duncan Campbell-Smith, *Masters of the Post: The Authorized History of the Royal Mail* (London: Allen Lane, 2011), pp. 323–76 for the best history of the GPO to date.

⁴⁶ Aldrich, *GCHQ*, p. 5.

⁴⁷ See Hilary and Steven Rose, *Science and Society* (Harmondsworth: Penguin Books, 1975), p. 59.

⁴⁸ William Gilman, 'Weapons Secret and Scientific', *The Antioch Review*, 6: 4 (Winter 1946), 475–87; Jon Agar, *Science and Spectacle: The Work of Jodrell Bank in Post-war British Culture* (Amsterdam: Harwood Academic Publishers, 1998), p. 5; Agar stated that scientists became part of extensive networks of contacts within the Government, the armed services, and industry. The same applied to intelligence – the mass-organisation at Bletchley was prime example.

Inferior Red

Scientific intelligence as a viable autonomous construct was born from the machinations behind RDF, essentially because the man at the helm of the body responsible for the development of Britain's RDF umbrella was concerned that Germany was probably going through the same motions and producing the same hi-tech defence hardware. As Chairman of the CSSAD, Tizard had seen all aspects of scientific and technological possibilities that British scientists had imagined.⁴⁹ Various factors had contributed to the creation of the Tizard Committee. In response to Stanley Baldwin's (oft-cited) 'counsel of despair' in 1932 of 'the bomber will always get through', Lindemann was quoted in *The Times* in August 1934 demanding all resources of science and invention to be harnessed for the purposes of Air Defence.⁵⁰ Unanswered questions persisted regarding the plausibility of radiant energy as a means of anti-aircraft (AA) defence.⁵¹ The CSSAD was briefed to 'consider how far recent advances in scientific and technological knowledge' could be 'used to strengthen' methods of 'defence against hostile aircraft'.⁵²

⁴⁹ The CSSAD first met on 28 January 1935 in Room 724 of the Air Ministry. Those present were scientists, Patrick Blackett, A.V. Hill, and Tizard himself. Also present were Wimperis and his assistant Rowe, who between them formed the crucial communication channel to the Air Ministry: Clarke, *Tizard*, p.116.

⁵⁰ F. A. Lindemann, 'Science and Air Bombing', *The Times*, 8 August 1934, 11; Jones, 'Lindemann beyond the Laboratory', 199; R. V. Jones and William S. Farren, 'Henry Thomas Tizard 1885–1959', *Biographical Memoirs of Fellows of the Royal Society*, 7 (November 1961), 332. See also G. M. Young, *Stanley Baldwin* (London: Rupert Hart-Davis, 1952), pp. 174–5 for an explanatory account of Baldwin's speech.

⁵¹ Rowe, *One Story of Radar*, pp. 5–7; Watson Watt, *Three Steps to Victory*, pp. 80–1; Judkins, 'Making Vision into Power', pp. 101–2. Resulting from all these technological uncertainties Wimperis distributed a lengthy document to key members of the Air Ministry recommending a committee and specifically naming Tizard, Hill, and Blackett: Clarke, *Tizard*, p. 110.

⁵² CCAC CHAR 25/5, 'Committee for the Scientific Survey of Air Defence First Interim Report', dated 15 May 1935. This Interim Report constituted a summary of the findings from the first seven meetings of the Tizard Committee from 28 January to 15 May 1935. The Reports of these meetings can also be found at TNA AIR 2/4481 and TNA AIR 2/4482. See also Clark, *Tizard*, pp. 105–27; Judkins, 'Making Vision into Power', p. 102.

There is a possibility that Lindemann believed Wimperis responsible for Baldwin's 'lugubrious warning', and that the CSSAD would be 'hampered by a similar defeatist attitude'.⁵³ Three weeks after the formation of the CSSAD another scientific investigative body was established – attached to the CID, proposed by Lindemann (through Churchill) to the Prime Minister, Ramsay MacDonald, who knew nothing it seems of the Air Ministry's CSSAD creation. Once MacDonald was made aware of CSSAD he invited Lindemann to sit on both Committees.⁵⁴ The CID's Sub-Committee on Air Defence Research (ADRC), met for the first time on 11 April 1935 and Tizard was invited to join.⁵⁵ Of importance here is the fact that Tizard was party to discussions on developments tabled for both committees; no-one was more aware than Tizard of the extent of British science and technology tailored to warfare.

The first recorded mention of intelligence relative to a scientific appreciation of airborne attack on Britain was in the first interim report of the CSSAD. It was agreed that the Committee would be 'greatly assisted by a better knowledge of the probable methods of attack'.⁵⁶ These issues were discussed in three separate meetings (9 February, 16 April, and 17 May). Winterbotham was present at each to discuss 'scientific co-operation with the Intelligence Directorate' for it had become apparent that there was a 'weakness in liaison'.

⁵³ Clark, *Rise of the Boffins*, p. 43. Lindemann's warning in *The Times* was that to 'adopt a defeatist attitude' in the face of the threat of air power was 'inexcusable'; Lindemann, 'Science and Air Bombing', *The Times*, 8 August 1934, 11.

⁵⁴ Judkins, 'Making Vision into Power', p. 105.

⁵⁵ Those in attendance for the first meeting of the ARDC were Secretary of State for the Colonies, Philip Cunliffe-Lister; First Commissioner of Works, W. Ormsby-Gore; Lord Weir; Permanent Secretary to the Treasury, Warren Fisher; DSIR Secretary, Frank E. Smith; Third Sea Lord, Vice-Admiral R. G. H. Henderson; Master General of the Ordnance, Hugh J. Elles; Air Member for Research and Development, Hugh Dowding; and Tizard. An important caveat was that the sub-committee was authorised 'to invite the co-operation of any person' who could 'render it assistance'.

⁵⁶ CCAC CHAR 25/5, CSSAD 'First Interim Report', 15 May 1935, p. 15.

At the third meeting, approval was 'obtained for the appointment of a Scientific Officer' to Winterbotham's staff 'for liaison duties', and that 'the appointment would be made as soon as a suitable man for the position could be found'.⁵⁷

The Committee appreciated that they lacked intelligence of whether a 'probable hostile power' was 'concentrating upon any particular form of attack, such as pilotless aircraft, or low-altitude bombers' and whether such aircraft were being produced on large scales. The committee also sought 'meteorological data' to assist in 'assessing the accuracy of attacks from pilotless aircraft or indiscriminate bombing from above the clouds', and data on the probable nature of hostile aircraft approaches. They recommended 'frequent trials, under (as near as possible) war conditions, to see if existing defences could withstand or counter all possible methods of attack'.⁵⁸ These intelligence requirements were later resonated in the conclusions of the second meeting of the ADRC, in which it was agreed 'to recommend that every step should be taken by the Air Staff to obtain intelligence as to the probable nature of the attacks which were to be expected'.⁵⁹

Evidently much scientific and technological research was being empirically tailored to Britain's defence. By the turn of 1937 all scientific committees had agreed that RDF should be the main priority. Owing to acquisition difficulties,

⁵⁷ Ronald Lewin, *Ultra Goes to War: The Secret Story* (London: BCA, 1978), p. 366. This decision to appoint a scientific liaison to Air Intelligence has been defined as 'another forward thinking development' alongside SIGINT of the 1939 Air Ministry: Samir Puri, 'The Role of Intelligence in Deciding the Battle of Britain', *Intelligence and National Security*, 21: 3 (June 2006), 429.

⁵⁸ CCAC CHAR 25/5, CSSAD 'First Interim Report', 15 May 1935, p. 16.

⁵⁹ CCAC CHAR 25/5, Conclusions of the second meeting of the Committee of Imperial Defence, Sub-Committee on Air Defence Research, dated 27 May 1935, p. ii. The committee made it clear that they were not suggesting that such surveys did not exist, but that they had simply not seen surveys of that character. In reality no such surveys existed.

almost all of the equipment was still being hand-made by the Bawdsey scientists and technicians, while RDF had not proven entirely effective in trials.⁶⁰ Nevertheless, RDF combined with an Observer Corps, was perceived as being by far the best option available and research into other matters was curbed. One such investigation, infra-red detection of heat from aircraft magnetos, had been ruled out for day aircraft detection by the summer of 1935.⁶¹ The young scientist undertaking this investigation was Jones who, under Lindemann's tutelage at Oxford University's Clarendon Laboratory, had just obtained a physics doctorate researching infra-red radiation by designing and creating infra-red detectors scientifically known as spectrometers.⁶²

Lindemann had been head of the Clarendon since 1919. Within the space of a few years he transformed it into a thriving hub of research to rival the more famous Cavendish Laboratory at Cambridge.⁶³ Modern research programmes were introduced, such as spectroscopy, astrophysics, thermodynamics and low-temperature physics.⁶⁴ Jones has written convincingly on his infra-red research at the Clarendon during 1935–37, and always held that Lindemann's judgment on the possibilities of infra-red for aircraft detection were 'not as wild' as some critics made them to be.⁶⁵

⁶⁰ Judkins, 'Making Vision into Power', pp. 127–8.

⁶¹ CCAC CHAR 25/5, 'Committee for the Scientific Survey of Air Defence First Interim Report', dated 15 May 1935, p. 10.

⁶² Jones, *Most Secret War*, p. 10.

⁶³ For the Cavendish Laboratory, see Norman Feather, 'Rutherford's Cavendish', *The New Scientist*, 10 March 1960, 598–600.

⁶⁴ CCAC RVJO B.384, Professor William Hayes, 'Introduction' to the Lindemann Centenary, delivered on 7 October 1986. Some 'brilliant work' on centimetric radar was also undertaken at the Clarendon: see Rowe, *One Story of Radar*, p. 35.

⁶⁵ R. V. Jones, 'Infra-Red Detection in British Air Defence, 1935–38', *Infrared Physics*, 1 (1961), 153–62; republished in Jones, *Instruments and Experiences*, pp. 10–21; Jones, 'Lord Cherwell's Judgment', 323; Jones, 'Lindemann beyond the Laboratory', 200.

On 10 December 1935 Wimperis telephoned Lindemann to discuss further the possibility of detecting aircraft with infra-red, and to implement CSSAD proposals for research in this field to commence at the Clarendon. As Lindemann already had facilities for such research, it had been agreed that he would take charge of this line of defence investigation.⁶⁶ The following day Lindemann wrote to Wimperis to confirm that Jones, who had been working on similar problems, was willing to undertake the new project.⁶⁷ Lindemann set Jones the brief of investigating the use of infra-red to detect aircraft emissions, to make the necessary instruments, and undertake trials. Jones had already submitted an eight page report on his findings to the NPL, who in turn had reported to the ADRC, who passed it to the CSSAD.⁶⁸ This process was due to the NPL being 'an impartial body'. Jones's subsequent investigations at the Clarendon produced another report in March 1936.⁶⁹

Lindemann had long been a proponent of the use of infra-red for the detection of aircraft. He had proposed such an idea in 1915, although such methods of detection were technologically impossible at the time.⁷⁰ Jones's personal interest in the matter had 'fortuitously' revived Lindemann's old interest in

⁶⁶ Jones recalled that the NPL were initially asked to investigate Lindemann's proposal that there should be substantial infra-red emission from hot carbon dioxide in aircraft exhausts, but the NPL could not perform the function because they lacked thermopiles, galvanometers, and other measuring equipment suitable for the purpose: R. V. Jones, 'Research Establishments', *Proceedings of the Royal Society of London: Series A, Mathematical and Physical Sciences* 342: 1631 (April 1975), 483.

⁶⁷ University of Oxford Nuffield College (hereafter UONC) D.123/2, Lindemann to Wimperis, 11 December 1935.

⁶⁸ CCAC CHAR 25/6, NPL report on 'Infra-Red Radiation from Aeroplanes', 18 November 1935 collaboratively submitted by John S. Anderson and R.V. Jones. Anderson was an NPL researcher.

⁶⁹ UONC D.123/4, 'Interim Report on The Detection of infra-red radiation from aeroplanes' signed by R. V. Jones, 22 March 1936.

⁷⁰ Jones, 'Lindemann Beyond the Laboratory', 191–2. See also Ernest Putley, 'Thermal radiation and its Applications' in Robert Budd and Philip Gummett (eds.), *Cold War Hot Science: Applied Research in Britain's Defence Laboratories, 1945–1990* (Amsterdam: Harwood Academic Publishers, 1999), p. 185. Putley cited the original Advisory Committee for Aeronautics Report (T510) *A Suggestion for the Detection of Aircraft by Long-Wave Radiation* of April 1915 that emanated from Lindemann's recommendation.

infra-red.⁷¹ Lindemann established an energetic bout of spectroscopic research at the Clarendon, first with his 'protégé' Derek Jackson who worked in collaboration with émigré German H.G. Kuhn, and then with Jones, later joined by George Pickard.⁷² Under Lindemann's guidance Jones produced his first publication, for which he was awarded 'the prize of ten guineas', on thermoelectric matters.⁷³ The influx of German émigrés caused security concerns for Lindemann, however, particularly relative to Jones's research.⁷⁴

In his memoirs, Jones recounted the events surrounding his introduction to military research matters. This is valuable, for the archive material is very limited in this regard. Jones and Lindemann apparently had an altercation over the direction of CSSAD infra-red research and so Jones decided to leave the Clarendon. He was successful in being awarded a Balliol Senior Studentship in Astronomy to work in the Oxford University observatory with H.H. Plaskett on the infra-red spectrum of the sun. Lindemann regretted their misunderstanding and asked Jones to return. Although Jones had committed to the Studentship, Lindemann allowed Jones to continue using the Clarendon research facilities. Jones's prospects were good, and he expected to gain a Commonwealth Fellowship to research in the Californian Mount

⁷¹ Clark, *Tizard*, pp. 133–4. Jones was in the process of making thermopiles for Paul Macneil, a retired US Naval officer-turned-inventor who planned to sell infra-red detectors to the Air Ministry. See also Jones, *Most Secret War*, pp. 17–18.

⁷² The Earl of Birkenhead, *The Prof in Two Worlds: The official life of Professor F.A. Lindemann, Viscount Cherwell* (London: Collins, 1961), p. 106; Jones, *Most Secret War*, p. 38; Jones, 'Infrared Detection in British Air Defence', 153–62; Kurt Mendelssohn, 'The coming of the refugee scientists', *The New Scientist*, 26 May 1960, 1343. Judkins commented that Jones was Lindemann's protégé; 'Making Vision into Power', p. 354. Jones owed a great deal to Lindemann for his career development, but it is doubtful that Jones was as close to Lindemann as Jackson.

⁷³ CCAC RVJO A.112, H.R. Lang to R.V. Jones, 8 April 1935. The publication was 'The design and construction of thermoelectric cells' in the 1934 volume of *Journal of Scientific Instruments*.

⁷⁴ UONC CP D.123/6, Lindemann to Wimperis, 12 May 1936.

Wilson observatory, followed by further research in South Africa.⁷⁵ As with almost all scientists, war severed any potential research expectations.

Although infra-red produced 'inconclusive results' Lindemann insisted upon its 'further reconsideration' by the CSSAD.⁷⁶ His efforts were futile, for by this time the CSSAD had agreed on RDF as the priority research project. This was not the end of Jones's relationship with infra-red however, for he was surprised to learn that his report had sparked the idea of airborne infra-red detectors mounted in nightfighters in order for them to detect and attack bombers.⁷⁷ He was asked to proceed with research into this matter, and in doing so impressed his superiors. In early-October 1936, Wimperis wrote to Lindemann stating that he agreed with David Pye, the new Air Ministry DSR, regarding the 'remarkable progress in the technique of infra-red detection' made by Jones.⁷⁸ Consequently, 'steps' were taken 'at once' to 'approach Jones with a view to his excellent work being continued on a less temporary basis'. Jones was offered an appointment on the Air Ministry's scientific research staff, and extended 'ample laboratory and full-scale facilities and assistance' at Farnborough's Royal Aircraft Factory (later Establishment, RAE) in addition to those still available to him at the Clarendon.⁷⁹

⁷⁵ Jones, *Most Secret War*, p. 11.

⁷⁶ Lindemann relayed this determination for 'further reconsideration of infra-red detection' to Rowe over the telephone on 2 October 1935; see IWM HTT 79, Rowe to Tizard, 3 October 1935; Clark, *Tizard*, p. 157.

⁷⁷ Jones, *Most Secret War*, p. 11.

⁷⁸ UONC D.123/7, David Pye to Lindemann, 15 July 1936; CCAC RVJO A.112 & UONC D.123/8, Wimperis to Lindemann, 5 October 1936.

⁷⁹ CCAC RVJO A.112 & UONC D.123/8, Wimperis to Lindemann, 5 October 1936.

Jones recounted in *Most Secret War* that within two months he had successfully 'created new detecting elements and had designed and built an electric amplifier'. He emphasised that, as a 'scientific officer and full-time member of the Air Ministry staff' on a salary of £500p.a., he had become the highest paid scientist of his age in government service, although documentary evidence confirms that he held out for such a large remuneration.⁸⁰ More importantly, Jones was requested to report his progress to the CSSAD on 16 October 1936. This was the first time he attended a Tizard meeting, and it was agreed that despite the committee's differences with Lindemann over the direction of British air defence, Jones was to continue his infra-red airborne instrument research at the Clarendon.⁸¹ Jones recalled that during the winter of that year, he 'constructed a new infra-red detector for mounting in an aircraft', with which he flew and detected another aircraft in flight at a range of 500 metres.⁸² Jones's infra-red research was, however, being continually viewed as less important for the purpose of aircraft detection. It had become (as Jones dubbed this episode in his memoirs) 'inferior red' – 'inferior to the technique of detecting aircraft by echoes arising from radio waves'.⁸³

⁸⁰ UONC D.123/10, Jones to Lindemann, 18 September 1936; UONC D.123/13, Jones to Lindemann, 20 September 1936; Jones, *Most Secret War*, p. 37. Jones likened the original salary offers by Wimperis to that of 'office boys'. Wimperis eventually offered £450p.a. but even then Jones 'played for time' and wrote to Wimperis requesting £500. Jones received a reply from the Air Ministry on 20 September 1936 approving his request.

⁸¹ UONC D.123/9, Wimperis to Lindemann, 21 October 1936; Jones, *Most Secret War*, p. 38.

⁸² Jones, *Most Secret War*, pp. 34 & 38. Jones firmly believed that this was 'the first occasion on which one aircraft was detected from another by infra-red means'. See Jones, 'Infrared Detection in British Air Defence' for the technical specifics. See also Putley, 'Thermal Radiation and its Applications', p. 196; Clark, *Tizard*, p. 157.

⁸³ Jones, *Most Secret War*, p. 39. Jones failed to mention that his invention was sealed as a 'secret patent' with his rights protected. Both Wimperis and Pye recommended to Lindemann that Jones be put in touch with a television firm, such as EMI or Bairds, for potential manufacture; UONC D.123/17, Wimperis to Lindemann, 24 February 1937; UONC D.123/18, Pye to Lindemann, 10 March 1937.

The first formal indication Jones received regarding closure of his infra-red research was when he was again summoned by the CSSAD on 21 October 1937, and informed of the committee's decision to remove his research from Oxford. Jones was then invited to lunch with Tizard. These developments were at the height of the notorious clash between Tizard and Lindemann.⁸⁴ Indeed, Lindemann informed Jones before he lunched with Tizard to be mindful of Tizard's 'artfulness'. Jones was caught in what Tizard referred to as the 'ridiculous quarrel', and during their lunch Tizard proposed that Jones continue his infra-red research with him at Imperial College (of which Tizard was Rector). Jones, preferring not to leave Oxford, declined Tizard's offer.⁸⁵

Tizard wrote to Jones to advise him that his alternatives to Oxford 'were probably London, Bawdsey or Farnborough'.⁸⁶ Jones replied by suggesting that Tizard should visit the Clarendon to see his work first-hand, in Lindemann's absence or Pye to visit in Tizard's stead.⁸⁷ Jones had many reasons for not wishing to move to Bawdsey. He commented on the isolation 'from a technical and a social viewpoint' – bad for scientific development, and had 'sad effects on the morale of the men'. Jones argued that scientists and technical men (not being the most self-respecting individuals at the best of

⁸⁴ The hostility was made the more famous by C. P. Snow's pernicious publication *Science and Government* (London: OUP, 1961). For Jones's critique of Snow, see 'Scientists at War: Lindemann v. Tizard', comprising of 'Air Defence Clash in the Thirties', *The Times*, 6 April 1961; 'Fruitless attempts to Patch Quarrels', *The Times*, 7 April 1961; and 'Complete Change in Bombing Methods', *The Times*, 8 April 1961. Jones also wrote a letter to *The Times* on 12 April 1961 entitled 'Scientists at War', which countered Snow's comments on the Tizard Committee. Frederick Brundrett wrote that this was the only matter in which he 'found Tizard really unreasonable', although Lindemann 'was worse', and that 'both these eminent gentlemen behaved like a couple of spoiled children': F. Brundrett, 'Obituaries: Sir Henry Tizard, G.C.B., A.F.C., F.R.S.', *Nature*, 4708 (23 January 1960), 211. See also Jessica Wang, 'Merton's Shadow: Perspectives on Science and Democracy since 1940', *Historical Studies in the Physical and Biological Sciences*, 30: 1 (1999), 279–306.

⁸⁵ Jones, *Most Secret War*, p. 40.

⁸⁶ Clark, *Tizard*, p. 157.

⁸⁷ IWM HTT 63, Jones to Tizard, 26 November 1937; Clark, *Tizard*, p. 157.

times) living in such close proximity would degenerate the standards of living 'pretty quickly' – this being 'partly the fault of the men, but more the fault of a short sighted policy which put them there'. Jones believed that the 'ultimate solution of the aircraft detection problem' lay 'in the region of wavelengths between 1 and 10mm'.⁸⁸ This letter provides early insight into Jones's finicky behaviour and obstreperous attitude which would, in later years, cause him to be disliked both in Whitehall and scientific circles. In his favour the letter shows that Jones was scientifically prescient about the use of centimetric wavelengths for airborne RDF, even to the detriment of his own infra-red research being replaced by concentrated radio wave exploration for the purposes of air-to-air and air-to-surface night detection.

Tizard sent a copy of Jones's letter to Pye and recommended sending copies to all members of the Defence Committee and to Watson Watt. For Tizard, the importance of Jones's letter was that, for all his research into the possibilities of detecting aircraft using infra-red, Jones's ideas of centimetric wavelengths were 'closely in line with those of Watson Watt and his staff'. Tizard saw no reason therefore, for 'leaving R.V. Jones to work as an independent worker at Oxford'.⁸⁹ On 3 December 1937 Jones visited Bawdsey where his old Clarendon colleague Gerald Touch was working on airborne RDF with Bowen and Hanbury Brown.⁹⁰ Here Jones saw for himself the 'tremendous feat' these men had accomplished in developing airborne

⁸⁸ IWM HTT 63, Jones to Tizard, 26 November 1937.

⁸⁹ IWM HTT 77, Tizard to Pye, 30 November 1937.

⁹⁰ E. G. Bowen, *Radar Days* (Bristol: Adam Hilger, 1987); Robert Hanbury Brown, *Boffin: A Personal Story of the Early Days of Radar, Radio Astronomy and Quantum Optics* (Bristol: Adam Hilger, 1991); R. Hanbury Brown, H. C. Minnett, F. W. G. White, 'Edward George Bowen. 14 January 1911–12 August 1991', *Biographical Memoirs of the Royal Society*, 38 (November 1992), 43–65.

RDF for night detection, and how this was indeed 'going to be superior to infra-red'.⁹¹ In this development, according to Bowen, Tizard had been masterful, and had been the only man in the mid-1930s who 'correctly foresaw how the situation would develop and what should be done about it'; Tizard passed these thoughts on to Watson Watt, who in turn passed them onto the Bawdsey boffins.⁹²

Little action was taken over Jones's research until 28 January 1938, when Jones received a letter from Pye severing his work at the Clarendon. It had been decided that in view of the urgency of other defence problems, the Air Ministry programme as a whole would best be served with Jones employed elsewhere. Pye suggested 31 March as a suitable date for the termination of Jones's Air Ministry research work at the Clarendon. In recollection Jones was 'very annoyed' (which, owing to the forty years passage of time, was probably restrained). He was particularly disappointed in the CSSAD and in Tizard who had verbally invited him to continue his research at Imperial. Jones felt that he had 'burnt' his 'academic boats' while his contemporaries had been continuing with their normal researches. He had worked his 'utmost' on non-publishable secret developments that were not intended to be used. He had lost his chances of academic appointment and instead was a civil servant. At the same time, convinced that war was inevitable, he did not wish to leave the defence field, although he certainly wanted to get well away from Watson Watt, Tizard, and the rest, who had played him as 'a pawn in a

⁹¹ Jones, *Most Secret War*, p. 39.

⁹² Bowen, *Radar Days*, pp. 31–41. See also Clark, *Tizard*, p.158.

distinctly unpleasant game'.⁹³ Much of this was grumbling in hindsight. He was not alone in the late-1930s in having to leave the research cloisters for defence work, and many were not as fortunate in their appointments as he was. He had no significant cause for complaint with regard to publishing, for while being a civil servant during this pre-war period, Jones had increased his publications with two 'spin-off' research articles.⁹⁴

Two weeks after receiving the letter from Pye, Jones wrote to Tizard with ideas he had on searchlight improvements. Clearly he was feeling redundant. He also informed Tizard that infra-red work had 'come entirely to a standstill' since it had been decided to 'dissolve' his project. He was ordered to Bawdsey but had 'no idea of what work he was to do', for it seemed that 'something fresh' had to be thought of. Jones did 'not look forward to the change particularly enthusiastically', especially 'after nine years in Oxford'.⁹⁵

Jones recalled being instructed to commence work at Bawdsey on 1 April 1938. Just before this date however, Jones received a telegram requesting his presence at Air Ministry Headquarters in London. Jones believed that his complaints had led Rowe and Watson Watt to consider him a 'disruptive influence with an awkward personality', and that machination was set in place to remove him 'as far as possible from any place where [he] could cause trouble'. He was to be sent to the Admiralty Research Laboratory (ARL) at Teddington where he would be 'disciplined in the tradition of the Senior

⁹³ Jones, *Most Secret War*, p. 41–2. The 31 March 1938 letter is not in the Jones papers.

⁹⁴ CCAC RVJO J.458 contains drafts of these writings by Jones. See also Jones, *Instruments and Experiences*, pp. 3–21. Appendix II of this thesis details all of Jones's publications throughout his life.

⁹⁵ IWM HTT 63, Jones to Tizard, 14 February 1938.

Service'. A plausible alternative reason for Jones's transfer to ARL was that in an effort to make the most effective use of Britain's limited scientific resources the Admiralty had agreed to undertake infra-red research on behalf of the three services. As a contribution to this commitment the Air Ministry agreed to second Jones to the Admiralty as their leading expert in the field.⁹⁶ Whatever the reason, because the Admiralty were not ready for Jones's arrival he was assigned to the new Directorate in Air Ministry to 'cool his heels'. Forty years on Jones still felt rather sorry for himself. In *Most Secret War* he wrote that this 'was rotten reward for three years of desperate work', from which he 'could not even recover the kudos of papers in scientific journals'. He 'wanted never again to become involved with Lindemann, Tizard, or Watson-Watt'.⁹⁷

Jones defined this early-career episode as 'exile' from active research in air defence. He reported to W/Cdr Leedham, the Air Ministry's Assistant Director of Instrument Research and Development, under whose supervision Jones became involved in RAF trials of the first airborne television equipment, and importantly first encountered Air Intelligence Reports. In his memoirs, Jones reminisced that he 'tried to extract every possible item of information out of them, and thus started to interact with Air Intelligence'. One particular report detailed VHF radio developments on the mountain called Brocken, about which Jones wrote to his friend and Oxford colleague Charles Frank (who

⁹⁶ TNA ADM 116/4558, 'Minutes of Meeting to discuss the lines on which research directed towards satisfaction of the requirements of the Services for Infra-Red Apparatus can most profitably proceed and the facilities required', meeting held 24 March 1938. See also Ernest Putley in 'Radar expert's wartime high point', *The Times*, 27 December 1997, 21. Air Ministry representatives at the meeting agreed that 'as part of their contribution they should supply a Scientific Officer' (Jones) but reserved 'the right to withdraw him after three months for any urgent development work peculiar to Air Ministry needs'. The chairman agreed that Jones was 'a very suitable officer for the work envisaged'. Jones's future (unbeknownst to him) had been pre-arranged.

⁹⁷ Jones, *Most Secret War*, pp. 43–4.

immediately burned the letter when he discovered its contents, according to Jones). Frank visited Brocken and returned with a postcard picturing a new television tower erected on the summit. Both were highly interested in the inexplicable array of beacons.⁹⁸ Such scientific curiosity by Jones and Frank would play a key role in scientific intelligence during the forthcoming war.

Jones eventually arrived at Teddington on 2 July 1938. His first 'step in the disciplinary process' was to sign the 1911 version of the Official Secrets Act.⁹⁹ That he had not been asked before suggests perhaps that the Admiralty were stricter in scientific secrets than the Air Ministry at this time. Documentation confirms that Jones was transferred from the Air Ministry along with his research and all the relevant paperwork by 6 September 1938.¹⁰⁰ He soon became bored at the ARL.¹⁰¹ EMI had been contracted by the Air Ministry to manufacture Jones's invention of a thermiconoscope, while Messrs. Hilger had been contracted to produce 'polished samples' of Silver Chloride Crystals, but the matter had 'been left in abeyance pending the formation of a new laboratory' for infra-red work.¹⁰² Evidently Jones's research bore more fruit than commentators have allowed. He did not discuss it further in his memoirs, and probably would have if his efforts had generated lasting success. Jones was more interested in describing how he met his future wife,

⁹⁸ Jones, *Most Secret War*, pp. 46 & 50–1. Jones reported Frank's Brocken findings to the Air Ministry Intelligence Service, and believed that this 'did not go unnoticed'.

⁹⁹ Jones, *Most Secret War*, pp. 46–47.

¹⁰⁰ TNA ADM 116/4558, Air Ministry file entitled 'Infra-Red Thermiconoscope and Silver Chloride Crystals. Transfer of investigation from Air Ministry to A.R.L.' including letters from Watson Watt to Wright regarding Jones's transfer, dated 11 & 17 August 1938.

¹⁰¹ He later recalled 'unhappiness' at having little to do at Teddington and remarked that he spent his evenings distributing gas masks – more than 2000 in three days: Jones, *Most Secret War*, p. 51.

¹⁰² TNA ADM 116/4558, Air Ministry file entitled 'Infra-Red Thermiconoscope and Silver Chloride Crystals. Transfer of investigation from Air Ministry to A.R.L.' including letters from Watson Watt to Wright regarding Jones's transfer, dated 11 & 17 August 1938.

Vera Cain, and how Neville Chamberlain returned from Munich with his 'pathetic scrap of paper'. He recalled being 'as angry as a cat which had just been robbed of its mouse' and claimed that there was an air of inevitability about forthcoming war—that Chamberlain had simply 'postponed the reckoning'.¹⁰³ Inevitability aside, there is a sense that Jones was quite excited about the prospect of war.

A Scientific Intelligence Service

Under what was known as the '1921 arrangement', a system was established which created consumer liaisons, seconded to SIS, and defined as the following 'Circulating Sections':

Section I	Political Section
Section II	Air (Air Ministry)
Section III	Naval (Admiralty)
Section IV	Military (War Office)
Section V	Counter-Espionage
Section VI	Industrial/Commercial
Section VII	Finance
Section VIII	Radio/Cypher

These formed the backbone of service/SIS collaboration during the Second World War. This thesis is concerned only with Section II – the Air Ministry Circulating Section within SIS. This Air Ministry presence within SIS was

¹⁰³ Jones, *Most Secret War*, p. 51.

established as late as 1929, although the reason for this lateness is unclear. This Air Section, as it was known inside SIS circles was headed by Group Captain (Gr/Cpt) Frederick Winterbotham as Air Ministry's Director of Intelligence, designation AI1(c) for Chiefs of SIS Sections would also individually be assigned their Section designation. He was exceptional in the role, and his Air Section 'proved to be the locus of a great deal of innovative thinking and activity within SIS'. As Section II developed under his innovative leadership, it 'began to address the SIS need for technically and scientifically literate intelligence gathering'.¹⁰⁴ The twin arts of PR/PI, for example, were established by Winterbotham.

Winterbotham had made a name for himself in Whitehall during the 1930s through clever means of obtaining intelligence from the inner circles of Nazi Germany.¹⁰⁵ Realising the importance of technical aeronautical knowledge, Winterbotham became intent on seeking 'foreigners' willing to sell information about their countries' technical aeronautical developments. Moreover, in order to process such technical data, he required intelligence operatives who were 'a considerable cut above the run-of-the-mill agent whose job was primarily to report on what he saw and seldom what he knew'.¹⁰⁶

Discrepancy regarding the conception of scientific intelligence is evident in the recollections of those involved. Winterbotham's memory of this stemmed from Watson Watt questioning him in the inter-war period over German RDF

¹⁰⁴ Davies, *MI6 and the Machinery of Spying*, pp. 61–2.

¹⁰⁵ See Jeffery, *MI6*, p. 294; Winterbotham, *The Ultra Secret*, p. 21; F. W. Winterbotham, *Secret and Personal* (London: William Kimber, 1969), pp. 23 & 29–62.

¹⁰⁶ Winterbotham, *The Nazi Connection*, pp. 18–19; Davies, *MI6 and the Machinery of Spying*, p. 66.

developments. Jones and Frank, however, recalled that it had been Tizard who had alerted the Air Ministry to the 'science gap in Intelligence'.¹⁰⁷ Although particularly vague on this particular matter in his biographical work on Tizard, Clark stated that it was the Tizard Committee which suggested in early-1939 'that the Air Ministry was lamentably ignorant about German weapons and that a scientist should be attached to the Intelligence Branch of the Air staff in order to remedy the defect'.¹⁰⁸ In one autobiography Winterbotham recalled that he found radar 'a bit complicated' and so 'asked for some scientific assistance', whereupon Tizard and Watson Watt attached 'a young scientist' to his staff.¹⁰⁹ In another he wrote that in early-1939 he set up 'the first Scientific Intelligence Unit', that he was 'supplied' with Jones, and that he provided Jones with an office close to his own in SIS headquarters.¹¹⁰

Documentation confirms the date to be 9 February 1939 when the CSSAD recommended the formation of 'a scientific and technical section attached to the directorate of Intelligence' as a 'preliminary measure towards improving the co-operation between scientists and the intelligence organisation'.¹¹¹ Jones recalled that it had been proposed that a scientist of 'some standing' was to be appointed to conduct an enquiry into British intelligence services, and then make recommendations of improvements. In a display of uncharacteristic modesty, Jones suggested that 'Tizard may have had in mind

¹⁰⁷ UOB DM1310/J.112, Frank in review of *Most Secret War* for *Physics Bulletin*; Jones, *Most Secret War*, p. 52.

¹⁰⁸ Clark, *The Rise of the Boffins*, p. 99.

¹⁰⁹ Winterbotham, *Secret and Personal*, p. 142.

¹¹⁰ Winterbotham, *The Ultra Secret*, p. 24.

¹¹¹ TNA Air 20/181, 'Minutes of the 46th Meeting' of the CSSAD, 9 February 1939; Hinsley *et al*, *British Intelligence in the Second World War, Volume I*, p. 15. See also IWM, HTT 15/54, 'Scientific Intelligence: Summary of Technical Information received by R.T.P. from Intelligence Sources. October 1939'. This document is dated and annotated on the third and final page 'papers destroyed 10.7.40'.

Thomas Merton'.¹¹² This is interesting, for Merton could certainly be declared as the first true scientific intelligence officer. Unable to fight on the western front due to ill-health, Merton – a 'celebrated physicist' – had instead been engaged by 'C' in June 1916 as SIS's first-ever scientist. One of his first discoveries was the method of secret writing employed by German agents, and he later invented a secret writing method of his own. Bombs too, it seems, were in Merton's scientific intelligence sphere.¹¹³

After the war, Frank wrote that the 'eminent were doubtless too busy' in 1939, but Jones was 'an available security-cleared physicist', because 'the progress of radar development had lowered the priority of his task' in infra-red.¹¹⁴ In contrast, according to Jones, the issue at stake was financial, as the Treasury refused support by declaring that 'science was international and that British scientists should be able to tell how their opposite numbers were thinking by talking to them at conferences, and that this should cost nothing'.¹¹⁵ Winterbotham also spoke of imposed financial restraint that caused struggles between SIS, the Tizard Committee and the Treasury delaying implementation of a scientific sub-section to Section II until the outbreak of war.¹¹⁶ No other commentator has since relayed this Treasury restraint, and there appears to be no existing corroborative primary evidence. If true, it does

¹¹² Jones, *Most Secret War*, p. 52. Modesty or not, an account of wartime scientific intelligence by Jones clearly shows that at the time he believed himself to be the first. As he wrote; 'Scientific Intelligence only started seriously in September 1939. Up to that point the S.I.S. had had no scientifically qualified agents or any scientific headquarters staff; see CCAC RVJO B.113, 'Scientific Intelligence in the S.I.S., 1939–45', no date. For more on Merton, see Harold Hartley and D. Gabor, 'Thomas Ralph Merton, 1888–1969', *Biographical Memoirs of Fellows of the Royal Society*, 16 (November 1970), 421–40.

¹¹³ Jeffrey, *MI6*, pp. 55 & 66–7. Jeffrey stated that Sir Mansfield Cumming 'warmly encouraged scientific and technical research', and was 'always ready to try out new gadgets'.

¹¹⁴ UOB DM1310/J.112, Frank in review of *Most Secret War* for *Physics Bulletin*.

¹¹⁵ Jones, 'Scientific Intelligence', 353; Jones, 'Emotion, Science and the Bomber Offensive', 907.

¹¹⁶ Davies, *MI6 and the Machinery of Spying*, p. 87.

seem to be a remarkably naïve attitude to take given that so many émigré scientists were in British state employ by that time. Science had obviously become nationalistic owing to worldwide events, and international scientific conferences were a thing of the past. Perhaps in hindsight Jones was denigrating his own suitability for the position being so young (27 years old) in 1939. Perhaps he saw himself as a rational afterthought or a last resort by his superiors. But whatever the reason, it was Jones they considered.

That Jones was a loose component in the ever-tightening British war engine had much to do with it. The Tizard Committee Secretary, A.E. Woodward-Nutt, was the man who suggested Jones, who telephoned Jones to arrange initial contact, and who visited Jones at Teddington in May 1939. Jones recalled that as he showed Woodward-Nutt the infra-red research, he 'sensed that there might be a deeper reason' for Woodward-Nutt's visit and told him so. Woodward-Nutt replied that 'there was indeed another reason': Tizard and his colleagues did not know what the Germans were doing in applying science to air warfare, and British intelligence services 'were unable to tell them'. It had 'been agreed that a scientist should be attached to these Services for a period to discover why they were producing so little information, and to recommend what should be done to improve matters'. Woodward-Nutt thought of Jones, and wondered whether he would be interested. Jones's reply was immediate. A 'man in that position could lose the war' and so he took the opportunity. The two men agreed it appropriate to give the ARL time to replace Jones and the date for Jones's transfer to the Air

Ministry DSR was set for 1 September 1939.¹¹⁷ A more foreboding date could not have been fixed for Jones's appointment.

Clearly Jones was initially employed to assess the scientific collation processes within SIS, and Tizard was the driving force behind Jones's appointment to fulfil the role. The manner in which Jones recalled jumping at the opportunity is also important, as is the desperation to understand German science and technology. What Tizard was proposing in 1939 was something special. For years he had experienced wide appreciation of British scientific and technological capabilities applied to defence and offence possibilities, and realised that to avoid complacency it was also essential to understand potential enemies' scientific and technological capabilities. That intelligence was inherently weak in this regard was alarming to him, and to the CSSAD. A scientist (one of their type) should therefore begin to appreciate such knowledge based on assessment of scientific information.

When Jones arrived for duty at the Whitehall offices of the Air Ministry DSR, he found them in the throes of evacuation. Woodward-Nutt assigned Jones to Winterbotham, about whom Jones knew nothing (indeed he was ignorant of AI1(c), which was as it should have been).¹¹⁸ Jones's Broadway internal designation was Ild, although he never referred to himself as such contemporaneously or in any of his post-war literature. His early SIRs were signed by Jones as S.R.3 (presumably for Scientific Research, although the '3' is inexplicable). It was agreed that Jones should investigate the SIS files

¹¹⁷ CCAC RVJO A.9; Article for French Magazine *Histoire*, 1980; Jones, *Most Secret War*, p. 3.

¹¹⁸ Peter Calvocoressi's recollection of his first awareness of Winterbotham was precisely the same as Jones's: Calvocoressi, *Top Secret Ultra*, p. 17.

regarding new military weapons, before being evacuated to Harrogate.¹¹⁹ This assignment is contrary to Winterbotham's recollection, in which Jones was 'to begin his training in the art of spotting the difference between good and bad information and evaluating such Intelligence' as could be obtained.¹²⁰ Clearly many of Winterbotham's recollections were erroneous, although they are instructive in piecing together the origins of scientific intelligence. A document in the Tizard papers also places Winterbotham and Tizard together in early scientific intelligence discussion.¹²¹

On 19 September 1939, Hitler made a speech in Danzig which was recorded by the BBC.¹²² The speech contained the words '*eine waffe worin wir nicht angegriffen werden können*', rendered by a Foreign Office translator as 'a weapon against which no defence would avail'.¹²³ This translation led to all manner of suspicions of a secret weapon of terrifying destructive power. Consequently, Chamberlain instructed SIS to investigate. The task fell to Jones following an 'urgent call from Winterbotham' for him to return to London in order to search the records of SIS for possible references to novel weapons.¹²⁴ Instead of carrying out his designated task of discovering 'what was wrong with the intelligence services' Jones was unexpectedly 'thrown' into 'practical intelligence work'.¹²⁵

¹¹⁹ Jones, *Most Secret War*, p. 58.

¹²⁰ Winterbotham, *The Ultra Secret*, p. 24.

¹²¹ IWM HTT 15/54, 'Scientific Intelligence: Summary of Technical information Received by R.T.P. from Intelligence Sources', dated October 1939.

¹²² For War Cabinet assessments regarding the geopolitics of Hitler's Danzig speech, see TNA CAB 66/2/29 and TNA CAB 66/2/31.

¹²³ UOB DM1310/J.112, Frank in review of *Most Secret War* for *Physics Bulletin*. The full text of Hitler's speech is reproduced in CCAC RVJO B.2 & TNA AIR 20/8535, Air Scientific Intelligence Report No.1 'The Hitler "Waffe"', 11 November 1939. See also Clark, *Rise of the Boffins*, p. 100.

¹²⁴ See Collier, *Hidden Weapons*, p. 61; see also Jones, *Most Secret War*, pp. 58–9

¹²⁵ CCAC RVJO A.9, Article for French Magazine *Histoire* (1980).

There was much confusion over the precise meaning of Hitler's speech. Still unclear (or ignorant) as to the importance of secrecy in intelligence work, Jones wrote to Frank about the contents of Hitler's speech. Frank informed Jones that a refugee had confirmed that the German was so bad that no explicitly correct translation was possible. Frank translated literally 'a weapon in which we cannot be attacked'. Frank offered a third possibility of 'a weapon which prevents us from being attacked'. For Frank, the most probable meaning (taking it purely as a translation problem) was the official one 'which cannot be used against us'. The next probable was Jones's 'which is proof against attack', although Frank believed this to be the least probable. Instead he noted that the obscurity may have been intentional, and that the most likely suggestion he had heard was that it was 'another sort of gas to make your flesh creep'.¹²⁶ However Frank later claimed that it 'was fairly clear from the context (in so far as anything in Hitler's speeches was ever really clear), that he was referring to the *Luftwaffe*'.¹²⁷ Jones took care to consider Frank's suggestions. Evidently Jones needed to share ideas with Frank from the outset of his scientific intelligence career. Theirs would be an enduring and fruitful partnership throughout the war as this thesis will demonstrate.

Jones's scientific assessment of German weaponry technicalities – his opening gambit in real intelligence work – culminated in the first SIR, although he did not officially designate it as such at the time. It detailed known potential

¹²⁶ CCAC RVJO B.118, Frank to Jones, 8 November 1939.

¹²⁷ UOB DM1310/J.112, Review of *Most Secret War* by Frank for *Physics Bulletin*. Frank also noted that when English newspapers asked 'What is Hitler's secret weapon?', Whitehall 're-echoed the query (overlooking the fact that the newspapers, not Hitler, had contributed the word 'secret') strongly enough for the Air Ministry to obtain authority to send a scientist to look through the files of the Secret Service to search for anything relevant'. For a newspaper reference to 'secret weapon', see 'We Have Secret Weapon', *The Daily Mail*, 9 November 1939.

threats: long-range guns, gas and chemical propellants, gliding bombs and pilotless aircraft. It also covered doubtful references to magnetic guns and engine-stopping ray guns. Through scientific deduction, Jones ruled out these possibilities and wrote that 'it is therefore reasonably certain' that the 'waffe' Hitler claimed to possess described the British Navy, and was 'thus a striking force rather than a specific appliance'.¹²⁸ Contrary to re-translation by German-language professor, Frederick Norman, who simultaneously deduced that Hitler's 'waffe' was the *Luftwaffe*, or air weapon, Jones was initially unprepared to commit to the nature of the striking force, claiming it difficult to decide between some branch of, or the whole of, the GAF or submarine arm.¹²⁹ Jones ruled out the latter on grounds that U-boats had been extensively used by the time of the speech. Jones concluded by stating that it had 'been shown with a high degree of probability that Hitler's weapon was neither bluff nor novelty', but merely extensive use of the *Luftwaffe*, assumed superior to the RAF. Jones listed some unconventional auxiliary weapons and advised that Britain 'should anticipate the employment of such weapons, and take precautionary action'.¹³⁰

Considering this was Jones's first intelligence production it amounted to superb supposition based on amassed evidence and scientific reason. In his memoirs Jones claimed that his conclusion was very much an anti-climax,

¹²⁸ CCAC RVJO B.2 & TNA AIR 20/8535, Air Scientific Intelligence Report No.1 'The Hitler "Waffe"', 11 November 1939, p. 2.

¹²⁹ Collier, *Hidden Weapons*, p. 61; 'Bimbo' Norman came to be Jones's great friend and key wartime Bletchley Park contact. Jones claimed that Norman returned from reading the BBC recording of the speech full of indignation at Hitler's grammar; Jones, *Most Secret War*, p. 64.

¹³⁰ CCAC RVJO B.2 & TNA AIR 20/8535, Air Scientific Intelligence Report No.1 'The Hitler "Waffe"', 11 November 1939, p. 6. The Appendices to this report detailed intelligence on potential secret weapons, collated over the previous three years, and held in the SIS files examined by Jones.

and unpopular with the Admiralty which had encouraged him to report that the secret weapons were magnetic mines partly because a German prisoner of war (POW) had said so.¹³¹ But due to his impartial analysis of the evidence, Jones allowed his conclusion to stand. In doing so, Jones systematically proved Hitler's *waffe* to be neither intentional bluff nor novelty. Moreover, and in establishing his position, Jones wrote in summary of the 'serious indications' of German developments in 'bacterial warfare, gases, flame weapons, glider bombs and pilotless aircraft, and long-range guns', and recommended that necessary precautions be taken.¹³²

As Jones later mused, Hitler had provided 'a great service by securing' Jones's 'base in the very heart of intelligence'.¹³³ Apart from mathematicians breaking codes for GC&CS, Jones was the only research scientist in the inner sanctum of British intelligence. And as both research and intelligence alike demand rigorous deduction from suspect premises, Jones was suitably primed to recognise what was scientifically feasible by the enemy and to implement countermeasure employment.¹³⁴ His preliminary and initially peripheral role as Scientific Liaison Officer was secure. The British Government could now act upon gathered and considered scientific knowledge of their enemies for the first time in history.

One of the greatest sources of intelligence on German scientific and technological capability during the Second World War came from an

¹³¹ Jones, *Most Secret War*, p. 65.

¹³² CCAC RVJO B.2 & TNA AIR 20/8535, Air Scientific Intelligence Report No.1 'The Hitler "Waffe"', 11 November 1939, p. 6.

¹³³ Jones, *Most Secret War*, p. 66.

¹³⁴ See UOB DM1310/J.112, Review of *Most Secret War* by Frank for *Physics Bulletin*.

anonymous provider, and reached Broadway through British continental espionage channels.¹³⁵ This was the famous Oslo Report. Of the varied types of intelligence Jones employed in his quest to understand German scientific and technological capabilities, it was this type of casual source he found most intriguing. He recalled that at times of alarm, such as the outbreak of war and Hitler's Danzig speech, casual sources cropped up in large numbers. Many were useless, but not all.¹³⁶ ADI (Science) later wrote that casual sources 'should not be treated flippantly', could not be tailored to any planned intelligence attack for they were 'apt to crop up at any time', and stemmed from interrogation or individual 'accidental' contact with aspects of foreign activity of interest to intelligence.¹³⁷ The Oslo Report was a prime example of the 'accidental' type of casual source, and was officially defined as 'one of the most remarkable intelligence reports' of the Second World War.¹³⁸

As Jones was completing his 'Hitler Waffe' report, Winterbotham 'dumped' the small package on Jones's desk, deeming that from the obvious scientific content it should be handed over to his new Air Scientific Liaison Officer.¹³⁹ It proved to be, as Jones described fifty years later, a 'synoptic glimpse of much of what was foreshadowed in German military electronics'.¹⁴⁰ Jones believed that the Oslo Report was integral to his wartime work, so much so that,

¹³⁵ The package was delivered anonymously on 4 November 1939 to the British Naval Attaché in Oslo, Captain (later Rear Admiral) Hector Boyes, who then sent it to Broadway via the British Legation and the Admiralty: Jones, *Most Secret War*, pp. 68–9; Jones, *Reflections on Intelligence*, pp. 265–7.

¹³⁶ Jones, 'Scientific Intelligence', 353.

¹³⁷ CCAC RVJO B.117 & TNA AIR 20/1716, ADI (Science) report 'Casual Sources', no date, p. 1.

¹³⁸ Hinsley *et al*, *British Intelligence in the Second World War, Volume I*, p. 100.

¹³⁹ Jones, *Most Secret War*, pp. 68–9; Jones, *Reflections on Intelligence*, pp. 265–7. Jones elaborated his recollections with varying narratives of 'gingerly opening the box because it might easily have been a bomb', even though it is obvious that for Winterbotham to have known to hand the package to Jones, he and others would have previously examined the contents. See also Andrew, *Secret Service*, p. 433.

¹⁴⁰ Jones, *Reflections on Intelligence*, p. 275.

because it contained information ‘of remarkable interest’, in the few dull moments he experienced during the war he examined it ‘to see what should be coming along next’.¹⁴¹

The Oslo Report was quite different from anything Jones had so far seen in intelligence.¹⁴² His practical intelligence experience was negligible by November 1939, but Jones knew enough scientifically to realise the potential in the package.¹⁴³ Jones was indeed right to ‘recognise that the Oslo Report was pregnant with warning’, for it indicated ‘the trend of German military scientific research’.¹⁴⁴ This intelligence, later rated ‘as one of the most incredible windfalls even in the long history of espionage’, was ‘genuine and extremely valuable’ even though, aside from Jones, little attention was paid to it in Whitehall.¹⁴⁵ That it had been obtained without any effort from the Allies, but instead ‘offered, unsolicited, through the conscientious revulsion against Nazism of a German scientist’, made it the more pleasing.¹⁴⁶ Upon opening the small package on his desk, Jones discovered inside seven pages of typewritten text and a sealed box. Inside the box was an electronic triggering device from a German proximity fuse – a gadget designed to trigger anti-aircraft shells upon reaching close proximity of their targets. Crucially, this

¹⁴¹ Jones, ‘Scientific Intelligence’, 353.

¹⁴² Jones, *Most Secret War*, p. 69.

¹⁴³ See TNA AIR 40/2572 & IWM Germisc 159/002417/0006 for the original German text of the Oslo Report; see Jones, *Reflections on Intelligence*, p. 337 for the translation he employed. See Hinsley *et al*, *British Intelligence in the Second World War, Volume I*, pp. 508–12 for an alternative translation. Neither translation is available in the Jones Papers or The National Archives. The only original translation is preserved at the Imperial War Museum. This was translated by W. Todhunter of the Admiralty, and is annotated for the attention of a Mr Knight. The accompanying letter is telling of the scientific complexity of the Oslo Report, for Todhunter ‘was not quite clear on the special electrical terms’. The translation also differs slightly from that provided by the official historians, and largely from that provided by Jones. This thesis nonetheless refers throughout to Jones’s translation.

¹⁴⁴ Keegan, *Intelligence in War*, pp. 300 & 334.

¹⁴⁵ CCAC RVJO K.475, Transcript for ‘The Battle of the Beams’, p. 13; Johnson, *The Secret War*, p. 9; Andrew, *Secret Service*, p. 433.

¹⁴⁶ Bennett, *Behind the Battle*, p. 32.

electronic gadget fully emphasised how little the British were aware of German military scientific and technological capabilities. It further demonstrated how German scientists and technicians were on par, if not in advance of their British counterparts in technological developments.¹⁴⁷

Originally referred to as the Photo-Electric (PE) Fuse, this appliance was designed for guided projectiles, was sensitive to the shadow of an enemy aircraft and would therefore detonate once this stimulus was detected.¹⁴⁸ The report stated that these fuses were produced by *Rheinmetall* at Sömmerda in Thuringia.¹⁴⁹ Jones made little reference to this electrical gift in his publications; the only mention in *Most Secret War* was to confirm technical specifics of the 'electronic triggering device'.¹⁵⁰ In *Reflections on Intelligence* Jones added that the fuse 'proved to be much better than anything we had available in Britain'.¹⁵¹ This in itself should have been satisfactory proof for Whitehall sceptics that the Oslo Report was genuine.¹⁵² After a few days, Jones handed the fuse to his former ARL colleagues 'to get them to evaluate its performance', but also because it was not his immediate concern.¹⁵³

¹⁴⁷ For more on British development of the proximity fuse, see Hartcup, *The Challenge of War*, pp. 170–81; Brian Ford, *Allied Secret Weapons* (London: MacDonald & Co., 1970), p. 76. See also Churchill's account of him personally demonstrating a prototype proximity fuse to the British War Cabinet: Winston S. Churchill, *The Second World War, Volume Two: Their Finest Hour* (London: Reprint Society Ltd. 1951), p. 322.

¹⁴⁸ Ford, *Allied Secret Weapons*, p. 76. The British proximity fuse was chosen as one of the items 'gifted' to the USA through the Tizard Mission. The Americans in turn mass-produced the fuse and come the end of the war it proved a most valuable technological addition to Allied weaponry. For accounts of US development and production of the proximity fuse, see James Phinney Baxter III, *Scientists Against Time* (London: MIT Press, 1946); Ralph B. Baldwin, *The Deadly Fuze, The Secret Weapon of World War II* (London: Jane's Publishing Company, 1980).

¹⁴⁹ Jones, *Reflections on Intelligence*, p. 337.

¹⁵⁰ Jones, *Most Secret War*, p. 68.

¹⁵¹ Jones, *Reflections on Intelligence*, p. 267; Andrew, *Secret Service*, p. 433.

¹⁵² See Michael Smith, *Foley: The Spy Who Saved 10,000 Jews* (London: Hodder and Stoughton, 1999), p. 179.

¹⁵³ Jones, *Most Secret War*, p. 69.

The document told how the Ju88 was a twin-engined long-range bomber with the potential advantage of doubling as a dive-bomber, and how 'several thousands (probably 5000)' Ju88s were being produced every month. 'Up to April 1940', the translation informed, 25–30,000 Ju88 bombers were being produced. It was largely this information that alarmed Whitehall over the validity of the Oslo Report. Jones later calculated that 'the alleged rate of production of Ju88s was far in excess of actuality; instead of 5000 per month, the most optimistic planned production in August 1939 was 300 per month'.¹⁵⁴ Richard Overy confirmed that total annual German aircraft production was 8295 in 1939, and 10,247 in 1940 – making a mockery of the Oslo Report's projection of 25–30,000 Ju88s alone by April 1940.¹⁵⁵

Jones later announced the 'leading doubter' to be John Buckingham, the Admiralty Deputy Director of Research (DDR), who implied that Jones was 'innocent in intelligence work, and that the whole thing was a 'plant''. Buckingham argued further that the 'German hoaxers had over done it', for it was highly unlikely that any one person in Germany could possess such comprehensive knowledge of developments in so many different fields. When Jones expressed his belief regarding the report's honesty, Buckingham informed him that it was 'an old trick' (which indeed it was) in which 'you give your victim something genuine that you know he already knows, in the hope of convincing him that the rest of the report, which contains the hoax is

¹⁵⁴ Jones, *Reflections on Intelligence*, p. 267. Jones deduced these calculations from figures extracted from David Irving's *The Rise and Fall of the Luftwaffe* (London: Weidenfeld & Nicolson, 1974).

¹⁵⁵ Overy, *The Air War 1939–1945*, p. 15. Production figures further show that Germany only produced an annual figure of 3,865 aero-engines in 1939 and 15,510 in 1940, so to have made 5000 twin-engine bombers per month would have been pointless without sufficient numbers of engines to power them.

genuine'.¹⁵⁶ A leading intelligence historian stated that Whitehall 'found continuing difficulty in distinguishing good from bad intelligence', and cited failure to recognise the value of the Oslo Report as confirmation of this argument.¹⁵⁷ Another posited that the *Abwehr* had 'an unjustified reputation of duplicity' in the wake of the Venlo incident and other calamitous intelligence fiascos, and so SIS 'took the collective view that volunteered intelligence should be treated as suspect'.¹⁵⁸ Jones however, not discouraged like (or by) his colleagues, or even by the overwhelming Ju88 elaboration, retained his copy and subsequently used it as a basis for much of his thought.¹⁵⁹

Importantly, the report also discussed 'remote-control gliders'. In effect these were air-to-surface (ASV) missiles, three-metres long with three-metre span, carrying large explosive charges, controlled by remote-control, and containing electric altimeters that checked flying height above water. Codenamed *Ferngesteuerte Zielflugszeug* (FZ21), these missiles were being tested in an experimental establishment at Peenemünde, at the mouth of the River Peene, near Wolgast, in the vicinity of Greifswald.¹⁶⁰ This was the first Jones had heard of Peenemünde, and at the time would have meant very little. Failure to monitor these technologies would become a key concern for Britain, and for ADI (Science), later in the war.

¹⁵⁶ Jones, *Most Secret War*, pp. 69–70; West, *MI6*, p. 192.

¹⁵⁷ Andrew, *Secret Service*, pp. 432–3.

¹⁵⁸ Nigel West, *MI6: British Secret Intelligence Service Operations, 1909–45* (London: Grafton Books, 1983), p. 191. The Venlo incident, which occurred on 9 November 1939, involved two British agents caught in an *Abwehr* trap.

¹⁵⁹ Jones, *Most Secret War*, p. 70; Jones, *Reflections on Intelligence*, p. 267.

¹⁶⁰ 'The Oslo Report' in Jones, *Reflections on Intelligence*, p. 333.

Under the heading of 'Autopilot', the report referred to development of FZ10 remote-controlled aircraft, controlled from manned aircraft to be used for destroying balloon barrages.¹⁶¹ These were much later developments designed to be fired from fast jet aircraft, such as the Me262. Nevertheless, the Oslo Report was alluding to some amalgam of rocket/jet experimentation. The report also referred to Rechlin (sixty miles northwest of Berlin) where GAF laboratories and development establishments provided promising targets for bomber attacks.¹⁶² Jones had little to say on Rechlin, other than defining the research facilities as the German equivalent of the RAE in Farnborough.¹⁶³ It is one of the great mysteries of the war why Rechlin was not targeted by the Allied bomber commands, and that RAE was not targeted by the *Luftwaffe*. Jones did at one stage of the war recommend the 'crude' countermeasure of bombing Rechlin, stating that the German RAE had 'long merited attention' and was 'well worth a visit'.¹⁶⁴ Almost all secondary sources regard Rechlin's war activity with little consequence, presumably because

¹⁶¹ There has been some misunderstanding over the FZ10. Indeed, many possibilities arise upon study of the eventual German secret weapons designs and developments. For example, FZ10 could have been a forerunner of the 'Natter' (Viper), a manned rocket-craft – rocket-projected and autopilot controlled initially – before human pilots took control at required altitudes. Alternatively, it may well have been referring to an air-to-air missile, such as the 'Fritz-X', or the 'X-4' – missiles released and controlled by parent aircraft pilots: Ian V. Hogg, *German Secret Weapons of the Second World War, the Missiles, Rockets and New Technology of the Third Reich* (London: Greenhill Books, 1999), p. 90; see also Roger Ford, *Germany's Secret Weapons in World War II* (Staplehurst: Spellmount, 2000) and Brian Ford, *German Secret Weapons: Blueprint for Mars* (London: MacDonald & Co., 1969).

¹⁶² Jones, *Reflections on Intelligence*, p. 334.

¹⁶³ Jones, *Most Secret War*, p. 69.

¹⁶⁴ CCAC RVJO B.16 & TNA AIR 20/1670, Air Scientific Intelligence Interim Report No. 2 'The X-Gerät', 24 September 1940, p. 6; CCAC RVJO B.18 & TNA AIR 20/1627, Air Scientific Intelligence Report No.10, 'The X Gerät', 12 January 1941, p. 22. Appendix 6 of this SIR showed GAF establishments and manufacturers 'compiled in the hope that some of them may be bombed'. These were Rechlin, Lueneburg, Köthen, Vannes, Telefunken at Berlin (Schröderdamm and Zehlendorf), Philips at Eindhoven, and any research establishments belonging to Siemens-Schuckert, Neuberger, Hydra, Hescho, Ziehl-Abegg, and Pintsch.

Rechlin did not suffer the same bombing treatment as Peenemünde, and thus offered little on the narrative front.¹⁶⁵

The Oslo Report item that most piqued Jones's technical abilities was regarding 'Aircraft Warning Devices', or German RDF. The report explained in some technical detail that along the entire German coast there were short-wave transmitters which sent out very short pulses that were reflected back by any aircraft within the wave's vicinity. These reflected waves were then registered by wireless receivers and cathode-ray tubes, and from the interval between the transmission and reciprocation of the transmitted wave the distance of aircraft could be ascertained.¹⁶⁶ Two things are striking with this inclusion. The operational description of this aircraft-warning device was excellent, particularly as most people in 1939 would not have understood the technicalities involved. This led to the conclusion that the author had to have scientific and technical knowledge. The report also directly linked this development with the Ju88 programme. This was an odd connection to make, for it led the reader away from the fundamental point that Allied aircraft were being 'picked up' by German RDF at distances of 120km from the coast.¹⁶⁷

The Oslo Report concluded the subject of aircraft-warning devices by highlighting methods of countermeasures, whereby German RDF receivers

¹⁶⁵ The official historians of wartime British intelligence did note that the GAF first demonstrated the rocket-propelled interceptor aircraft He176 at Rechlin, and that the GAF research station at Peenemünde was a subsidiary connected to the main research establishment at Rechlin: Hinsley *et al*, *British Intelligence in the Second World War, Volume I*, pp. 333 & 391.

¹⁶⁶ Jones, *Reflections on Intelligence*, pp. 334–5.

¹⁶⁷ This was unknown to the British, but clearly (with hindsight) accounted for the fifty-percent loss rate experienced in the 4 September 1939 bomber raid on the Wilhelmshaven naval base, in which no serious damage was done to German ships, but five out of ten RAF Blenheim bombers were shot down by Anti-Aircraft: Gilbert, *Second World War*, p. 5. The report stated 'English airmen' and 'English aircraft', rather than British or Allied.

could be blocked by transmitting waves of the same frequency from land installations. While it did not state the actual wavelength, the report did suggest that the British find out for themselves in order to jam the transmissions. This proved impractical however (until D-Day), because of the German occupation of France, Belgium and Holland. The report then detailed 'Aircraft Distance-Measuring Instruments', a system for finding ranges of friendly bombers by transmitting signals, modulated at low frequencies so as to be differentiated from all other pulses. Once received by aircraft, the signals would be returned to observing stations on different frequencies again, so that distances of aircraft could be measured by the 'phase lag'. The distance information could then be transmitted to bombers, which could be positioned relative to the pre-determined target.¹⁶⁸

Again the author had demonstrated high technical knowledge, even providing scientific formulae based on phase angles. Inadvertently hidden within the detail was a hint of GAF bombers using radio beams for navigation and bombing accuracy. This data confirmed that the Germans were much more advanced than the British in bombing-accuracy instrument design, although this was a matter that Jones would have to discover through practical experience. Bombing accuracy apparatus were beneficial assets for offence, not necessary components for national defence. The Oslo Report highlighted the nature of forthcoming air strategy: Germany required instrumentation for bombing accuracy, the British required sophisticated early-warning systems.

¹⁶⁸ Jones, *Most Secret War*, p. 69.

Finding the author of the Oslo Report became an obsession for Jones in later life, and in *Reflections on Intelligence* he revealed that his investigations had been satisfied ‘undoubtedly’ by Hans Mayer, Director of Central Laboratories of Siemens & Halske.¹⁶⁹ Some authors have been convinced.¹⁷⁰ Others have not.¹⁷¹ Research by Arnold Kramish (who believed that the Oslo Report was ‘a passion’ for Jones) placed significant doubt upon the validity of Jones’s theory that he had found the Oslo Report’s anonymous author.¹⁷² Reports of a similar scientific and technical nature occurred throughout the war – the ‘Lisbon Report’ which provided information on the German rocket programme; the ‘Istanbul Report’ which provided MI6 with Enigma keys for *Abwehr* signal trunk routes; and the ‘Berne Report’ which provided insight into the German Foreign Ministry signals.¹⁷³ None of these intelligence reports were given the same levels of post-war attention as the Oslo Report – made famous by Jones just as he enjoyed fame from it.¹⁷⁴

¹⁶⁹ Jones, *Reflections on Intelligence*, chapter entitled ‘In Search of an Author’, pp. 276–332.

¹⁷⁰ Maddrell, *Spying on Science*, p. 4; Smith, *Foley*, p. 316; Michael Smith, *New Cloak, Old Dagger: How Britain’s Spies Came in from the Cold* (London: Victor Gollancz, 1996), p. 104.

¹⁷¹ Arnold Kramish, *The Griffin, The Greatest Untold Espionage Story of World War II* (London: Macmillan, 1986), pp. 63–72; Stanley, *V-Weapons Hunt*, p. 47.

¹⁷² See in particular all correspondence between Jones and Arnold Kramish: CCAC RVJO B.326; RVJO B.329–B.330; RVJO B.334–B.335; RVJO B.440–B.446; RVJO E.231–E.232; RVJO G.422; RVJO J.435; RVJO J.621. Shortly before he died on 15 June 2010, Kramish informed the author of this thesis that he had convincing proof that Jones was wrong in his assertion that Hans Mayer was the author of the Oslo Report: Arnold Kramish email to author, 31 May 2010.

¹⁷³ Anthony Cave Brown, *Bodyguard of Lies* (London: W.H. Allen & Co., 1977), pp. 199–200. See also CCAC RVJO B.441, Jones to Arnold Kramish, 19 February 1985 for confirmation that Jones did receive the Lisbon Report of 1943.

¹⁷⁴ Jones revealed the Oslo Report to the British press following his 1947 RUSI lecture: see ‘The Letter to Oslo gave us V-Warning’, *Daily Mail*, 20 February 1947, p. 3. Seven years later, in a most elaborate display of sensationalist journalism, the *Sunday Express* published an article in 1954 purporting to ‘bring to light a story hidden for fifteen years’. The article claimed that ‘at the cost of a 4d stamp’ the Oslo Report gave information ‘worth millions to British Intelligence’: Ian Colvin, ‘The Most Startling Letter Ever Posted (maybe because of it YOU are alive today!)’, *Sunday Express*, 22 August 1954. Thereafter Jones wrote liberally on the importance of the Oslo Report, and the two – man and document – became inextricable.

Swiftly following 'The Hitler Waffe' report was Jones's paper detailing his perceived responsibility for scientific intelligence. Entitled 'A Scientific Intelligence Service', this paper pressed home, albeit tentatively, the urgency required in enhancing the status of scientific intelligence. He began by comparing scientific intelligence in 1939 England with that of Athenian policy in Classical Greece and reminded his readers, after Thucydides, that Athens lost the war. As reproduced in Diagram I, Jones highlighted the stream of scientific intelligence as it stood in 1939 before the outbreak of war (and his arrival in Air Intelligence). He emphasised that he had used the Air Ministry as example because it was the department with which he was acquainted. The essential point to the diagram for Jones was that between the Air Ministry Directorate positions and the sources of information there were two (or perhaps three) non-technical filters. As Jones highlighted, these branches all had other work to do and could not be expected to cope with scientific and technical reports. In short, there was no one man to acquire the continuous supply of such intelligence elements 'with which to construct the puzzle'. Needless to say, Jones saw himself as that man.¹⁷⁵

Clearly Jones was driven by immense enthusiasm to ensure his position. Nonetheless, he had prepared a convincing and commanding scheme that emphasised the importance of his new role, and its smooth integration into the orthodox structure. The former was catered for by statements such as a

¹⁷⁵ CCAC RVJO B.106 & TNA AIR 20/1717, paper written by Jones entitled 'A Scientific Intelligence Service', 7 December 1939, Appendix I. The National Archives have this document marked as 'assumed author R.V. Jones', the element of doubt presumably due to the fact that Jones neglected to assign his name to it.

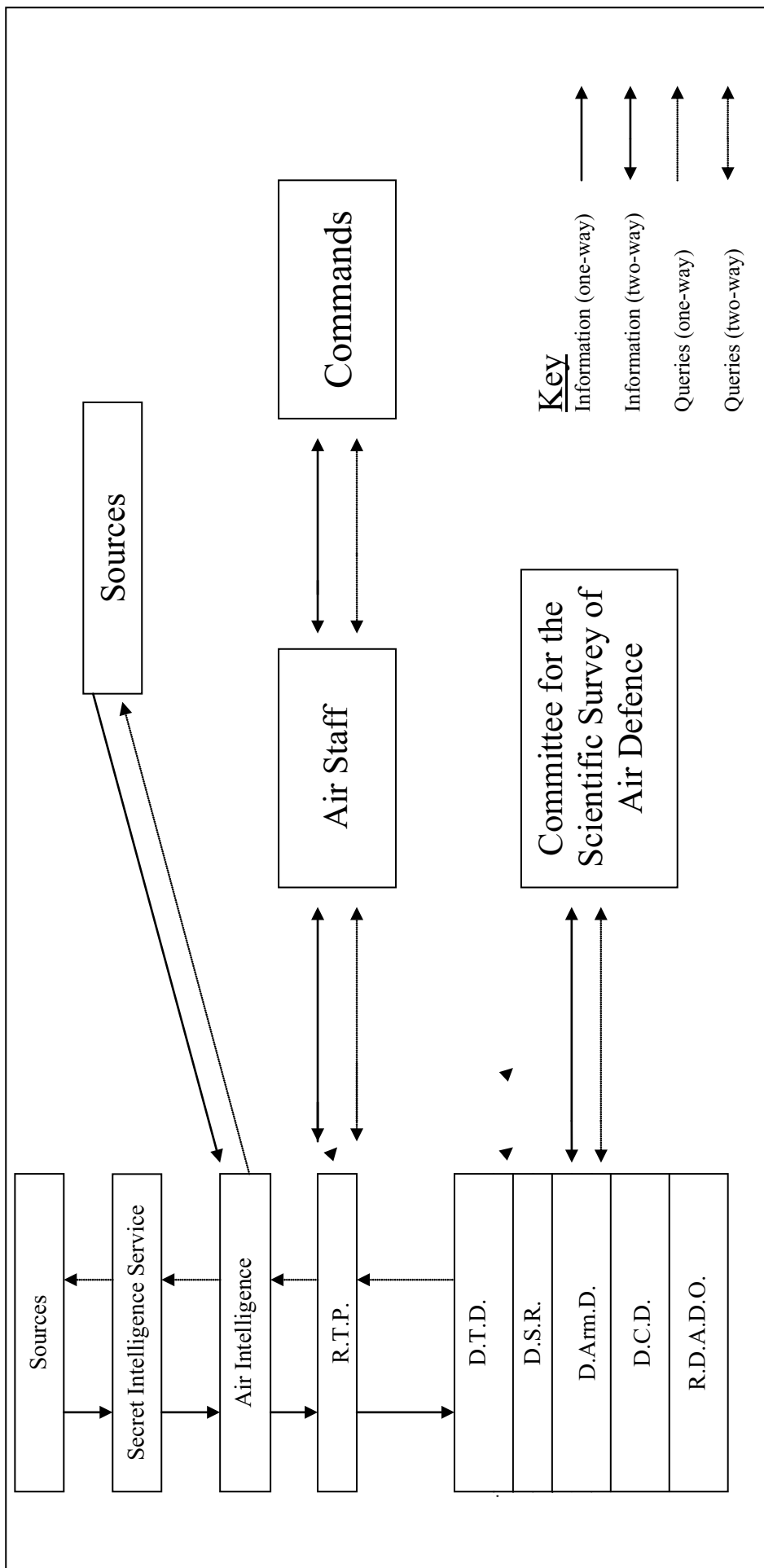


Diagram I: Streams of Scientific Intelligence in Air Ministry before the War

Source: CCAC RVJO B.106 & TNA AIR 20/1717, 'A Scientific Intelligence Service', 7 December 1939, Appendix I.

‘serious disparity in scientific intelligence’ between Britain and Germany which ‘almost certainly’ existed at that time; and that it was obvious that SIS sources and methods were inadequate, and attempts had to be made ‘to improve them’ – by recruitment proposals, source possibilities, service integration and departmental considerations. In addition, Jones proposed a modification to the usual process of intelligence flow by alternating the stream between the Central Section and the Service Sections in times of war and peace. The logic behind this proposal was that ‘existence of a state of war’ naturally increased ‘the importance of the Service Sections relative to the Central Section’, because many of the latter’s sources had dried up while the Service Sections had ‘access to a new flood of information resulting from direct contact with its enemy’.¹⁷⁶ A logical deduction it seems, and yet one that had not been implemented beforehand. Jones diagrammatically portrayed these streams in Appendix II of his report, as reproduced in Diagram II.¹⁷⁷

With this diagram, Jones was keen to highlight his ability to utilise the contacts he had made, and thereby further reinforce the decision to place himself in his then position as Scientific Liaison Officer, and in his envisaged role as a Scientific Intelligence Officer. It is interesting how he positioned infra-red alongside the Admiralty DSR – clearly this research was still important to him, irrespective of the portrayal of waning interest shown in his memoirs. But in this, Jones was clearly emphasising his experience in dealing with respective organisations, such as the Admiralty, GC&CS, Bawdsey, RAE, and the

¹⁷⁶ CCAC RVJO B.106 and NA AIR 20/1717, paper written by Jones entitled ‘A Scientific Intelligence Service’, 7 December 1939, pp. 9–10.

¹⁷⁷ CCAC RVJO B.106 & TNA AIR 20/1717, paper written by Jones entitled ‘A Scientific Intelligence Service’, 7 December 1939, Appendix II.

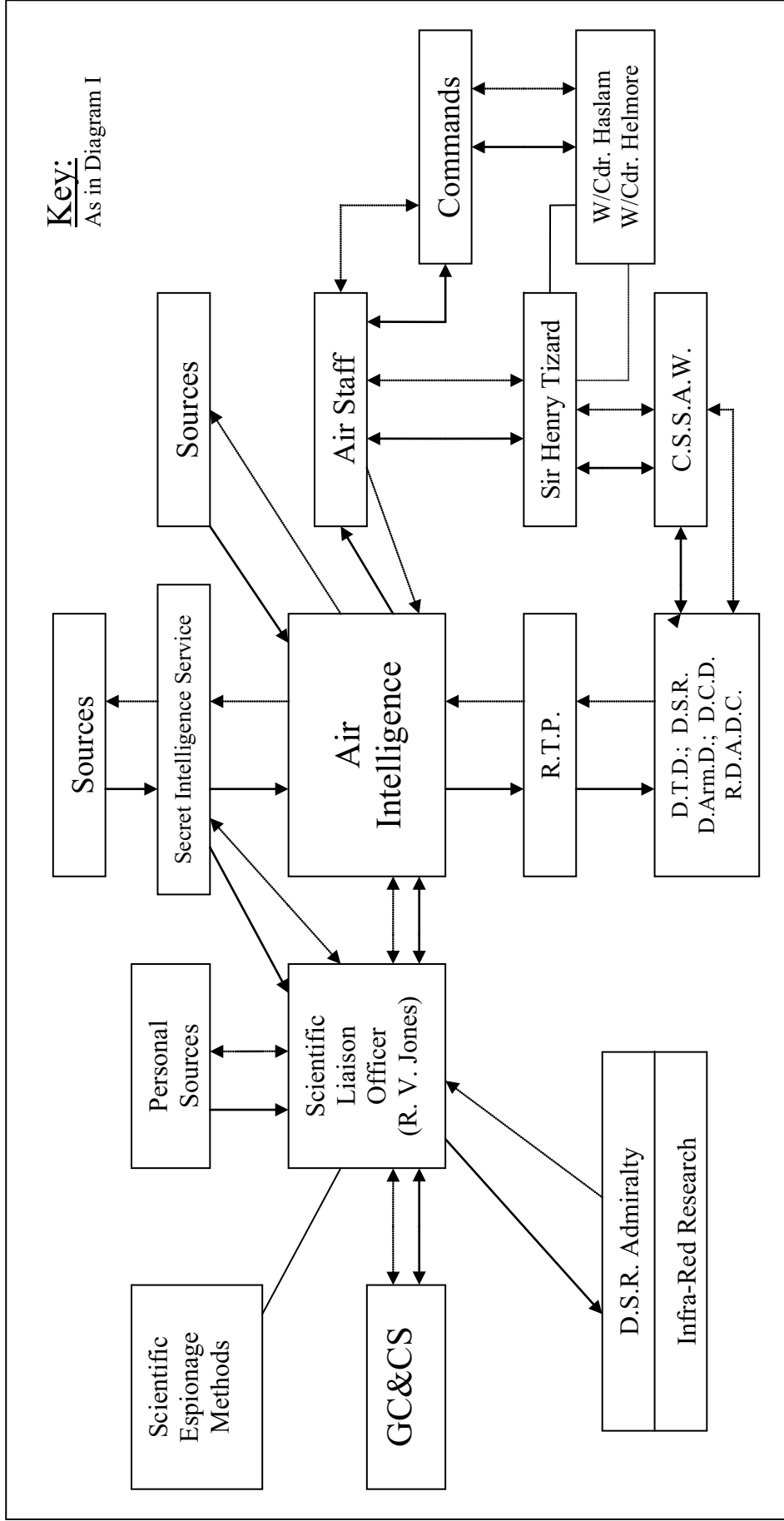


Diagram II: Streams of Scientific Intelligence in the Air Ministry after the Appointment of a Scientific Adviser to the Chiefs of Staff, and of one Scientific Liaison Officer.

Source: CCAC RVJO B106 & TNA AIR 20/1717, 'A Scientific Intelligence Service', Appendix II.

Y- service. He even mentioned liaison with MI5 in the text of his report.¹⁷⁸ The Security Service certainly had its own scientific adviser at about this time, following the Chief of B Division, Guy Liddell, recruiting direct from Cambridge the ‘brilliant young zoologist Victor (third baron) Rothschild’ to head MI5’s first counter-sabotage department, designated B1c.¹⁷⁹ Rothschild maintained a laboratory at his own expense, recruited the traitorous Anthony Blunt, and later came to be one of the greatest scientific mandarins of the British government.¹⁸⁰ But while Rothschild yielded important scientific advice to British intelligence, Jones did not consider it to be as valuable as the type of scientific intelligence he envisaged necessary for the defence of Great Britain.¹⁸¹ Instead, he saw himself in such a role—as liaison to MI5.

It is also interesting how Jones positioned Tizard within his proposed structure – as a sort of intelligence clearing house between the Air Staff, the scientific committees, and operational staff. This also vividly demonstrates just how important Tizard was to the Air Ministry structure at that time; and at an individual level, how important Tizard was to Jones and his own personal

¹⁷⁸ CCAC RVJO B.106 & TNA AIR 20/1717, paper written by Jones entitled ‘A Scientific Intelligence Service’, 7 December 1939, p. 3.

¹⁷⁹ Christopher Andrew, *The Defence of the Realm: The Authorized History of MI5* (London: Allen Lane, 2009), p. 219; Philby, *My Silent War*, pp. 46 & 68; Andrew and Dilks, *The Missing Dimension*, p. 177. For details on B1c, see F. H. Hinsley and C. A. G. Simkins, *British Intelligence in the Second World War, Volume IV: Security and Counter-Intelligence* (London: HMSO, 1990), pp. 179–80.

¹⁸⁰ Andrew, *The Defence of the Realm*, p. 219; Miranda Carter, *Anthony Blunt: His Lives* (London: Pan Books, 2002), pp. 250–1; Chapman Pincher, *Too Secret Too Long: The great betrayal of Britain’s crucial secrets, and the cover-up* (London: Sidgwick & Jackson, 1984), p. 345; Philip Gummett, *Scientists in Whitehall* (Manchester: MUP, 1980), p. 196; Hennessy, *Whitehall*, pp. 223–35 & 244–9. See also Suzanne Reeve and Richard Bentley, ‘Nathaniel Mayer Victor Rothschild, G.B.E., G.M., Third Baron Rothschild, 31 October 1910–20 March 1990’, *Biographical Memoirs of Fellows of the Royal Society*, 39 (February 1994), 368. Rothschild was awarded the George Medal for his scientific advice to MI5 during the war.

¹⁸¹ Jones spelled out that the ‘primary problem of a Scientific Intelligence Service’ was ‘to obtain early warning of the adoption of new weapons and methods by potential or actual enemies’: CCAC RVJO B.106 & TNA AIR 20/1717, paper written by Jones entitled ‘A Scientific Intelligence Service’, 7 December 1939, p. 4.

development (irrespective of his earlier professed desire to escape him). Most importantly, he positioned himself directly in the centre of the Air Intelligence structure, between SIS and GC&CS, and between GC&CS and Air Intelligence. In this position he saw his role as the collator of various sources which would be directed towards scientific and technical intelligence. These sources would report directly to him, and he in turn would combine the scientific and technical data for analysis. He would then filter this intelligence to SIS, Air Intelligence, and the Air Ministry Directorates.

Remarkably Jones took these ideas to another level. In the third Appendix to his report, reproduced in Diagram III, he proposed a Central Scientific Section as a core construct within the SIS structure. Whether he envisaged himself eventually heading such an organisation within the British intelligence structure can only be speculated upon. Nevertheless, that Jones proposed such integral scientific analysis of intelligence at such an early stage in his career, and so early on in the war, points to this conclusion. Attached to this proposed Central Scientific Section were GC&CS, and (interestingly) a Scientific Espionage Committee. There is no evidence hinting to what Jones intended for the latter, unique idea. Nor did he discuss it in any of his published literature.¹⁸² It does seem however, that Winterbotham was convinced over Jones's proposals and is on record approving the notion of a 'new central SI service' in November 1939.¹⁸³

¹⁸² CCAC RVJO B.106 & TNA AIR 20/1717, paper written by Jones entitled 'A Scientific Intelligence Service', 7 December 1939, Appendix III.

¹⁸³ IWM HTT 15/54, 'Scientific Intelligence: Summary of Technical Information Received by R.T.P. from Intelligence Sources', from October 1939 to July 1940. The third page of this list is disappointingly annotated 'Papers destroyed, 10.7.40'.

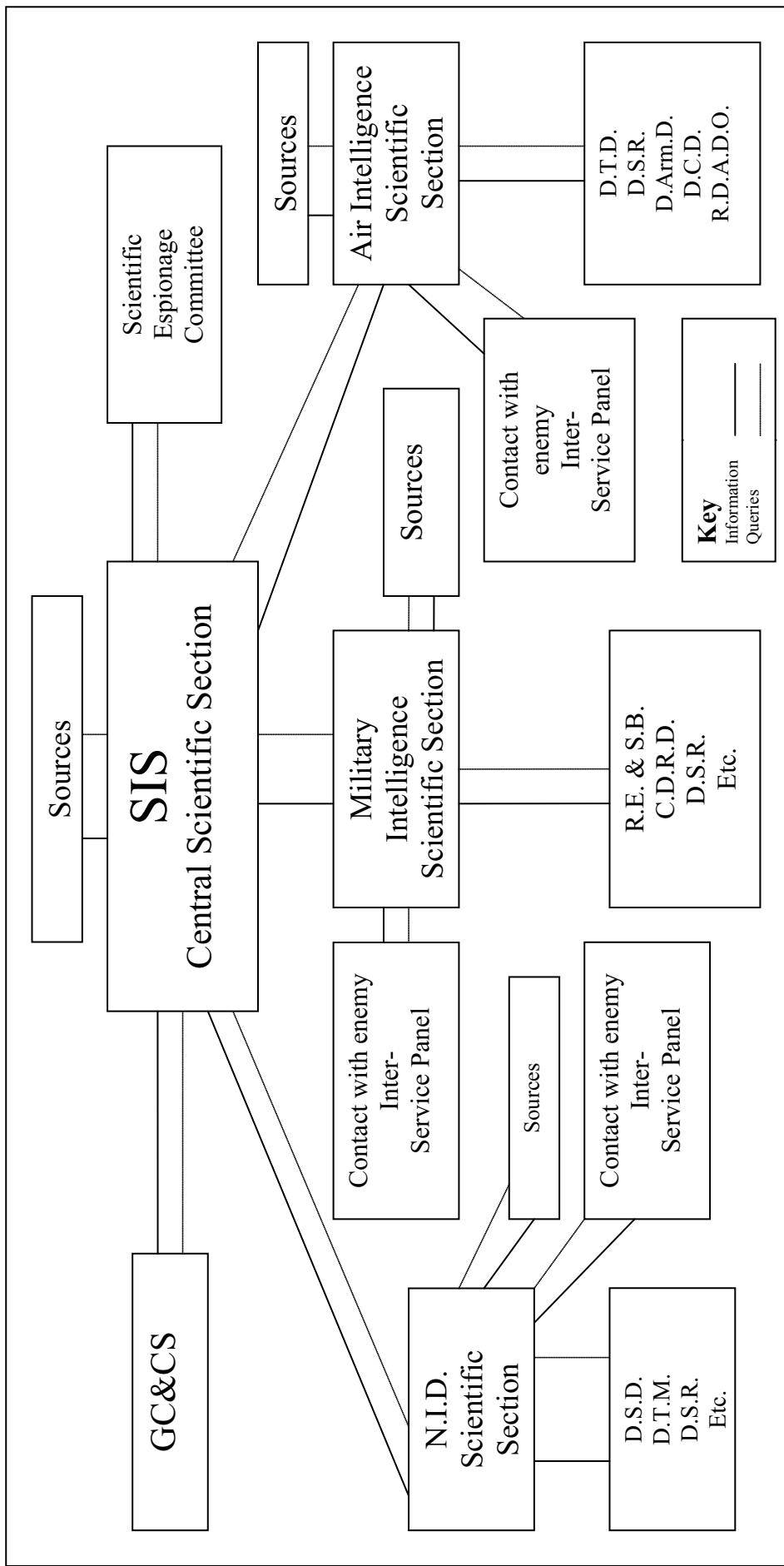


Diagram III: A Suggested General Scheme for Scientific Intelligence.

Source: CCAC RVJO B106 & TNA AIR 20/1717, 'A Scientific Intelligence Service', Appendix III.

That GC&CS only served SIS in his model shows how little was expected of SIGINT at the outbreak of war. Also attached to the Central Scientific Section were three respective Service Scientific Sections, each with their own sources, and contacts with the enemy, and each with their own inter-service panel. The interaction of queries and information between SIS and each Section, and each section and their sources, and contacts were inter-flowing. Such inter-service collaboration was not only prescient, but also clever. Jones believed that, although this scheme appeared 'extravagant', it was necessary because the functions of the Central and Service sections differed considerably.¹⁸⁴ In many respects, Jones's proposed idea for such uniform and integrated STI was well ahead of its time. It would take a protracted and costly war to produce a combined STI organisation even remotely similar to the one Jones visualised in December 1939. In the meantime, reality was wholly different and almost entirely based on pragmatism.

In his memoirs, Jones was keen to emphasise that he received praise for his report. Tizard 'promptly wrote congratulating' him and professed hope that the proposals 'would be accepted'; Pye too 'wrote in the same vein', stating that it seemed to him 'an excellent outline of what [was] required'.¹⁸⁵ Pye's letter was sent care of Winterbotham, and confirmed Pye's intention to show Jones's report to Tizard. There is no archival confirmation of Tizard's congratulations. There is, however, a summary of information on intelligence passed through Tizard during 1939/40 that confirms Tizard's acceptance of Jones's report on 16 December from Pye. Six days later a 'preliminary draft',

¹⁸⁴ CCAC RVJO B.106 & TNA AIR 20/1717, paper written by Jones entitled 'A Scientific Intelligence Service', 7 December 1939, p. 9.

¹⁸⁵ CCAC RVJO B.118, Pye to Jones, 16 December 1939; Jones, *Most Secret War*, pp. 74–5.

based on Jones's report was sent by the Directorate of Intelligence for Tizard's approval. On 27 December, Tizard sent 'suggested amendments' detailing the three DSRs that were 'to be brought in'.¹⁸⁶ Although Jones had not gained satisfaction in regard to a Central Scientific Intelligence organisation, he had at least inspired more scientific personnel being brought into the heart of the Air Ministry decision-making process.

For Jones, the aims, methods and requirements for satisfactory scientific intelligence were considerably more involved than had been first envisaged by Tizard and Winterbotham. Jones had proposed a division of objectives, methods and requirements to serve the Central Section of the British intelligence services as well as the Service Sections. The unprecedented primary objective for all was 'to ascertain the development of new weapons and improvement of existing ones by other countries'. Additional objectives of the Central Section were to 'mislead potential or actual enemies' on the state of Britain's weapons; to 'mislead the enemy about the success of his own weapons'; and to 'assist technically in espionage and its counter'. To this latter point Jones added codes and ciphers, where 'technicians are becoming important at the expense of classical scholars'.¹⁸⁷

A secondary objective for both Central and Service Sections pointed to the necessary coordination of scientific intelligence between all intelligence and armed services, as well as the maintenance of 'a close two-way liaison

¹⁸⁶ IWM HTT 15/54, 'Scientific Intelligence: Summary of Technical Information received by R.T.P. from Intelligence Sources. October 1939'.

¹⁸⁷ CCAC RVJO B.106 & TNA AIR 20/1717, paper written by Jones entitled 'A Scientific Intelligence Service', 7 December 1939, p. 10.

between them'. The methods to be employed for satisfactory results to all the afore-mentioned objectives was to exploit existing sources from all intelligence services, and to establish academic and industrial contacts (or agents) abroad. The armed forces were expected to obtain and examine evidence resulting from contact with the enemy. The requirement for all this activity was thorough knowledge of domestic academic research, service research, and industrial research, as well as a thorough understanding of the requirements of the armed forces. This last point was evidently 'hinting' at more service infiltration of Operational Research (OR), for which Jones recommended rotational interchange of personnel within the Research and Development Directorates.¹⁸⁸

Jones also provided detailed proposals for staffing the relevant sections. This is of little surprise given the enormity of the task he had presented. But, as was the case in many areas of early-wartime state machinery, additional manpower was impractical. Yet owing to the delicacy of the subject material there was more to it than manpower shortage. It was a question of expertise. While Jones and his immediate superiors were keen for a 'healthy organization' of scientific intelligence, the concept faltered on one man's considered opinion, which Jones later wrote 'had something to it'. Buckingham argued that 'while he would like to see the collection of scientific information about the enemy encouraged, it should be assessed and interpreted not by an Intelligence organization but by scientific experts in the

¹⁸⁸ CCAC RVJO B.106 & TNA AIR 20/1717, paper written by Jones entitled 'A Scientific Intelligence Service', 7 December 1939, pp. 10–11.

Scientific Directorates'.¹⁸⁹ In effect, Buckingham was attempting to ensure that any intelligence of a scientific nature remained 'in-house' within the relevant service departments. It appears that this Admiralty stance had influence upon Tizard's final decision, although this remains speculative.

Had Jones not been so convinced of the importance of his new role (real and visionary) following rejection of his report, he may well have been recalled from intelligence altogether. Jones was adamant however, that 'failure of scientific intelligence to detect the development of a new hostile weapon in time might well result in national disaster'.¹⁹⁰ He pleaded not to be allowed to abandon his work on the grounds that 'sooner or later the work was going to be important'; Jones even requested the recruitment of Frank at this stage, (because of his outstanding scientific ability and knowledge of Germany and the German language) only to be told by Pye that he could not authorize any recruitment.¹⁹¹ Jones was therefore, as one intelligence agent later claimed,

¹⁸⁹ Jones, *Most Secret War*, p. 75; CCAC RVJO B.346, Jones to A. R. Michaelis, Science Correspondent for the *Daily Telegraph*, 3 December 1964. Jones's opinion on this issue was toned down for his memoirs. He had earlier written that his idea of an inter-service scientific intelligence organisation was 'wrecked on the rock' of the Admiralty's DDR, whose argument proved during the war to be 'a fallacy' that 'torpedoed' an inter-service organisation 'that could have been built up'.

¹⁹⁰ Jones, 'Scientific Intelligence', 354.

¹⁹¹ CCAC RVJO B.342, Jones to David Irving, 10 July 1964; CCAC RVJO B.346, Jones to Michaelis, 3 December 1964; Jones, *Most Secret War*, p. 77. Jones recalled that Pye 'got cold feet when his opposite number in the Admiralty [Buckingham] would not co-operate', and 'even suggested withdrawing' Jones 'for other work', perhaps in the Air Ministry DSR. In March 1940, Pye initially retracted authorisation of Frank's Air Ministry employment as a potential scientific intelligence officer, for 'the position in regard to the Scientific Intelligence Group' was 'slightly obscure'. Evidence has since been brought to light that it was certainly Buckingham who vetoed Frank's appointment on the grounds that there was not enough scientific intelligence work to 'justify the employment of two people!' The February 1940 minute from Buckingham was later acknowledged by Jones as accurate. He would have appreciated this for it corroborated his own version of Buckingham's early obstruction of air scientific intelligence, and justified his hostility towards the Admiralty DSR. First published in 1987 and later acknowledged in print by Jones, this discovery is a fine example that Jones was not omniscient about scientific intelligence, even when issues under discussion directly involved him and his colleagues: Tom Bower, *The Paperclip Conspiracy: The Battle for the Spoils and Secrets of Nazi Germany* (London: Michael Joseph, 1987), p. 27. Bower cites from a minute written by Buckingham which can be accessed in TNA CAB 21/1421.

‘a one-man, all-source intelligence evaluation, collection and analysis section’ (for a while at least).¹⁹²

Jones had suggested a single scientific intelligence organisation working on behalf of the defence system as a whole. He subsequently distributed reports of this nature that were rarely accepted, essentially because ‘the importance of Scientific Intelligence was not (then) generally appreciated’, and he had not merely failed ‘to get an inter-service organization’ but also ‘failed to get any help at all, not even a secretary’.¹⁹³ Some fourteen years later, Jones still maintained his annoyance that ‘the Treasury would not even authorize some of the scientific posts required for defensive work, and so there was no scientific effort for the offensive’.¹⁹⁴ Instead, single-handedly for just over a year in 1939–40, and then later doubling with Frank, Jones undertook all the tasks he laid out in his 1939 report. By the end of the war, scientific intelligence was much more in line with Diagram II, rather than Diagram III.

With Jones’s grand visions in mind, it is appropriate to contextualise his position as scientific intelligence officer within the full British intelligence structure, shown in Diagram IV as it functioned in 1939. The Foreign Office had a direct line to the CID, primarily because of empire, but also because of SIS and GC&CS. Of interest is that the IIC was direct in the intelligence flow, yet the JIC was indirect. The latter would transform enormously during the course of the Second World War to become the primary filter. Scientific intelligence was one of the Air Intelligence Sub-Sections within the Air

¹⁹² James Woolsey, ‘CIA Awards Medal to Top British Scientist’, *The Times*, 29 Oct. 1993, 15.

¹⁹³ Jones, ‘Scientific Intelligence’, 354.

¹⁹⁴ Jones, ‘Emotion, Science and the Bomber Offensive’, 907.

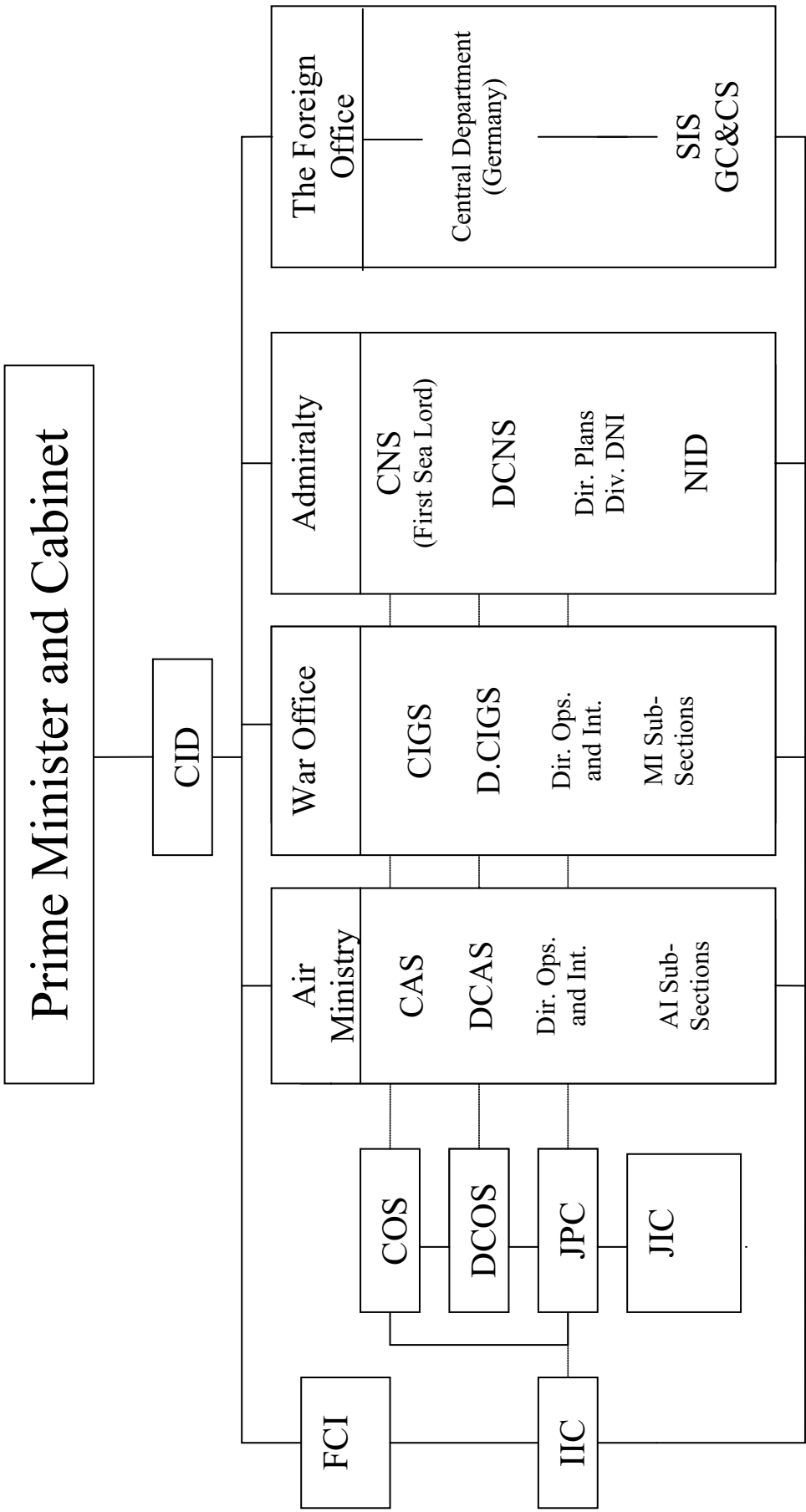


Diagram IV: The Organisation of British Intelligence in 1939.

Source: Wark, *The Ultimate Enemy*, p. 241.

Ministry. This consisted of Jones alone, under the command of Winterbotham, and attached to Air Signals Intelligence, designated AI1(e). Because of this (and because of initial evacuation of SIS from London) Jones was billeted at Bletchley during the 'secret weapon scare'. Here he became familiar with Commander Edward Travis, Alan Turing and other cryptographers, intelligence analysts, and Y-service operatives, and became very familiar with the operations at Station 'X'. This was a 'stroke of luck', according to Jones, which was to prove immensely beneficial to the successes of scientific intelligence during the Second World War.¹⁹⁵ Nevertheless, despite Jones's (and Tizard's among others) firm belief that scientific intelligence was vitally important to British defence, in the bigger picture, it was a tiny component of the British intelligence organisation, and still relatively insignificant. It would take unorthodox means using unorthodox channels to enable scientific intelligence to be effective during the Second World War.

Before the First World War, British intelligence organisation was still notably adolescent and tentative. This had much to do with the fact that it was 'run on a shoestring'—MI5 for example employed only seventeen staff.¹⁹⁶ And although British intelligence proved its worth during the First World War, it was stifled by retrenchment in the inter-war years. German rearmament and outward aggression made it glaringly obvious that expansion of British intelligence was imperative. Yet it was rapid technological progress that highlighted the

¹⁹⁵ Jones, *Most Secret War*, pp. 62–3.

¹⁹⁶ Andrew, *Defence of the Realm*, p. 29. It was emphasised after the First World War that 'the functions of MI5 were advisory', and that 'this fact governed its relations with all government Departments and the Services'. A consequence of this was that the British police force, acting on information obtained from MI5, 'were responsible for the conduct of cases against all enemy agents who were detected in espionage': TNA KV 4/1, 'The Security Service: Its Problems and Organisational Adjustments, 1908–1945', p. 40.

technical deficiencies of the intelligence gathering and analysis processes. Although there were incidences of secret agency providing SIS with intelligence of a technical nature (for example from Otto Krüger, a consultant engineer and longest-serving SIS agent, who provided valuable intelligence on German naval construction), scientific and technological research and development had advanced so rapidly that specialists were required not just to collect the data, but also to analyse and collate it.¹⁹⁷ Moreover, the IIC demonstrated that spying on industrialised societies required industrial espionage. Diplomatic and political intelligence had become inadequate by itself. Other, more expert, intelligence collation and assessment was required. Scientific intelligence was one of many components hastily incorporated into the British intelligence engine for effective functionality.

It was not just intelligence that required a scientific and technological boost. The service ministries and other government departments across the spectrum found themselves in desperate need of expert advice, and so in many ways the British government pragmatically became a technocratic government during the mid-twentieth century. In particular, technocrats led the Admiralty and the Air Ministry, and infiltrated scientists into their councils and committees, and science and technology into their establishments in a remarkable and unprecedented way. The Central Register ensured that other government ministries as well as public and private industry followed suit. RDF, as an integral element of the air defence of Great Britain, was born from

¹⁹⁷ Andrew, *Secret Service*, pp. 433–4; Andrew, *Defence of the Realm*, p. 245. See also TNA KV 4/1, ‘The Security Service: Its Problems and Organisational Adjustments, 1908–1945’, p. 75; Andrew, *Defence of the Realm*, pp. 181–4 for details of communist infiltration into the Woolwich Arsenal in 1937 with the primary intent to extract classified documentation on British defence technology.

such technocracy; scientific intelligence was born of RDF. Just as importantly, Jones was a 'product' of Tizard and Lindemann.

Jones's relationship with Tizard was just one example of how the Air Ministry became intertwined with intelligence as a consequence of technological progress and the exigencies of war. Secret agents required air travel, parachutes, radio equipment, firearms, ammunition, and other gadgetry, and much of this emanated from the RAF.¹⁹⁸ PR/PI was another example of the essential need to combine airpower and intelligence for the purposes of war.¹⁹⁹ Scientific intelligence was yet another refinement to the already proficient air component of British intelligence. It would, however, take Jones many months of clever networking inside and out of Whitehall to eventually secure a success worthy of establishing scientific intelligence as a permanent pursuit. This would be combined with more than one man's fair share of good fortune during a tumultuous world war. In November 1939 however, although he had created for himself a unique position within British intelligence, Jones was still very much a new boy in an old boy's network.

¹⁹⁸ See TNA AIR 40/2659, 'RAF Resources (made available to SIS), 1939–45' for co-ordination of SIS and RAF during the Second World War.

¹⁹⁹ For a brief but useful comparative survey of aerial photography during the Second World War, see Jeffrey T. Richelson, *A Century of Spies: Intelligence in the Twentieth Century* (Oxford: OUP, 1995), Chapter 10 entitled 'Aerial Spies', pp. 157–72.

Chapter II: The Battle of the Beams

British tenacity in the face of adversity emanating from Churchill's 'never surrender' policy is etched into the annals of British history. Myths surrounding the events are known respectively as the 'Battle of Britain' and the 'Blitz'.¹ There was much more to these two episodes of the Second World War than stubborn stoicism fuelled by defiant speeches. Some issues have been significantly underplayed by historians who preferred the grandeur of the more heroic broader picture. The role of scientists (and scientific intelligence) in defence of Britain is a prime example of how less heroic matters have been brushed aside to avoid complicating the finely-sculpted myths.

Considered analysis of secondary source on the Battle of the Beams within Second World War historiography proves this point. This was to be Jones's next, arguably most dramatic, adventure in his quest to establish scientific intelligence within the echelons of British state military machinery. Much more importantly, using various sources of intelligence, Jones scientifically assisted the defence of British people against the German bombers. Yet the episode has been allowed to be relegated to little more than a footnote in the connected myths of the Battle of Britain and the Blitz. Churchill's war memoirs

¹ Dunkirk could also be included, with the three historical events blending into a heroic story of the British nation standing alone in defiance against the Teutonic monster of Nazism. It is, or at least has been, too easy to slip between history and myth. See Malcolm Smith, *Britain and 1940: History, Myth and Popular Memory* (Abingdon: Routledge, 2000); Richard Overy, 'Glory to the Few', *BBC History Magazine*, 11: 8 (August 2010), 72. See also Amy Bell, 'Landscapes of Fear: Wartime London, 1939–1945', *Journal of British Studies*, 48: 1 (January 2009), 153–75.

emphasised the scientific intricacies involved, and the need for public consideration of the value of the scientists to be no less than the 'Few':

During the human struggle between the British and German Air Forces, between pilot and pilot, between AA batteries and aircraft, between ruthless bombing and the fortitude of the British people, another conflict was going on step-by-step, month by month. This was a secret war, whose battles were lost or won unknown to the public; and only with difficulty is it comprehended, even now, by those outside the small scientific circles concerned. No such warfare had ever been waged by mortal men. The terms in which it could be recorded or talked about were unintelligible to ordinary folk. Yet if we had not mastered its profound meaning and used its mysteries even while we saw them only in the glimpse, all the efforts, all the prowess of the fighting airmen, all the bravery and sacrifices of the people, would have been in vain.²

Churchill's account of the Battle of the Beams is highly praising of Jones and his work in countering the German bombing raids. This is of little surprise, for Jones assisted Churchill in drafting 'The Wizard War' chapter.³ Official historians followed suit.⁴ Two 1960s authors also dedicated a chapter each in their books to the Battle of the Beams.⁵ Both generated excellent accounts, but were variants of the same story as told to them by Jones, and neither can be counted as a critical assessment of the event. Moreover, as both were ULTRA silent, they excluded a fundamental aspect of the source intelligence

² Winston S. Churchill, *The Second World War, Volume II: Their Finest Hour* (London: The Reprint Society, 1951), p. 311.

³ Although it seems that Jones only sent Churchill copies of the relevant Air Scientific Intelligence Reports; see for example CCAC CHUR 4/398A/75, a covering note from Jones to Churchill detailing enclosure of SIR No.7. This note was written on Air Ministry headed paper and, as Jones left the Ministry in 1946, is further confirmation that Churchill started to compile the 'Wizard War' chapter in that year. See also CCAC CHUR 4/197B/262-70 for an annotated draft of the beams episode.

⁴ Collier, *The Defence of the United Kingdom*, pp. 157-8 & 262-73; Collier, *Hidden Weapons*, pp. 147-53; Hinsley *et al*, *British Intelligence in the Second World War, Volume I*, pp. 322-8 & 550-64.

⁵ Clark, *Rise of the Boffins* pp. 98-125; Price, *Instruments of Darkness*, pp. 19-54.

involved. Once the ULTRA ban was lifted in 1977, it was left to Jones himself to tell the story as accurately as memory would allow.

The mechanical and electronic specifics behind the GAF navigation and bombing beams are highly technical. All that is required here is brief operational explanation. The beam systems were known as 'Knickebein', 'X-Verfahren' (X-System), and 'Y-Verfahren' (Y-System), and relied respectively on standard Lorenz, 'X-Gerät' (X-Apparatus) and 'Y-Gerät' (Y-Apparatus).⁶ Each system directed 'beams' of radio waves from German (and German-occupied) territory so that one beam would point directly over a target, and bombers could therefore fly along the beam in the knowledge that if they then released their bombs at the correct point their targeting would be accurate. That bomb-release point was defined by other beams set to cross the director beam, or by range measurements along the beam from its point of origin. British countermeasures sent false signals to obliterate or, better still, appear to distort the beams or spoil the range measurements.⁷

Technically, *Y-Verfahren* was the first beams system Jones encountered, for it was this activity that had been discussed in the Oslo Report as being potentially researched at Rechlin. *X-Gerät* next came to his attention, and he discovered the *Knickebein* system just before the commencement of the

⁶ The word *Knickebein* literally meant variations of the same thing; 'cracked leg', 'crooked leg', 'broken leg', even 'dog leg': Jones, *Most Secret War*, p. 105. For *X/Y-Verfahren*, see P. E. Judkins, 'First Blood' in Keith Thrower (ed.), *Key Components for EW: the Lessons for Today, Proceedings of the Tenth Annual Symposium* (Shrivenham: Defense Electronics History Society, 2011), pp. 7–31.

⁷ Jones, *Reflections on Intelligence*, p. 28. Jones concluded this description of the German beams by stating that an account of the cut-and-thrust of the consequent 'Battle of the Beams' could be found in his earlier publication *Most Secret War*. These issues covered approximately one fifth of Jones's narrative in his war memoirs: Jones, *Most Secret War*, pp. 92–188.

Battle of Britain. But clearly, during the winter and spring of 1939–1940, he was unaware which was likely to come first, or indeed, whether there was any differentiation between the three systems. Jones's position in Air Intelligence meant that he knew more than most however, and he saw it as his task to predict the imminent possibilities of war, based on any source information he could muster. The 'chase' of the German use of radio-beams was to be his first practical method of fulfilling this task. The Battle of the Beams would secure a permanent place in British government machinery for the need of, and desire for, scientific intelligence.

Contrary to common belief, *Most Secret War* is not the definitive account on the beams episode that would be expected from memoirs of the man directly involved. There are three key reasons for this. Jones overlooked discussion of much of the source information that was available to him in 1940. For example, in the National Archives there are two large files of POW interrogation extracts relevant to the Battle of the Beams, specially selected for Jones by the Air Intelligence interrogation section AI1(k). Throughout the 100 or so pages Jones dedicated to the beams investigation in *Most Secret War*, he mentioned POW intelligence only six times, and then in little detail. While these six mentions were clearly the ones most significant to his story, neglect of the remainder underplays the importance of POW intelligence to his investigations. Jones also discounted much of the information from his SIRs, selecting only the items that favoured him in retrospect. Much more fundamentally, although Jones was keen to acknowledge some of those who assisted him, his account of the Battle of the Beams is inherently biased and

implies that Britain may well have lost the war without him. Because Jones's account has been entirely accepted by all twentieth century histories without exception, the Battle of the Beams requires re-assessment.

The official history of British intelligence follows Jones's account very closely. Therefore, while the dry non-characterised technically-driven account from Hinsley *et al* was true to state archival documentation, as per their brief, it also added authenticity to Jones's recollections. Moreover, the official history was researched from a greater depth of archival sources, including documentation Jones may not have had access to in 1978, or even seen in 1940.⁸ Yet even Hinsley *et al*, with all the relevant documentation available to them, still overlooked essential primary evidence relating to the Battle of the Beams. This chapter draws from untapped evidence to determine the accuracy of the received wisdom, and shows how all secondary accounts have contributed (some unforgivably inaccurately) to reducing the beams episode to a bit-part element of the great myths of 1940. Importantly, this chapter argues that the Battle of the Beams was bedrock for future scientific intelligence, and effectively made Jones famous.

The 'Chase'

Irrespective of war, by April 1940, life for Jones had taken on a most welcome homely transformation. Following a year-long engagement to Vera Cain (who Jones met while exiled at ARL), the couple married on 21 March 1940, and moved into a top-floor flat in the upmarket district of Richmond, overlooking

⁸ See for example Appendix 11 on 'GAF Navigational Aids', which is a detailed account of the whole beams episode; Hinsley *et al*, *British Intelligence in the Second World War, Volume I*, pp. 550–64.

Kew Gardens. From here, Jones would drive each day to his Broadway office seeking, or as he preferred 'chasing', intelligence of scientific nature.⁹ During the uncertain months of the so-called 'phoney war', however, Jones found he had little to do. This inactivity almost caused a negative effect to the war-work he had become so highly enthusiastic about. Scientific intelligence was almost abandoned, for there were 'few visible results to show', since all effort went into 'spadework with the SIS'. There was also a school of opinion mainly outside Air Ministry circles that 'there was no need for a scientist to work inside the intelligence organisation', and that all 'problems could be solved by quickening the flow of information between SIS and the research departments, which would do their own collation'. ADI (Science) later cited this as the primary obstacle to scientific intelligence expansion throughout the war, as well as the reason for Jones's December 1939 inter-service proposals to be rejected, which left the Air Ministry as the only government body officially adopting scientific intelligence for the first four years of the war.¹⁰

Jones was not idle during the phoney war. He made contacts, within both the official intelligence community, and more familiar scientific circles. Many would prove invaluable later in the war. In the meantime, although Jones was learning of atomic developments, RAF bomber and AA improvements, he felt he was not actually accomplishing anything tangible himself. He was on the fringes of the magnetic mine alarm, and tried to make the most of his scientific capabilities to improve wider knowledge of the enemy, such as arranging distribution and guidance for spectrosopes and spectrographs in observer

⁹ Jones, *Most Secret War*, p. 86.

¹⁰ CCAC RVJO B.83 & TNA AIR 40/1532, ADI (Science) official history 'Air Scientific Intelligence in War, 1939-45', 1 April 1946, pp. 3-4; AHB, 'Air Ministry Intelligence', pp. 286-7.

aircraft, in order to promote understanding of German searchlight capabilities.¹¹ These were however, all relatively minor details of little significance to the universality of the ever-growing war.

Jones's phoney war frustrations came to an abrupt halt in March 1940. Since the arrival of the Oslo Report, his scientific expertise had been drawn to investigate German radio capabilities. Alongside the prospect of invasion becoming ever more acute, came the probability of a bombing onslaught by the *Luftwaffe*—a softening-up process before the main event. The combination of German radio capabilities and German offence spawned Jones's first major quarry. Unbeknownst to him at that time, the chase of this quarry would cement his position in Air Intelligence for the duration of the war.

Hints of this new intelligence investigation came from a most unexpected source. To establish exactly what Germany had in store for Britain the Combined Services Detailed Interrogation Centre (CSDIC) undertook interrogation of POWs. From March 1940 CSDIC became an MI9 responsibility.¹² Of the CSDIC facilities often defined as 'cages', it was at Trent Park, near Barnet, Hertfordshire (also known as 'Cockfoster's Camp'), that captured *Luftwaffe* pilots were interrogated.¹³ These were POWs of key

¹¹ Jones, *Most Secret War*, pp. 79–84.

¹² Hinsley *et al*, *British Intelligence in the Second World War, Volume I*, p. 90. In December 1941 the division of MI9 responsible for enemy POWs was hived off as a new section designated MI19, and under the command of Captain A.R. Rawlinson: TNA WO 208/4970, 'The Story of MI19', p. 6; M. R. D. Foot and J. M. Langley, *MI9: The British Secret Service that fostered escape and evasion, 1939–1945 and its American counterpart* (London: The Bodley Head, 1979), p. 35; Stephen Twigge, Edward Hampshire & Graham Macklin, *British Intelligence, secrets, spies and sources* (London: National Archives, 2008), pp. 117–8.

¹³ See TNA WO 208/3513, various memoranda regarding interrogation of Prisoners of War produced during November and December 1940; TNA WO 208/4970, 'The Story of MI19', Appendix E. Trent

interest to Air Intelligence, and the data they provided was gleaned, collected, and disseminated to relevant operational departments by AI1(k). It has been estimated that some forty copies of each AI1(k) report were distributed across respective service intelligence organisations during the Battle of Britain. In essence, AI1(k) was the RAF interrogation sub-section of the British Intelligence Directorate.¹⁴ It was from AI1(k) that knowledge of German use of radio beams first came to light.

Attempts had been made by British intelligence authorities during the final stages of the First World War to harness the intelligence potential of enemy captives. By 1939, however, there was little previous established model or method upon which to base a new POW interrogation organisation.¹⁵ Not surprisingly, given the nature of early twentieth century air warfare, no mechanism for POW interrogation existed at the Air Ministry before 1939. Pre-war expectations were that the Army would have the largest influx of POWs, and so the Army was allocated responsibility for co-ordinating POW matters. Because the war quickly followed a different pattern to that envisaged, the RAF became inundated with POWs while the Army, apart from a small spate at the time of Dunkirk, had few POWs to interrogate in Britain until 1943.¹⁶

Park housed German Generals later in the war, where they were given the relative comfort of 'freedom' of the house and grounds.

¹⁴ Sebastian Cox, 'A Comparative Analysis of RAF and *Luftwaffe* Intelligence in the Battle of Britain', *Intelligence and National Security*, 5: 2 (April 1990), 427. Both Jones and Hinsley *et al* were unclear in all their respective publications about how AI1(k) integrated with the whole intelligence structure.

¹⁵ Kent Fedorowich, 'Axis Prisoners of War as Sources for British Military Intelligence, 1939–42', *Intelligence and National Security*, 14: 2 (Summer 1999), 157.

¹⁶ TNA AIR 2/4591, 'The History of ADI(k)', dated 24 March 1944, p. 1.

Irrespective of these pre-war expectations however, by September 1939 the small CSDIC nucleus (one Royal Navy officer, three Army officers, and two RAF officers) had been created within the Tower of London.¹⁷ With the rapid influx of POWs CSDIC naturally expanded, so that in October 1939, RAF interrogators became AI1(k), while army and naval interrogators were re-designated MI1(k) and NID11 respectively. Key requirements for effective AI1(k) interrogators were a good understanding of up-to-date flying processes, and excellent German (although preferably imperfect, otherwise POWs would be uncomfortably suspicious). Interrogation skills were minimal in the early months of the war due to lack of practical experience. For many in AI1(k), therefore, an ability of improvisation and swift adaptive learning were also essential requirements.¹⁸ Jones told of how the chief interrogator of AI1(k), the then Squadron Leader (Sq/Ldr) Denys Felkin, was still learning to develop his technique when they first met, and that he went on to become a brilliant interrogator.¹⁹

It was Felkin who confirmed Jones's belief that radar and radio aids would indeed be the first German threat to alert his scientific curiosities. In the early months of 1940, Felkin was involved in an interrogation process whereby certain *Luftwaffe* POWs would be individually bunked with other selected POWs in 'M' ('Miked') Rooms in which microphones were hidden so that

¹⁷ TNA WO 208/4970, 'The Story of MI19', p. 1.

¹⁸ TNA AIR 40/1177, 'Intelligence from Interrogation', pp. 1–7.

¹⁹ Jones, *Most Secret War*, p. 61. Jones witnessed first-hand Felkin's early inexperienced interrogating on a POW numbered A.4; the low number clearly emphasising how few subjects the interrogators had to practice on in the first few months of the war. Felkin was a Flying Officer at outbreak of war: see TNA AIR 40/1177, 'Intelligence from Interrogation', p. 2.

interrogators could listen in to POW conversations.²⁰ As soon as important data was overheard by listening German and Austrian exiles, a gramophone was started.²¹ The listening instrumentation was initially installed by the commercial enterprise Radio Corporation of America (RCA), and documentation exists detailing their involvement in the setting up of the 'Cockfoster's Camp'.²² For security reasons, however, 'bugging' was later maintained by The Post Office Research Station at Dollis Hill.²³ The 'M' Rooms inevitably led to the logical implementation of 'stool pigeons'.²⁴ German and Austrian refugees were employed in this role, supplemented later in the war with deserters and 'turned' POWs. This process of obtaining intelligence always remained 'questionable'. The key benefit was that interrogators could manipulate interrogations to prompt later conversation, with the potential of better value information than from direct interrogation.²⁵

Standard interrogation of *Luftwaffe* POWs in February 1940 had produced intelligence on a new and secret German apparatus called 'X-Gerät, supposedly for detecting aircraft by electrical or wireless process 'based on a British invention'. The subsequent Air Ministry Weekly Summary divulged X-

²⁰ TNA WO 208/4970, 'The Story of MI19', Appendix E entitled 'The "M" Room'.

²¹ Sönke Neitzel, *Tapping Hitler's Generals: Transcripts of Secret Conversations, 1942–45* (Barnsley: Frontline Books, 2007), pp. 20–1. Each record lasted seven minutes. See also Sönke Neitzel and Harald Welzer, *Soldaten: On Fighting, Killing and Dying* (London: Simon & Schuster, 2012).

²² TNA WO 208/3457, RCA Photophone Limited to Major Kendrick, dated 14 February 1940.

²³ TNA WO 208/4970, 'The Story of MI19', p. 2. The Post Office Research Station was the same establishment, incidentally, where 'Tommy' Flowers designed and built the Colossus machinery which was so essential to later GC&CS developments.

²⁴ These surreptitious intelligence practices have only recently been researched in detail even though they were made famous in the 1950s by the escapades of Franz von Werra as *The One That Got Away*: see Kendal Burt & James Leasor, *The One That Got Away* (London: Collins, 1956), 'Chapter V: Walls have Ears', pp. 60–9; *The One That Got Away*, produced by Earl St. John in 1957 for ITV Productions; See also Sophie Jackson, *British Interrogation Techniques in the Second World War* (Stroud: The History Press, 2012), pp. 91–106.

²⁵ TNA AIR 40/1177, 'Intelligence from Interrogation', pp. 11–12.

Gerät and elaborated with mention of ‘wooden towers’.²⁶ On 21 February 1940, Felkin prompted an *obergefreiter* (POW number A.35) about *X-Gerät*. The POW said (or did) nothing. Upon returning to his ‘M’ room, A.35 spoke to prisoner A.29, an *unteroffizier*, and said, ‘he came in again this morning about *X-Gerät*; three months ago he heard something about it – a report came from France’. A.29 replied, ‘did you tell him that you knew something about it?’ ‘No’ answered A.35, ‘I naturally did not let him notice that I had heard about it.’²⁷

After further interrogation A.29 was put into another bugged room with A.34, an *unteroffizier* pilot. A.29 was overheard saying, ‘that *Bombenblindwurf* business’ and warned A.34 ‘don’t say anything about that’. Later that same day, A.29 was overheard being asked ‘what is *X-Gerät*?’ by *Funkmaat* N.125, to which A.29 replied, ‘it has something to do with dropping bombs on an invisible target’.²⁸ Each of these POW statements was extracted from general conversation. On 23 February 1940, *X-Gerät* was prompted again in interrogation. A.34 was then placed with A.30, a *Feldwebel* and pilot. The interrogators now had limited knowledge—that *X-Gerät* was a method to aid bombing, possibly in the dark. In further interrogation they had to be careful not to divulge how they knew, and almost always devised clever cover stories to explain their new-found knowledge.

²⁶ TNA WO 208/3507, AI1(k) summary report ‘*X-Gerät*’, 3 June 1940, p. 1. The extraordinary secrecy of *X-Gerät* was such that one POW stated ‘you get your head chopped off even if you discuss it amongst the *Staffel*’.

²⁷ TNA WO 208/3506, Extracts from interrogation reports on ‘*X Gerat*’ and ‘*Knickebein*’, Extract 1 dated 21 February 1940.

²⁸ TNA WO 208/3506, Extracts from interrogation reports on ‘*X Gerat*’ and ‘*Knickebein*’, Extracts 2 & 3, both dated 21 February 1940. The number N.125 designated a naval POW, and the high number shows how many more *Kriegsmarine* POWs were available in the early months of the war compared to *Luftwaffe* POWs.

The interrogators informed A.34 that a German aircraft shot down in France had the secret *X-Gerät* on board. Had this been the case, TRE technicians would have quickly deduced its purpose. The interrogators were therefore attempting to ascertain whether or not there was any radio apparatus in *Luftwaffe* aircraft, and whether or not it had anything to do with *X-Gerät*.²⁹ Later that day, A.34 was overheard stating to A.35 that the interrogators seemed 'to be bothering their heads a lot about the *X-Gerät*'. Also that day A.35, A.30 and A.29 were accommodated together. They were heard discussing *X-Gerät* but evidently knew little about it, although A.29 knew more than the others for he dealt with 'new things'.³⁰ Felkin believed he had enough material to write a report and circulate it through Air Intelligence to see whether there was any departmental interest. This speaks volumes about the rudimentary nature of early war intelligence, and confirms that Jones's position as scientific intelligence was not adequately understood. Jones was, nonetheless, in the limited group to whom the report was circulated and, being instantly interested, he telephoned Felkin accordingly. They arranged to meet at 'The Bath' club on 28 February 1940, whereupon Jones informed Felkin of his ideas of what he thought *X-Gerät* might be.³¹

In his memoirs Jones did not go into any detail of his discussion with Felkin that day. But Felkin produced a typescript copy of their meeting. He wrote that Jones said of *X-Gerät* that 'from the evidence this could only be a radio apparatus, probably an electric echo sounder', and that in this field the British

²⁹ TNA WO 208/3506, Extracts from interrogation reports on 'X Gerat' and 'Knickebein', Extract 4 dated 23 February 1940.

³⁰ TNA WO 208/3506, Extracts from interrogation reports on 'X Gerat' and 'Knickebein', Extract 5 dated 23 February 1940.

³¹ Jones, *Most Secret War*, p. 84.

were 'probably as ahead in this branch as the Germans'. Jones informed Felkin that there 'was also evidence from the two cross-beams mentioned of a second apparatus', probably of the 'nature of a super-sensitive' direction-finder, which 'might probably release bombs when an aeroplane flying along a certain beam crossed another beam'. Jones 'thought this might conceivably be done for Paris, but not for London', and that the British might 'have tried to intercept some rays which are believed in the nature of more reliable D/F unaffected by the returned ones from the heavy side layer'. Tests had shown however, that such rays could 'not reach as far as England', and could not be intercepted. Jones suggested that 'as it must be some radio instrument', interrogators should say to A.29 that they knew 'all about it', and that the British could 'jam it'.³²

This document is informative. The use of the term 'electric echo sounder' is interesting, for clearly Jones's first instinct upon reading the interrogation extracts was that the *Luftwaffe* were employing some kind of airborne radar. Had that been the case, the British were indeed 'as ahead' as the Germans, as Jones well knew from his contacts at Bawdsey. The mention of two cross-beams is particularly fascinating. There is no mention of this POW cross-beam conversation in the archival documentation – the only mention of cross-beams in the POW extracts comes much later in 1940. This is not to suggest it did not happen, but rather that the evidence has not survived. Jones certainly did not believe at this time that radio beams transmitted from Germany could reach England, and so deduced that it had to be a bombing

³² TNA WO 208/3506, typescript entitled 'Interview with Dr. Jones' dated 28 February 1940. The ionosphere known as 'Heaviside Layer' was discovered in 1924 by Appleton, by using radio pulses to measure the echo's time of travel.

system to target Paris. This is also excellent evidence of the surreptitious method of prompting future bugged conversations, with Jones recommending that POWs be informed of prepared countermeasures. It is interesting also how Jones selected A.29 for this purpose, evidently noticing from the extract that A.29 was the most technically knowledgeable prisoner. This is the first prime example of scientific intelligence liaison with less scientifically-informed intelligence-gathering organisations. It set an important precedent.

Jones claimed in his memoirs that the POWs appeared confused between two systems: one used a radio altimeter that scanned the ground below, and gave positions of reflecting obstacles with sufficient accuracy for bombing; the other intersected radio beams transmitted from Germany, whereby characteristic signals of two stations combined to give signals that might even operate bomb release gear. It is much more likely however, that from the limited information available to him, it was Jones who was confused. Jones wrote in his memoirs that at the time he thought he ought to draw attention to the problem and so, on 4 March 1940, reported that *X-Gerät* was a bombing apparatus involving an application of pulse radio technique.³³ However, no report, memo or minute dated 4 March 1940 exists in the archives. There is instead a one-page document dated 14 March 1940 entitled 'Night Detection of Aircraft' in which Jones wrote that there was 'a strong case for believing' Germany had 'at least experimented on a large scale with a pulse radio detector of ground targets from aircraft and may be fitting equipment to Ju88s'. Jones added that it was 'well to bear this in mind as possibly providing

³³ Jones, *Most Secret War*, p. 85.

the means for an ideal method of detecting raiders using such equipment'. The *Luftwaffe* 'would employ it on occasions when they could not see, and therefore could not be seen themselves', and if such conditions were combatted, the 'recognition problem would incidentally be solved'.³⁴

Jones meticulously preserved all his wartime reports, so it is hard to believe that the 4 March report was lost. In a later SIR, Jones discussed the 4 March report stating that the 'analysis was perhaps carried beyond the reliability of the evidence', no doubt a statement to exonerate his earlier confusion over the beams.³⁵ This mention of the report does nonetheless confirm its contemporary existence, and clearly Jones, when writing his memoirs, copied the 4 March report extract from this SIR.³⁶ The 14 March report certainly demonstrates how muddled Jones's thinking was over the possibilities. That he mentioned 'fitting equipment to Ju88s' further shows how much the Oslo Report was affecting his deductions. Moreover, how Jones contemplated British location of German bombers using the same electronic equipment is not explained. Perhaps the slight scientific confusion shown by Jones in this report is the reason why he chose not to mention it in his memoirs. Whether muddled or not, it is a fair assumption that as the evidence had come from POWs, Jones was not entirely convinced of its accuracy. He discussed the idea with a friend who was working on ASV at Bawdsey. Gerald Touch

³⁴ CCAC RVJO B.4, one-page typescript entitled 'Night Detection of Aircraft', 14 March 1940, written by R.V. Jones in collaboration with Winterbotham as AI1(c).

³⁵ CCAC RVJO B.7 & TNA AIR 20/1623, Air Scientific Intelligence Report No.6 entitled 'The Crooked Leg', 28 June 1940, p. 1.

³⁶ CCAC RVJO B.7 & TNA AIR 20/1623, Air Scientific Intelligence Report No.6 entitled 'The Crooked Leg', 28 June 1940, p. 2; Jones, *Most Secret War*, p. 85. One source held that the 4 March report was written by another author, and thereafter handed to Jones. Without definite evidence it would be wrong to over-doubt Jones's recollection in this matter: Johnson's *The Secret War*, p. 12.

clarified Jones's thinking on the physics involved in the problem, and consequentially Jones was able to rule out the possibility of *X-Gerät* being an airborne radar device.³⁷ He was therefore left with the only plausible explanation of the intersecting beams.

A lunch-time discussion with Woodward-Nutt on the matter further clarified this possibility. He informed Jones of a French rumour concerning German radar stations on the Franco-German frontier, and that RAE technicians had deduced that radio transmissions could indeed be concentrated into narrow beams.³⁸ Jones later informed Clark that the idea of the beams first crossed his mind after this casual conversation with Woodward-Nutt.³⁹ In *Most Secret War* however, Jones claimed that it served only as further encouragement.⁴⁰ Whether this was the defining moment or not, it is certain confirmation of how, during March and April 1940, Jones was formulating the beam-bombing theory. Appropriately, it was Felkin who provided the clinching evidence of *Luftwaffe* beam activity. This time, it was not from POWs, but from a scrap of paper found in a downed He111.⁴¹ It was a note – an *aide mémoire* for the navigator according to one source – which translated read:

³⁷ In file CCAC RVJO B.145, there is a lengthy letter from Touch to Jones, dated 1 April 1940. This was a reply to two letters Jones had written to Touch. Amongst many other fascinating matters, Touch discussed possible ASV application to bomb-sighting. Touch also mentioned the plausibility of beamed radio waves being used in relation to surprise bombing, although only relative to ASV. This letter shows how Jones was very mindful at this time of all RDF possibilities in attempting to understand *X-Gerät*, and how much he turned to his well-placed friends for help and advice.

³⁸ Jones, *Most Secret War*, p. 86.

³⁹ Clark, *Rise of the Boffins*, p. 104. For the early-1960s correspondence written between Jones and Clark, see CCAC RVJO B.354–B.363.

⁴⁰ Jones, *Most Secret War*, p. 86.

⁴¹ No source whatsoever has a date for this aircraft being shot down, nor a date for Felkin providing the intelligence to Jones. According to Brian Johnson's television programme *The Secret War*, the He111 was shot down by an RAF nightfighter directed to its target by ground radar: see CCAC RVJO K.475, Transcript for 'The Battle of the Beams', p. 6; Johnson, *The Secret War*, p. 11.

Navigational Aid: Radio beacons working on Plan A.

Additionally from 06:00 hours Beacon Dühren. Light beacon after dark.

Radio Beacon *Knickebein* from 06:00 hours on 315°. ⁴²

This was the first mention of *Knickebein*. Jones knew that radio beacons had become standard aids for aircraft navigation. ⁴³ If bombers were to attack England, from Germany, beacon bearings would lie to the east – say between 45° and 135° round from north. If *Knickebein* was situated at 315°, it would be ahead of the outward aircraft. It therefore looked to Jones that *Knickebein* had to be a beamed beacon, which on the day the He111 crashed, was set to transmit in a north-westerly direction. ⁴⁴ This was an important scientific deduction, for generally British intelligence was confused by such technicalities. Trevor-Roper, whose job was to seek spies in the ether for RSS, recalled ‘hunting a quarry that did not exist’, for German bombers were not led forward to their targets by head-beacons in England established by German spy activity, but were ‘directed from behind by tail-beacons in Germany’. ⁴⁵

⁴² Johnson, *The Secret War*, p. 11; Millar, *The Bruneval Raid*, p. 67.

⁴³ Navigational radio beacons were originally created as wireless fog beacons to guide shipping to port, with transmitting beacons situated on the shore for receiving equipment in ships to home toward. It was a logical step to place beacons on airfields and fit receivers in aircraft: see E. C. Shankland, ‘Marconi’s Wireless Pilot’, *Nature*, 134: 3384 (8 September 1934), 387–8.

⁴⁴ Jones, *Most Secret War*, p. 85.

⁴⁵ Hugh Trevor-Roper, Lord Dacre of Glanton, ‘Sideways into S.I.S.’, in Hayden B. Peake and Samuel Halpern (eds.), *In the Name of Intelligence: Essays in Honor of Walter Pforzheimer* (Washington DC: NIBC Press, 1994), p. 253. It is notable that also at this time, ‘certain senior figures’ within the British intelligence community were permitting ‘an astrologer to submit appreciations’ on Hitler’s ‘strategic mind-set’: Ewan Montagu, *Beyond Top Secret U* (Newton Abbot: Readers Union, 1978), p. 29; P. R. J. Winter, ‘Libra Rising: Hitler, Astrology and British Intelligence, 1940–43’, *Intelligence and National Security*, 21: 3 (June 2006), 407.

Little further information on *X-Gerät* was immediately forthcoming from the POWs. AI1(k) were clearly trying, for there are three further extracts from bugged conversations entered in the archived reports; one of little consequence on 28 March; one on 17 April, in which A.52 claimed that *X-Gerät* was 'FUGE10' (codename for the standard cockpit radio receiver); and on 24 April, when A.47 pleaded astonishment at being asked about *X-Gerät*.⁴⁶ Then, on or after 27 April 1940, another He111 crashed in England. Coincidentally, it was the replacement machine for the aircraft downed in March, deduced by both aircraft having the same call sign of 1H+AC of *Kampfe Geschwader* (KG) 26. It was likely, therefore, that this aircraft was also navigating using *Knickebein* beacons, and a thorough search of the aircraft revealed a diary, with the entry: '5.3.40: Two thirds of the *Staffel* on leave. In afternoon studied about *Knickebein*, collapsible boats, etc'.⁴⁷

Jones neglected to mention this important piece of evidence in *Most Secret War*. This second piece of intelligence obtained from KG26 was, however, definite 'compromising literature'.⁴⁸ It must have confirmed to Jones that *Knickebein* rather than *X-Gerät* was operational, if indeed there was a

⁴⁶ TNA WO 208/3506, Extracts from interrogation reports on 'X Gerat' and 'Knickebein', Extracts 10, 11 and 12. The sharp increase to the designated prisoner numbers, demonstrates the intense influx of downed *Luftwaffe* personnel during the months of the phoney war.

⁴⁷ CCAC RVJO B.7 & TNA AIR 20/1623, Air Scientific Intelligence Report No.6 entitled 'The Crooked Leg', 28 June 1940, p. 1. There has been much discrepancy amongst secondary sources over the date this intelligence came to light. The final diary entry was 27 April 1940. Jones's SIR correctly acknowledged that the diary dated the loss of the aircraft as after this date. The official historians vaguely stated (after Alfred Price) that the second aircraft crashed two months after the first: Price, *Instruments of Darkness*, p. 25; Hinsley *et al*, *British Intelligence in the Second World War, Volume I*, p. 552. The official line led Collier to write that the second aircraft crashed in May 1940: Collier, *Hidden Weapons*, p. 148. Johnson used the phrase 'soon after', while the accompanying television programme stated that the second aircraft crashed 'a few nights later'; CCAC RVJO K.475, Transcript for 'The Battle of the Beams', p. 6; Johnson, *The Secret War*, p. 11.

⁴⁸ CCAC RVJO K.475, Transcript for 'The Battle of the Beams', p. 6; Johnson, *The Secret War*, p. 11.

difference between them. Clearly KG26 were primed to use *Knickebein* for future operations, probably against mainland Britain. The smaller islands of the United Kingdom had come under attack as early as 17 October 1939, but the first German bomb to fall in Britain since 1918 landed in Canterbury on 9 May 1940.⁴⁹ From a scientific intelligence perspective therefore, it was certainly fortunate for the British that the two He111s of KG26 had crashed on British soil (rather than in the sea), and remained adequately salvageable. These 'fortunate' incidences certainly inspired Jones to chase *Knickebein*.

Felkin once again raised Jones's awareness of the German diary entry, whereupon Jones immediately asked Felkin to question POWs on *Knickebein*, rather than *X-Gerät*.⁵⁰ On 30 April A.57 and A.5 (both *Leutnants*) were overheard discussing *Knickebein* in their room. A.57 informed A.5 of his interrogation experience, during which he was asked whether *Knickebein* transmitted on 315°, to which he had feigned confusion. A.57 whispered to A.5 that *Knickebein* was 'something like *X-Gerät*', but would not 'tell any more', except 'that a beam is sent on the short wave' and 'always become broader' but 'no broader' than 1km 'even as far as London'.⁵¹ Jones wrote in SIR No.6 that Felkin 'questioned a prisoner, who hedged', and that Felkin subsequently obtained the information.⁵² This rarely cited evidence confirmed that *Knickebein* was like *X-Gerät*, and this was crucial to Jones's final deduction that *Knickebein* was definitely a cross-beam bombing system.

⁴⁹ Ministry of Information, *Frontline 1940–41: The Official Story of the Civil Defence of Britain* (London: HMSO, 1942).

⁵⁰ Felkin must have initially telephoned the information to Jones, for the report of the diary intelligence was dated 24 May 1940, almost a month after the find of the diary.

⁵¹ TNA WO 208/3506, 'Extracts from interrogation reports on 'X Gerat' and 'Knickebein'', Extract 13.

⁵² CCAC RVJO B.7 & TNA AIR 20/1623, Air Scientific Intelligence Report No.6 entitled 'The Crooked Leg', 28 June 1940, p. 1; Jones, *Most Secret War*, pp. 85–6; Johnson, *The Secret War*, p. 12.

Knickebein

At dawn on 10 May, Hitler's armies stormed across the frontiers of neutral Holland, Belgium and Luxembourg.⁵³ A few hours later, Churchill became Prime Minister; immediately positioning himself as Minister of Defence with undefined powers, thereby assuming the general direction of the war.⁵⁴ Three days later he announced his Coalition Government. It was the continental military crisis, however, rather than the Whitehall upheaval, that put British intelligence organisations into a state of agitation. Within less than a week the Dutch had surrendered, and German Panzer divisions were sweeping through France, severing many heavily-relied-upon intelligence sources. This created near-hysteria in Britain over Fifth Column operations on British soil preparing for an imminent German invasion.⁵⁵

At the time, and still more in retrospect, Jones believed Fifth Column activity in Britain to be entirely imaginary.⁵⁶ He nonetheless became involved in the fracas surrounding the scare, and during his investigations discovered an unusual transmission emanating, approximately eight miles away, from an RDF station. He therefore wrote an SIR based on his findings and requested a D/F van be sent to investigate. Jones later produced an elaborate version of these events in his memoirs.⁵⁷ He also commented on the alarm in SIS owing to the change of government, which resulted in a request for him to update his

⁵³ Max Hastings, *Finest Years: Churchill as Warlord 1940–45* (London: HarperPress, 2009), p. 5.

⁵⁴ Churchill, *Their Finest Hour*, p. 29.

⁵⁵ For more detailed information on suspected Fifth Column activity, see Hinsley and Simkins, *British Intelligence in the Second World War, Volume IV*, pp. 40–65, 282, & 315; Stafford, *Churchill and Secret Service*, pp. 204–20; Grant, 'The Role of MI5 in the Internment of British Fascists during the Second World War'; Paul Addison and Jeremy A. Crang (eds.), *Listening to Britain: Home Intelligence Reports on Britain's Finest Hour – May to September 1940* (London: The Bodley Head, 2010).

⁵⁶ Jones, *Most Secret War*, p. 114.

⁵⁷ CCAC RVJO B.8, memorandum regarding visit to Bircham Newton and RDF station at West Beckham, entitled 'MI9', dated 5 July 1940; Jones, *Most Secret War*, pp. 114–19.

secret weapon report of November 1939 for Churchill's attention.⁵⁸ Jones believed that such an indiscriminating catalogue, however much it might have protected SIS, would have been of little value to Churchill, and was, in effect, a 'play safe' mechanism placing the intelligence recipient more at risk than the provider.⁵⁹ Such was the reason for SIR No.5 entitled 'Indications of new German weapons to be used against England'.⁶⁰

Jones reported that the mine campaign had been won due to British ingenuity and also perhaps to a shortage of mines. He reassured readers that the use of *Wehrmacht* 'death rays' in Belgium was propaganda, and that there was nothing further to report on German use of gas or bacterial warfare. He rejected rumours of possible flame and incendiary weapons, for no intelligence existed of their successful development, although he alerted readers to the use of incendiary bombs in glass containers dropped by aircraft 'around Scapa'. He wrote that the use of 1800kg bombs was 'absolutely confirmed', that 5000kg bombs 'may be built', and that gliding bombs were still being experimented with in Germany. To corroborate this intelligence, Jones spoke of a 'good source' – the same source, who in May had given 'warning of intense preparations for air attacks on England' in which powerful aerial torpedoes with double fuses were to be used.⁶¹ This may well have been discreet reference to early (but limited) ULTRA successes blended with Oslo

⁵⁸ Jones, *Most Secret War*, p. 88.

⁵⁹ R.V. Jones, 'Intelligence and Command', *Intelligence and National Security*, 3: 3 (July 1988), 291.

⁶⁰ CCAC RVJO B.6 & TNA AIR 20/1622, Air Ministry Scientific Intelligence Report No.5 'Indications of new weapons to be used against England', 23 May 1940.

⁶¹ CCAC RVJO B.6 & TNA AIR 20/1622, Air Ministry Scientific Intelligence Report No.5 'Indications of new weapons to be used against England', 23 May 1940, pp. 1–3. Even though it was 'beyond the scope' of this SIR, Jones also commented upon the feasibility and wisdom of an attempted invasion of Britain by Germany. He believed that there was 'perhaps something in the view that actual invasion' was 'not imminent', but that 'after a swift and heavy attack from the air', and 'using all the weapons at his command', Hitler would 'then offer seductively moderate terms'.

Report data. It is certainly the first hint of varied intelligence sources filtering into Jones's scientific appraisals, used to provide convincing deductions from evidence received. This was the first example of true scientific intelligence.

SIR No.5 also referred to RDF and *X-Gerät*. Jones reported that POWs had confirmed vague indications of some form of German RDF, and concluded that it was reasonable to presume German knowledge of the British system. Jones posited that Germany might try to defeat British RDF in three ways: overload it by flying in large numbers of small formations; night attack, and/or in 10/10 cloud; or intentional jamming. He also warned of the possibility of German ASV, and felt sufficiently confident (due to all the evidence obtained) to announce *Knickebein*. Interestingly, he was still at this stage referring to it as *X-Gerät* (subtitled the SIR sub-section as such). He was evidently still unsure whether the two systems were one and the same, or different. Nonetheless, he reported that it was possible that the Germans had 'developed a system of intersecting radio beams' to 'locate a target such as London sufficiently accurately for indiscriminate bombing'. There was 'no information available regarding the wavelength to be employed, but the expected location accuracy was 'something like ½ mile over London from the western frontier of Germany', and efforts 'were still being made to determine' probable wavelengths for countermeasure purposes.⁶²

⁶² CCAC RVJO B.6 & TNA AIR 20/1622, Air Ministry Scientific Intelligence Report No.5 'Indications of new weapons to be used against England', 23 May 1940, p. 5; Jones, *Most Secret War*, p. 89. Jones later explained that his secretary typed 'metre' instead of 'mile', but that even this did not create undue interest: CCAC RVJO K.475, Transcript for 'The Battle of the Beams', p. 7.

This report had no direct effect. *Knickebein* (or *X-Gerät*) was there for all to see, but to Jones's amazement there was a lack of interest. He was fully aware that the fragments of evidence were insubstantial, yet firmly believed the beams existed and posed a significant threat to British citizens. Jones needed to acquire more evidence in order to unravel the mystery further.

On 11 June 1940 Jones received two telephone calls which had significant effect on the beams investigation, and consequently altered the course of his life. One call was from Gr/Cpt Lyster Fettiplace Blandy, Chief of RAF Y-Service, and the other was from Lindemann. As arranged, Jones visited Blandy (also in 54 Broadway), who showed Jones a scrap of paper, asking if it meant anything to him. It read: '*Knickebein Kleve, ist auf punkt 53 grad 24 minuten nord und ein grad west eingerichtet*' (Cleves *Knickebein* is confirmed (or established) at position 53° 24' north and 1° west).⁶³ Jones knew immediately that it was an Enigma decrypt, and informed Blandy that it did indeed link to his work. Jones deduced that the message referred to a *Knickebein* beacon in Cleves, on the western border of Germany, and that the geographical position of the map reference given had to be in England. Jones believed this to be confirmation of a radio beam, transmitted from Cleves and intersecting at the grid reference given.

This message was the first time ULTRA would affect scientific intelligence.⁶⁴ Jones later wrote (for Churchill's benefit) that it was the 'critical evidence in

⁶³ CCAC RVJO B.7 and TNA AIR 20/1623, Air Ministry Scientific Intelligence Report No.6, 'The Crooked Leg', p. 3; Jones, *Most Secret War*, p. 89; Clark, *Rise of the Boffins*, p. 105.

⁶⁴ Lewin, *Ultra Goes to War*, pp. 64 & 365.

the story' of *Knickebein*.⁶⁵ Once initial scepticism had dissipated, ULTRA was deemed impeccable, unadulterated intelligence, primarily because Germany had no knowledge that their Enigma codes were being broken, and that their signals traffic was compromised. To ensure its security therefore, ULTRA had an extremely limited and highly select audience. For this reason Jones could not discuss it in any scientific intelligence reports, although he frequently referenced clandestine and unmentionable sources. In SIR No.6 Jones sub-headed his explanation of how ULTRA assisted his deductions of the German use of beams with the title 'The Contribution of Secret Intelligence', and created a cover-story to protect the source. He wrote that intelligence had been difficult to garner 'owing to the rate of German consumption of neutrals rendering it inadvisable to circulate questionnaires', but on 9 June Britain's 'best source reported that he had seen', on 5 June 'the flimsy of the following message kept by the Chief Signals Officer of *Flieger Korps IV*'.⁶⁶

This 'flimsy' was the *Knickebein Kleve* decrypt, initially sent by the Chief Signals Officer of *Flieger Korps IV* on 5 June, and decoded four days later.⁶⁷

Jones realised that he required more data on *Flieger Korps IV*, and investigated the order of battle information collated by AI3(b). He then used the opportunity to mask the flimsy further by stating that the same source had

⁶⁵ CCAC CHUR 4/197B/300–2, Churchill's dictated draft of the 'Wizard War' chapter, circa 1946–8. Jones still had to suggest to the draftees that it was simply a non-descript message.

⁶⁶ CCAC RVJO B.7 and TNA AIR 20/1623, Air Ministry Scientific Intelligence Report No.6, 'The Crooked Leg', p. 3; Jones's use of the word 'flimsy' here is interesting (not to mention contemporaneously imprudent), for it was used by GC&CS operatives and recipients of ULTRA to describe translations of one or more decrypts: see Christopher Andrew, 'Churchill and Intelligence', *Intelligence and National Security*, 3: 3 (July 1988), 188.

⁶⁷ Jones, *Most Secret War*, pp. 93–4. This Enigma decrypt caused consternation after it had been decoded, for co-ordinates pointed to Retford, a small town south of Doncaster. An Air Staff unit, headed by Plans Directorate Officer Gr/Cpt D. L. Blackford, was rushed to Retford on the theory that *Knickebein* was Fifth Column activity. They found nothing suspicious, but this activity certainly emphasises the understandable state of alarm the British experienced in the summer of 1940.

been further approached on the subject, whereupon 'he stated that the bombing force consisted of KGs 4 and 27', equipped with He111s, (although some re-equipment was taking place), based 'at Krefeld and Kirchellen, with an advanced base at Doullens'.⁶⁸ Jones concluded his discussion of 'Secret Intelligence' by confirming that its contribution 'may be summarised in the facts that the Germans possessed some method of establishing intersections over England, known as *Knickebein*, and that such intersections could be observed by means of the equipment carried in He111s'. Jones added that 'the accuracy of intersection was 1 minute' or 'roughly 1 mile square'. Such accuracy would have been alarming to the readers of SIR No.6. Covertly referring to ULTRA, Jones explained that it was 'impossible to rate this independent contribution too highly'.⁶⁹

Considering Jones waited patiently before being able to write his memoirs with ULTRA inclusion, it is somewhat surprising that he rarely mentioned its significant contribution to scientific intelligence. This has perhaps had the (probably inadvertent) effect that the influence of ULTRA upon scientific intelligence has been subsequently downplayed. For example, Jones wrote that during the Battle of the Beams in 1940 and 1941, he read every Enigma message'.⁷⁰ This comment however, pays scant justice to the extensive behind-the-scenes work at Bletchley in the quest for scientific intelligence on Jones's behalf. Jones spent more words in his memoirs discussing his

⁶⁸ CCAC RVJO B.7 and TNA AIR 20/1623, Air Ministry Scientific Intelligence Report No.6, 'The Crooked Leg', p. 3; Jones, *Most Secret War*, p. 94.

⁶⁹ CCAC RVJO B.7 and TNA AIR 20/1623, Air Ministry Scientific Intelligence Report No.6, 'The Crooked Leg', p. 4.

⁷⁰ Jones, *Most Secret War*, pp. 122, 154, & 323; Hinsley *et al*, *British Intelligence in the Second World War, Volume I*, pp. 550–64 for the key Enigma decrypts used by Jones to combat the GAF radio beams.

acumen for collegiality, and the contributions he made to GC&CS personnel understanding his work, than assessing ULTRA influence upon scientific intelligence throughout the war. For Jones, GC&CS was just another intelligence gathering organisation, while its operatives were unsuitably trained for scientific intelligence collation. This is not an undue criticism, for such was the contemporary thinking.⁷¹

Three subjects were treated differently from others at Bletchley. Special arrangements were made for handling material relative to the success of Allied deception operations.⁷² Naval interceptions were dealt with separately: Hut 8 decrypting, and Hut 4 collating, *Kriegsmarine* Enigma messages. Naval and military intelligence also had their own special dissemination channels in Hut 3, known respectively as '3N' and '3M'.⁷³ Most importantly for scientific intelligence, any decrypted data of scientific nature was extracted at the preliminary scanning stage and passed to a back-room that provided a direct

⁷¹ GC&CS operatives were indeed mostly incapable of assessing scientifically-characterised ULTRA. One operative wrote that the reason for special arrangements for this type of intelligence 'was presumably the difficulty which the non-specialist would have encountered at the stage of evaluation': see William Millward, 'Life in and out of Hut 3', in Hinsley and Stripp (eds.), *Codebreakers*, p. 25.

⁷² For ULTRA in deception operations, see Charles Cruikshank, *Deception in World War II* (Oxford: OUP, 1979); Michael Howard, *British Intelligence in the Second World War, Volume V: Strategic Deception* (London: HMSO, 1990); Michael Smith, 'Bletchley Park, Double Cross and D-Day' in Smith and Erskine (eds.), *Action This Day*, pp. 279–300; Ben Macintyre, *Operation Mincemeat: The True Spy that Changed the Course of World War II* (London: Bloomsbury Publishing, 2010).

⁷³ Brunt, 'Special Documentation Systems at the Government Code and Cypher School', 130–6. For Naval ULTRA, see TNA HW 3/137, 'The History of N.S. VI (Technical Intelligence)', 1945–6; Patrick Beesly, *Very Special Intelligence: The Story of the Admiralty's Operational Intelligence Centre, 1939–1945* (London: Hamish Hamilton, 1977); Hinsley *et al*, *British Intelligence in the Second World War, Volume I*, 7–13, 141–3, 267–8, & 285–7; *Volume II*, 162–233 & 525–72; *Volume III*, 211–90, and *Volume IV*, 453–96; John Terraine, *Business in Great Waters: The U-Boat Wars, 1916–1945* (London: Leo Cooper, 1989); David Kahn, *Seizing the Enigma: The Race to Break the German U-Boat Codes, 1939–1943* (London: Arrow Books, 1996); Ralph Erskine, 'Breaking German Naval Enigma on Both Sides of the Atlantic' and Rolf Noskwith, 'Hut 8 From the Inside' in Smith and Erskine (eds.), *Action This Day*, pp. 174–96 & 197–210 respectively; Hugh Sebag-Montefiore, *Enigma: The Battle for the Code* (London: Weidenfeld & Nicolson, 2000); C. I. Hamilton, 'The Character and Organisation of the Admiralty Operational Intelligence Centre during the Second World War', *War in History*, 7: 3 (2000), 295–324; Roy Conyers Nesbit, *Ultra versus U-Boats: Enigma Decrypts in the National Archives* (Barnsley: Pen & Sword, 2008). See also Hinsley and Stripp (eds.), *Codebreakers* for many fascinating Naval ULTRA recollections.

channel to the Broadway offices of the Assistant Chief of Air Staff responsible for intelligence, designated ACAS(I).⁷⁴ The September 1940 opening of this channel was made possible by breaking Enigma 'Brown' – a communications link between German research establishments and GAF bases in France.⁷⁵

Brown decrypts became 'the specialist province' of Norman in Hut 3, who separated 'fragments of recondite scientific vocabulary' for Jones's scientific examination.⁷⁶ Norman, who had assisted Jones in translating the Hitler *Waffe* speech in November 1939, worked within a sub-structure of Hut 3. From 'late in 1942 onwards' this was called '3G', and was created specifically to research (past and present) decrypts relative to specific interests.⁷⁷ Norman's party of research analysts within 3G were designated 3G(N), and were a 'very important research party' linking ULTRA to scientific intelligence.⁷⁸ This vague definition of 'research' party was a contemporary application, which in reality meant that Norman (and later his growing team of analysts) 'became single-handedly responsible for all intelligence which concerned Dr. Jones, the German Y Service, Code names, abbreviations and German vocabulary'.⁷⁹

⁷⁴ Millward, 'Life in and out of Hut 3', p. 25; see also Welchman, *The Hut Six Story*, pp. 160–1 Calvocoressi, *Top Secret Ultra*, p. 72. Calvocoressi stated that the small group 'worked in the manner of back-room boys' working 'on the less urgent intelligence problems'. There were 'back-room' girls employed in Hut 3 as well.

⁷⁵ Christine Large, *Hijacking Enigma: The Insider's Tale* (Chichester: John Wiley, 2004), p. 86.

⁷⁶ Ralph Bennett, 'The Duty Officer, Hut 3' in Hinsley and Stripp (eds.), *Codebreakers*, pp. 30 & 36.

⁷⁷ TNA HW 43/69, 'Report on the work of 3G(N)', 1 August 1945, p. 8. The 'G' stood for 'General'. 3G was divided into six small sub-sections: see Campbell, *Target London*, p. 14.

⁷⁸ Lewin, *Ultra goes to War*, p. 112; Bennett, 'The Duty Officer, Hut 3', p. 37; Calvocoressi, *Top Secret Ultra*, p. 75. The latter source defined them as 'invaluable'.

⁷⁹ TNA HW 43/69, 'Report on the work of 3G(N)', 1 August 1945, p. 7.

Rarely has 3G(N) been discussed by historians.⁸⁰ The linguistic-scientific partnership between Jones and Norman was, through to the end of the war, 'the avenue by which scientific information was passed from all sources' cracked by GC&CS, whether they were 'en clair, simple codes, Playfair, or machine ciphers'.⁸¹ At any given time during the Second World War, the Germans were operating approximately fifty different Enigma keys (each changed and reset every twenty-four hours), as well as some twenty different Fish (non-Morse) cipher links used for high-level more diplomatic messages.⁸² Moreover, ULTRA applied originally to only seven ciphers including Enigma, Purple, and JN-25, with other code-words, such as 'Thumb', 'Rabid', and 'Pearl' applied to lower-level decrypts and SIGINT intelligence analysis.⁸³ 3G(N) were not exclusively limited to ciphers. Through their liaison with scientific intelligence they necessarily engaged with outside sources such as PR/PI, and reports of POW and espionage intelligence.⁸⁴

The 3G(N) and ADI (Science) connection began even before the special channel between Bletchley and Broadway opened with the cracking of Brown Enigma. Decrypts from 'Red' Enigma (used by 'countless' *Luftwaffe* units), during late-spring/early-summer of 1940, provided 'a good deal of interesting

⁸⁰ Christy Campbell can be credited as the first to record 3G(N), but he only briefly explained the inner-workings of the organisation, and his discussion was limited to the British counter to German rockets and flying bombs, known colloquially as V-Weapons: Campbell, *Target London*, p. 14. Rodney Brunt mentioned Norman in 3G, but did not extend to the 3G(N) designation: Brunt, 'Special Documentation Systems at the Government Code and Cypher School', 136.

⁸¹ TNA HW 43/69, 'Report on the work of 3G(N)', 1 August 1945, pp. 6 & 10.

⁸² Hinsley, 'British Intelligence in the Second World War', p. 210; Hinsley, 'The Influence of ULTRA in the Second World War', 4. For Allied success over Fish, see J. V. Field, 'British Cryptanalysis: The Breaking of Fish' in Ad Maas, and Hans Hooijmaijers, *Scientific Research in World War II: What Scientists did in the War* (London: Routledge, 2009), pp. 213–31.

⁸³ Edward J. Drea, 'Ultra and the American War against Japan: A Note on Sources', *Intelligence and National Security*, 3: 1 (January 1988), 195. Purple and JN-25 were Japanese codes.

⁸⁴ TNA HW 43/69, 'Report on the work of 3G(N)', 1 August 1945, p. 2.

information on *Knickebein* and similar gadgets'.⁸⁵ Red was a comparatively easy cypher to break, but its yield was limited, as the fall of France led the GAF to revert to landlines. Nonetheless, Red was 'the Principal Luftwaffe Cypher', and because it remained uninterrupted for the rest of the war, it 'became the staple' of ULTRA providing 'German mistakes' and 'cribs in plenty'.⁸⁶ Upon creation of 3G(N), Norman was assisted by only two female staff. It remained that way until 1943 when 'radar work' became 'even more important', and 'research into the threatened secret weapons' began 'seriously'. By war's end there were 'ten or eleven people working constantly in the department', none of whom were scientifically trained.⁸⁷ Other than Jones and later ADI (Science), the only connection with the outside world that 3G(N) had was 'through a serial publication known successively as CX/FJ, CX/JQ and ultimately CX/MSS'.⁸⁸ These were intelligence reports based on Enigma decrypts disguised as agents' reports.⁸⁹ Disguised decrypts would use 'standard MI6 preamble to an agent's report', referenced by 'CX'. 'CX/FJ' changed to 'CX/JQ' in the summer of 1940, and during 1941 to 'CX/MSS'. Later 'MSS' was replaced by 'ULTRA', while in its turn ULTRA was succeeded by other names nearly all of which resulted from the cryptographers' penchant for five-letter groups'.⁹⁰

⁸⁵ TNA HW 43/69, 'Report on the work of 3G(N)', 1 August 1945, p. 6. 'Yellow' Enigma had also been broken on 15 April, five days after its introduction by the Germans. Yellow was voluminous, but mostly operational, so of little importance to scientific intelligence; Hinsley *et al*, *British Intelligence in the Second World War, Volume I*, p. 137; Calvocoressi, *Top Secret Ultra*, p. 87. Red was first broken on 22 May (traffic of 20 May).

⁸⁶ Calvocoressi, *Top Secret Ultra*, pp. 87–9.

⁸⁷ TNA HW 43/69, 'Report on the work of 3G(N)', 1 August 1945, pp. 8–9; Calvocoressi, *Top Secret Ultra*, p. 75. Calvocoressi remembered that the 'group comprised three or four professors with twice that number of assistants'.

⁸⁸ TNA HW 43/69, 'Report on the work of 3G(N)', 1 August 1945, p. 10.

⁸⁹ TNA HW 43/2, 'History of British SIGINT, 1914–1945, Volume II', p. 544.

⁹⁰ R. V. Jones, 'A Sidelight on Bletchley Park, 1942', *Intelligence and National Security*, 9: 1 (January 1994), 3.

The 'CX' prefixed reports were essential to scientific intelligence. Important material was sent by teleprinter direct to Broadway, but when the volume became too great it was delivered once or twice a week by courier.⁹¹ 3G(N) were unable however, to officially report anything to ADI (Science) that did not proceed through Hut 3 channels, so there was extensive telephoning between 3G(N) and ADI (Science). Often ADI (Science) assisted in emendation of reports for which the decrypts were too corrupt for adequate dissemination. Most 'teasers' of this nature were solved by Frank, although Jones 'with no German at all, solved quite a number'.⁹² Between 3G(N) and ADI (Science) there was a special symbiosis, which made an as yet rarely appreciated contribution to Allied victory in the Second World War.⁹³ It was unlikely that a German 'diplomat could presume to discuss a scientific matter without it reaching ADI (Science)' through 3G(N).⁹⁴ As Jones's 'principal researcher' at Bletchley, Norman (and his staff) scanned 'every type of decrypt for signs of German technological and scientific innovations'.⁹⁵ This was accomplished through the 'Abbreviations and Equivalent Index' – a card system that enabled Norman to build a glossary of GAF abbreviations, and cross-index

⁹¹ TNA HW 43/2, 'History of British SIGINT, 1914–1945, Volume II', p. 544; Calvocoressi, *Top Secret Ultra*, p. 75; Hinsley *et al*, *British Intelligence in the Second World War, Volume I*, p. 138; Montagu, *Beyond Top Secret U*, p. 85. The Admiralty's Operational Intelligence Centre (OIC) also received couriered 'CX' prefixed reports, although arrangements also existed for ADI (Science) to be informed of naval technical intelligence: Hinsley *et al*, *British Intelligence in the Second World War, Volume III, Part I*, p. 561.

⁹² TNA HW 43/69, 'Report on the work of 3G(N)', 1 August 1945, pp. 11–12.

⁹³ A fine example occurred in January 1942, when Norman unofficially showed Jones and Frank a Bletchley bombe in operation, an action for which he was evidently reprimanded for afterwards. In an apologetic letter to Travis (by then Director of GC&CS), Norman wrote that he had 'solemnly stressed' to Jones and Frank that 'if one of them opens his mouth on the subject they deserved to be boiled in oil': TNA HW 14/27, Norman to Travis, 28 January 1942; Campbell, *Target London*, p. 52.

⁹⁴ TNA HW 43/69, 'Report on the work of 3G(N)', 1 August 1945, p. 10.

⁹⁵ Thomas, 'A Naval Officer in Hut 3', p. 44.

compound German words such as *Mine*, *Gerät*, and *pumpe*.⁹⁶ There is no doubt that Jones owed Norman, and the fabulous index he maintained, 'an only partly acknowledged debt of gratitude'.⁹⁷

On occasion, intelligence provided by Norman could lead Jones to incorrect supposition. Such was the case when a Red flimsy spoke of 'Knickebein Dezi'. By then Jones knew of *Knickebein* and that it operated on wavelengths of approximately ten metres. Coupling the *Dezi* decrypt with previous mention of a German technician making a 13cm adjustment to the radio beams, Jones posited that *Knickebein Dezi* was decimetric radio beam navigation. On this supposition he obtained Churchill's permission to order a search of the airwaves. As it turned out, Jones's deduction was false. *Knickebein Dezi* did indeed refer to decimetric wavelengths, but for communications links integral to the German signals network. Jones later admitted that this was a prime example of deliberately straining the evidence to obtain action from uninitiated superiors.⁹⁸ Nevertheless, the ordered airwave search did discover wavelengths of 80cm. Although these meant very little to Jones at the time, a year later they would prove hugely significant. The fledgling 3G(N) had indeed 'provided early insight into German decimetre transmission'.⁹⁹

⁹⁶ Brunt, 'Special Documentation Systems at the Government Code and Cypher School', 132–40. The Hut 3 Abbreviations and Equivalents Index was established and co-maintained by Trevor Jones, a linguist recruited from the University of Cambridge. For a fascinating insight into the importance of linguists at Bletchley Park (and in other wartime organisations), including Trevor Jones and Norman, see Hilary Footitt, 'Another Missing Dimension? Foreign Languages in World War II Intelligence', *Intelligence and National Security*, 25: 3 (June 2010), 271–89. See also John Lee, 'Station X': The Women at Bletchley Park' in Celia Lee and Paul Edward Strong (eds.), *Women in War* (Barnsley: Pen and Sword, 2012), p. 163. Lee provided a figure of 570 Wrens who managed the Hut 3 Index.

⁹⁷ Thomas, 'A Naval Officer in Hut 3', p. 44.

⁹⁸ R. V. Jones, 'Temptations and Risks of the Scientific Adviser', *Minerva*, 10 (1972), 443.

⁹⁹ TNA HW 43/69, 'Report on the work of 3G(N)', 1 August 1945, p. 6.

After leaving Blandy on 12 June, Jones crossed Whitehall and visited Lindemann as arranged. By the time he arrived in Lindemann's office it was afternoon, his mind was fully focused on the 'flimsy', and he was intent on discussing it with his old tutor. Lindemann had called Jones the day before to arrange a meeting to discuss any findings Jones had on German RDF, presumably for Churchill's later digestion.¹⁰⁰ In subsequent conversation, Lindemann asked Jones if he had heard any more news about *X-Gerät*, to which Jones relayed his intersecting beam theory, based on all the evidence he had received. Contemporary scientific wisdom on radio waves travelling the equivalent distance between Germany and England was orthodox. It was generally perceived that transmitted waves for radio navigation would need to be short-waves, and even then could not bend with the curvature of the earth. With this in mind Lindemann rejected Jones's *Knickebein* theory as implausible. Jones had previously considered wave propagation orthodoxy, and his research brought attention to an unpublished paper by Thomas Eckersley, Marconi's radio propagation expert and Y-Service consultant.¹⁰¹ Using a computed range for a 20cm transmitter working at Brocken, Eckersley's paper demonstrated that a nine metre transmitter at Cleves would be detectable over most of England.¹⁰² This evidence was (eventually) sufficient to convince Lindemann.¹⁰³

¹⁰⁰ CCAC RVJO B.7 and TNA AIR 20/1623, Air Ministry Scientific Intelligence Report No.6, 'The Crooked Leg', p. 4; Jones, *Most Secret War*, p. 93; Clark, *Rise of the Boffins*, p. 105; Clark, *Tizard*, p. 228; Price, *Instruments of Darkness*, p. 26; Adrian Fort, *Prof: The Life of Frederick Lindemann* (London: Jonathan Cape, 2003), p. 259.

¹⁰¹ Jones, *Most Secret War*, p. 87.

¹⁰² CCAC RVJO B.7 and TNA AIR 20/1623, Air Ministry Scientific Intelligence Report No.6, 'The Crooked Leg', p. 4.

¹⁰³ CCAC RVJO B.7 and TNA AIR 20/1623, Air Ministry Scientific Intelligence Report No.6, 'The Crooked Leg', p. 5; Jones, *Most Secret War*, pp. 93–5; Clark, *Rise of the Boffins*, p. 105; Price, *Instruments of Darkness*, pp. 26–7. It took Jones two attempts (on 12 and 13 June) to convince

In the twenty-four hours that it took for Lindemann to be swayed, Jones sought intelligence from AI1(k), knowing they had processed POWs from KG4 and KG27 (units of *Flieger Korps IV*). Felkin informed Jones that prisoners had been overheard discussing *Knickebein* in their room following interrogation, in which one POW said that his questioner asked about *Knickebein*, and the other said that he too had been asked. Apparently, they both laughed and one said, 'They'll never find it, they'll never find it'.¹⁰⁴ Upon hearing this, Jones immediately deduced that the receiver had to be hidden in the He111 cockpit.¹⁰⁵ In *Most Secret War*, Jones unconvincingly implied that he knew beforehand that the equipment had to be in the He111 and had prompted Felkin accordingly. If Jones had known of *Knickebein* receivers in He111s then he would no doubt have ensured their discovery. A fundamental problem with this part of Jones's recollection is that there is no proof of this POW conversation in any of the extracts. Perhaps that particular extract had not been recorded, or perhaps because Felkin relayed the information by telephone, he deemed it unnecessary to record. Lack of evidence all too often demands that Jones's memories be accepted.

To locate the receiver Jones requested a technical examination report of a downed He111.¹⁰⁶ This was provided by air technical intelligence, designated

Lindemann that Eckersley's theory was sound. At an Air Signals Intelligence (AI1(e), later AI4) conference on 13 June, Eckersley was given all the facts concerning *Knickebein*.

¹⁰⁴ Jones declared this POW statement with excitement in his interview for the BBC television programme *The Secret War*: see CCAC RVJO K.475, Transcript for 'The Battle of the Beams', p. 6; Johnson, *The Secret War*, p. 10; Jones, *Most Secret War*, p. 93; Clark, *Rise of the Boffins*, p. 106.

¹⁰⁵ Jones, *Most Secret War*, p. 94.

¹⁰⁶ According to one secondary source, this particular He111 was 'brought down in the Lammermuir Hills, north of Edinburgh as early as 28 October 1939'. If this was the case, then the secret of

AI1(g) and later re-designated AI2(g).¹⁰⁷ Jones made no mention in *Most Secret War* that this report came from scientific intelligence's sister branch of AI1(g). This was a common occurrence throughout his post-war literature. As is shown throughout this thesis, Jones avoided reference to technical intelligence (except in hostility), essentially because of the blurred differentiation between technical and scientific intelligence. Because the examined aircraft had landed intact, the AI1(g) report included complete descriptions of all radio installations. Jones found nothing technically unusual and guessed it had to be something to do with the Lorenz Blind Landing Receiver, labelled EBL.1 (*Empfänger Blind 1*). This particular item of equipment had been examined by Sq/Ldr N. Cox-Walker at RAE. Cox-Walker informed Jones by telephone that he had considered the Lorenz equipment to be nothing special, for Lorenz Blind landing sets were standard equipment for many aerodromes worldwide.¹⁰⁸ When pressed by Jones, however, Cox-Walker recalled that the set under investigation had a higher complexity than required for blind landing. The AI1(g) report also spoke of an extra plug socket, the function for which was unknown. For Jones this was convincing proof that this was the equipment used to receive *Knickebein*.¹⁰⁹

Lorenz Blind Landing was essentially a system whereby two directional-beam aerials radiated two wide beams of radio waves that overlapped above an

Knickebein was in British hands for months before its discovery: Richard Hough and Denis Richards, *The Battle of Britain: The Jubilee History* (London: Guild Publishing, 1990), p. 69.

¹⁰⁷ CCAC RVJO B.7 and TNA AIR 20/1623, Air Ministry Scientific Intelligence Report No.6, 'The Crooked Leg', p. 4.

¹⁰⁸ See Erik M. Conway, 'The Politics of Blind Landing', *Technology and Culture*, 42: 1 (January 2001), 81–106 for useful examinations of interwar application of blind landing technology in the USA.

¹⁰⁹ CCAC RVJO B.7 and TNA AIR 20/1623, Air Ministry Scientific Intelligence Report No.6, 'The Crooked Leg', p. 4; Jones, *Most Secret War*, p. 94; see also Johnson, *The Secret War*, p. 16; Dudley Saward, *Victory Denied: The Rise of Air Power and the Defeat of Germany 1920–45* (London: Buchan & Enright Publishers, 1985), p. 197.

aerodrome runway. Aerials were mechanically switched so that one radiated dots and the other radiated dashes. These dots and dashes could be heard audibly (like long and short Morse pulses) by aircrew tuned into the correct frequency. Where the beams overlapped, the dots and dashes combined to give a continuous note, known as the equi-signal. Pilots positioned the aircraft on the equi-signal so as to be guided to land safely when flying in blind conditions. Although theoretically simple, instrument flying called for high standards of proficiency, particularly in difficult conditions. The standard range for Lorenz flying was approximately thirty miles.¹¹⁰ The marvel was that German scientists had extended this by simply ignoring orthodox wisdom on wave propagation, and deducing through experimentation that the higher the receiving aircraft could fly, the further the beam could reach.

Convinced that the beams were indeed a potential threat to Britain's defence, Lindemann wrote a note to Churchill:

There now seems some reason to suppose that the Germans have some type of radio device with which they hope to find their targets. Whether this is some form of RDF and they have IFF [Identification: Friend or Foe] beacons planted by spies to guide them, or whether it is some other invention, it is vital to investigate and especially to seek to discover what the wavelength is. If we know this, we could devise means to mislead them; if they use it to shadow our ships there are various possible answers; if they rely on IFF beacons to find targets, we could lead them astray; if they could use a sharp beam this

¹¹⁰ For the best explanation of the Lorenz system, see Johnson, *The Secret War*, p.16–18; for Jones' rather complicated explanation see *Most Secret War*, pp. 97–9; for a good online explanation see <http://s374444733.websitehome.co.uk/beams/beammain.htm> on the website www.duxford-update.info, accessed 3 June 2013. The authors of this website explained that the extra sensitivity of the Lorenz equipment examined by RAE was due to the unusual presence of five pentode valves.

can be made ineffective. With your approval, I will take this up with the Air Ministry and try to stimulate action.¹¹¹

Churchill's response was to forward this letter to Sinclair, adding that the issue was 'most intriguing' and requesting that it be 'thoroughly examined'.¹¹² This important document is early insight into the immediacy of Prime Ministerial attention that Jones appreciated throughout the war. In many respects scientific intelligence, through Lindemann, went direct to Churchill. The letter shows that there was still doubt about how the beams operated (was it ASV? Were IFF beacons employed? What were the wavelengths?). Jones recalled that even up until 20 June, he was still not entirely convinced that *Knickebein* and *X-Gerät* were separate systems.¹¹³ Most importantly, this letter shows that Lindemann demonstrated a calm approach to the situation by carefully considering and suggesting countermeasures.¹¹⁴ Jones did not present the contents of this letter in his memoirs, but stated only that Lindemann wrote it, and Churchill acted upon it.¹¹⁵ Perhaps this was because the idea of countering the beams was put forward by Lindemann (at least on paper) before Jones, but also that countermeasures were not as dramatic an action as Jones preferred to remember. On 14 July Sinclair appointed Air Marshal Philip Joubert to take charge of the investigation.

Further intelligence from AI1(k) significantly escalated the confusion over German beam technology. On 14 June POW A.231 told Felkin during

¹¹¹ UONC G.335/1, Lindemann to Churchill, 13 June 1940; Clark, *Tizard*, p. 228. For British development of IFF, see Rowe, *One Story of Radar*, p. 64.

¹¹² UONC G.335/2, Churchill to Sinclair, 14 June 1940; Clark, *Tizard*, p. 228.

¹¹³ Jones, *Most Secret War*, p. 100.

¹¹⁴ UONC G.335/1, Lindemann to Churchill, 13 June 1940; Clark, *Tizard*, p. 228.

¹¹⁵ Jones, *Most Secret War*, p. 95.

interrogation that *Knickebein* was a bomb dropping device involving two intersecting beams located with Lorenz receivers that released the bombs automatically. A.231 stated that it was developed at Rechlin and had been used to bomb Warsaw. This prisoner (claiming to be anti-war) drew a sketch of a transmitting tower he had seen at Rechlin that agreed exactly with a photograph Jones had been puzzling over for some time.¹¹⁶ A.231 also stated that when aircraft located the beam, the pilot flew a level course, seeing that the bank and turn indicators, the altimeter, and the artificial horizon markers all read zero. Pilots could then start their auto-pilot, which flew the aircraft along the beam. A.231 added that the apparatus had been fitted to He111s and Ju52s, but not Ju88s.¹¹⁷

Jones was summoned to a meeting held in Joubert's office on 15 June.¹¹⁸ It was agreed that the evidence was sufficiently strong for immediate action to be taken, and that the rough outlines of the *Knickebein* system were known, 'from conjecture and the combined evidence of AI1(c), AI1(e), AI1(g), AI1(k) and Bomber Command Intelligence'. There 'seemed reasonable hope' that the beams could be found, and 'counteraction either by jamming, or by false beams' implemented.¹¹⁹ Urgency was further demonstrated by the proposal to call an extraordinary meeting of the Night Interception Committee (NIC) on Sunday 16 June. Tizard was a leading member of this Committee, but

¹¹⁶ CCAC RVJO B.7 and TNA AIR 20/1623, Air Ministry Scientific Intelligence Report No.6, 'The Crooked Leg', p. 5; Jones, *Most Secret War*, p. 95. Jones wrote in his memoirs that he knew the tower to be a Lorenz beacon, although this is contrary to what he wrote in SIR No.6.

¹¹⁷ CCAC RVJO B.7 and TNA AIR 20/1623, Air Ministry Scientific Intelligence Report No.6, 'The Crooked Leg', p. 5.

¹¹⁸ Clark, *Tizard*, p. 229.

¹¹⁹ CCAC RVJO B.7 and TNA AIR 20/1623, Air Ministry Scientific Intelligence Report No.6, 'The Crooked Leg', p. 5.

surprisingly regarded the beams as a rather routine affair, and chose not to attend.¹²⁰ His obvious initial scepticism was to play a key role in forthcoming events. It was agreed in Tizard's absence that certain recommendations should be acted upon. An aircraft was to be fitted with Lorenz equipment and used to try to locate the beams, and a jamming system was to be devised. Blackford was (surprisingly) to continue searching for concealed instruments and Fifth Column involvement, and Joubert should lead the investigation and compile weekly reports for Churchill. Jones's personal scientific input was evident through the recommendations of trials of an infra-red telescope over industrial areas to search for possible infra-red beacons.¹²¹

As activity naturally bred more activity, and as those in command delegated responsibility, the hunt for *Knickebein* became fairly extensive. Technicians from RAE were informed of the situation so that they could consider jamming possibilities. The Blind Approach Development Unit (BADU), an organisation that had the most experience in Lorenz-type beams, was re-formed at Boscombe Down for the airborne investigation.¹²² AI1(e) and AI1(k) officers sought other helpful snippets of intelligence. The best operators from the Very High Frequency (VHF) watch of the Y-Service were temporarily transferred to BADU, and their special receivers were fitted to an AVRO Anson aircraft.¹²³

¹²⁰ Clark, *Tizard*, p. 229.

¹²¹ CCAC RVJO B.7 and TNA AIR 20/1623, Air Ministry Scientific Intelligence Report No.6, 'The Crooked Leg', pp. 6–7. Price commented that from this meeting forward, 'Jones had the big guns firing for him': Price, *Instruments of Darkness*, p. 27.

¹²² TNA AIR 41/46, 'Royal Air Force No.80 Wing Historical Report, 1940–1945', p. 4; Jones, *Most Secret War*, p. 97.

¹²³ CCAC RVJO B.7 and TNA AIR 20/1623, Air Ministry Scientific Intelligence Report No.6, 'The Crooked Leg', p. 8; Price claimed that BADU had three Ansons available for the task, although if this was the case, it is certain that only one flew up at any one time: Price, *Instruments of Darkness*, p. 28.

Some of these wireless operators were pre-war radio amateurs.¹²⁴ Pre-set frequencies of German receivers previously found in crashed He111s were 'sensibly recommended' by AI1(e), although two attempts to locate the beams failed due to lack of enemy activity.¹²⁵

POW intelligence was garnered daily during mid-June. Jones later marvelled that the British 'had been far luckier' than they 'ought to have been in shooting down German aircraft', that each captured German airman was interrogated skilfully through 'a battle of wits', which resulted in 'quite a lot of information' and 'documents too'.¹²⁶ One such document obtained by AI1(k) on 18 June was salvaged from a German aircraft shot down in France, which, by this time, must have been very difficult to send to London. This document confirmed *Knickebein* from Kleve, and *Knickebein* from Bredstadt, with the beams transmitting directly over Scapa Flow.¹²⁷ Further POW intelligence derived from a W/T operator's log in which the first entry stated simply '*Knickebein Kleve, 31.5*'. This, Jones deduced, confirmed Scott-Farnie's theory on the wavelength frequency being exactly 3, 3.15, or 3.3 megacycles per second (M/Sc).¹²⁸ Also that day, a most interesting conversation was recorded between POWs N.300 (*Kriegsmarine oberleutnant*), and A.212

¹²⁴ Johnson, *The Secret War*, p. 20.

¹²⁵ CCAC RVJO B.7 and TNA AIR 20/1623, Air Ministry Scientific Intelligence Report No.6, 'The Crooked Leg', p. 8; Jones, *Most Secret War*, p. 99. The AI1(e) officer who 'sensibly recommended' the frequencies was Flight Lieutenant (F/Lt) Rowley Scott-Farnie, one of the few men in Air Intelligence that Jones befriended during the war.

¹²⁶ CCAC RVJO K.475, Transcript for 'The Battle of the Beams', p. 13. Jones remarked that in the 'battle of wits' Felkin 'was really very, very good'.

¹²⁷ CCAC RVJO B.7 and TNA AIR 20/1623, Air Ministry Scientific Intelligence Report No.6, 'The Crooked Leg', p. 8; Jones, *Most Secret War*, p. 99.

¹²⁸ Jones, *Most Secret War*, pp. 99–100.

(*Luftwaffe oberleutnant*), in which the latter claimed blind-bombing on 'spot-targets' was the way of the future.¹²⁹

Upon receipt of the Cleves and Bredstadt data, Jones attempted to obtain PR evidence, but was informed that PR Spitfires did not have sufficient range to reach Bredstadt, while sorties over Kleve had been persistently foiled by cloud. PR was able however, to photograph a new *Knickebein* transmitter at Beaumont-Hague, and repeatedly photographed the site from 20 June (before the station was operative).¹³⁰ The initial intelligence on Beaumont-Hague had derived from ULTRA, which often 'pin-pointed' *Knickebein* transmitters 'to the nearest mile'.¹³¹ The Beaumont-Hague discovery is of prime importance, for it marks the first collaboration between SIGINT, PR/PI and scientific intelligence. PR evidence also allowed Jones to self-educate on the technicalities of PI. Contemporaneously masking ULTRA, Jones acknowledged 'debt to the source who pin-pointed the transmitter, and who has done so much other work in this connection', and declared it 'beyond redemption'. The 'best photograph' of the Beaumont-Hague site was taken on 24 August, by which time it was operational. Less than a month later, Jones announced the Beaumont-Hague *Knickebein* transmitter 'as a bomb target'.¹³²

¹²⁹ TNA WO 208/3506, SR Extract 16, dated 19 June 1940. The naval *leutnant* showed a keen interest in the beams operations and was asking the *Luftwaffe leutnant* how the beams worked in practice. The latter claimed that while he knew the theory behind the beams apparatus, he had never seen one and did not know whether it was being used or was going to be used. This does raise the question of whether N.300 was a stool pigeon, but it is equally possible that he was simply an inquisitive sailor.

¹³⁰ CCAC RVJO B.15 & TNA AIR 20/1626, Air Scientific Intelligence Report No.9 'Knickebein Photographed', 20 September 1940, p. 1. Although Jones did not refer to this PR breakthrough in the main text of his memoirs, he did provide a 'tentative sketch' (based on his new PI experience) made in September 1940 of the Knickebein installation at Beaumont Hague: Jones, *Most Secret War*, p. 133.

¹³¹ Jones, *Most Secret War*, p. 132.

¹³² CCAC RVJO B.15& TNA AIR 20/1626, Air Scientific Intelligence Report No.9 'Knickebein Photographed', 20 September 1940, pp. 2-3.

POW intelligence further complicated the overall question of differentiation between *Knickebein* and *X-Gerät*, especially when A.212 discussed blind bomb-sighting apparatus 'independent of the human brain' dropping bombs on the intersection of two 'wireless' beams. While this evidence tended to show only one operating system, Jones chose to remember that other evidence contradicted this theory.¹³³ Evidence that was beyond fantastic materialised, yet proved the beams theory beyond question. During a 19/20 June night-raid on Britain, a German aircraft was shot down and the W/T operator baled out and parachuted safely to the ground. Conscious that he still had his notebook with him, he tore it up and attempted to bury the pieces, but was seen doing so by oncoming captors. Some 3000 pieces were eventually unearthed and sent to AI1(k) headquarters, where personnel spent half the night gluing the pieces back together again.¹³⁴ The result was invaluable, for they provided the information that the second cross-beam transmitter was at Stolberg in Schleswig-Holstein.

Jones neglected to mention this incredible story in *Most Secret War*, and yet this essential piece of evidence provided him with a plausible theory on how the system worked. The two beams were rotatable and made to intersect over any target. As the transmitting stations were considerable distances apart (400 kilometres) they gave good angles of 'cut' – essential for accuracy.¹³⁵ By

¹³³ CCAC RVJO B.7 and TNA AIR 20/1623, Air Ministry Scientific Intelligence Report No.6, 'The Crooked Leg', p. 8; TNA WO 208/3506, SR Extract 16.

¹³⁴ Jones later stated that Felkin informed him of the 3000 pieces: CCAC RVJO K.475, Transcript for 'The Battle of the Beams', p. 13. See also CCAC RVJO B.7 and TNA AIR 20/1623, Air Ministry Scientific Intelligence Report No.6, 'The Crooked Leg', p. 9; Johnson, *The Secret War*, p. 21; Price, *Instruments of Darkness*, p. 29.

¹³⁵ Johnson, *The Secret War*, p. 21.

21 June, therefore, Jones had two sites and two frequencies definitely fixed, and keenly paid credit where credit was due. The contribution of AI1(k) to the solving of the *Knickebein* mystery, which they themselves had discovered, 'rated very highly indeed'.¹³⁶ In *Most Secret War*, Jones presented contrasting evidence that documents retrieved in France pinpointed the second transmitter in Schleswig-Holstein.¹³⁷ SIR No.6 clearly shows that it was the fragments of paper recovered from near-oblivion that actually confirmed the transmitter's location in Stolberg, a place also not mentioned in Jones's memoirs. It seems that in his haste to get to the next, more exciting part of his story, Jones overlooked key items of evidence.

On the morning of 21 June, while Hitler sealed French humiliation in a railway carriage in the forest of Compiègne, Churchill held a Cabinet meeting to consider the threat posed to Britain by the German radio beams.¹³⁸ Perhaps not wishing to bore the Cabinet with the friction between himself and Tizard, Lindemann advised that Jones be summoned to personally explain his discoveries.¹³⁹ It was therefore doubly fortunate that Jones had been able to establish with considerable precision the locations and frequencies of two *Knickebein* transmitters.¹⁴⁰ Contrary to common belief, Churchill was not

¹³⁶ CCAC RVJO B.7 and TNA AIR 20/1623, Air Ministry Scientific Intelligence Report No.6, 'The Crooked Leg', p. 9.

¹³⁷ Jones, *Most Secret War*, p. 100.

¹³⁸ Clark, *Tizard*, p. 235; Price, *Instruments of Darkness*, p. 30.

¹³⁹ Thomas Wilson, *Churchill and the Prof* (London: Cassell, 1995), p. 44; Churchill, *Their Finest Hour*, pp. 313–4; Martin Gilbert, *Winston S. Churchill, Volume VI: Finest Hour 1939–1941* (London: Heinemann, 1983), p. 580. Wood and Dempster stated that Churchill presided over a 'full meeting' to discuss the beams on 6 June 1940. This was not so. Churchill did not personally intervene in the beams issue until after he had received Lindemann's 13 June letter confirming the existence of *Knickebein*: Wood and Dempster, *The Narrow Margin*, p. 123.

¹⁴⁰ Price, *Instruments of Darkness*, p. 30.

blindly-led by Lindemann on all scientific matters.¹⁴¹ Admittedly, this common perception primarily stems from Churchill's own praising comments of his friend and scientific adviser. To a large extent Churchill saw Lindemann as his most valuable watchdog on all matters, in addition to simplifying many aspects of scientific and statistical intelligence.¹⁴² Churchill was, of course, on many occasions guided by Lindemann, yet there were occasions where Churchill pursued scientific and technological projects contrary to the Prof's advice.¹⁴³ In Britain, especially on scientific and technological issues, there was a full expression of different views, and if conflicts of opinion existed Churchill 'wanted' to hear about them. Professed doubts over the beams existed and so Lindemann had Churchill's full attention.

Perhaps due to secrecy or to organising the gathering in haste, no minutes of the meeting were taken. Recollections of the event are few.¹⁴⁴ Hyperbolic secondary accounts are legion.¹⁴⁵ Churchill recalled there being fifteen

¹⁴¹ Wilson, *Churchill and the Prof*, p. 44. Wilson worked with Lindemann for three of the war years as an economist in Lindemann's Statistical Branch, dealing mostly with aircraft production.

¹⁴² Churchill claimed that 'Lindemann could decipher the signals from the experts on the far horizons', and elucidate in 'homely terms' the issues involved: Churchill, *Their Finest Hour*, p. 312.

¹⁴³ The prime example was the 1942 'Habbakuk' project to establish aircraft carriers made from icebergs, which (theoretically) could have been floated to wherever required for operational use: CCAC GOEV 3/1, various articles on 'Habbakuk', including in particular 'The Ice-Ship Fiasco', *Discovery*, July 1951, pp. 207–8, written by Charles Goodeve. Lindemann was highly sceptical of this project from outset. See Winston Churchill, *The Second World War, Volume IV: The Hinge of Fate* (London: The Reprint Society, 1953), pp. 672, 724, & 757; Zuckerman, *From Apes to Warlords*, pp. 151, 158–61, 177, & 380; Maurice Goldsmith, *Sage: A Life of J.D. Bernal* (London: Hutchinson, 1980), pp. 112–21 & 174; Andrew Brown, *J.D. Bernal: The Sage of Science* (Oxford: OUP, 2005), pp. 216–38, 256, & 292; Bernard Fergusson, *The Watery Maze: The Story of Combined Operations* (London: Collins, 1961), pp. 145–6, 287–99, & 414; Philip Ziegler, *Mountbatten: The Official Biography* (London: Guild Publishing, 1985), pp. 209–11, 217, 370, & 650.

¹⁴⁴ Churchill, *Their Finest Hour*, p. 313; Jones, *Most Secret War*, p. 101; Clark, *Tizard*, pp. 234–6; Clark, *Rise of the Boffins*, p. 109; Millar, *The Bruneval Raid*, p. 70; Birkenhead, *The Prof in Two Worlds*, pp. 230–1; Snow, *Science and Government*, p. 42; Fort, *Prof*, p. 262.

¹⁴⁵ See as examples, Robert Buder, *The Invention that Changed the World: The Story of Radar from War to Peace* (London: Little, Brown, 1997), pp. 194–5; Carlo D'Este, *Warlord: A Life of Churchill at War, 1874–1945* (London: Allen Lane, 2009), pp. 528–9; Hastings, *Finest Years*, pp. 84–5; James Holland, *Battle of Britain: Five Months that Changed History, May-October 1940* (London: Bantam

persons present; Jones remembered ten.¹⁴⁶ Jones arrived without expectations some twenty-five minutes late due to the surprise caused by the request for his attendance.¹⁴⁷ Upon entering the Cabinet Room, Jones saw Churchill flanked by Lindemann on the right and Beaverbrook on the left. Everyone else was on the opposite side. In his memoirs, Jones recalled that he walked into a 'clearly tense' atmosphere, perhaps 'that of a confrontation'. He 'immediately' encountered a conflict of loyalties, and so sat in 'no-man's land' somewhat isolated in the 'chair nearest the door'.¹⁴⁸

Churchill eventually addressed Jones regarding technicalities, after which Jones fully explained his theory on German bombers using radio beams for navigation and bomb-dropping accuracy. Churchill later recalled this to be 'one of the blackest moments of the war'.¹⁴⁹ In reassurance, Jones recommended proving the beams' existence by flying along the beams themselves, and suggested countermeasures of either a false cross-beam or some form of jamming. Churchill added full weight to these suggestions, and took the opportunity to propose sowing fields of aerial mines along the

Press, 2010), pp. 374–5; Taylor Downing, *Churchill's War Lab, Codebreakers, Boffins and Innovators: Mavericks Churchill led to Victory* (London: Little, Brown, 2010), pp. 165–7.

¹⁴⁶ Churchill, *Their Finest Hour*, p. 313; Jones, *Most Secret War*, pp. 100–1. The ten men were Churchill, Lindemann, Lord Beaverbrook, Archibald Sinclair, Cyril Newall (Chief of the Air Staff), Dowding (now Commander-in-Chief (C-in-C) Fighter Command), Charles Portal (C-in-C Bomber Command), Joubert (as nominal adviser on Combined Operations), Tizard (as Scientific Adviser to the Air Staff), and Watson Watt (as Scientific Adviser on Telecommunications).

¹⁴⁷ Many commentators have reiterated Jones's recollection that he initially thought his Downing Street summons to be a joke: Churchill, *Their Finest Hour*, p. 313; Jones, *Most Secret War*, p. 100; Clark, *Rise of the Boffins*, p. 107; Millar, *The Bruneval Raid*, p. 70. In the Charles Frank papers there is an amusing account of the telephone call received that day by Daisy Mowatt (Winterbotham's secretary) from Churchill's Secretary: UOB DM1310/J.104, Frank to Hewens, dated 29 June 1976.

¹⁴⁸ CCAC RVJO B. 356, Jones to Clark, 3 May 1962; Jones, *Most Secret War*, p. 101–2; Clark, *Tizard*, p. 235; Clark, *Rise of the Boffins*, p. 108; Millar, *The Bruneval Raid*, p. 70.

¹⁴⁹ Jones, *Most Secret War*, p. 108; Martin Gilbert, *Churchill: A Life* (London: Heinemann, 1991), p. 666; D'Este, *Warlord*, p. 529.

beams.¹⁵⁰ Only Tizard objected to Jones's beams theory. Insult was added to injury for Tizard when it was agreed that results of further investigations were to be reported to Lindemann.¹⁵¹ Rarely has this fact been noted, yet, it was crucial to an event later that afternoon that almost ended the Battle of the Beams before it had operationally commenced. Churchill later wrote that if his approval of locating the beams and implementing countermeasures had encountered any serious obstruction he would have 'appealed and told a long story to these friendly tribunals'.¹⁵² In essence, he implied that had Tizard vociferously pressed his scepticism, Churchill would have rebuked him on his feud with Lindemann. Jones was elated at having convinced the Prime Minister over his scientific intelligence. Unintentionally however, he had wounded the prestige of Britain's finest defence scientist, and inadvertently marked a watershed in Tizard's influence on scientific direction of the war.¹⁵³

According to consensus, Tizard wrote his resignation at the Athenaeum Club that afternoon, and presented it to Newall who confirmed that Tizard 'could not do otherwise'.¹⁵⁴ Yet an unsent letter written by Tizard for Sinclair confirms that Tizard had every intention of resigning before the 21 June

¹⁵⁰ Aerial mines had been a pet project for Churchill and Lindemann for years. Jones later wrote that the Germans with their beam-flying provided targets which would have been peculiarly favourable to aerial mine defence: see 'Lord Cherwell's Judgement in World War II', 323.

¹⁵¹ Clark, *Tizard*, pp. 234–6. In a letter to A. V. Hill written a few days later, Tizard stated 'I do not think I should have been asked to this meeting', and implied that his antipathy toward Lindemann, and the manner in which he felt he was being treated, was at last beginning to sway his judgement.

¹⁵² Churchill, *Their Finest Hour*, p. 315.

¹⁵³ Millar, *The Bruneval Raid*, p. 72; Clark, *Rise of the Boffins*, p. 108.

¹⁵⁴ Churchill, *Their Finest Hour*, p. 315; Jones, *Most Secret War*, pp. 108–9; Snow, *Science and Government*, p. 42; Clark, *Tizard*, pp. 236–7; Hastings, *Finest Years*, p. 85. Hastings wrote that 'Tizard's career was, alas, virtually destroyed by his mismanagement' and that 'never again did Tizard wield important influence'. This is wrong. Tizard later assumed the chairmanship of two most important post-war government bodies, namely the Defence Research Policy Committee and the Advisory Council on Scientific Policy. In these roles Tizard was the unofficial Chief Scientific Adviser to the Attlee administration. See also Jones, 'Sir Henry Tizard'; 'Scientists and Statesmen: The Example of Henry Tizard'.

Cabinet meeting.¹⁵⁵ Moreover, he had been sceptical of the beams rather than dogmatically opposed to their existence.¹⁵⁶ Jones nonetheless thought Tizard's scepticism had been 'perhaps overdone'.¹⁵⁷ Scientific doubt and being by-passed in the beams issue does not, however, satisfactorily account for Tizard's resignation. He was deeply upset by his declining influence in political circles, with Lindemann being the new 'scientific star'. Tizard had chaired the CSSAD and the Committee for the Scientific Survey for Air Offensive (CSSAO), both of which were amalgamated into the Committee for the Scientific Survey of Air Warfare (CSSAW) that ceased to exist after Churchill became Prime Minister. With Lindemann 'at Number 10 their power was gone'.¹⁵⁸ Not being invited to the 15 June extraordinary meeting in Joubert's office (which is probably why he declined to attend the NIC meeting of 16 June), simply exacerbated the situation, and it was then that Tizard decided to resign. This he did five days later using his scepticism of the beams as reason. There can be little doubt that he had allowed his judgement to be clouded by Lindemann's support of Jones's theory.¹⁵⁹ Frank later asked, 'who can blame Tizard (a chemist) for giving more weight to the dismissive

¹⁵⁵ IWM HTT 58, Tizard to Sinclair, 19 June 1940. Tizard wrote that he wished to resign his position and rid Sinclair 'of one of the spoiling cooks'. This he did with regret, but felt that he was only 'adding to the confusion, and not helping on the war, by hanging on' in 'difficult circumstances'. He would resign therefore unless there was 'a position of clear cut responsibility' that he could 'usefully fill'.

¹⁵⁶ Clark, *Tizard*, p. 232. Clark commented that Tizard was not a man to 'chip away at scientific integrity' and 'did not play politics'. Instead he resigned 'however politically unwise' that might have been. Lord Ashby once wrote that the 'scientist adviser who takes umbrage because his advice has been disregarded is likely to be someone who lacks the antennae which are the ultimate organs of perception in politics': see Lord Ashby, 'Scientists in the Whitehall Village', *Minerva*, 19 (1983), 641. From this perspective, Tizard simply lacked political acumen.

¹⁵⁷ Jones, *Most Secret War*, p. 102.

¹⁵⁸ University of Manchester Jodrell Bank Archive, (UOM JBA), Un-catalogued document entitled 'The Tizard Committee on Air Matters', no date or author specified. Rarely is the CSSAW referenced, and there is very little primary evidence of its activity. One of the CSSAW's lasting recommendations was the Radio Research Committee, which, after an initial period of inaction under Appleton, was reinvigorated in June 1941 by Lord Hankey who reformed the committee by attaching it the Chiefs of Staff under the title R.D.F. Policy Sub-Committee of the Chiefs of Staff Committee, first chaired by Air Marshal Joubert: Clark, *Tizard*, pp. 320–1.

¹⁵⁹ Zimmerman, *Top Secret Exchange*, p. 66; Fort, *Prof*, p. 262.

judgement of the country's senior expert on radio propagation than to a young physicist new to the arts of Intelligence?'¹⁶⁰ If indeed this was how Tizard saw the matter, he most certainly was not the only person to do so.

A letter written the day after the Downing Street meeting confirms that, irrespective of his intention to resign, and contrary to his stance that there was 'unnecessary excitement' about the 'alleged German system for dealing with' Britain, Tizard leant towards the beams' existence. He wrote of doubt in the opinion of all qualified to judge the technical possibility of the use of 'a beam system from an enemy operated country'. This letter showed no signs of grievance (or indeed rejection). Tizard saw it as his responsibility to encourage activity by generating further investigation through the channels of RDF and the Observer Corps, and concluded the letter by stating that he may have been wrong but there seemed to be 'unnecessary excitement' about 'this latest alleged German system for dealing with this country'. Although doubt was clearly evident in the language Tizard used, his scientific mindset ensured that regardless of improbability, experimentation should follow. He even laid out the possibility of British bombers being fitted with equipment to make use of the beams in order 'to follow German aircraft home and deal with them on their own aerodromes after a night raid'. This, he fancied, was the best way at that time to defend Britain from night air attack.¹⁶¹ Evidence also confirms that Tizard maintained interest in Jones's work.¹⁶²

¹⁶⁰ UOB DM1310/J.112, Frank in review of *Most Secret War for Physics Bulletin*.

¹⁶¹ IWM HTT15/44, Tizard to Newall, 17 June 1940. Tizard mistakenly referred to Jones in the letter as 'Dr. R.B.Jones, S.R.3 with A.I.1 (c)'.

¹⁶² IWM HTT 14, 'Tizard's Notebook Containing Occasional Diary Notes', entry for 30 October 1940. Tizard wrote that that he had seen Jones, who 'went through information about beams'; that Jones was 'writing a report'; and that Jones agreed to give Tizard a summary of this report for his records.

Even for Jones and scientific intelligence, the Downing Street meeting had not entirely put the beams beyond doubt. Jones was asked to attend an afternoon meeting that same day in the office of Air Commodore 'Daddy' Nutting, Director of Signals. The purpose of this conference was to consider the threat of pulse transmissions as navigational aids to German aircraft.¹⁶³ Eckersley took the opportunity to refute Jones's concept of *Knickebein* on theoretical grounds.¹⁶⁴ Jones responded by stating that this new calculation contradicted Eckersley's previous computations. Jones was startled to hear Eckersley reject his unpublished paper as an academic exercise, and an elaboration on a theory not to be taken as a guide to practical use.¹⁶⁵ Upon hearing this Lywood proposed that, as two investigative flights had also found nothing, further scheduled flights ought to be cancelled. Eckersley and Tizard were friends, so perhaps it was no coincidence that they were the only two men who rejected the beams theory.¹⁶⁶ That Eckersley's attempts to end any further investigation occurred directly after Tizard's humiliation in the Cabinet Room appears on the surface highly suspect. With lack of proof however, any suspicion has to remain as conjecture. It certainly placed Jones in an awkward predicament, for he had used Eckersley's computations to convince

¹⁶³ Jones, *Most Secret War*, pp. 102–3. Present at this meeting were Scott-Farnie, Eckersley, Nutting, and his two deputies, Air Commodore O. G. Lywood and Blandy. Operational technicians were also present at this meeting (not previously mentioned by any source), as recounted by Harry Spencer of AMRE: 'Bob Light, Vic Russell and I were rushed up to Whitehall to a conference on Knickebein at which R.V. Jones was present. It turned out to be a rather heated discussion, and I had to tread warily as I probably knew as much about Knickebein as anyone there except Jones': CCAC ROCO 1/1, 'Skirmish', by Harry Spencer. This document is signed by E. B. Callick and dated December 1994. Spencer recalled the date incorrectly as 'one evening in early June'.

¹⁶⁴ CCAC RVJO B.7 & TNA AIR 20/1623, Air Scientific Intelligence Report No.6 entitled 'The Crooked Leg', 28 June 1940, p. 10. Eckersley had calculated that the field strength at Nottingham of a one kilowatt beam transmitted from Cleves was 0.014 microvolts/metre, which was a negligible value, as the Lorenz receiver could only detect a minimum of about ten microvolts.

¹⁶⁵ Jones, *Most Secret War*, p. 103; Clark, *Rise of the Boffins*, p. 110.

¹⁶⁶ Clark, *Rise of the Boffins*, p. 105.

Lindemann, and, in turn, Churchill had approved action. Jones quickly pointed out that Eckersley's two sets of calculations neutralised themselves, and that flights for beam location had been authorised by Churchill, to which Lywood backed down and the flights went ahead.¹⁶⁷

There exists primary evidence to firmly suggest that there was more than one flight that night which confirmed the *Knickebein* beam; the one rarely discussed was undertaken by Sq/Ldr Robert Blucke and Harry Spencer of AMRE. The latter was a pre-war amateur radio enthusiast who had been enrolled as a 'listener'. Spencer recalled that Jones knew the actual frequencies of the 'K signals', but Spencer did not because his home built 'ham' radio receiver stopped at 30 MegaHertz (MHz) which was just below the beam frequencies. Spencer 'had some difference of opinion' over Eckersley's ideas on 'how strong the signals' were, for Eckersley was unaware 'of what had been going on in the ham band'. So it was agreed that Blucke and Spencer could attempt to 'find the signals'. Flying over the North Sea, they found the signals, but were 'spotted by an Me109 and had to take avoiding action in the mist at sea level', for 'the Anson was a slow aircraft and had no armament'. They returned safely to Northolt and reported their findings.¹⁶⁸

Spencer's recollection is instructive about the rudimentary nature of radio technology being employed by the services; in this instance the RAF were, by far, the most technologically-minded service of the three. It shows how radio

¹⁶⁷ Jones, *Most Secret War*, p. 103; Millar, *The Bruneval Raid*, pp. 72–3. Jones informed Millar that he did not immediately know that Lywood had backed down, and left the Air Ministry that day, went home 'and spent one of the most miserable nights of his life'.

¹⁶⁸ CCAC ROCO 1/1, 'Skirmish', by Harry Spencer.

amateurs were employed as 'listeners' for the Y-Service some two years before war commenced. Spencer also confirmed Jones's stance that Eckersley's evidence was tenuous, and further corroborated Eckersley's unfamiliarity with new procedures in listening for radio waves. That Spencer knew as much as Jones about the beams is also interesting, especially as Jones obtained the frequencies from ULTRA. The encounter with the Me109 demonstrates the danger these men from BADU faced in finding the beams. Perhaps their contribution was no less than that of the 'few' who more conspicuously defended Britain from *Lutwaffe* attacks.¹⁶⁹

The Anson flight that confirmed the existence of the beams took off from Wyton in Huntingdonshire piloted by Flight-Lieutenant (F/Lt) Bufton of BADU, with Corporal Mackie as observer on the evening of 21 June.¹⁷⁰ Jones had carefully considered that a possible prime target for German bombers could well be Derby, where, amongst other important industrial sites, the Rolls-Royce factory made Merlin engines for Spitfires and Hurricanes. He therefore directed the flight towards Derby in the hunt for the beam.¹⁷¹ One mile south of Spalding, Bufton and Mackie found a narrow beam (approximately 400–500 yards wide) having dots to the south and dashes to the north, on a bearing of 104°–284°. The carrier frequency was 31.5 mc/sec modulated at 1150 cycles, similar to Lorenz characteristics. They later found a second beam with similar characteristics, but with dots to the north and dashes to the south,

¹⁶⁹ Price, *Instruments of Darkness*, p. 38.

¹⁷⁰ S. Peach, *The Pathfinder Station: A History of Wyton Airfield* (St Ives: JMS Design, 1983), pp. 22–4. Jones provided the foreword to a later edition of this publication: see R. V. Jones, 'In Search of the Knickebein Beams' in S. Peach, *The Pathfinder Station: A History of Wyton Airfield* (Souvenir Edition, June 1984). This article was also published as 'Battle of the Beams', *Fly Past*, August 1984.

¹⁷¹ Jones, *Most Secret War*, p. 103; Seward, *Victory Denied*, pp. 198–9.

synchronised with the southern beam, apparently passing through a point near Beeston, bearing 60°+, and less than 104°. ¹⁷²

The flight did not take place over Derby as some authors have erroneously stated. Indeed, care must be taken over many accounts of the *Knickebein* chase. One author, for example, wrote that from 'scraps of intelligence' Jones 'worked out what the Germans were doing, told Churchill's Cabinet about it, and sent up a plane over Derby to discover that the narrow directional beam was two thicker radio beams, one of dots, the other of dashes, overlapped. Radio countermeasures could then be set in force, the *Knickebein* bombing beam bent, the *X-Gerät* of precision bombing annulled'. ¹⁷³ It was not Churchill's Cabinet, the plane did not fly over Derby, the *Knickebein* beams were not bent, and the Anson findings did not annul *X-Gerät*.

A meeting on 22 June 1940 set countermeasures in motion, the operations for which were aptly code-named 'Headache'. ¹⁷⁴ Lywood proposed formation of a special unit to counter the beams, named No.80 (Signals) Wing. The first unit was headed by RAF Signals Officer, W/Cdr E.B. Addison, and was initially established in a disused garage in Garston, North Watford, and later formed headquarters at Radlett in Hertfordshire. ¹⁷⁵ No.80 Wing was closely

¹⁷² CCAC RVJO B.7 & TNA AIR 20/1623, Air Scientific Intelligence Report No.6 entitled 'The Crooked Leg', 28 June 1940, p. 10; Jones, *Most Secret War*, p. 104; Clark, *Rise of the Boffins*, p. 112; Price, *Instruments of Darkness*, p. 31; Johnson, *The Secret War*, pp. 26–7.

¹⁷³ Nicholas Rankin, *Churchill's Wizards: The British Genius for Deception, 1914–1945* (London: Faber and Faber, 2008), p. 224; Ford, *Secret Weapons*, p. 254.

¹⁷⁴ Price, *Instruments of Darkness*, p. 31. Jones chose not to credit Lywood with the initiation of No. 80 Wing in *Most Secret War*, presumably because their relationship was strained.

¹⁷⁵ TNA AIR 41/46, 'No.80 Wing Royal Air Force Historical Report, 1940–1945', written by E. B. Addison and dated 11 January 1946, p. 10; Johnson, *The Secret War*, p. 28; Price, *Instruments of Darkness*, p. 32; Saward, *Victory Denied*, p. 199; Laurie Brettingham, *Royal Air Force Beam Benders: No.80 (Signals) Wing, 1940–1945* (Leicester: Midland Publishing, 1997), pp. 25–30.

connected to the Y-Service throughout the war, and allowed technical countermeasures to be prepared swiftly and effectively.¹⁷⁶ Lorenz apparatus were installed in RAF nightfighters so that they could ‘hunt the enemy up and down the beams’.¹⁷⁷ Design and development of technical countermeasures, were also initiated by a small team at AMRE under the guidance of a young physicist called Robert Cockburn. This marked the true beginnings of Radio Countermeasures (RCM), and heralded the entry of AMRE into the radio war—a war in which AMRE (and later TRE) would be the Allies’ vanguard.¹⁷⁸ Their immediate task was to produce radio jamming devices, but development of these would inevitably take time. By September 1940, when the *Luftwaffe* altered tactics to urban night bombing, No.80 Wing was positioned to cause maximum disruption of *Knickebein*.¹⁷⁹ A month later, the *Luftwaffe* began to realise that *Knickebein* was compromised.¹⁸⁰

In the meantime, interim measures were implemented. Addison requisitioned electro-diathermy sets (hospital equipment which employed radiation waves to cauterise wounds) and had them modified to transmit a kind of ‘mush’ noise on the same frequencies as *Knickebein* so as to ‘drown’ the dots and dashes. These were set up in selected police stations across the country, and Duty Constables were trained to switch them on when instructed by No.80 Wing.¹⁸¹ Addison also secured some Lorenz transmitters and had them modified to

¹⁷⁶ Hinsley *et al*, *British Intelligence in the Second World War, Volume I*, pp. 554–6.

¹⁷⁷ Although this idea was impractical as British nightfighters, for various reasons, were unable to partake in offensive activity until at least mid-1941: TNA AIR 41/17, AHB, ‘The Air Defence of Great Britain, Volume III: Night Air Defence. June, 1940–December, 1941’, p. 54.

¹⁷⁸ See CCAC ROCO 1/1 & CCAC RVJO B.158, ‘The Radio War’ by Robert Cockburn.

¹⁷⁹ Seward, *Victory Denied*, p. 200.

¹⁸⁰ TNA AIR 41/10, *The Rise and Fall of the German Air Force*, p. 93.

¹⁸¹ Addison cited in CCAC RVJO K.475, Transcript for ‘The Battle of the Beams’, p. 19; Jones, *Most Secret War*, p. 127; Clark, *Rise of the Boffins*, p. 114; Millar, *The Bruneval Raid*, p. 80; Johnson, *The Secret War*, p. 28.

radiate a beam similar to that from German *Knickebein* transmitters; the idea being that false beams would possibly confuse the German beam-bombers and push them off-course. No.80 Wing also took control of the early-war broadcast restrictions enforced to stop German aircraft using British radio waves to assist their navigation. A number of BBC engineers were commissioned as fresh technical personnel.¹⁸² And in case German aircraft were navigating using beacons (makeshift Fifth Column ones or otherwise), No.80 Wing took over GPO-inspired countermeasures of Masked Beacons, known as 'Meacons'. The first *Meacon* became operational on 24 July at Flimwell, near Tunbridge Wells.¹⁸³ No.80 Wing would pick up the German beacon signals, and then, in conjunction with GPO transmitters, would re-transmit them. This led to German pilots being unable to get true bearings on the beacons to determine their exact positions. There were nine *Meacons* operating in Britain by the middle of August 1940.¹⁸⁴

Sophisticated long-term countermeasures consisted of powerful transmitters designed and built by AMRE. Within five days of the 21 June Cabinet Room meeting, Joubert was able to report that US-built 'Hallicrafter' receivers had been installed atop RDF towers at Ottercops, Bawdsey, West Beckham, Staxton Wold, and Dover. These countermeasures, codenamed 'Aspirins', were to cure the *Headache*. Eventually, twenty-eight *Aspirins* were installed along the east coast of Britain.¹⁸⁵ Mobile vans equipped with radio apparatus were also used to assist in monitoring German signals, and to render jamming

¹⁸² TNA AIR 41/17, AHB, 'The Air Defence of Great Britain, Volume III: Night Air Defence. June, 1940–December, 1941', p. 50.

¹⁸³ Price, *Instruments of Darkness*, pp. 32–5; see also Jones, *Most Secret War*, p. 127.

¹⁸⁴ Clayton, *The Enemy is Listening*, p. 70.

¹⁸⁵ Clark, *Rise of the Boffins*, p. 115; Johnson, *The Secret War*, p. 29.

more effective.¹⁸⁶ *Aspirins* transmitted dots similar to those of *Knickebein*, and so 'fake' dots were synchronised with *Knickebein* giving the appearance of bending the beams and sending German bombers off course.¹⁸⁷

Countermeasures however, were not the domain of intelligence. While *Knickebein* was tackled by RAF personnel and AMRE scientists and technicians, Jones contemplated his next step and compiled SIR No.6. For Jones, the lessons were obvious: German RDF technique was well developed (almost beyond what British scientists thought possible), for if the GAF could place aircraft to within 400 yards over Britain, 'they may well have had an extremely accurate system of RDF' the British knew nothing of. Clearly Jones felt the need to further press his case for the continuing appreciation of scientific intelligence, particularly by emphasising that *Knickebein* had been discovered by piecing together intelligence from sixteen independent sources. In praising those involved, Jones ended his exemplary *Knickebein* SIR with the phrase if 'good fortunes hold' the 'crooked leg' may well be pulled.¹⁸⁸ Joking aside, while praising those who had originally established him in scientific intelligence (Tizard, Pye, Winterbotham, and Woodward-Nutt), Jones could not resist criticising initial Treasury opposition to his employ in characteristic 'told you so' manner.¹⁸⁹

¹⁸⁶ TNA AIR 41/17, AHB, 'The Air Defence of Great Britain, Volume III: Night Air Defence. June, 1940–December, 1941', p. 50.

¹⁸⁷ Robert Cockburn cited in CCAC RVJO K.475, Transcript for 'The Battle of the Beams', p. 19; Jones, *Most Secret War*, pp. 127–8; Johnson, *The Secret War*, pp. 31–2. Jones wrote that *Aspirins* transmitted dashes not dots.

¹⁸⁸ CCAC RVJO B.7 & TNA AIR 20/1623, Air Scientific Intelligence Report No.6 entitled 'The Crooked Leg', 28 June 1940, p. 11. Jones praised Bufton and Mackie for the excellence of their observations in 'heavy cloud and darkness' during the 21/22 June Anson flight. There is no mention of Blucke and Spencer's flight in this document.

¹⁸⁹ CCAC RVJO B.7 & TNA AIR 20/1623, Air Scientific Intelligence Report No.6 entitled 'The Crooked Leg', 28 June 1940, p. 1.

Even though chasing *Knickebein* 'had its frights', it was 'the best fun' Jones ever had.¹⁹⁰ Moreover, those ten days (11–21 June 1940) thrust him 'from obscurity to the highest level of the war'.¹⁹¹ This cannot be doubted, and although Churchill and Jones were not to meet personally again for another two years, the *Knickebein* chase ensured Churchill's attention whenever Lindemann mentioned Jones's name again. Thereafter, Prime Ministerial attention to scientific intelligence was almost guaranteed directly via Lindemann, and throughout the war every SIR written was written with Churchill in mind. With a sense of personal pride Jones believed that at that time he had stood 'alone in a vital gap' in Britain's defence.¹⁹² He was far from alone in the Battle of the Beams however, for he was greatly assisted by a careful selection of contacts. Jones was much more praising of his *Knickebein* compatriots in SIR No.6, than he was in any of his later recollections.

Intelligence is (and always has been) the endeavour of knowing the enemy by gathering dependable information.¹⁹³ In the *Knickebein* chase, Jones accomplished the first part of this statement admirably – at least as far as understanding what science Germany was utilising to threaten Britain's defence. As to the second part of the statement, it is doubtful whether Jones believed that the evidence he was piecing together was 'dependable'. In 1940 ULTRA was untried and untested and, irrespective of its absolute secrecy, its authenticity was yet to be confirmed. To say that 'the first Enigma decrypts were being thrown into waste paper baskets is undoubtedly going too far, but

¹⁹⁰ Jones, 'Scientific Intelligence', 356; Clark, *Rise of the Boffins*, p. 117.

¹⁹¹ Jones, 'Intelligence and Command', p. 288; Jones, *Most Secret War*, p. 108.

¹⁹² Jones, *Most Secret War*, p. 109.

¹⁹³ Eva Horn and Sara Ogger, 'Knowing the Enemy: The Epistemology of Secret Intelligence', *Grey Room*, 11 (Spring 2003), 61–2.

the result was similar'.¹⁹⁴ POW evidence was strong on the surface, but certainly did not amount to much on its own and, for the first two years of the war, was not considered one of the more reliable sources of intelligence.¹⁹⁵ Of all the fragmentary evidence Jones worked with in the chase for *Knickebein*, the documents salvaged from *Luftwaffe* aircraft (the diary and unearthed torn pieces of paper) proved the most convincing items of all. The RAE deserve more than the weakly-acknowledged credit in the *Knickebein* affair as well.

Intelligence analysis however, is so much more than information processing. Jones's tenacious belief in the beams theories (despite the weight of evidence to the contrary thrust upon him by the so-called experts) proved at least that Jones had grasped this fundamental point. Scientific intelligence required that extra element of scientific deduction. Clearly Jones did not doubt his own scientific abilities during the *Knickebein* chase, yet others did. If the *Knickebein* issue had taught Jones anything, it was to be wary of, perhaps even avoid, expert advice. As Jones wrote at the time, *Knickebein* 'nearly succeeded because of its sheer incredibility'.¹⁹⁶ This permanently altered his thinking, to the effect that he later believed that 'an expert is not the best man to interpret the information from Intelligence sources'. For Jones, experts were not collators but were source. He had no desire to demonstrate that he was better at his own job than were the experts who often tried to do his job for him, except in so far as it may 'ease the path' of his successors in scientific

¹⁹⁴ West, *MI6*, p. 186. West's argument was that in inventing the imaginary agent cover-name of 'Boniface', Menzies unwittingly devalued ULTRA. The reputation and credibility of SIS was so low in Whitehall that yet another SIS agent was greeted with understandable scepticism by all three services.

¹⁹⁵ TNA AIR 40/1177, 'Intelligence from Interrogation', p. 16.

¹⁹⁶ CCAC RVJO B.23, Air Scientific Intelligence Report No.12 'German Beam Policy', 23 July 1941.

intelligence.¹⁹⁷ He informed these successors that although the number of occasions on which experts were wrong was likely to be small, each occasion was likely to be important. Scientific intelligence was (and is) a specialist task; one with the ultimate responsibility of competent collation in the light of expert opinion and of the available intelligence.¹⁹⁸

Jones had to find all of this out the hard way through practical experience. For this reason Jones can safely be credited as being the trailblazer of scientific intelligence. In mid-1940 however, with a scenario of tenuous evidence trickling through to him and with sceptics and doubters everywhere, Jones's statement, that in mastering *Knickebein* he 'put Scientific Intelligence on the map', is questionable. Irrespective of his new-found high-profile audience, Jones and scientific intelligence still had a long way to go.

¹⁹⁷ Jones, 'Scientific Intelligence', 356.

¹⁹⁸ UOB DM1310/J.122, 'Scientific intelligencer' written by Jones, no date.

Chapter III: The Battle of the Beams, Part Two: *Wotan*

It is widely believed that the intelligence victory over *Knickebein* was a great triumph for Jones, and ensured that the next time the watchdog barked, people would listen and comply.¹ This was not the case. Throughout 1940 Jones was still perceived more as a yapping annoyance than a barking watchdog, particularly to many of the Air Staff officers. He had, however, become a little more important for, as the *Knickebein* problem had highlighted, there was ‘no-one else in a position to tell more than fragments of it’.² Jones would continue to be a solitary scientific intelligence warrior throughout the Battle of Britain and the Blitz—events which starkly demonstrated that the Battle of the Beams was far from over.

After the ‘Headache’ of *Knickebein* had cleared, Jones set himself the task of understanding the scientific concept behind *X-Gerät*. To use Jones’s phrase, *Knickebein* used ‘hotted-up’ Lorenz-type receivers.³ In contrast, *X-Gerät* required specialised equipment. Moreover, where *Knickebein* functioned with the transmitting of two beams crossing each other over bombing targets, *X-Gerät* functioned with five main beams. One was an approach beam that directed the pilot. Another was a reserve approach beam, adjacent (but not parallel) to the main approach beam. The other three were cross-beams, monitored by navigators who controlled visual indicators and bomb-release

¹ Price, *Instruments of Darkness*, p. 38; Lewin, *Ultra Goes to War*, pp. 80–1. Lewin attributed the *Knickebein* chase as a ‘triumph for Ultra’, essentially because, during the Battle of the Beams, ULTRA had confirmed other inconclusive intelligence.

² UOB, DM1310/A.16, Frank to Dr. Stanley Hooker FRS, dated 13 August 1981.

³ Jones, *Most Secret War*, p. 99.

computers pre-set to calculate wind speed and altitude.⁴ This small mechanical computer involved a stop-clock, started by navigators when location of the first cross-beam was acknowledged through audible receiving equipment. The mechanism was stopped on the main cross-beam and, assuming the correct height information had been set, the mechanism would independently calculate bomb-release.⁵

The only *Luftwaffe* formation equipped with *X-Verfahren* was the first 'Pathfinder Unit' in history. This was the specialist unit *Kampf Gruppe 100* (KGr100), later *Kampf Geschwader* (KG100), raised to drop incendiaries ahead of the main bomber force to light up that night's target.⁶ By late-September 1940, KGr100 had flown 40 sorties using *X-Gerät*, dropping bombs on numerous targets (half of the attacks were on London). During this period the squadron operated as an independent force, visiting targets alone and attempting precision attacks using the beams, while other *Luftwaffe* squadrons struggled with the increasingly-jammed *Knickebein*. By early-October, KGr100 reverted to accurately dropping incendiaries to mark targets for the rest of the 'de-*Knickebeined Luftwaffe*'.⁷

The Battle of the Beams has often been referred to (after Jones) as a 'cut and thrust' (or 'cat and mouse') episode, in which the GAF counter-attacked with

⁴ Robin Neillands, *The Bomber War: Arthur Harris and the Allied Bomber Offensive, 1939–1945* (London: John Murray, 2001), p. 62.

⁵ Jones, *Most Secret War*, p. 140.

⁶ See Clark, *Rise of the Boffins*, p. 118; Johnson, *The Secret War*, p. 44; John Ray, *The Battle of Britain: Dowding and the First Victory, 1940* (London: Cassell Military Paperbacks, 2001), p. 130.

⁷ CCAC RVJO J.1, 'The Radio War', 11 April 1946; CCAC RVJO B.18 & TNA AIR 20/1627, Air Scientific Intelligence Report No.10, 'The X-Gerät', 12 January 1940, p. 13; Churchill, *Their Finest Hour*, p. 316; Price, *Instruments of Darkness*, pp. 40–1.

X-Gerät following universal jamming of *Knickebein*.⁸ It was more complicated than this. German use of radio beams gradually accelerated, appending each technological system concurrently to the offensive.⁹ Even German POWs demonstrated confusion, perhaps because the two systems were in operation at the same time, with *Knickebein* the more widespread. Only when the GAF finally admitted that *Knickebein* was being jammed did they resort to using *X-Gerät* for fire-raising purposes, and even then *Knickebein* was still widely used for navigation.¹⁰ As late as February 1941, POW *Oberleutnant* bomber pilot A.704 confirmed to *Oberleutnant* Fighter pilot A.633 that transmissions of 'Knickebeins' and 'X' things' were simultaneous.¹¹ Developed sooner than anticipated, *X-Gerät* was first tested in the September 1939 bombing of Warsaw.¹² Jones discovered after the war that even *Y-Gerät* had been tested by spring 1940.¹³ The process was clearly more structural than reactive.

⁸ See as examples: Stafford, *Churchill and Secret Service*, p. 227; Ford, *Secret Weapons*, p. 256; Downing, *Churchill's War Lab*, p. 168.

⁹ Bennett, *Behind the Battle*, p. 62.

¹⁰ CCAC RVJO B.23, Air Scientific Intelligence Report No.12 'German Beam Policy', 23 July 1941, pp. 4 & 8. Although *X-Gerät* was probably only used in service trials, the fact that *X-Verfahren* transmitters were erected on the borders of Czechoslovakia, Poland, Holland and France respectively confirms that *X-Gerät* was used in conjunction with *Knickebein*. It is probable that *Knickebein* offered a much less-complicated option for the *Luftwaffe*, one with a speedier cockpit installation to accommodate the surprisingly swift continental victories. Another probability was that the GAF did not appreciate the merits of *X-Gerät* until it was too late. Captured diaries showed that it was still possible to use *Knickebein* for bombing purposes well into 1941.

¹¹ TNA WO 208/3507, Extract from SR Report No.882. Information received 1 February 1941.

¹² Scientist Hans Plendl adapted the Lorenz system in 1933, and within five years his work began to bear fruit with the introduction of *X-Gerät*: TNA WO 208/3507, 'Special Extract No.69 from S.R. Draft Report No.124'. Information received 8 November 1940; Price, *Instruments of Darkness*, p. 21.

¹³ Jones, *Most Secret War*, pp. 179–80.

The Post-*Knickebein* Lull

A Red Enigma message decrypted on 27 June 1940, confirmed the existence of '*Knickebein* and *Wotan Angalan* (installations) near Cherbourg and Brest'.¹⁴ *Wotan Angalan* was new to Jones. From his sparse knowledge on Norse mythology he knew that *Wotan* was Zeus of the German Gods, but was unsure of anything unusual about this deity. Norman, an expert in German heroic poetry, recalled to Jones on the telephone that *Wotan* had one eye, and made the supposition that the GAF could be implementing a one-beam system.¹⁵ This erroneously led Jones to believe that *X-Gerät* was exactly that.

Jones may well have been further deflected from the true method of *X-Verfahren* by additional POW information. POW A.231 (the anti-war German) was asked about *Wotan*. He stated that *Wotan* employed only one beam instead of two, involved some method of determining distance along the beam, and had a visual indicator which lit a red lamp when on course, and a green lamp when off course. Jones was not convinced and questioned the reliability of this evidence. His scepticism was based on the grounds that he believed that the Germans had much better ways of performing both operations. This thinking was strange considering he had just successfully countered *Knickebein* assisted by A.231's previous invaluable evidence. However, he wrote in his SIR No.7 that, although it would be unwise to rely on the details of POW evidence, the conclusion that *Wotan* was *Knickebein* with one beam comprising some method of distance determination was valuable in

¹⁴ CCAC RVJO B.9 & TNA AIR 20/1624, Air Scientific Intelligence Report No.7 'The Edda Revived', 17 July 1940, p. 1; CCAC RVJO B.15 & TNA AIR 20/1626, Air Scientific Intelligence Report No.9 'Knickebein Photographed', 20 September 1940, p. 1.

¹⁵ Jones, *Most Secret War*, p. 120; Jones, *Reflections on Intelligence*, p. 297.

itself. Nonetheless, in the same report, Jones also wrote that it was possible that the prisoners themselves were somewhat confused, and had mixed up the *Knickebein* and *Wotan* systems.¹⁶ Other POWs were asked of *Wotan* but nothing was forthcoming, not even in bugged conversations.¹⁷ By 3 June, AI1(k) had circulated their own theories on *X-Gerät*; that it worked by one or two 'very narrow Radio Beams, possibly with the addition of a Pulse Altimeter', and that 'Cross Radio Beams' were transmitted from Germany so that aircraft flew along one beam, and that upon reaching the intersection of the cross-beams bombs were 'released automatically'.¹⁸

It is impressive that AI1(K) had made such reasonable suppositions from interrogations and eavesdropping. That this evidence was taken so lightly however, confirms how low the regard was for POW intelligence. Jones was fully aware that Germany was exploiting its new geographical advantage by erecting fresh *Knickebein* towers, and hoped that Norman (and Enigma) would be more forthcoming on the subject. Covering ULTRA, Jones wrote that the secret intelligence source who provided vital information concerning *Knickebein* had been instructed to 'do his utmost' to follow up any further indications on *Knickebein* or any other related matter.¹⁹ On 5 July this source signalled that German aircraft had successfully intercepted British armed

¹⁶ CCAC RVJO B.9 &TNA AIR 20/1624, Air Scientific Intelligence Report No.7, 'The Edda Revived', pp. 3–5.

¹⁷ In the files TNA WO 208/3506 and WO 208/3507 there are only two mentions of *Wotan* during July 1940, the first on 5 July (Extract No.23), and the second on 31 July (Extract No.34). Neither prisoner offered any new data, although, in the former extract, A.258 stated that '*Wotan* changes so often now'.

¹⁸ TNA WO 208/3507, AI1(k) report entitled 'X-Gerat', 3 June 1940.

¹⁹ CCAC RVJO B.9 &TNA AIR 20/1624, Air Scientific Intelligence Report No.7, 'The Edda Revived', p. 2. With Norman as his Bletchley contact, it was easy for Jones to disguise Enigma decrypts in his reports.

reconnaissance flights owing to excellent *Freya-Meldung* (*Freya* reporting). The source also reported on 14 July something called *Freya-Gerät*.²⁰

Jones purchased a book on mythology and researched the possibilities. He read that *Freya* was a Norse Goddess who owned a necklace called *Brisingamen*. This necklace was guarded by *Heimdall*, the watchman of the Gods, who could see for a hundred miles by day and night. This was possibly a disguised reference to a coastal chain similar to that on the east coast of Britain, detecting with a range of 100 miles. Jones thought *Heimdall* himself would have been a better code-name for RDF, although perhaps too obvious. Jones concluded that *Freya-Gerät* was a portable RDF, and that *Freya* may possibly be associated with *Wotan*, for she was at one time his mistress.²¹ In effect, Jones was guessing at *Wotan* and *Freya*, while the offensive/defensive nature of this supposed German radar capability remained elusive. He could only assume that the POWs had been confused over the different systems, particularly in referring to automatic bomb-release which seemed extremely far-fetched. Jones's own confusion at this time can be seen in his belief that the *Knickebein* countermeasures would work against *Wotan*. *Most Secret War*, on the other hand, presents a much more systematic approach to the problems he encountered in July 1940.

The Air Staff remained highly sceptical over the beams theory. Lywood, for example, ridiculed Jones's *Knickebein* success as a 'nine-day wonder', for the

²⁰ CCAC RVJO B.9 & TNA AIR 20/1624, Air Scientific Intelligence Report No.7 'The Edda Revived', pp. 3-4; Jones, *Most Secret War*, p. 121.

²¹ CCAC RVJO B.9, Air Scientific Intelligence Report No.7 'The Edda Revived', p. 3; Jones also discovered that the Brocken mountain was the special abode of *Freya*. He also supposed that Hitler would have preferred the codename *Frigga*, who was *Wotan's* lawful wife.

beams had not materialised into a major threat after all. Jones claimed in his defence that Lywood resented his youth, and that Hitler had specifically forbidden the bombing of London at that time.²² Perhaps the intense pressure of July 1940 explains Jones's confusion over German radio and radar capabilities. He was learning quickly, and practically, that in intelligence you are expected to have all the answers, all of the time, and that not soon enough is not good enough. He spent the remainder of July preparing his monthly summary for August 1940.

Jones's monthly summaries had a wider distribution than the SIRs and briefly described new German scientific and technological developments.²³ It is questionable whether many of the items covered were subjects for scientific intelligence, but are nonetheless informative as to how much data Jones was receiving at that time. While preparing the August 1940 monthly summary, Felkin circulated a recovered document which again brought *Knickebein* to the fore. It referred to special tuning squads for *Knickebein* to be used at long range. On 27 July, an Enigma decrypt announced that one of these tuning squads had been requested by KG54 for the week beginning 5 August. This was important intelligence, for it not only heralded imminent attack on the west of England (known as the 'hunting ground' of KG54) but also confirmed that the Cherbourg *Knickebein* station was operational (Cleves *Knickebein* was out of range). Jones was therefore able to give warning on 4 August that

²² Jones, *Most Secret War*, p. 123. A fact confirmed by GC&CS.

²³ CCAC RVJO B.10, Air Scientific Intelligence Monthly Summaries Nos.3 and 4, 31 July 1940. Jones made an apology for not producing a Monthly Summary for June, owing to the 'preoccupation of the entire staff of this branch with a specific problem'. Jones's use of the words 'entire staff of this branch' is notable for its overstatement, and perhaps its cynicism.

major bombing appeared imminent, possibly on Manchester and Liverpool, and that 'Aspirins' should be set in place accordingly.²⁴

Jones thought that KG54 was either 'playing about' with 'new Lorenz Blind Landing Equipment', or intending 'to experiment with a new Knickebein beacon from Cherbourg'.²⁵ He was eagerly watchful for a *Knickebein* alternative—one more advanced, more superior, and possibly more sinister. In the meantime, AI1(k) persistently prompted POWs on *X-Gerät*, *Wotan* and *Freya*. On 31 July, POW *Hauptman* A.296 was overheard referring specifically to *Wotan* and *X-Gerät*.²⁶ Two days later, when asked of *X-Gerät*, *Leutnant* A.305 spoke of an explosive charge built inside the equipment, so that when a knob was pressed 'the inside of the thing falls apart'.²⁷ This was useful, for it confirmed the existence of cockpit mechanisms in connection with *X-Gerät*. Whether the POW believed the instrumentation would indeed explode upon tampering is hard to gauge, although the alternative suggests that he knew he was being bugged. On 5 August *Unteroffizier* A.302 and *Gefreiter* A.316 spoke of all the prompted words (including *Knickebein*) and expressed ignorance on them all.²⁸ *X-Gerät* was specific to the Pathfinders so most

²⁴ CCAC RVJO B.11, minute by R.V. Jones entitled 'Knickebein, Cherbourg', 4 August 1940; Jones, *Most Secret War*, p. 123. The other possibility Jones considered was that KG54's blind landing receivers needed expert attention, although AI3(b), responsible for aircraft order of battle intelligence, were unable to confirm whether Lorenz Blind landing equipment was installed at the two aerodromes mentioned in the Enigma decrypt (Evreux and St. André). Positioned some 30-40km south of Rouen, these aerodromes confirmed the operational area of KG54 to be Chichester-Reading-Oxford-Wolverhampton-Manchester-Liverpool-Shrewsbury-Bristol-Yeovil-Portland.

²⁵ CCAC RVJO B.11, minute by R.V. Jones entitled 'Knickebein, Cherbourg', 4 August 1940.

²⁶ TNA WO 208/3506, SR Extract No.34. Information received 31 July 1940. The POW stated that even if he wanted to, he could not tell anything 'because it is not known to me'.

²⁷ TNA WO 208/3506, SR Extract No.35. Information received 2 August 1940. Comparison of the high number of POW designations with the relatively low extract number clearly demonstrates the regular influx of POWs, and the very limited discussion in conversations on the beams systems.

²⁸ TNA WO 208/3506, SR Extract No.36. Information received 5 August 1940.

Luftwaffe crew would have known little about it but, as *Knickebein* was relatively universal, perhaps they had become aware of hidden microphones.

With the Operation *Eagle* offensive commencing on 13 August, the influx of *Luftwaffe* POWs comprised daylight bomber crews and fighter pilots, rather than night-bomber crews. These were necessarily pressed for more urgent information, and so *X-Gerät* matter was temporarily shelved by AI1(k).²⁹ Jones turned his attention to the broader analysis of the continental location of German radar. In doing so he was making a concerted effort to fully appreciate the scientific technicalities linking *Luftwaffe* cockpit apparatus to the root sources of transmissions received. That *X-Gerät* intelligence had temporarily become sparse was no reason to rest on his newly-earned laurels. On 14 August 1940, Jones circulated SIR No.8 on *Freya*, deeming it perhaps timely to review knowledge gained and to place fresh intelligence on record, including the data from AI1(k), from the 'A1 source' (Norman), and from a source of unknown reliability, which had reported oral evidence from an AEG engineer who witnessed a convoy of camouflaged trucks arriving in Cherbourg carrying mobile high frequency radio equipment.³⁰

Jones deduced that *Freya* was an aircraft reporting system, limited to possible detection principles of either visual, audible, infra-red, or some type of RDF. He selected the latter as the most plausible, based on knowledge of British

²⁹ There exist only eight POW extracts for the whole of August 1940 related to *Knickebein*, *X-Gerät*, *Wotan* and *Freya* – the two mentioned above, and also on 2, 13, 17, 18, and two on 25 August. None presented any fresh information. One of note was from *Leutnant* A.388 who believed *Knickebein* worked with X-Rays. He told his room-mate *Leutnant* A.358 how he had 'never used the beastly thing' and did not know how it worked. This was obvious.

³⁰ CCAC RVJO B.12 TNA AIR 20/1625, Air Scientific Intelligence Report No.8 'Freya', 14 August 1940, p. 1.

scientific capabilities and preferences. It is instructive that Jones compared German and British RDF, deeming Germany to be technologically behind due to the absence of any general method of IFF – which by this time was operational in British RDF ground stations differentiating between RAF and GAF aircraft and assisting successful interceptions. Jones also reported on German knowledge of British radar. On the day before *Adlertag* an Enigma decrypt spoke of *Luftwaffe* bomber, fighter, and heavy fighter squadrons amassing over France, rather than over the Channel, perhaps confirming German suspicions that the range of British RDF masts could reach as far as the French coast. This further provided explanation for the 12 August discriminating attacks of British RDF stations. Jones also referred to *Wotan* and how the general absence of German IFF did not rule out the possibility of pulse modulated bombing navigational aids, although it would heavily restrict its usage, for new equipment would be required to be fitted to GAF bombers. In conclusion, Jones surmised that *Freya* was mobile RDF, with a probable range of less than 70 miles, but great enough to facilitate fighter interception. He surmised that although the German method for controlling interceptor aircraft was still unknown, it was likely to be inferior to the British model, and pondered that, if the GAF were aware of British RDF locations (as demonstrated on the eve of *Adlertag*), then why had there been little or no effort to jam British radar.³¹

SIR No.8 is among the most informative items of primary evidence that details British understanding of German RDF capabilities during the Battle of Britain.

³¹ CCAC RVJO B.12 TNA AIR 20/1625, Air Scientific Intelligence Report No.8 'Freya', 14 August 1940, pp. 3–5.

Much of it was guesswork and supposition on Jones's part, albeit based on the fragments of evidence that he had garnered in various ways. Analysed now, with the benefit of hindsight, it is not too far off the mark. This report is also most telling of Jones's mindset at the time. He had passed aside the problem of *Knickebein* (for it was not his fight anymore), and it seemed *Wotan* and *X-Gerät* were temporarily off the agenda. There was little he could do intelligence-wise to assist the Spitfires and Hurricanes in aerial combat with the Dorniers, Messerschmitts, Junkers and Heinkels. But at least he could attempt to understand *Freya* in order to fulfil his still rather tenuous and unappreciated role. Hard work would eventually reap rewards, not only for him personally, but also for the pursuit of scientific intelligence.

Other than the Monthly Summary No.5 for August 1940, SIR No.8 is the only record of Jones's activity during that difficult month.³² Without corroborating evidence it is difficult to assess Jones's work in any depth during this time. Jones had little to say of this period in his memoirs, stating only that he had 'many minor distractions' and that he 'chased a miscellany of details'.³³ Many of these details were in his deductions of German RDF which he discussed in SIR No.8 and reiterated in the August 1940 Monthly Summary, along with other 'miscellany'.³⁴ This all amounts to scant work compared to most other months of the war, suggesting that British scientific intelligence was as hampered by the Battle of Britain as everything else. Drying-up of source

³² Throughout the Jones papers there is no correspondence for the month of August 1940, nor are there any entries in Jones's personal pocket diary; see CCAC RVJO A.205, Jones's Personal Diary 1940. In fact, there are no entries in Jones's personal pocket diary for the remainder of 1940 post 16 May. This is firm evidence of how the chase of *Knickebein* consumed his time after that date.

³³ Jones, *Most Secret War*, p. 125.

³⁴ CCAC RVJO B.13, Air Scientific Intelligence Monthly Summary No.5 for August 1940.

material, intermittent air raids, and general reactive and thus negative activity persisted. The Germans described their raids during this period as *störangriff* (dislocation or nuisance raids). One POW stated that nuisance raids against England were designed not only to affect British arms production, but also as a necessary sop to the German people.³⁵ Generally however, the German terminology *störangriff* was described as a means to disrupt sleep and production.³⁶ It seems that as far as scientific intelligence was concerned, the GAF achieved their goal.

Hitler ordered that the terror-bombing of London should be reserved for him alone to command.³⁷ On 24 August there occurred the ‘accidental’ bombing of London, perhaps caused by the jamming of *Knickebein*.³⁸ While historians have agreed that this was an accidental occurrence, they have not agreed on the specifics.³⁹ If beam-jamming countermeasures did force the unconfirmed quantity of GAF bombers to unload over London, then it could be firmly asserted that it was the quick responsive action of the scientists, technicians, and airmen involved in beam-jamming activity that really altered the course of the Battle of Britain. For in reprisal to the accidental bombing of London, Churchill demanded the bombing of Berlin. This sparked Hitler’s Reichstag speech of 4 September, in which he announced the determination to ‘stop the handiwork of these night pirates’. Thereafter he saw *terrorangriff* (terror raids)

³⁵ TNA AIR 40/2398, AI1(k) Report 213/1940 written by S. D. Felkin, 1 August 1940, p. 2.

³⁶ TNA AIR 41/17, AHB, ‘The Air Defence of Great Britain, Volume III: Night Air Defence. June, 1940–December, 1941’, p. 41.

³⁷ Ian Kershaw, *Hitler, 1936–1945: Nemesis* (London: Allen Lane, 2000), p. 309.

³⁸ Millar, *The Bruneval Raid*, p. 81.

³⁹ Churchill marked it as a ‘sporadic raid’: Churchill, *Their Finest Hour*, p. 281. For differing accounts of this ‘accidental’ raid see Gilbert, *Finest Hour*, pp. 120–1; Kershaw, *Hitler*, p. 309; Wood and Dempster, *The Narrow Margin*, p. 304.

as the final gamble in the search for a quick end to the war with Britain.⁴⁰ This opened a new phase in the GAF air offensive.

The Rise of X-Gerät

On the afternoon of 7 September a force of more than 300 bombers attacked the docks of East London. That evening 250 bombers visited the same objective guided by the still blazing fires.⁴¹ By dawn 306 civilians were dead, and 1337 seriously injured.⁴² The shift in GAF strategy has been one of the most hotly debated aspects of the Second World War. Consensus remains that British civilian suffering was the price for RAF reprieve. The irony is that the *Luftwaffe* high command was fully informed before the war that terror attacks on London would hardly contribute significantly to a war decision, but would strengthen the British will to resist.⁴³ This type of attack did, however, mean full operational use of navigational beams.

As more and more *Aspirins* and *Meacons* came on line, the use of X-Gerät to supplement *Knickebein* became operational. Dowding was alert to the danger that the *Luftwaffe* could traverse Britain 'unimpeded at night', and that they had begun to use flares to illuminate objectives.⁴⁴ Although this realisation was too little too late for Dowding's career and reputation, activity was stepped up to obtain further knowledge on German radio beams suspected to

⁴⁰ Overy, *The Air War*, p. 35.

⁴¹ Ministry of Information, *Frontline 1940–41: The Official Story of the Civil Defence of Britain* (London: HMSO, 1942), pp. 10–14; Butler, *Grand Strategy, Volume II*, p. 287.

⁴² John Terraine, *The Right of the Line: The Royal Air Force in the European War 1939–1945* (Ware: Wordsworth Editions, 1998), p. 208. For Jones's recollections of the 7 September 1940 raids see Jones, *Most Secret War*, p. 128.

⁴³ Horst Boog, 'German Air Intelligence in the Second World War', *Intelligence and National Security*, 5: 2 (April 1990), 357.

⁴⁴ TNA AIR 41/17, August 1940 memorandum written by Dowding cited in AHB, 'The Air Defence of Great Britain, Volume III: Night Air Defence. June, 1940–December, 1941', p. 46.

be guiding flare-dropping pathfinders. Due to the intense GAF night-bombing activity, source intelligence on *X-Gerät* dramatically increased in early September 1940. Hut 6 success in cracking Brown enabled access to a communications link between a navigational beams research establishment and KGr100's base in Vannes.⁴⁵ Norman discussed with Jones a decrypt detailing beams with widths of 8–10 seconds of arc (or an angle of 1 in 20,000), implying beams no wider than twenty yards at 200 miles. This decrypt also contained the 'electrifying' intelligence that *X-Gerät* was being fitted to an aircraft with the call-sign 6N+LK.⁴⁶

Jones also received information from Scott-Farnie that transmissions had been heard emanating from the Cherbourg/Calais area at 70mc/sec that were clearly not for communication, had all the same Lorenz characteristics of *Knickebein*, but with a distinct modulation note. Also the rate of keying of dots and dashes were on a much higher frequency. The Y-Service had concluded that these transmissions, owing to their unusual modulation and geographical source location, may have been intended for the navigation of mine-layers or Motor Torpedo-Boats (MTBs).⁴⁷ Jones perhaps received a POW conversation extract between *Oberleutnant* A.395 and *Leutnant* A.427, in which A.395 commented that he had been asked during interrogation about *Knickebein* that his *Geschwader* needed 'when the clouds started at the end of September'. A.427 remarked that 'someone must have blabbed'. But A.395 wanted to know how the British knew that *Knickebein* was needed in fog.

⁴⁵ Smith, *Station X*, p. 53.

⁴⁶ Jones, *Most Secret War*, p. 135.

⁴⁷ Johnson, *The Secret War*, p. 42.

A.427 replied that *Knickebein* was 'not so important', for there were 'other things besides *Knickebein*'.⁴⁸

In the meantime, Jones had established that aircraft 6N+LK was from KGr100 and so investigated their activities. By 11 September he was confident enough to produce an interim report on *X-Gerät*. He reported that the Germans were bringing into use a system of beam transmitters different from the *Knickebein* group, and that there were at least five new high-power beam transmitters; the one at Calais transmitting fine and coarse directional beams with a breadth of 8–10 seconds, and operational since 23 August. Jones posited that *X-Gerät* and KGr100 were closely associated, and concluded with near certainty that *Knickebein* and *X-Gerät* were not the same; although they employed similar principles, *Knickebein* was manually operated while *X-Gerät* was probably a fully automatic system of blind bombing. Jones proposed with some urgency that a similar treatment for *X-Gerät* as had been administered for *Knickebein* would be efficacious, if only to jam the coarse director beams and stop KGr100 finding the fine beams.⁴⁹

Thirteen days after his first official *X-Gerät* revelation, Jones produced a second 'scarcely credible' interim report.⁵⁰ Fresh intelligence had led him to believe that the coarse beams were being crossed by two fine beams for elimination of major bombing errors. Jones thought that this scientific development meant that 'the apparent eclipse of German science after the

⁴⁸ TNA WO 208/3507, Extracts from interrogation TNA reports on 'X Gerat' and 'Knickebein', Extract 43. Information received 7 September 1940.

⁴⁹ CCAC RVJO B.14 & TNA AIR 20/1669, Air Scientific Intelligence Interim Report, 'The X-Gerät', 11 September 1940, pp. 1–3.

⁵⁰ CCAC RVJO B.16 & TNA AIR 20/1670, Air Scientific Intelligence Interim Report No.2 'The X-Gerät', 24 September 1940, p. 6.

advent of Hitler was not due to the expulsion of the Jews, but to its having been kept secret'. As the coarse beams were thought to be located at 65–75mc/sec, and the fine beams on 10–50cms Jones was concerned that this posed a countermeasure problem, for it suggested that the Germans had mastered decimetric wave propagation.⁵¹ If this was so then no British electronic apparatus would be capable of jamming the beams, for centimetric wavelengths required centimetric wavelength propagation. British scientists had only just managed to generate high power on 10cm wavelengths with the newly devised cavity magnetron. With the magnetron still at the testing stage, universal application was relatively impossible.⁵² Jones proposed instead that the coarse beams be jammed, and that KGr100 aerodromes be bombed.⁵³

The assistance provided by Brown Enigma traffic in the chase for *X-Gerät* was stark, and yet Jones glossed over the value of this source in *Most Secret War*. Commenting that he pressed for every possible effort into making further breaks into the new line of traffic, he did not appraise the data he received from Norman. His account does nonetheless reference 'we' rather than 'I' in identifying the six beams code-named by the Germans after the rivers Weser, Spree, Rhein, Elbe, Isar, and Oder, in exactly positioning transmitting stations on the Hague peninsula, and near Calais and Brest, and in establishing that Dr Kühnhold was responsible for the beams.⁵⁴ Brown Enigma traffic, through

⁵¹ CCAC RVJO B.16 & TNA AIR 20/1670, Air Scientific Intelligence Interim Report No.2 'The X-Gerät', 24 September 1940, p. 1–5.

⁵² Johnson, *The Secret War*, p. 47.

⁵³ CCAC RVJO B.16 & TNA AIR 20/1670, Air Scientific Intelligence Interim Report No.2 'The X-Gerät', 24 September 1940, p. 6.

⁵⁴ Jones, *Most Secret War*, p. 136. Jones commented that he was in a much better position than if he had simply been in the Air Ministry because of the close and informal relationship with the Bletchley staff that had arisen through Winterbotham's agency.

Norman, was a 'wealth of information' from which Jones was able to report that *X-Verfahren* was understood, as was much on the organisation and procedures of its operations.⁵⁵ Just as AI1(k) had prepared the ground for scientific intelligence collation of *Knickebein*, Norman had done the same for *X-Gerät*.

This should not, however, detract from Jones's scientific computations involved in assessing the Brown data he received. His *X-Gerät* reports demonstrated strong scientific appreciation of the schematics and specifics involved in *X-Verfahren*, as well as important scientific analysis into the problems involved. That only seventeen days had passed since Jones first realised that *X-Gerät* and *Knickebein* were distinct, to the circulation of his second interim report, showed commitment to the cause. This must have made an impression on the largely non-scientific yet prestigious audiences of his reports, and boded well for the future of scientific intelligence. Jones noted that the details of the use of coarse and fine beams were 'merely the results of theorising' and may have been 'incorrect', yet the statements of SR3 (Jones) had 'borne a similar history to those of Cassandra' so he 'hoped' that this time they would 'be taken seriously'.⁵⁶ Disgruntlement aside, Jones's theorising would prove to be good scientific supposition.

Jones barked far too early however, on German decimetric/centimetric beam transmission. He had been alerted to the possibility of German centimetric wave capability both from the Oslo Report and from Bainbridge-Bell's written

⁵⁵ Hinsley *et al*, *British Intelligence in the Second World War, Volume I*, p. 556.

⁵⁶ CCAC RVJO B.16, Air Scientific Intelligence Interim Report No.2 'The X-Gerat', 24 September 1940.

report on the examination of the RDF array (codename 'Seetakt') found on the scuttled *Graf Spee*.⁵⁷ Jones's erroneous conjecture stemmed from one of the many Enigma decrypts detailing transmitters referred to as FUD2 and B1. Jones deduced that the 'D' represented the word 'Decimetre'.⁵⁸ Following circulation of the *X-Gerät* second interim report, the Chiefs of Staff Committee met to 'discuss the steps to be taken to counter certain German VHF Navigational Beams' and to anticipate German intentions regarding 'accurate bombing purposes over the London area'.⁵⁹ Top of the agenda was to determine the plausibility of German centimetric RDF possibilities.

Appleton and Lindemann were present at this meeting. Lindemann thereafter informed Churchill of German efforts to improve night bombing accuracy. He wrote that a 'number of new beams on a shorter wavelength than before' had appeared', and that KGr100, 'consisting of about forty machines', was 'equipped with special new apparatus to exploit these beams with which apparently accuracies of the order of 20 yards' were expected'. Although Lindemann supposed they probably would 'not reach much beyond London', he nonetheless proposed countermeasures. Apart from 'attacks on the

⁵⁷ Jones, *Most Secret War*, p. 136. Here is another example where the Oslo Report was discussed by Jones in hindsight but not at the time (according to documentation). A January 1942 copy of the Bainbridge-Bell Report can be found in CCAC RVJO B.159. It is a most interesting document, showing that *Graf Spee* probably had 60cm RDF capability, estimated to have been fitted between 1937 and July 1938. It operated with a cathode-ray tube which, for its time, was impressive and far in advance of British seaborne RDF capabilities. Bainbridge-Bell wondered why there had been no curiosity about the aerial on the control tower. The *Graf Spee* still sits immersed in the mud and silt outside Montevideo. There have been salvage attempts: one by Allied intelligence teams in 1940 (of which Bainbridge-Bell was part) and the latest in 2006 when the battleship's eagle figurehead was raised: see Roger Moorehouse, 'The Fate of the *Graf Spee*', *BBC History Magazine*, 11: 2 (February 2010), 44. For a useful cameo on L. H. Bainbridge-Bell, see Bowen, *Radar Days*, p. 14. Bainbridge-Bell co-authored *The Cathode Ray Tube in Radio Research* in 1933 with Robert Watson Watt.

⁵⁸ CCAC RVJO B.16, Air Scientific Intelligence Interim Report No.2 'The X-Gerat', 24 September 1940, p. 1; Hinsley *et al*, *British Intelligence in the Second World War, Volume I*, p. 557.

⁵⁹ TNA AIR 20/6020 8792, 'Summary of Conclusions' of Thames House meeting held on 27 September 1940; Johnson, *The Secret War*, p. 46.

machines using the beams', possible lines of defence he suggested were to destroy the specially-fitted KGr100 machines stationed at Vannes, Luneberg, and reserve station Köthen; to destroy the beam stations by bombing or by special 'Commando' operation; and to employ radio countermeasures.⁶⁰

That *X-Gerät* was not initially expected to reach much further than London is interesting, although this was not an opinion shared by Jones. Moreover, it is informative (if not surprising) that Lindemann proposed a rather daring commando raid as a means of defence. Importantly, this letter shows Lindemann once again relaying scientific intelligence directly to Churchill. At about the same time Jones realised that, by calculating the paths of the beams, *Luftwaffe* targets and co-ordinates for the transmitting beacons in France could be determined. This involved significant scientific calculation however, for it was necessary to take into account the fact that the earth is not a simple sphere, but is somewhat flattened towards the poles. It was therefore necessary to perform rapid calculations, using 'a spheroid that more accurately approached the true figure of the earth'.⁶¹

In his second interim *X-Gerät* report, Jones only vaguely explained the origins of the beams.⁶² By 5 October, in a third *X-Gerät* interim report, Jones confirmed that 'Rhein' and 'Elbe' were within 200 yards of one another, and that the distance between the cross-beams was exactly 15kms.⁶³ To assist in his calculations Jones enlisted the help of Colonel Willis, Air Ministry Chief of

⁶⁰ Price, *Instruments of Darkness*, pp. 39–40.

⁶¹ Jones, *Most Secret War*, p. 137.

⁶² CCAC RVJO B.16, Air Scientific Intelligence Interim Report No.2 'The X-Gerat', 24 September 1940, p. 4. 'Weser' emanating from The Hague peninsula, passing over London, with 'Rhein' and 'Elbe' probably sited in the Calais region, indicating targets in the London area.

⁶³ CCAC RVJO B.17, Air Scientific Intelligence Interim Report No.3 'The X-Gerat', 5 October 1940.

Maps. He, in turn, put Jones in touch with Dr Leslie Comrie of the Scientific Computing Service, who Jones later credited with doing most of the work which ultimately led to establishing the exact positions of the beam stations in the Calais area, and assisted in accurately determining *Luftwaffe* night targets.⁶⁴ These computations placed the origins of 'Rhein' and 'Elbe' together, somewhere near the French town of Ambleteuse. Crucially this process enabled Jones to easily predict nightly targets on each day Enigma provided bearings for raids. Jones was most praising of Comrie's 'elegant solution' and was pleased also to report that scientific intelligence should 'be able to determine nearly all the elements in the system', 'solve the target numbers already known', and 'assess the accuracy of the method'.⁶⁵ This meant correlating reams of snippets of data provided by Enigma, containing mostly operational information, times, bearings, and designated target numbers from 23 August when they first started to appear.⁶⁶

Another scientific conundrum Jones tackled during October 1940 was regarding an instrument called 'Anna', often mentioned in Enigma decrypts usually associated with a number between 10 and 85. The 10, along with various centimetre measurements occasionally mentioned by Norman, again led Jones (wrongly) to consider German centimetric wave possibilities. Enigma also provided a set of frequencies numbers (such as 8750 kilocycles

⁶⁴ Jones, *Most Secret War*, p. 142.

⁶⁵ CCAC RVJO B.17, Air Scientific Intelligence Interim Report No.3 'The X-Gerat', 5 October 1940.

⁶⁶ Hinsley *et al*, *British Intelligence in the Second World War, Volume I*, p. 557. It is interesting to note that 23 August was the date given by Jones for the new *Knickebein* stations near Dieppe and Cherbourg becoming operational, further demonstrating the combined use of the two systems by the *Luftwaffe* during the Battle of Britain: see CCAC RVJO J.1, 'The Radio War', p. 1.

per second) of crystals issued to beam stations to stabilise transmissions.⁶⁷ References to 'Grad' settings and a series of seven digit numbers were also provided.⁶⁸ When the bombing in his home town of Richmond was 'fairly intense' on 17 October, Jones set about analysing and correlating all the information he had received.⁶⁹ He thought it possible to connect Anna with frequencies used in the beam transmissions, so that Anna Grad numbers were equivalent to megacycles per second, and determined an exact correlation of 'Frequency in mc/sec=66.5+Anna Grad to the power of ten'.⁷⁰

In his memoirs, Jones wrote that not only did he have to wait until 17 October to be able to compile enough data in order to solve the problem of 'Anna', but also that he felt the solution to be purely instinctive.⁷¹ Whether instinctive or not, his formula entirely disposed of the hypothesis that the fine beams were to be found in the decimetre region.⁷² Jones deduced that 'Anna' had to be some type of wave-meter equipment for *Luftwaffe* aircraft to receive and recognise the newly-transmitted higher-frequency beams. The importance of

⁶⁷ Jones, *Most Secret War*, p. 136; CCAC RVJO B.18 & TNA AIR 20/1627, Air Scientific Intelligence Report No.10 entitled 'The X-Gerät', 12 January 1941, Appendix 1. Jones wrote, 'we had collected the following Anna numbers: 10,15,25,30,35,44,47,55,60,75, and 85. Of these twelve numbers all but two are multiples of 5, and Dr Cunningham estimated that 'the chance that this was accidental was just over one in a million'. Knowing that crystals oscillate at an integer of eight, Jones deduced the transmitter frequencies to be 66.5, 67.0, 67.5, 68.0, 69.0, 69.5, 70.0, 71.0, 71.1, 71.5, 72.0, 72.5, and 75.0 mc/sec. This particular selection of numbers being accidental was about one in twenty-three million. There is no mention of Dr Cunningham (or his assistance in this conundrum) in *Most Secret War*.

⁶⁸ Hinsley *et al*, *British Intelligence in the Second World War, Volume I*, p. 563. The seven digit numbers referred to works numbers, or factory markings, of the aircraft cockpit equipment. This was not determined until a He111 crash-landed on Chesel Beach, in Dorset, in November 1940. The last two digits of the apparatus works number retrieved from this craft were '37', and it was established later that this number designated the year of manufacture (1937). This confirmed that parts of *X-Gerät* had been in production for some time. This is further proof that *X-Gerät* was not a reactionary measure to the jamming of *Knickerbein*.

⁶⁹ Jones, *Most Secret War*, p. 137.

⁷⁰ CCAC RVJO B.18 & TNA AIR 20/1627, Air Scientific Intelligence Report No.10 entitled 'The X-Gerät', 12 January 1941, p. 2.

⁷¹ Jones, *Most Secret War*, p. 137.

⁷² CCAC RVJO B.18 & TNA AIR 20/1627, Air Scientific Intelligence Report No.10 entitled 'The X-Gerät', 12 January 1941, Appendix 1.

understanding 'Anna' not only ruled out German centimetric possibilities, but established the *X-Gerät* frequencies so as to enable satisfactory countermeasure consideration. Jones was therefore able to report to Cockburn's team at AMRE that the fine beams could also be jammed in a similar method as *Knickebein*. Differences in system frequencies meant the development of entirely new jamming countermeasures.

Jamming *X-Gerät* required considerably more effort than jamming *Knickebein*, which allowed the *Luftwaffe* 'to employ the *X-Gerät* pathfinding technique until the beginning of 1941'.⁷³ New jamming apparatus were codenamed 'Bromides' (stronger analgesic to counter a more potent 'headache' – odd considering the official codename for *X-Gerät* was 'Ruffian').⁷⁴ These were converted from British Army Gun-Laying Pulse Transmitters (GL/7, mk.1), and began to materialise from November 1940.⁷⁵ The Army and Navy were operating on high-frequency waves, yet the RAF was not, for it did not have the advantage of pursuing offensive research. While countermeasures were frantically being cobbled together, KGr100 could bomb without hindrance. By early November 1940, *X-Verfahren* stations had become so adept at setting and resetting their beams that KGr100 were able to mount attacks on two successive targets per night: on 4 November Birmingham and Coventry, on 5

⁷³ CCAC ROCO 1/1 & CCAC RVJO B.158, typescript original of 'The Radio War' written by Robert Cockburn, p. 18.

⁷⁴ See TNA AIR 20/1568 for a full glossary of the official code-names and other terminology used in connection with radio countermeasures.

⁷⁵ Jones stated that *Bromides* began to appear in October 1940 but they certainly did not come into operation until November, for the first three or four Bromide 4-metre jammers were ready in early November: Jones, *Most Secret War*, p. 138; Johnson, *The Secret War*, p. 47; Hinsley *et al*, *British Intelligence in the Second World War, Volume I*, p. 559; Price, *Instruments of Darkness*, p. 41. Jones had contradicted his own earlier statement that 'by the middle of September' he had found enough about *X-Gerät* to design countermeasures, 'but jamming equipment could not be produced for a further two months': see CCAC RVJO J.1, 'The Radio War', p. 2.

November Coventry and Birmingham, on 8 November Liverpool and Birmingham, and on 12 November, Liverpool and Coventry.⁷⁶ These were small raids in comparison to the 7 September London raid (and others), and were perhaps dry-runs for 'Moonlight Sonata'.

Coventry

The end of October 1940 marked the end of Jones's solitude in scientific intelligence. No doubt as a consequence of his fine and productive work in discovering the German beams, scientific intelligence was permitted a small expansion. Jones later recalled that he was authorised to recruit a scientist assistant purely on the argument that he 'was advising Fighter Command on the way to make fighter dispositions each night', and that if he was 'eliminated by a bomb there was absolutely no one else who knew the technique'.⁷⁷ Jones had already been allocated a clerical assistant, Harold Blyth, whose administrative contribution to scientific intelligence should not be underestimated, for he applied the format for all of Jones's and later ADI (Science)'s SIRs.⁷⁸ The growing importance of scientific intelligence however, meant that it was time for an additional scientist to join Jones at Broadway. Jones naturally chose Frank.

⁷⁶ Jones, *Most Secret War*, p. 136. Clark raised public awareness of an incident in which Jones supposedly pre-empted a raid on Wolverhampton. Based on tenuous guesswork from an Enigma flimsy, Jones persuaded the authorities to significantly increase the defences of Wolverhampton. No raid occurred. Jones recalled to Clark (and to Millar) that due to the wasted effort, 'for some while' his 'name was mud': Clark, *Rise of the Boffins*, p. 122; Millar, *The Bruneval Raid*, p. 86. In his memoirs, Jones wrote convincingly that the planned raid on Wolverhampton (Operation *Einheitspreis*) was cancelled because of the extra defence preparations: Jones, *Most Secret War*, p. 153. Whichever the case, the local press made Jones a hero of Wolverhampton following Clark's revelation: see Edward Ireland, 'Wolverhampton was saved by an unknown boffin', *Express and Star*, 8 October 1962. A cutting of this newspaper article is preserved in CCAC RVJO B.123.

⁷⁷ CCAC RVJO B.342, Jones to Irving, 10 July 1964; Jones, *Most Secret War*, p. 144.

⁷⁸ Jones, *Most Secret War*, p. 144. Blyth was 'an old Harrovian' draughtsman and concrete specialist.

Frank had to be released from Ministry of Supply (MOS) employ for 'some extremely important and urgent work'.⁷⁹ Writing to Frank, Pye hoped 'very much' that nothing would intervene to prevent him being able to join Jones, for he was 'undoubtedly overloaded with work of absolutely primary importance for the prosecution of the war'.⁸⁰ Both Jones and Frank were later unsure of the specific date of Frank's appointment.⁸¹ Jones wrote in his memoirs that Frank 'managed to extricate himself' from his Porton commitments, although Pye's letter to Gough suggests that Frank's spell at Porton was due to expire anyway.⁸² The transfer was quickly organised and scientific intelligence became a two-scientist team; 'he' became 'they' in reference to scientific intelligence. Jones's delight at Frank's arrival was enhanced by a promotion. Effective on 11 November 1940 Jones became Senior Scientific Officer, with an annual salary increase from £575 to £680.⁸³

Frank was immediately embroiled in the maelstrom of the beams issue. The bombing accuracy of KGr100 had been, in Jones's words, 'prostituted in order that the GAF might get the right part of the right town'. In the case of *Moonlight Sonata*, this transaction for the GAF had been a profitable one.⁸⁴ In his war memoirs Churchill stated that 'Coventry on November 14–15 was the

⁷⁹ UOB DM1310/A.12, Pye to Dr H. J. Gough, DSR to the MOS, 31 October 1940.

⁸⁰ UOB DM1310/A.12, Pye to Frank, 31 October 1940.

⁸¹ UOB DM1310/A16, Frank to Jones, 28 September 1976; UOB DM1310/A16, Frank to Edgington, 28 September 1976; UOB DM1310/J.104, Jones to Frank, 1 October 1976; Jones, *Most Secret War*, p. 144; Jones, 'Auld Acquaintance', p. 8. Documentation shows that Frank was employed by MOS 'for much of the time' during the war, and his records were never officially transferred to the Air Ministry: UOB DM1310/A.16, Edgington to Frank, 1 September 1976. Official documentation confirms that MAP requested enlistment of Frank's services from MOS on 31 October, and that Frank's letter of appointment was dated 9 November 1940: UOB DM1310/A.12, Pye to H.J. Gough, DSR of MoS, 31 October 1940; UOB DM1310/A.12, Confirmation of the promotion of Charles Frank from S2b(Tech), August 1943.

⁸² UOB DM1310/A.12, Pye to Gough, 31 October 1940; Jones, *Most Secret War*, p. 144.

⁸³ Jones, *Most Secret War*, p. 144.

⁸⁴ CCAC RVJO B.18 & TNA AIR 20/1627, Air Scientific Intelligence Report No.10 'The X-Gerät', 12 January 1941, p. 13.

first target attacked by the new method'.⁸⁵ This new method was the first of many major attacks by the GAF employing pathfinder tactics, later mimicked intensely by the Allies with horrific results.⁸⁶ *Moonlight Sonata* was the first Second World War air-raid with the dual purpose of civilian demoralisation by terrorisation, and determination to lower the enemy's military capability through intensive bombing of military production objectives.⁸⁷

The unpublished AHB history of the 'Air Defence of Great Britain' provided detailed analysis of *Moonlight Sonata* primarily because the raid represented 'an occasion of singular importance in the history of warfare'. This history stated that for the first time 'air power was massively applied against a city of small proportions with the object of ensuring its obliteration'. *Moonlight Sonata* represented the 'one occasion when the German tactics of night bombing, pursued not only during this phase of operation but throughout the offensive, were successfully consummated'. It illustrated 'the importance of guiding beams, the importance of marking the target with fires and the importance of KGr.100 to whom it so often fell to lead the attack'.⁸⁸

There are two other key reasons why the bombing of Coventry has been etched so graphically into the British version of the history of the Second World War. The first is that it was the *Luftwaffe's* 'most striking wartime

⁸⁵ Churchill, *Their Finest Hour*, p. 316.

⁸⁶ See Chaz Bower, *Path Finders at War* (Shepperton: Ian Allen Ltd., 1977), p. 36.

⁸⁷ John Ray, *The Night Blitz, 1940–1941* (London: Arms and Armour Press, 1996), pp. 153–4. In rebuttal to Norman Longmate's claim, that 'the Germans meant to hit military objectives, not to make a 'terror' attack on the civilian population', Ray convincingly argued that, in the case of Coventry, it is difficult to separate the two: see Norman Longmate, *Air Raid: The Bombing of Coventry* (London: Hutchinson, 1976), p. 64.

⁸⁸ TNA AIR 41/17, AHB, 'The Air Defence of Great Britain, Volume III: Night Air Defence. June, 1940–December, 1941', p. 82.

success in Britain'.⁸⁹ The second key reason, and one of significant controversy is the intelligence aspect of the raid. This was sparked by Winterbotham's claim that by 3pm on that fateful day an Enigma message was decrypted spelling out the name of Coventry as that evening's *Luftwaffe* target. Supposedly, as Churchill was in a meeting when the message arrived, Winterbotham spoke on the telephone to Churchill's secretary, informed him of what happened, and asked if Churchill could possibly call back when a decision had been made as to whether or not Coventry should be evacuated on the strength of intelligence received. If so, it meant the press (and thereby the public) gaining pre-knowledge of the raid, and consequently the possible revelation of ULTRA or, at the very least, hasty lies to maintain cover of the most valuable source. The decision, in the event, was that only the emergency services were to be informed, and so, according to Winterbotham, Churchill sacrificed Coventry in order to save ULTRA.⁹⁰

Winterbotham's aspersions were further fuelled by Anthony Cave-Brown and William Stephenson who chose to follow the same interpretation.⁹¹ The controversy within these publications, led archivist Norman Evans to research the matter and refute categorically that Churchill sacrificed Coventry.⁹² Nonetheless, historians have since continually felt the need to discuss the

⁸⁹ Angus Calder, 'Coventry: the day of death', *The Sunday Times*, 9 January 1977. A cutting of this newspaper article is preserved in CCAC RVJO B.291.

⁹⁰ Winterbotham, *The Ultra Secret*, pp. 82–3. The official historians maintained that the Air Ministry had two days notice of the Coventry raid from various sources (predominantly POW interrogations), and that ULTRA did confirm the raid, but with little time to spare: Hinsley *et al*, *British Intelligence in the Second World War, Volume I*, p. 535.

⁹¹ Cave Brown, *Bodyguard of Lies*, pp. 38–44; William Stevenson, *A Man Called Intrepid: The Secret War, 1939–1945* (London: BCA, 1976), p. 153. For a critique of the latter book which Hugh Trevor-Roper (then Lord Dacre) dubbed 'utterly worthless', see David Stafford, 'Intrepid': Myth and Reality', *Journal of Contemporary History*, 22: 2 (April 1987), 303–17.

⁹² N.E. Evans, 'Air Intelligence and the Coventry Raid', *RUSI*, (1976), 66–74. See also Hinsley *et al*, *British Intelligence in the Second World War, Volume I*, pp. 528–48.

matter in order to set the record straight, which has enhanced the mythological aspect of the story.⁹³ Often overlooked however, is that the success/failure of *Moonlight Sonata* hinged upon one minute technical detail involving the fine tuning of the Bromide jammers. These beam-bombing countermeasures failed to work that night due to being pre-set at the incorrect audible signal frequency.⁹⁴ The difference was incredibly slight (1500Hz instead of 2000Hz), likened by Jones to the distinction between a top 'C' and the corresponding 'G' below the 'C' on a piano.⁹⁵

Jones expressed significant anger over this error in *Most Secret War*, defining it as one of those instances from many 'where enormous trouble is taken to get the difficult parts right and then a slip-up occurs because of lack of attention to a seemingly trivial detail'. He thought that 'of all the measurements in connection with the German beams, easily the simplest was to determine the modulation note', because this could have been 'done at any time in comfort', yet 'whoever had done it either had been tone deaf or completely careless'. That nobody bothered to check the frequencies made Jones 'so indignant' that he believed that 'whoever had made such an error ought to have been shot'.⁹⁶

⁹³ See as examples David Kahn, 'Codebreaking in World Wars I and II: the Major Successes and Failures, their Causes and Effects', *The Historical Journal*, 23: 3 (September 1980), 630; Keegan, *Second World War*, p. 422; Lewin, *Ultra Goes to War*, pp. 99–103; Stafford, *Churchill and Secret Service*, p. 227; Gilbert, *Churchill*, p. 684; D'Este, *Warlord*, pp. 735–6; Spencer Tucker, *The Second World War* (Basingstoke: Palgrave Macmillan, 2004), p. 73; Downing, *Churchill's War Lab*, p. 169.

⁹⁴ CCAC RVJO B.18 & TNA AIR 20/1627, Air Scientific Intelligence Report No.10 'The X-Gerät', 12 January 1941, p. 3; Hinsley *et al*, *British Intelligence in the Second World War, Volume I*, p. 318; Price, *Instruments of Darkness*, p. 44; Lewin, *Ultra Goes to War*, p. 103.

⁹⁵ Jones, *Most Secret War*, p. 151; Johnson, *The Secret War*, p. 52.

⁹⁶ Jones, *Most Secret War*, pp. 151–2. This is a surprising statement from Jones given that he himself was permanently deaf in one ear caused by contracting diphtheria as a child: see Alan Cook, 'Reginald Victor Jones', *Biographical Memoirs of the Fellows of the Royal Society*, 45 (November 1999), 242.

Two factors need to be considered, however. No.80 Wing had only a few hours to place and set the *Bromide* jammers. If a minute detail was indeed overlooked it is understandable given the circumstances. More fundamentally, owing to 'AVP' filters in *X-Gerät*, the differentiation was in fact audibly negligible. This was the real culprit in this affair, and was only discovered by the scientists of AMRE (now TRE) upon later examination of a waterlogged He111 recovered off Chesel Beach. Cockburn recalled that a 'very sharp filter' was found in the equipment which meant that whereas perhaps the pilots had been listening, they might not have either noticed or appreciated much difference between 1500Hz and 2000Hz.⁹⁷ It is impossible to say whether these mistakes actually made any difference to the eventual outcome.⁹⁸ It was a clear moonlit night anyway, perfect for aerial bombing. *Unteroffizier* Günter Unger recalled that burning Coventry could be seen so clearly that 'the use of radio aids was practically unnecessary'.⁹⁹ If Unger was referring to *Knickebein*, it negates Jones's theory that the *Luftwaffe* was 'de-*Knickebeined*'. Unger's recollection also counters the argument that had the *Bromide* jammers been effective Coventry may not have been bombed, although the bombers would have been a great deal less accurate.¹⁰⁰ Jones recalled long after the event that he was unaware how long the British would

⁹⁷ CCAC RVJO K.475, Transcript for 'The Battle of the Beams', p. 28. For data on the AVP filter, see CCAC RVJO B.18 & TNA AIR 20/1627, Air Scientific Intelligence Report No.10 entitled 'The X-Gerät', 12 January 1941, p. 3. Millar claimed that this particular He111 had been beguiled by a *Meacon* operating near Bridport in Dorset: Millar, *The Bruneval Raid*, p. 83.

⁹⁸ Hinsley *et al*, *British Intelligence in the Second World War, Volume I*, p. 318.

⁹⁹ Günter Unger interviewed for *The Secret War*, BBC Productions. This oral account is not in the transcript due to subtitled translation in the programme, although Unger's contribution is confirmed: CCAC RVJO K.475, Transcript for 'The Battle of the Beams', p. 21.

¹⁰⁰ CCAC RVJO K.475, Transcript for 'The Battle of the Beams', p. 21; Robert Cockburn quoted in Johnson, *The Secret War*, p. 54.

have continued to jam the wrong modulation frequency, but that it could have been 'a long time' had the crashed aircraft 'not brought the error to light'.¹⁰¹

British lessons learned from the Coventry debacle resulted in steady improvements to intelligence, operational countermeasures, and equipment and methods. Thereafter great effort was placed in determining GAF activity (which aircraft, how many aircraft, how many sorties, how many casualties), and measured with an increasing degree of confidence and accuracy.¹⁰²

Much the same can be said for scientific intelligence. In January 1941, Jones circulated his most impressive SIR to date. Totalling twenty-two pages of detailed analysis on the means and methods of KGr100 and *X-Gerät*, Jones provided an extensive account of his scientific intelligence deductions on the *Luftwaffe's* X-beam system.¹⁰³ He was however, fairly derogatory about countermeasure effectiveness, so much so that his report aroused considerable hostility from some Air Staff who enforced its withdrawal.¹⁰⁴

Weaknesses were apparent in this report. The copy in the Jones papers is annotated throughout (in what appears to be Lindemann's hand) which exposes the immaturity of Jones's and Frank's scientific intelligence

¹⁰¹ CCAC RVJO B.350, Jones to David Irving, 18 September 1967.

¹⁰² Hinsley *et al*, *British Intelligence in the Second World War, Volume I*, p. 318. For example, in the Coventry raid Air Intelligence estimated the number of GAF bombers to be 340, whereas most source estimates held the number to be approximately 450. In contrast, on the night of 13 December, Air Intelligence estimated 95 aircraft of *FliegerKorps II* were active over Britain; captured documents later showed there to have been 97.

¹⁰³ CCAC RVJO B.18 & TNA AIR 20/1627, Air Scientific Intelligence Report No.10 entitled 'The X-Gerät', 12 January 1941.

¹⁰⁴ Portal recalled SIR No.10 from circulation following 'violent reaction' over its content. Thereafter, Jones became a topic of conversation at Chequers. Portal was 'amazed at the brilliance of the report yet appalled by its indiscretion', and so sought Lindemann's advice: Beaverbrook to Portal, 12 February 1941. Fully quoted in Jones, *Most Secret War*, p. 167. See also R.V. Jones, 'The Intelligence War and the Royal Air Force', RAF Historical Society Inaugural Lecture, 20 October 1986, available at <http://www.rafmuseum.org>, accessed 8 August 2010.

experience. There are examples in the text where scientific deductions remained unjustified, and suppositions were made with tenuous evidence. Detailed discussion on *Knickebein Dezi* is a fine example of how Jones and Frank allowed themselves to become over-enthusiastic in their work.¹⁰⁵ In another annotation, Jones's and Frank's scientific process of determining beam station locations using azimuths, was replied with the suggestion of flying 'down the beams' to 'take photographs'—more dangerous perhaps, but considerably quicker and certain.¹⁰⁶

The appendices to SIR No.10 were highly technical and vividly represented the welcome addition of Frank to scientific intelligence. Attached were fine sketches of beam determinations, and excellent aerial photographs of each of the beam stations, codenamed after 'Hitler and his colleagues' (Goering, Hess, Ribbentrop, and Himmler), and a photograph of a new beam station named 'Benito'. This station was referred to as a '*Wotan II*' station situated between Beaumont and Jobourg on the Hague peninsula. Although the transmitter at this station used the same type of turntable as *X-Verfahren*, *Benito* differed in that buried cables connected the turntable with another array unfamiliar to scientific intelligence. Their initial speculation was that the main *Wotan* transmitter would transmit only one beam frequency, similar to *Knickebein*, while the second array, *Wotan II*, would transmit both coarse and fine beams.¹⁰⁷ This conjecture was entirely muddled but Jones and Frank

¹⁰⁵ CCAC RVJO B.18 & TNA AIR 20/1627, Air Scientific Intelligence Report No.10 entitled 'The X-Gerät', 12 January 1941, pp. 12–21.

¹⁰⁶ CCAC RVJO B.18 & TNA AIR 20/1627, Air Scientific Intelligence Report No.10 'The X-Gerät', 12 January 1941, Appendix 3 'Methods of Locating New Beam Stations'.

¹⁰⁷ CCAC RVJO B.18 & TNA AIR 20/1627, Air Scientific Intelligence Report No.10, 'The X-Gerät', 12 January 1940, p. 18.

were convinced enough to name this system 'Benito' for they reckoned Mussolini to be the 'one-eyed end of the Axis'.¹⁰⁸ The discovery of *Benito* heralded the next phase of the Battle of the Beams.

Wotan II

The New Year of 1941 marked a change in the organisational structure of scientific intelligence. From inception, Jones had been officially attached to Pye (the Air Ministry DSR). In June 1940 a bold, wise, and timely Air Ministry internal separation occurred, forming the Ministry of Aircraft Production (MAP).¹⁰⁹ As part of the reorganisation, the Air Ministry DSR was moved to MAP – along with scientific intelligence.¹¹⁰ This may well have been satisfactory for the scientific aspect of Jones's work, but proved wholly unsatisfactory for the intelligence element. Jones had been in intelligence for over a year, yet had not once met Air Commodore Boyle, Director of Air Ministry Intelligence, nor had he met Menzies. Jones therefore suggested a possible transfer to the Air Ministry and was permitted interviews with Boyle and Pye on Boxing Day. According to Jones, Boyle demonstrated enthusiasm for scientific intelligence, claiming the beams deductions as the 'finest piece of Intelligence he had ever seen', and readily agreed to Jones becoming an Assistant Director of Intelligence (ADI), which Pye approved before arranging official transfer of scientific intelligence.¹¹¹ Action on these proposals however,

¹⁰⁸ Jones, *Most Secret War*, p. 178. Johnson stated that No.80 Wing called the *Y-Verfahren* stations 'Benito': Johnson, *The Secret War* p. 58.

¹⁰⁹ Maurice Dean, *The Royal Air Force and Two World Wars* (London: Cassell, 1979), p. 125–6. Sir Maurice Dean was Chief of the Air Staff Secretariat (a civil service position) throughout the war.

¹¹⁰ CCAC RVJO B.118, Formal notice of Transfer of Air Staff to the Ministry of Aircraft Production, from Principal Establishment Officer to Jones, dated 1 July 1940.

¹¹¹ Jones, *Most Secret War*, pp. 162–7. Portal's recall of SIR No.10 had the unexpected effect that everybody involved was overly keen to read it, 'as was human in this type of circumstance'. Jones believed that it had been Lywood who had pressed Portal the hardest to recall the report.

was not immediately forthcoming. It took the controversy surrounding SIR No.10 to set the transfer in motion.

Lindemann believed Jones's criticisms of No.80 Wing in SIR No.10 to be entirely justified. Portal therefore agreed that the transfer of scientific intelligence should proceed and minuted Sinclair accordingly. Sinclair then wrote to Beaverbrook expressing the importance attached to Jones's 'work on the German radio methods of navigation', and British countermeasures. Sinclair was 'inclined to believe' that if the British were at that 'moment on top in the silent and secret battle of the beams' then 'the lion's share of the credit' should go to Jones, and noted his intention to appoint Jones as Deputy Director of Intelligence (Scientific Intelligence).¹¹² Beaverbrook summoned Jones to ask if he wished this transfer, to which Jones replied that he had requested it.¹¹³ The move took place, and ensured that scientific intelligence was not to be a wartime peripheral activity. It was absolutely necessary for air scientific intelligence to be attached to the air commands for the smooth two-way transition of information. Jones deserves credit for instigating this move.

In almost all narratives of the Battle of the Beams, *Y-Verfahren* – the third and most sophisticated beam system – is afforded few words.¹¹⁴ Perhaps this is because intelligence-gathering and countering of *Y-Verfahren* did not have the same political glamour of the *Knickebein* chase, or the fatal failures inherent in foiling *X-Gerät*. Jones's own account of 'Wotan's other eye' is

¹¹² Beaverbrook to Portal, 12 February 1941. Fully quoted in Jones, *Most Secret War*, p. 167.

¹¹³ Jones, *Most Secret War*, p. 167.

¹¹⁴ Clark, for example, mentioned *Y-Gerät* only twice in passing: Clark, *Rise of the Boffins*, pp. 124–5. Millar was also cursory over *Y-Gerät*: Millar, *The Bruneval Raid*, pp. 87–8.

surprisingly short, essentially because he firmly believed that he had won the *Y-Gerät* battle before it had begun. Almost all historians have uncritically concurred. While it was indeed the case that scientific intelligence was little troubled by *Y-Gerät* in comparison to *Knickebein* and *X-Gerät*, in glossing over *Y-Verfahren* Jones overlooked important information relative to the Battle of the Beams, and the GAF night-bombing strategy.

Y-Gerät was a change in principle from its predecessors. Cross-beams were abolished and replaced by range measurements along the director beam.¹¹⁵ In effect, once bomber aircraft located the beam, they were flown to the target by ‘automatic pilot’, and bombs were dropped by Morse Code signals transmitted down the beam emanating from ground-stations.¹¹⁶ These signals were transmitted on frequencies between 42–48MHz, in approximately seven metre wavelengths. Instead of making the instrument work off the beam therefore, German technicians made the beam work off the instrument. The result was an ‘equisignal’ beam, and an improved instrument.¹¹⁷ This instrument was crucial to the sophistication of *Y-Verfahren*, for VHF waves could only be recognised by electro-magnetic equipment. So complex were the Y-beams, that it was immediately obvious to all concerned that the radio waves could only be interpreted by some form of visual indicator. By the end of January 1941, the scientists at TRE had been able to analyse the wave-

¹¹⁵ CCAC RVJO B.23, Air Scientific Intelligence Report No.12 ‘German Beam Policy’, 23 July 1941, p. 12; Jones, *Most Secret War*, p. 172.

¹¹⁶ Neillands, *The Bomber War*, p. 63.

¹¹⁷ CCAC RVJO B.23, Air Scientific Intelligence Report No.12 ‘German Beam Policy’, 23 July 1941, p. 13.

form of the *Benito* signal on a cathode-ray tube, in order to assess its method of operation and then devise countermeasures.¹¹⁸

The scientific principles behind this method of bombing were undoubtedly advanced. This was a primary reason why the GAF resorted to its operational use so soon after losing confidence in *X-Verfahren* by January 1941. Jones omitted any discussion of the *Y-Gerät* mechanism, preferring instead to emphasise his ‘delicious method of upsetting the ranging system’.¹¹⁹ The signal was picked up by the aircraft’s receiver (FUG-17), and then re-radiated back to the ground station on a frequency with some 2MHz differentiation. Ground crews displayed the waveform of original audio signals and retransmitted signals on cathode-ray tubes, so as to compare the phase difference, providing the time of the signal transmission from ground to aircraft and back again. Ground crews were therefore able to accurately measure (within 100 yards at 250 miles) distances to the aircraft. All aircraft crew had to do was locate the beam in the sky. Once over the target, bombs could be dropped by ground-station command.¹²⁰

Designed by Hans Plendl (the German counterpart to Eckersley) by the summer of 1939, *Y-Gerät* was ready for operational use by 1940.¹²¹ Jones reported however, that there was no record of operational use before the

¹¹⁸ Johnson, *The Secret War*, p. 58

¹¹⁹ Jones, *Most Secret War*, p. 175.

¹²⁰ The FUG-17 interpreted the synchronising pulse, designed specifically to be interpreted by automatic signal decoders. These gave visual indication on left/right meters, and steered aircraft by autopilots, which could maintain it on the beam far more accurately than human pilots: CCAC RVJO B.23, Air Scientific Intelligence Report No.12 ‘German Beam Policy’, 23 July 1941, pp. 14–16; Johnson, *The Secret War*, p. 58.

¹²¹ For ‘German counterpart to Eckersley’, see Jones, *Most Secret War*, p. 173. When Jones asked Eckersley about Plendl during the war, Eckersley commented that Plendl was ‘not much good’ for he based his ‘theory on experiment’.

autumn of 1940, nor of any extensive trials. Importantly, this highlights the inherent systemic problem of *Y-Verfahren*. KG26 was given only three weeks to practice before using it over Britain. Jones contemporaneously commented that from a military perspective the decision to use *Y-Verfahren* too early was in all respects bad, and that the *Luftwaffe* would have been wiser not to have revealed it for at least another year.

Many narrators of the Battle of the Beams have assumed that British countering of *X-Gerät* led the GAF to prematurely introduce *Y-Gerät* but this simply was not the case—its first operational use was in the second week of October 1940, a full month before *Moonlight Sonata*. Although a military motive remains unclear, it can be partly explained by the political relations of the two scientists (Plendl and Kühnhold) involved in developing the beam systems. Ambition on the part of the former led to the untimely demise of their apprentice/master relationship. As Plendl was the designer of *Y-Gerät*, he convinced the GAF High Command that his system was not only far superior than Kühnhold's now-dated *X-Gerät*, but, more importantly, it was ready for use. If careerism can be attributed then it was at least successful, for Göring in his role as Prussian Prime Minister, made Plendl a *Staatsrat* owing to the experimental success of the new beam system. Jones believed there to be no other reason for the imprudent untimely revelation of *Y-Verfahren*.¹²² Jones later discovered that while Plendl had been initially responsible for the development of *X-Verfahren*, he then handed over complete control to Kühnhold in order to proceed with development of *Y-Verfahren*. Plendl first

¹²² CCAC RVJO B.23, Air Scientific Intelligence Report No.12 'German Beam Policy', 23 July 1941, p. 15.

tested the signal-measuring principle at Rechlin in 1938, started ground station development in 1939, and commenced flight experiments in the spring of 1940. Jones was delighted with this discovery, for it neatly tied in with his recollection that he first heard of *Y-Gerät* from the Oslo Report.¹²³

In *Most Secret War* Jones wrote that ‘thanks to the Oslo Report we were on the lookout for the Y-transmissions, which we were quickly able to find and thus devise countermeasures’.¹²⁴ The conviction in this statement has probably been responsible for *Y-Verfahren* being the beam system least discussed by historians. Primary evidence however, does not satisfactorily corroborate Jones’s statement. Documents showing Jones’s first encounters with *Y-Verfahren* offer no suggestion that he was prepared for its arrival. It is more likely that he was as reactive to *Y-Gerät* as he was with *Knickebein* and *X-Gerät*, and only appreciated the true value of the Oslo Report after he fully understood *Y-Verfahren*. Examination of the ‘chase’ of *Y-Gerät* (a matter usually taken for granted) is required to confirm this argument. The first document showing Jones giving of any consideration of a one-beam range-finding system was SIR No.7 in which he wrote that ‘it might be possible to design a system in which the RDF and Wotan transmitters’ were combined, so that the beam was ‘keyed to give the aircraft the direction of the target, and the reflection give the range’. Jones posited that ‘the presence of the Freya-

¹²³ The sixth item mentioned in the Oslo report detailed the laboratories and development establishments for the GAF at Rechlin. The ninth item referred to ‘Aircraft Distance-Measuring Instruments’ for determining the range of friendly bombers by transmitting signals, thereby alluding to radio beam navigation; Jones, *Reflections on Intelligence*, pp. 334–5.

¹²⁴ Jones, *Most Secret War*, p. 173.

Gerät near the chosen site for a Knickebein or Wotan transmitter' suggested that in July 1940 the GAF used 'separate transmissions'.¹²⁵

This was (albeit good) supposition which demonstrates how Jones operated when tackling the intelligence puzzles before him. His speculation was based on two factors: the 'one-eye – one beam' telephone call from Norman, and confused POW intelligence on *Knickebein*, *X-Gerät*, *Freya* and *Wotan*.¹²⁶ Jones had discounted *Freya*, mastered *Knickebein*, was chasing *X-Gerät*, but had no formulated idea on *Wotan*. He later discovered that *X-Gerät* and *Wotan* were German codenames applied to the same multi-beam system, the former referring to aircraft apparatus and the latter to transmitting stations. At the time however, Jones followed Norman's idea that *Wotan* was a one-beam system. Jones commented in his memoirs that from then on, and in view of the Oslo evidence, he was inclined to look for something like a *Knickebein* beam with continuous wave method range measurement. Apparently Norman enthusiastically applauded this suggestion, and together they chased every possible clue.¹²⁷ Yet Jones did not mention the Oslo Report evidence in SIR No.7, distributed a month after Norman's idea. Perhaps because he had been unable to convince others, he chose to exclude the source from his SIRs. Or perhaps Jones did not correlate the Oslo Report evidence with *Y-Gerät* intelligence until much later.

¹²⁵ CCAC RVJO B.9 & TNA AIR 20/1624, Air Scientific Intelligence Report No.7 'The Edda Revived', 17 July 1940, p. 5.

¹²⁶ Jones, *Most Secret War*, p. 120; CCAC RVJO B.9 & TNA AIR 20/1624, Air Scientific Intelligence Report No.7 'The Edda Revived', 17 July 1940, p. 5.

¹²⁷ Jones, *Most Secret War*, p. 121. Hinsley *et al* confirmed that the message derived from Vannes; Hinsley *et al*, *British Intelligence in the Second World War, Volume I*, p. 561.

A further discrepancy exists in an Enigma signal decrypt of October 1940. This was a message from the Vannes base of KGr100 to a station known as 'Wotan II', the one on the Hague peninsula which Jones later called 'Benito'. The message read: 'Target 1 co-ordinates 50°41'49.2" N, 2°14'21.2" W'.¹²⁸ Jones calculated the geographical target to be the Bovington Armoured Corps depot in Dorset.¹²⁹ Moreover, KGr100 were clearly operating with *Y-Gerät*, albeit presumably in trial runs.¹³⁰ Jones did not mention this fact in his memoirs. There has been no satisfactory explanation as to why KGr100 were involved with *Y-Gerät*. All Jones said was that 'the aircraft using the new system were not from KGr100 but from Third Gruppe of KG26, commanded by an outstanding officer, Major Viktor von Lossberg'.¹³¹ The first confirmation that KG26 were involved in beam bombing however was in November 1940 when the Y-Service intercepted transmissions coming from the French town of Poix, known to be the base of *Gruppe III* of KG26.¹³² Before this, Enigma provided Jones with two other signals stemming from Vannes in specific relation to 'Wotan II' – the first with 'Practice Target Co-ordinates' for 13 October, the second with co-ordinates for Target 5229 which he calculated to

¹²⁸ CCAC RVJO B.18 & TNA AIR 20/1627, Air Scientific Intelligence Report No.10 'The X-Gerät', 12 January 1940, p. 16.

¹²⁹ The precise date of *Luftwaffe* bombing of Bovington Armoured Corps depot has never been determined. Even the Tank Museum on the grounds of the old Armoured Corps depot does not have records of the event. All secondary sources followed Jones's belief that Bovington was bombed a few nights after the 6 October Enigma message had been received: Jones, *Most Secret War*, p. 173; CCAC RVJO B.18 & TNA AIR 20/1627, Air Scientific Intelligence Report No.10, 'The X-Gerät', 12 January 1940, p. 16. David Fletcher, historian and Chief Librarian of Bovington Tank Museum, wrote that 'Bovington suffered a night attack by two German aircraft a few nights later; they got the distance to their target spot on but were not quite so precise in terms of direction – off beam you might say': David Fletcher, 'Target No.1', unpublished article. Fletcher defined Jones as 'probably one of the most brilliant Britons of his generation'.

¹³⁰ Hinsley *et al*, *British Intelligence in the Second World War, Volume I*, p. 561.

¹³¹ Jones, *Most Secret War*, p. 173.

¹³² Hinsley *et al*, *British Intelligence in the Second World War, Volume I*, p. 561.

be gas works at Nine Elms in London.¹³³ This intelligence enabled Jones to confidently report that, as the orders came from KGr100, there was no doubt that they were operating with the *Wotan II* system.¹³⁴

The Y-Service provided intelligence that *Y-Verfahren* beams radiated different characteristics from its predecessors; instead of dots and dashes there were distinct pauses in the transmissions, on modulating frequencies of approximately 10–30mc/sec.¹³⁵ Of primary importance was that the Y-Service confirmed that aircraft were re-radiating the beams back to their base stations. From this Jones realised the necessity, after confirming KG26 were integral to *Y-Verfahren*, to clarify KGr100's role. Based on tenuous evidence and supposition, Jones deduced that Gruppe III of KG26 was using a system that coincided with what he expected of *Wotan*, although what version of *Wotan* remained to be proved. Brown Enigma had mentioned the use of *Wotan* by KGr100, but had also indicated a link between *Wotan* and III/KG26, arising from a tour of outstations by Dr Matthiesen from Vannes, who took a flight on 23 October to St. Omer with Eckhart, Plendl's chief scientific assistant (there was also mention of another of Plendl's assistant scientists, Schwarz). On 27 October Matthiesen was certainly at Cassel, conducting certain measurements with Eckhart. Jones confirmed that there was no evidence to

¹³³ CCAC RVJO B.18 & TNA AIR 20/1627, Air Scientific Intelligence Report No.10 'The X-Gerät', 12 January 1940, p. 16; Hinsley *et al*, *British Intelligence in the Second World War, Volume I*, p. 561. The target numbering system is different here due to the GAF resetting their system, so that Bovington Armoured Corps Depot was Target No.1.

¹³⁴ CCAC RVJO B.18 & TNA AIR 20/1627, Air Scientific Intelligence Report No.10, 'The X-Gerät', 12 January 1940, p. 16. Jones also wrote that a 'second station' also known as 'Wotan II' existed at Cassel, some 30km south east of Dunkirk, and that the 'exact repetition of the name' suggested reference 'to a "Mark II" pattern of the Wotan system'.

¹³⁵ Jones, *Most Secret War*, p. 172. The complexity of *Y-Verfahren* has produced confusion. See for example the succinct account from Neillands, in which he erroneously called *Y-Gerät* 'Wotan', and that it operated on Lorenz-type beams 'with the usual system of dots and dashes': Neillands, *The Bomber War*, p. 63.

suggest that KGr100 used the Cassel transmitter, that *Wotan II* on the Hague peninsula was obviously more convenient for them, and that *Wotan II* at Cassel may therefore have been used by the more suitably based III/KG26.¹³⁶ From intelligence received from Norman between October 1940 and January 1941 therefore, Jones had traced the whereabouts and activities of the key scientists involved in *Y-Verfahren*, and had devised a plausible explanation for the involvement of KGr100 and III/KG26. By January 1941 however, Jones established that *Y-Verfahren* was exclusive to KG26.¹³⁷

In his *Benito* interim report, Jones wrote that a KG26 He111 had been brought down near Eastleigh. He reported that this aircraft 'of *Gruppe 9/KG26*' was of particular interest, 'as it belonged to the only *Gruppe* in the G.A.F. known to be using the Benito system', yet in *Most Secret War* Jones wrote that the aircraft was of *Gruppe III*.¹³⁸ The aircraft was badly damaged and 'almost the only useful relic was the W/T operator's notebook', recovered by AI1(k). There 'was little beyond a few scribbled notes', but these were 'sufficient to show that the aircraft had used the Benito system'.¹³⁹ Jones wrote in his memoirs that this 'charred at the edges' notebook was essential to his full understanding of *Y-Gerät*, although there is no mention of it in the official history.¹⁴⁰ The notebook contained two handwritten tables of figures which

¹³⁶ CCAC RVJO B.18 & TNA AIR 20/1627, Air Scientific Intelligence Report No.10, 'The X-Gerät', 12 January 1940, p. 17.

¹³⁷ Hinsley *et al*, *British Intelligence in the Second World War, Volume I*, p. 561.

¹³⁸ CCAC RVJO B.20 & TNA AIR 20/1672, Air Scientific Intelligence Interim Report 'Benito', 5 February 1941, p. 1; Jones, *Most Secret War*, pp. 173–4.

¹³⁹ CCAC RVJO B.20 & TNA AIR 20/1672, Air Scientific Intelligence Interim Report 'Benito', 5 February 1941, p. 1.

¹⁴⁰ Jones, *Most Secret War*, p. 173. The only mention Hinsley *et al* make of retrieval of *Y-Verfahren* evidence from crashed aircraft is from 3–4 May 1941: see *British Intelligence in the Second World War, Volume II*, p. 561.

Jones relayed in full in the *Benito* interim report, and in *Most Secret War*.¹⁴¹ From the tables, Jones and Frank concluded that aircraft approached targets from the direction of Cassel; aircraft were unconcerned with distance calculations on the outward flight, and therefore employed some special method of navigation; aircraft intended to return direct to an aerodrome at or near Poix once their mission was over; and that beam bearings from Cassel were used on the outward flight to check magnetic compasses, which were then used for the homeward flight.¹⁴² Once again, through the fate and fortune of a crashed aircraft had come the elementary evidence required to complete a scientific intelligence puzzle. This spoke volumes for the necessity of absolute security regarding technological apparatus in offensive operations, a lesson the RAF certainly learnt from the *Luftwaffe*. By February 1941, Jones was able to confirm that all distance measurements preparatory to bomb release in the *Benito* system were made at ground-stations.¹⁴³

Y-Verfahren had therefore been mastered before significant operational use of it was made by the *Luftwaffe*. Whether it was the triumph for scientific intelligence that Jones later made it to be, and which other narrators have wholly accepted, is debatable. Instead scientific intelligence success was due to fundamental errors of timing by the *Luftwaffe*, and possibly due to over-zealous behaviour from Plendl. In SIR No.12 Jones wrote much on the

¹⁴¹ CCAC RVJO B.20 & TNA AIR 20/1672, Air Scientific Intelligence Interim Report 'Benito', 5 February 1941, pp. 1–2; Jones, *Most Secret War*, pp. 173–4. A diary was also recovered from the crashed aircraft, which detailed that the pilot had taken part in attacks on Avonmouth and Swansea on 16/17 January respectively. Jones believed at the time that this was further confirmation that KG26 and KGr100 were frequently attacking the same target; CCAC RVJO B.20 & TNA AIR 20/1672, Air Scientific Intelligence Interim Report 'Benito', 5 February 1941, p. 4.

¹⁴² CCAC RVJO B.20 & TNA AIR 20/1672, Air Scientific Intelligence Interim Report 'Benito', 5 February 1941, pp. 1–2; Jones, *Most Secret War*, pp. 173–4.

¹⁴³ CCAC RVJO B.20 & TNA AIR 20/1672, Air Scientific Intelligence Interim Report 'Benito', 5 February 1941, p. 2.

apparent failure of *Y-Verfahren*, and even of how KG26 had returned to *X-Verfahren*. Appended to this observation was a warning for the future, relayed using classical mythology as was often Jones's way. He told of Alcibiades 'who had a handsome dog'. Alcibiades purposefully cut off the dog's tail to give the citizens of Athens something to talk about, and 'so miss finding worse things to criticise about him'. Jones's point here was that the *Luftwaffe* may well have implemented *Y-Verfahren* early to allow a saturation of *X-Verfahren* over Britain. Alternatively, *X-Verfahren* might have been maintained to such a degree that it masked the operational use of *Y-Verfahren*. The latter is certainly plausible, for as Jones commented *X-Verfahren* had indeed saturated British intelligence up to December 1940 so much so, that only moot warnings of the general principles of *Y-Verfahren* could be given.¹⁴⁴ When the *Luftwaffe* was to return *en masse* in 1942, it was *X-Verfahren* bombers once again employed in the famously named 'Baedeker Raids' (discussed in chapter V of this thesis).

Jones tailored his forewarning into contemplation of future British adoption of new schemes, that they 'might with profit adopt the strategy of Alcibiades' by giving German intelligence 'something to occupy its attention while the British achieve some months of freedom with a real scheme'.¹⁴⁵ Jones was referring to deception—a trait much employed by British forces in the years of war to come. He was also spelling out the hallmarks of scientific intelligence. He had established scientific and technological threats to British security based on

¹⁴⁴ CCAC RVJO B.23, Air Scientific Intelligence Report No.12 'German Beam Policy', 23 July 1941, p. 18.

¹⁴⁵ CCAC RVJO B.23, Air Scientific Intelligence Report No.12 'German Beam Policy', 23 July 1941, p. 18.

data acquired from intelligence gatherers, processed the data into plausible suppositions, and provided effective countermeasures where appropriate.

TRE operatives found countering *Y-Verfahren* a relatively simple process of re-radiating the signals emanating from aircraft on slightly different frequencies, thereby confusing ground stations on the precise locations of the aircraft. Sufficient instability was therefore introduced in to *Y-Verfahren* to render the range measurements unreliable.¹⁴⁶ It was swiftly established that the dormant yet powerful BBC television transmitter at Alexandra Palace had been designed to transmit on the similar frequency of 45MHz.¹⁴⁷ This transmitter was commandeered by Cockburn of TRE and manned by a team of RCM technicians, who converted it to *Y-Verfahren* frequencies.¹⁴⁸ Another transmitter was later erected on Beacon Hill in Salisbury, and the two transmitters provided complete coverage over southern England.¹⁴⁹ These RCMs were code-named 'Domino', and its official definition was 'a ground system for spoiling the enemy 'Benito' range-measuring device over Britain by receiving the re-radiated signal from the aircraft and mixing it with the signal sent to the aircraft'.¹⁵⁰ This official definition confirms that *Y-Verfahren* was tampered with and not jammed, as has been misleadingly suggested.¹⁵¹

¹⁴⁶ CCAC ROCO 1/1 & CCAC RVJO B.158, Cockburn, 'The Radio War', p. 21.

¹⁴⁷ Norman Moss, 'The Theoretical Joker', *The Sunday Times Magazine*, 18 February 1973, 47; Johnson, *The Secret War*, p. 60.

¹⁴⁸ CCAC ROCO 1/1 & CCAC RVJO B.158, Cockburn, 'The Radio War', p. 21; Jones, *Most Secret War*, p. 175.

¹⁴⁹ Johnson, *The Secret War*, p. 60.

¹⁵⁰ TNA AIR 20/1568, 'Glossary of Code Names and other terms used in connection with RCM', p. 2.

¹⁵¹ See for example Price, *Instruments of Darkness*, p. 49. Price spoke of 'Domino' jammers and how *Y-Gerät* was jammed.

Jamming countermeasures were indeed later devised for *Y-Verfahren*, code-named 'Benjamin'. These denied *Benito* beams to German aircraft that were nearer to the jammer than to the beam-transmitting station, and proved effective countermeasures covering parts of Britain not under the *Domino* umbrella.¹⁵² But *Benjamin* could not be devised until *Y-Gerät* had been fully examined, and this did not occur until May 1941 when three He111s of KG26 were downed in England, and radio equipment from each carefully removed and delivered to RAE for examination.¹⁵³ These examinations revealed a surprising lapse on the part of German technicians, for it was discovered that the synchronising impulse of the beam signal could in fact be jammed. For Cockburn this was an example of 'one of the dangers to be avoided in making too complex a system', as in general 'any mechanical interpretation can be more readily interfered with once its mechanism is understood, than that by a human observer'. In the case of *Benito* receivers, the lapse was 'the more interesting because the weakness could have been removed by the addition of two small components'. For this reason 'the temptation to exploit Achilles' heel was not accepted, and the *Benito* system jammed by unsynchronised modulation in the same way as the two previous systems'.¹⁵⁴

There were other flaws in *Y-Verfahren*. The system's automation made it much easier to deceive than human observer autonomy; *Y-Gerät* acted as a transponder and so radiated signals that nightfighters could 'home' toward; and being a ground-controlled system, any one station could only handle one bomber at a time and the communication channel would be potentially easy to

¹⁵² TNA AIR 20/1568, 'Glossary of Code Names and other terms used in connection with RCM', p. 1.

¹⁵³ Price, *Instruments of Darkness*, p. 49.

¹⁵⁴ CCAC ROCO 1/1 & CCAC RVJO B.158, Cockburn, 'The Radio War', p. 21–2.

deceive.¹⁵⁵ There were many reported incidences where GAF ground-crews became so puzzled by re-radiated signals that they engaged in heated exchanges with *Luftwaffe* aircrew in mid-operations, often resulting in the abortion of proposed bombing due to suspected technical faults.¹⁵⁶ That 89 Y-*Verfahren* sorties over England during the first two weeks of March 1941 resulted in only eighteen aircraft receiving instructions to release their bomb-loads is perhaps testament to this.¹⁵⁷ This also confirmed the effectiveness of *Domino*, for although *Benjamin* was eventually designed to jam the Y-beams, it was not before the *Luftwaffe* was ordered to dramatically reduce bombing in Britain and prepare for Operation *Barbarossa*. The last great bombing raid on London occurred on 10 May 1941 and was the *Luftwaffe*'s final throw in a campaign lasting for eight long months.¹⁵⁸ *Benjamin* first went 'on air' seventeen days later.

It was not countermeasures that proved the death knell of *Luftwaffe* activity in the west, but *Barbarossa* and the British development of Air Interception Radar (AI) for nightfighters. The first installations of AI (mark IV) were made in Blenheims and Beaufighters in August 1940. These were of little use during the heavy autumn raids of 1940, however; of the 12,000 German night sorties, only 66 aircraft were confirmed destroyed—54 by AA guns, eight by Fighters without AI, and four by balloons.¹⁵⁹ Evidence shows that the first GAF machine shot down with AI assistance was not until 22 July, and even then the problem of intercepting illuminated targets was seen as still unsolved,

¹⁵⁵ Johnson, *The Secret War*, pp. 58–9.

¹⁵⁶ Jones, *Most Secret War*, p. 172

¹⁵⁷ Price, *Instruments of Darkness*, p. 49.

¹⁵⁸ Ray, *The Night Blitz*, p. 231.

¹⁵⁹ Hanbury Brown, *Boffin*, p. 62.

largely due to a lack of proper night-flying organisation and an inadequate system of ground control.¹⁶⁰ With the invention of Plan Position Indicators (PPI) – cathode-ray tube displays showing maps of the area around the radar – the concept of all-round looking radar was feasible. Developed by AMRE, this system was called ‘Ground Control Interception’ (GCI), and was operational from October 1940. By the end of 1940, five more GCI stations were complete, with swift additional developments thereafter.¹⁶¹ By February 1941, at which time Jones stated the ‘Battle of the Beams was as good as won’, Fighter Command nightfighters had AI mark IV, VHF radio communication and IFF sets (Beaufighters also had four cannons).¹⁶² To assist interceptions, CH coastal radar watched for inward-bound bombers, and GCI watched inland.¹⁶³

Scientific applications to British nightfighter organisation had multiplied the effectiveness of GAF machines gunned down sixfold, and doubled the probable ‘kills’ and damaged aircraft.¹⁶⁴ Had beam-saturation occurred over Britain, the GCI and AI would have proven a much more potent counter than

¹⁶⁰ TNA AIR 41/17, AHB, ‘The Air Defence of Great Britain, Volume III: Night Air Defence. June, 1940–December, 1941’, p. 51.

¹⁶¹ Rowe, *One Story of Radar*, p. 63; Hanbury Brown, *Boffin*, pp. 62–3. Development was as follows: January – Sopley, Waldringfield, Orby, Durrington, Willesborough, Ambury; none in February; March – Stowminster, Ambury resited at Exminster; April – St. Quivox, Wartling, Hack Green, Langtoft; May – Cumberton, Trowson Sands; June – Treleaven, Hampton Hill; July – Huntspin, Neatishead, Ripperstone, Wrafton; none in August; September – Cricklade; October – Dirleton, Newford, Hope Cove, Lunestea and Bruinderry (both in Northern Ireland); December – Trimley Heath, Foreness, mobile GCI at Boarscroft moved to East Hill later: TNA AIR 41/17, AHB, ‘The Air Defence of Great Britain, Volume III: Night Air Defence’, June, 1940–December, 1941’, Appendix 13.

¹⁶² Jones, *Most Secret War*, p. 179.

¹⁶³ Hanbury Brown, *Boffin*, p. 63. For the problems and delays encountered during the development of British GCI, see David Zimmerman, ‘British Radar Organisation and the Failure to Stop the Night-time Blitz’, *Journal of Strategic Studies*, 21: 3 (September 1998), 86–106.

¹⁶⁴ TNA PREM 3/22/3, Night Fighter Combat Reports, Appendix A, dated 30 March 1941. Churchill annotated this minute with ‘very interesting, I did not know they could reload in the air’, after reading that a Beaufighter had re-engaged the enemy after reloading.

any other implementations.¹⁶⁵ Decoy fires (codenamed 'Starfish') were also devised.¹⁶⁶ With *Domino* and *Benjamin* operational, further German beam-bombing would have proved wholly ineffective. Little wonder then that Sholto Douglas wrote shortly after the war that 'the AI-equipped Fighter became the principal weapon of the nightfighter force, and took over from the anti-aircraft gun as the chief means of inflicting casualties on the night-bomber'.¹⁶⁷ Jones did at least comment on these developments when discussing the defeat of *Knickebein*, *X-Verfahren*, and *Y-Verfahren*. He recalled that many bombs went astray 'often attracted by the decoy fires', and that 'good airborne radar' and 'ground controlled interception technique improved to the extent' that British nightfighters could 'effectively hunt along the beams'. By April and May 1941, the *Luftwaffe* was 'not only tending to miss its targets', but 'was beginning to encounter losses on a potentially prohibitive scale'.¹⁶⁸

That a bomber squadron had been formed for the express purpose of 'bombing down the beams', clearly demonstrates that the beams were far from defeated, and were being used operationally with alacrity.¹⁶⁹ Without the effectiveness of AI and GCI, and irrespective of RCMs, the beams could have saturated the skies over Britain with many more D/F stations being

¹⁶⁵ See CCAC RVJO B.23, Air Scientific Intelligence Report No.12 'German Beam Policy', 23 July 1941, Appendix for known GAF navigational beam stations were: eleven *Knickebein* stations at Stavanger, Bredstadt, Den Helder, Bergem-op-Zoom, Boulogne, Dieppe, Caen, Morlaix, Kleve, and two at Cherbourg; four pseudo-*Knickebein* stations at Recklinghausen, Etaples, Caen, and Morlaix; eight *Ruffian* stations, one at Den Helder, three at Boulogne, and two at both Cherbourg and Morlaix; and three Benito stations at Cherbourg, Cassel, and Dieppe. Other *Y-Gerät* stations were constructed at Cherbourg (March 1941), St Valeri (July 1941), Commanna (October 1941), De Boursin (May 1942), Stavanger (June 1943) giving a total of thirty beam stations in all.

¹⁶⁶ Jones, *Most Secret War*, p. 179; Brettingham, *Beam Benders*, 30–58 & 109–22.

¹⁶⁷ Sholto Douglas, *London Gazette*, 14 September 1948, 5018; Hanbury Brown, *Boffin*, p. 63. Rowe declared that the 'night war of the air was the second major British victory of the war': Rowe, *One Story of Radar*, p. 74.

¹⁶⁸ Jones, *Most Secret War*, p. 179.

¹⁶⁹ TNA DEFE 40/2, Deputy Chief of Air Staff (DCAS) Arthur Harris to Assistant Chief of Air Staff, Research (ACAS(R)) Philip Joubert, 1 February 1941.

constructed along the French west coast. Moreover, the obvious success of AI and GCI had a buoyant effect on the morale of RAF night fighters and a correspondingly significant detrimental effect on GAF bomber pilots. There is sporadic evidence to suggest that POWs were unhappy with the ineffectiveness of the navigational/bombing beams, and comparison of POW reports for the summer of 1940 with POW reports from early 1941 shows significant shifts in morale from generally very good to generally poor.¹⁷⁰

As far as Jones and Frank were concerned the beams had been defeated by February 1941. Their job was done. They had deduced, predicted, and warned, and it was time to move on to the next scientific intelligence conundrum. Jones's narration however, has proved misleading, for the beams were still in operation long after the date given by Jones, even if only for navigational purposes. AI1(k) intelligence extracts of July 1941, reported that III/KG26 were making all kinds of experiments to find the best method of overcoming British interference, and that radio-controlled auto-pilots were only used in areas known to be unaffected by jamming. If beams were jammed, then aircraft kept the same course using ordinary gyro-controlled auto-pilots. On 3 July crews had been ordered to drop *Y-Verfahren* as a method of bombing until further notice, although they could use beams for navigation, 'particularly when near a target'. The general feeling in III/KG26, 'no doubt instilled' by countermeasures, was that Britain was well-ahead of Germany in W/T developments, and because *Y-Verfahren* had become 'too dangerous and unserviceable', III/KG26 were 'seriously considering' reverting to X-

¹⁷⁰ TNA AIR 40/2398 to 40/2404, Air Ministry AI1(k) Prisoner of War Reports, 1940–1941.

Verfahren, even though confidence in that system was also significantly undermined.¹⁷¹

Y-Verfahren has widely been regarded as being inept from inception, but this was not the case. Churchill's conclusion to his beams narration (provided by Jones) stated that by 'good fortune and the genius and devotion of all concerned', Britain 'had divined the exact method of working the "Y-apparatus" some months before the Germans were able to use it in operations, and by the time they were ready to make it their pathfinder' Britain 'had the power to render it useless'.¹⁷² Such has been the predominant theme throughout all histories since. Yet the Battle of the Beams continued, fought not by those in Whitehall, but by those at TRE developing AI, PPI, and IFF sets, *Aspirins*, *Bromides*, and *Benjamins*. It was fought by the two-crew Blenheims and Beaufighters directed to their incoming quarry by many WAAFs in GCIs. It was fought by the men who manned the AA batteries in defence of their towns and cities.

German navigation beams were still on the war agenda as late as 1943. In preparation for a second Tizard Mission, this time to Moscow, Tizard suggested revealing information on RDF and beam navigation to the Russians. This did not extend to RCMs, however, for Russia had their own 'perfectly good radio technicians' and so could 'devise their own methods'. This sparked lengthy debate prompted by the Radio Policy Sub-Committee (chaired by Tizard) and the Moscow mission did not materialise: partly due to

¹⁷¹ TNA WO 208/3506, AI1(k) to ACAS(I), dated 12 July 1941.

¹⁷² Churchill, *Their Finest Hour*, p. 317.

American scepticism and British caution, for the Russians had 'stood on the touchlines of the conflict, benevolently cheering on the German forces'.¹⁷³

Much Ado about Nothing

Despite the success of scientific intelligence during the Battle of the Beams, many of the Air Staff were still not convinced of its worth. Joubert was one of the few exceptions. In early 1941, he was fully alert to the significant increase in German beams, and wrote to DCAS Air Marshal Arthur Harris, recommending the future bombing of transmitting stations. Harris's long reply utterly rejected Joubert's recommendations for various reasons. He asked whether people were tending to lose their sense of proportion over the German beams, that there were 'endless' POW reports showing that *Luftwaffe* crews could no longer rely upon beams because the British 'monkey about with them so successfully'. Harris referred to Coventry and Birmingham as object lessons of the most destructive raids that 'took place under weather conditions where beams were not essential for reaching the objectives', and added that the RAF did not use beams yet bombed 'just as successfully' deep into Germany. Harris believed that the lack of beams would 'not stop the Bosche'. He did not agree that the beams were 'a serious menace' to Britain, or even that they had been. For Harris they were 'simply aids to navigation', were 'not indispensable to the successful prosecution of bombing

¹⁷³ For the discussions at War Cabinet level, see TNA CAB 66/34/17, 'Interchange of Technical Information with the USSR', 16 February 1943; TNA CAB 65/33/32, War Cabinet Minutes 32 (43), 18 February 1943. The War Cabinet's principal objection to a second Tizard Mission to the USSR was that 'past experience' dictated that Britain 'communicated a great deal of information and got nothing in return'. The disappointment caused by the failure of diplomacy to ensure the undertaking of this Mission was to be the last in a long line of disappointments for Tizard. He subsequently relinquished all his posts within the Air Ministry, and this time his resignation was accepted by Churchill and by Sir Stafford Cripps, the Minister of Aircraft Production. Clark, *Tizard*, p. 344–5. See also E. H. Beardsley, 'Secrets between Friends: Applied Science Exchange between the Western Allies and the Soviet Union during World War II', *Social Studies of Science*, 7: 4 (November 1977), 447–73.

expeditions', and 'not even really useful'. He thought the beams were 'largely a bogey', and that the GAF could 'do without them' just as well as the RAF. On the other hand, they were 'frequently a means' of giving 'advance information' of GAF intentions. Harris thought that on the whole the beams had been 'of more value' to the British than to the German bombing effort. It was therefore not to Britain's advantage to knock them out, and still less could be afforded the diversion of effort required to do so. Harris thought it would be a blow to British defences if the 'Bosche' stopped using beams, although he agreed that 'Bending' the beams had given 'great amusement, and the Bosche a great deal of annoyance, and, possibly, loss'. Harris concluded that Bomber Command were 'not such fools to use methods of questionable utility' to advertise intentions, and declared 'Long may the Bosche beam upon us!'¹⁷⁴ Jones commented on this minute from Harris in *Most Secret War* noting it as a 'pungent reply' to Joubert's recommendation. Jones stated that after reading it he took a copy and wondered whether its writer would one day see the light. He later appreciated the irony when Harris took over Bomber Command on 22 February 1942, and became the man selected to introduce the new policy of bombing with radio aids for which he had been so scathing.¹⁷⁵

¹⁷⁴ TNA DEFE 40/2, Harris to Joubert, 1 February 1941. This surprised Joubert who wrote in reply defending the efforts of all concerned in countermeasure activity ('some 70 officers and 1,500 men employed' to 'cope with these beams'). Joubert questioned whether the services of these men had been wasted, and if Harris believed there was justification in continuing or even increasing these efforts, or whether they should 'draw in the horns': TNA DEFE 40/2, Joubert to Harris, dated 7 February 1941.

¹⁷⁵ Jones, *Most Secret War*, p. 169. Jones commented that 'Bert' Harris was 'notorious for writing pungent minutes', and provided as example one which read: 'in order to get on in the Army, you have to look like a horse, think like a horse, and smell like a horse!' A biographer of Harris commented that his minute to Joubert was certainly one of Harris' better missives which did nothing to persuade Jones that Harris had sufficient understanding of the more advanced technologies that were going to be so important to air warfare in the future: Henry Probert, *Bomber Harris: His Life and Times* (London: Greenhill Books, 2003), p. 110. Probert stated in Harris's defence that Harris himself subsequently admitted that he did not then have the high regard for the ability of the scientists that he later acquired. For a critique of Harris's contribution to Allied victory, see Tami Davis Biddle, 'Bombing by the Square Yard: Sir Arthur Harris at War, 1942–1945, *The International History Review*, 21: 3 (September 1999), 626–64.

Irrespective of Harris's inherent disregard for the GAF beam policy, his underlying message was, however, logically sound. His argument amounted to agreement in 'bending' the beams if the 'idiot Bosche' continued to place any reliance upon them, as well as total rejection of bombing action against the beam stations if it required 'special effort'.¹⁷⁶ The only real problem with Harris's argument was that he regarded British bombing on par with German bombing. Throughout 1940 and 1941 Bomber Command sought in vain any type of bombing aid mechanisms even remotely as effective as the GAF beam systems.¹⁷⁷ The scientific principles behind them were truly impressive, and have been always underplayed by historians. That in 1941 the GAF were still way ahead of the RAF in the radio war was obvious, and it was to this imbalance that Jones and Frank would next focus their attention.

The Battle of the Beams meant everything to the infant organisation of scientific intelligence. It had crucially generated Prime Ministerial attention, and had confirmed the importance of having a scientist in the heart of intelligence. Nevertheless, it is imperative to further assert that Jones's (and later also Frank's) successes were considerably aided by successes in other branches of intelligence, especially Felkin's AI1(k) and Norman at Bletchley. POW evidence was essential to the discovery of *Knickebein*, and contributed to the understanding of *X-Verfahren* and *Y-Verfahren*. Documentation retrieved from downed German aircraft also proved essential elements for deduction in all three systems, and was vital in understanding *Y-Gerät*.

¹⁷⁶ TNA DEFE 40/2, Harris to Joubert, dated 8 February 1941.

¹⁷⁷ Max Hastings, *Bomber Command* (London: Pan Books, 2007), p. 189.

Enigma decrypts carefully selected by Norman for Jones's attention were vital pieces of the puzzle. While at first ULTRA was doubted, once its product became unquestionable (particularly after the 'Brown' traffic had been broken), Enigma decrypts provided scientific intelligence with a distinct air of authority that was to be appreciated thereafter for the duration of the war.¹⁷⁸

In post-war publications, Jones placed much emphasis on how important the Oslo Report had been to the chase of *Y-Gerät*. However, this is doubtful. Only after his 'one-eye, one-beam' conversation with Norman did Jones actively seek a possible one-beam system, and this conversation had been prompted by the mention of *Wotan* in an Enigma decrypt, which was referring to *X-Gerät*, not *Y-Gerät*. It is much more likely therefore, that realisation of *Y-Verfahren* firmly confirmed the authenticity of the Oslo Report, rather than the other way around. Paradoxically this is important, for with the Oslo Report's authority on German scientific developments firmly confirmed by the existence of *Y-Gerät*, Jones was able to rebut any potential scepticism over the Oslo Report contents, and it became, in effect, another string to his bow—one that would continue to be true in all future quests. The aerial photography that contributed to SIRs No.9 and No.10 also deserve special mention. During the Battle of the Beams, Jones nurtured friendly relations with Claude Wavell, a brilliant mathematician and stereoscopic PI, who would shortly become an invaluable companion in scientific intelligence pursuits.¹⁷⁹

¹⁷⁸ As Calvocoressi wrote, ULTRA was not Jones's only source of intelligence, but ULTRA, being what it was 'set the seal of fact on his surmises': Calvocoressi, *Top Secret Ultra*, p. 92.

¹⁷⁹ Taylor Downing, *Spies in the Sky: The Secret Battle for Aerial Intelligence during World War II* (London: Little, Brown, 2011), p. 72.

Frank's recruitment firmly established scientific intelligence as an organisation—a unit of personnel rather than an individual. That this occurred at the heart of the quest for *Wotan* was no accident. Jones had pressed for Frank to join him in the early stages of the *Knickebein* chase and was denied. It would take two successes on paper (*Knickebein* and *X-Verfahren*) to have this decision revoked, and for sense to prevail in expanding the infant branch of scientific intelligence. Before *Knickebein*, scientific intelligence was certainly an untested entity and Jones was seen by many as a 'wild card' young upstart baffling military authority with new-fangled physics. After the war, Jones wrote that the primary reason for Frank's enlistment was that Jones was scientific intelligence, and that had he been 'knocked out in the Blitz', it would have been the end of that.¹⁸⁰ But it was clear that Frank's assistance was needed, and he was to play a key role thereafter in the development of wartime scientific intelligence.

It is also important to consider the strange quirk of fate. Intelligence collation always requires an element of good luck and fortune, and Jones himself often gladly noted that he certainly had his fair share throughout the war. In the case of the beams, it was provided paradoxically by the Germans themselves. Carelessness with their radio beam policy can only be explained through complacency. At crucial stages of testing, training and final development, the GAF deployed the beams over Britain for long periods of time, at all times of the day, despite the fact that they had vast swathes of Europe (from the Arctic

¹⁸⁰ Jones, 'Scientific Intelligence', p. 357. According to Clark, Jones and Frank shared the same flat at this time (probably due to Frank temporarily residing with the Joneses in Richmond). This arrangement continued until it was pointed out that 'an unlucky hit by even a small bomb might well wipe out the entire Scientific Intelligence Staff': Clark, *Rise of the Boffins*, p. 124.

Circle to the Pyrénées) over which to test the beams safely. The German lack of security was astonishing, yet from a British perspective it must be recorded as a remarkable intelligence windfall.¹⁸¹

The move in January 1941 back to Air Ministry DSR from MAP for scientific intelligence was important. It provided Jones with a 'better say' within the Air Staff, and asserted a more recognised position for Jones and for scientific intelligence.¹⁸² Thereafter scientific intelligence was an autonomous organisation loosely but vitally attached to Air Ministry command arrangements. The Battle of the Beams, therefore, had placed scientific intelligence in its rightful place within the British intelligence machinery and within the Air Ministry structure. In April 1941, Winterbotham wrote to Pye congratulating him on his choice of Jones as his 'scientific assistant' and was sure that Pye would agree that although Jones's work over the previous twelve months had 'not always been palatable to some departments', it was 'of outstanding merit and value to all concerned'.¹⁸³ Jones's Royal Society biographer commented that the beams established Jones's credentials.¹⁸⁴ It had; for thereafter, Jones was perceived as an authority in air intelligence.

The extent of British RCM activity had dramatically improved as a consequence of scientific intelligence in the Battle of the Beams. More fundamentally, organisations, such as No.80 Wing and the reinvigorated BADU, had become dependable aspects of Britain's defence against German

¹⁸¹ Johnson, *The Secret War*, p. 30.

¹⁸² Jones, *Most Secret War*, p. 162.

¹⁸³ Winterbotham, *Secret and Personal*, p. 150.

¹⁸⁴ Cook, 'Reginald Victor Jones', p. 244.

bombers using navigational aids.¹⁸⁵ BADU became the Wireless Intelligence Development Unit (WIDU), which was later absorbed by No.80 Wing.¹⁸⁶ TRE and RAE scientists and technicians also became essential components of British defence (and later offence). It has been stated that *Knickebein* marked the entry of TRE into the radio war, with Cockburn's group leading the way in research into development and construction of radio equipment for use against German radar, aircraft guidance and communication equipment.¹⁸⁷ AMRE (later TRE) contributions in AI and GCI should also be recalled. By February 1941, the combination of British nightfighter strategy and AA gun-control was making a dramatic difference to GAF bomber losses, while countermeasure success was still sporadic.

Jones once stated in an interview that, the *Luftwaffe* 'virtually could have plastered Derby' (with *Knickebein*), and that what 'went wrong at Coventry' could 'have happened every night'.¹⁸⁸ Had Jones not discovered the existence of *Knickebein*, history may well have been written differently. Irrespective of initial contemporary doubt, *Knickebein* was the vital element to the German beam policy, and its effective neutralisation in key production areas of Britain played a contributory role toward British success in the Battle of Britain.¹⁸⁹ Moreover, Jones's discovery of the beams was the first example of scientific intelligence having a direct influence on policy. Lindemann's

¹⁸⁵ Hinsley *et al*, *British Intelligence in the Second World War, Volume I*, p. 328.

¹⁸⁶ TNA AIR 41/46, 'No.80 Wing Royal Air Force Historical Report, 1940–1945', written by E. B. Addison and dated 11 January 1946, Appendix B; Brettingham, *Beam Benders*, p. 11; Hinsley *et al*, *British Intelligence in the Second World War, Volume I*, pp. 324–5.

¹⁸⁷ CCAC ROCO 1/1 & CCAC RVJO B.158, E.B. Callick's Preface to 'The Radio War'.

¹⁸⁸ CCAC RVJO K.475, Transcript for 'The Battle of the Beams', p. 31.

¹⁸⁹ Ronald Clark perhaps went too far by stating that the 'hindsight of history may well see' the Battle of the Beams 'as one of the most significant episodes' of all in the record of 'co-operation between the services and the scientists', and 'of prime importance in the story of Britain's survival': Clark, *Rise of the Boffins*, p. 98.

involvement in the *Knickerbein* affair has been woefully underplayed by historians, and deserves further acknowledgement as does Tizard's early forethought to thrust Jones onto a semi-reluctant Air Ministry.¹⁹⁰ Tizard and Lindemann restored some degree of civility between them just over a week after the declaration of war between Britain and Germany. Tizard wrote to Lindemann suggesting that 'any remnant of a private hatchet should be buried' and that the two men 'should remember old friendships'. Perhaps a shade frostier, Lindemann replied the next day stating that hatchets were 'made to be buried', above all when so many trenches were available, and added that all he wanted was to co-operate as much as they could 'in the common cause'.¹⁹¹ Despite their legendary differences, Lindemann and Tizard played their own fundamental parts in the British victory in 1940.

Churchill wrote of the 'Wizard War' that 'noble efforts in the high air and in the flaming streets would have been in vain if British science and British brains had not played their 'ever-memorable and decisive part'.¹⁹² Through scientific intelligence, Jones played a decisive part. He had been able to share in the effort of the relatively small band of scientists and engineers which had affected the outcome of the Battle of Britain and the Blitz.¹⁹³ He believed that his failure to obtain help in the early days had an interesting result unappreciated at the time; as 'maid-of-all-work' he was unfettered by

¹⁹⁰ Clark, *Tizard*, p. 239; Bullard, 'Processes of scientific intelligence', 191. Bullard wrote that 'Lindemann's support of Jones' was 'effective and important', and 'probably the most useful thing he did during the war', and speculated whether Tizard or Blackett could have done as well in Lindemann's place.

¹⁹¹ CCAC RVJO B.384, extracts from a Lord Cherwell folder entitled 'Distinguished Scientists'. The extracts are dated 10 September 1939 and 11 September 1939 respectively.

¹⁹² Churchill, *Their Finest Hour*, pp. 318–9.

¹⁹³ Jones, *Most Secret War*, p. 180.

restricting divisions of duties and he later ‘framed’ the scientific organization to take advantage of this experience.¹⁹⁴ At the time however, under-nourishment of science/intelligence collaboration caused some concern. Writing in 1941, Tizard stated that Jones had ‘done some extremely able work’ and claimed it a ‘pity that the work was not expanded some time ago by giving him more assistance’.¹⁹⁵ A year later there was alarm that ‘enemy RDF’ was ‘growing apace’ and that German RDF equipment was expected in comparison to ‘soar’. Tizard wrote in warning that RDF was ‘a radio game in which’ Britain had to ‘keep well ahead until the whistle blows’.¹⁹⁶

German precision, applied to the Greater Reich air defence system, would be a matter which would trouble Jones and his small but growing team for many months to come. With the *Wehrmacht* busy invading the USSR, and with most of the *Luftwaffe* supporting this immense land offensive, Britain realised the potential for stepping up concentrated air attacks against Germany, combined with subversive activity in, and pin-prick raids upon, the German-occupied countries. Expansion of Bomber Command was requisite in this regard, as well as the creating and equipping of subversive and raiding forces, and defence expectation appreciation from the British intelligence services. As the next chapter narrates, scientific intelligence would play its own part in all of these offensively-designed activities.

¹⁹⁴ TNA AIR 20/1719, Jones, ‘Scientific Intelligence I’, 354.

¹⁹⁵ IWM HTT262, ‘Letters and Memoranda from Tizard to the Minister of Aircraft Production October 1940–May 1941’; letter dated 14 February 1942; see also IWM HTT18, ‘Diary Notes, Memoranda, Minutes and Letters January–December 1941’ for an earlier (30 September 1941) diary reference to Jones in which Tizard wrote ‘R.V. Jones and his gang are doing excellent work, but they tend to hold up reports until they can make an interesting book of them’.

¹⁹⁶ IWM HTT19/18, ‘Tizard Diary notes January–December 1942’, paper entitled ‘Some Notes on RDF and the War’, 26 January 1942.

Chapter IV: Scientific Intelligence on the Offensive

The problem of understanding German radar developments was, for Jones, as congenial as the Battle of the Beams 'at least in technicality if not in morality'. In brief summary, Jones's 'exhilarating' adventure followed these lines: because sustained air bombardment of Germany was to be a 'major instrument of military policy', ADI (Science) drew up their 'plan of attack'. As there were very few British agents operating in Europe at this time, and as it would take time for subversive activities to ferment in German occupied-territory, this plan of attack was restricted to the Channel coast and largely reliant upon photographic evidence. As German night defences were deeper inland, they were less accessible to PR. ADI (Science) therefore reverted back to their earlier knowledge of German RDF for clues; actively seeking fresh evidence through their own ingenuity, while waiting for other snippets to come their way, and building a solid picture until eventually British disbelief in the existence of German RDF was overcome.¹

Scientific and Technological Mid-War Expansion

Two closely linked methods of offense for British forces were at opposite ends of the technological spectrum: long-range bombers and lightly armed guerrillas.² Well-known as the Trenchard Doctrine, long-range bombing had been a mainstay of British strategy ever since the end of the First World War. In contrast, guerrilla (or subversive) warfare was frowned upon by British

¹ Jones, *Most Secret War*, pp. 184–90.

² Evan Mawdsley, *World War II: A New History* (Cambridge: CUP, 2009), p. 322.

military authorities, yet played a crucial role during the Second World War. The organisation Churchill instigated to take the lead in subversive warfare was the Special Operations Executive (SOE), established in July 1940.³ SOE activity was seriously impaired for the first fourteen months of their existence. In response to Churchill's request to 'set Europe ablaze', SOE could do no more than smoulder, for 'the twigs of early resistance were still too damp'.⁴ A primary problem was technical capacity. Agents were trained and Wireless Telegraphy (W/T) sets supplied, but facilities (and trained operatives) did not exist for wireless communications to be received independently. By April 1941, some 300–400 SOE agents were in various stages of training, yet 'C' insisted that SIS was not 'in a position to take any messages from more than a few'.⁵ This was one of many instances which perpetuated the situation in which SOE and SIS had 'permanently vexed relations' throughout the war.⁶

In June 1940, Churchill also requested 'a corps of at least 5,000 parachute troops', but was informed in August that such a request could not be satisfied

³ For embryonic discussions toward the creation of SOE, see TNA CAB 121/305, Chiefs of Staff Committee memorandum entitled 'Subversive Activities in Relation to Strategy', 25 November 1940.

⁴ M. R. D. Foot, *SOE: An outline history of the Special Operations Executive, 1940–1946* (London: BBC, 1984), p. 30.

⁵ TNA CAB 121/305, Gladwyn Jebb to Ismay, 12 April 1941. The appeal was stark: 'But however many people we may drop, so equipped and so trained, will avail us nothing, unless there is an organisation at this end which can take their communications in'.

⁶ Competing requirements for aircraft was a persistent quarrel between SIS and SOE: Hinsley *et al*, *British Intelligence ion the Second World War, Volume III, Part I*, p. 462. Another primary problem for SIS was the fundamental politics behind the creation of SOE. Perhaps to satisfy the Labour contingency of the coalition government, Churchill entrusted SOE to Hugh Dalton, the Minister for Economic Warfare. This exacerbated the anxieties of SIS, whose 'unhappy experience' of Labour in power indicated that a British governmental organisation could potentially encourage the spread of communism across Europe: Cradock, *Know Your Enemy*, p. 18; Foot, *SOE*, pp. 19–20; Robert Cecil, 'The Cambridge Comintern' in Andrew and Dilks (eds.), *The Missing Dimension*, p. 177; David Stafford, 'Secret Operations versus Secret Intelligence in World War II: The British Experience' in Timothy Travers and Christon Archer (eds.), *Men at War: Politics, Technology and Innovation in the Twentieth Century* (Chicago: Precedent Publishing, 1982), pp. 119–36.

for another twelve months.⁷ He further ordered a Directive for 'Raiding Operations' – what he later defined as a 'butcher and bolt' policy – 'to harass the enemy and cause him to disperse his forces and to create material damage, particularly on the coast line from Northern Norway to the western limit of German-Occupied France'.⁸ By late October 1940 however, the complexity of offensive planning was acute.⁹ For all Churchill's grand plans of taking war to the Germans, it proved obvious that British resources would not allow British offence.¹⁰ In reality, time was required to amass, organise, equip, and train soldiers and civilians in order to effectively 'set Europe ablaze'.

During the months of the Blitz, small 'tip and run' raids on German occupied territory had been mounted. Although these raids had mixed success they were important, for essential experience was gained in both technical and operational preparation. The 'Special Forces' that carried out these raids were originally known as 'The Independent Companies', later referred to using the Boer War name of 'Commandos'.¹¹ Early raids demonstrated the benefits

⁷ Niall Cherry, *Striking Back: Britain's Airborne and Commando Raids, 1940–42* (Solihull: Helion & Company, 2009), pp. 41 & 54. Churchill nonetheless increased his request by adding 10,000 small 'bands of brothers' developed in the idea of storm troopers or Commandos for 'lightning action', only to face obstinate War Office resistance to 'irregulars' with their 'unconventional attire and free-and-easy bearing': Churchill, *Their Finest Hour*, p. 374. See also T. B. L. Churchill, 'The Value of Commandos', *RUSI*, 95: 577 (February 1950), 85–90.

⁸ TNA AIR 8/1044, Directive to Lieutenant-General A. G. B. Bourne, Royal Marines, 17 June 1940. This formed the basis for 'Combined Operations' (CombinedOps), and also formed the basis for Special Forces (SAS, SBS, Paras). For 'butcher and bolt', see I. C. B. Dear & M. R. D. Foot (eds.), *The Oxford Companion to the Second World War* (Oxford: OUP, 1995), p. 1152.

⁹ Parachutists were removed from the jurisdiction of CombinedOps, as an 'airborne force' was considered to form 'an integral part of the imperial reserve of troops for offensive operations overseas': TNA AIR 8/1044, 'Memorandum by the Vice Chief of the Imperial General Staff', 30 October 1940.

¹⁰ For example, aircraft were not yet designed to drop parachute troops: TNA DEFE 2/1, 'Air Needs for Irregular Forces', 2 August 1940.

¹¹ TNA DEFE 2/1, collected recollections of commandos in 'The Independent Companies', 1 June 1940. See also Ministry of Information, *Combined Operations, 1940–1942* (London: HMSO, 1943), pp. 10–11; J. W. Hackett, 'The Employment of Special Forces', *RUSI*, 97: 585 (February 1952), 28. Nigel West suggested that Churchill's Boer experiences led to him being fascinated by guerrilla tactics and novelty gadgets, especially of the exploding variety: see Nigel West, *Secret War: The Story of SOE, Britain's Wartime Sabotage Organisation* (London: Hodder & Stoughton, 1992), p. 16.

gained from good PR of proposed targets, and of models constructed from the resulting photographs for pre-raid briefing and training purposes. Early raids also set precedent (which played a key role in scientific intelligence as the war progressed), as Special Forces ‘pinched’ or destroyed scientific and technological data and apparatus. Operation *Claymore*, in which Enigma key tables and code wheels were captured, is a prime example.¹²

Mansions and stately homes were requisitioned across the British countryside, in preparation for smaller and larger scale offensive operations on the continent. Finishing Schools were established, and agents and Special Forces were trained in readiness for the opportunity to strike back at the Nazis.¹³ Secret weapons centres became almost commonplace, such as The Frythe in Welwyn, which created highly technical gadgets for field use by SOE agents, and Aston House in Stevenage where such gadgets were packaged and despatched.¹⁴ The famous organisation dubbed ‘Winston Churchill’s

¹² TNA DEFE 2/140 and TNA DEFE 2/141, ‘Operation Claymore’ miscellaneous papers, which contain CMD.6270, *Secret German Documents seized during the Raid on the Lofoten Islands on the 4th March 1941* (London: HMSO, 1941). Christopher Mann in his article ‘Combined Operations, the Commandos, and Norway, 1941–1944’, *The Journal of Military History*, 73: 2 (April 2009), 471–95 commented on the fact that the Naval Enigma wheels were found by chance, and highlights the fact that only in Captain Caslon’s post-raid report were the ‘spare wheels for a cipher machine’ mentioned, thereby confirming that intelligence gathering was not a prime objective. See also MOI, *Combined Operations*, pp. 33–36; Cherry, *Striking Back*, pp. 107–119; John Durnford-Slater, *Commando* (London: Tandem, 1975), pp. 40–53. See also Hinsley *et al*, *British Intelligence in the Second World War, Volume I*, p. 337; Stephen Harper, *Capturing Enigma: How HMS Petard Seized the German Naval Codes* (Stroud: Sutton Publishing Limited, 2002), p. 22; Lewin, *Ultra Goes to War*, p. 204; Jürgen Rohwer, ‘Radio Intelligence and its Role in the Battle of the Atlantic’ in Andrew and Dilks (eds.), *The Missing Dimension*, pp. 163–4; Kahn, *Seizing the Enigma*, p. 136. See also Kahn’s preceding chapter entitled ‘In the Locked Drawer of the *Krebs*’ which details the Lofotens ‘pinch’.

¹³ The village of Beaulieu in Hampshire, for example, came to be the base for Free French parachutists, radio security training, Finishing Schools for (male and female) European agents, and Small Scale Raiding Force training: Cyril Cummingham, *Beaulieu: The Finishing School for Secret Agents* (Barnsley: Pen & Sword, 2011). Philby joined the teaching staff at Beaulieu: Philby, *My Silent War*, pp. 26 & 30. Many others towns and villages across the UK were centres for such clandestine training, even though many of their inhabitants were unaware of the specifics of such activity. For an extensive list of SOE’s Special Training Schools, see Appendix 2 of West, *Secret War*, pp. 267–9.

¹⁴ See Frederick Boyce and Douglas Everett, *SOE, the scientific secrets* (Stroud: Sutton Publishing, 2004); Des Turner, *SOE’s Secret Weapons Centre: Station 12* (Stroud: The History Press, 2011). There

Toyshop' (MIR(c) or M.D.1), spawned from the early organisation of such activity, was closely guarded and encouraged throughout the war by Lindemann.¹⁵ In addition, an extensive intelligence network was created, also utilising requisitioned stately homes, for these were good for security and much less likely to be targeted by the *Luftwaffe*.

Jones was critical of what he defined as the wartime 'country house complex'; positing that each organisation believed that its contribution to the collective war effort was better than all the rest, and that rivalry and friction could sometimes cause overlap in operations.¹⁶ Perhaps, but immediacy dictated pragmatism as there was neither time, or resources, for construction as expansion decreed. Space available in large requisitioned stately homes encouraged further service expansion, and was therefore beneficial to eventual plans for offence. No.80 Wing was a perfect example of this, for by 1943, it became a sub-extension of a new Bomber Command organisation called No.100 (Special Duties) Group, charged with providing direct support to night bombing and other operations by attacking enemy night fighters and ground installations. Equipped with a wide range of highly technical electronic warfare devices, its role was multi-purpose, comprising of airborne Electronic Intelligence (ELINT), ground/airborne jamming, and provision of ground/airborne electronic warfare support for Bomber Command. In effect,

is a full list of all 18 SOE research and development establishments in Appendix A of Boyce and Everett, pp. 289–90. SOE was just one organisation of many in Britain's war machine which had R&D establishments such as these. For an insight into the distribution of this SOE gadgetry, see Charles Fraser-Smith, *The Secret War of Charles Fraser-Smith: The 'Q' Gadget Wizard of World War II* (London: Michael Joseph, 1981).

¹⁵ Stuart Macrae, *Winston Churchill's Toyshop: The Invention and Making of England's Secret Weapons* (New York: Walker and Company, 1971), p. 175; West, *Secret War*, p. 16; Boyce & Everett, *SOE, the scientific secrets*, pp.8–9. Macrae wrote that the 'Prof grew very proud of M.D.1 in time and nothing pleased him more than to bring out some VIP to see the place'.

¹⁶ R. V. Jones, 'The Intelligence War and the Royal Air Force', pp. 18–19.

No.100 (SD) Group was formed to provide offensive RCMs against the GAF.¹⁷ The history of No.80 Wing (from beam-countering through to ultimate victory) in many ways mirrored the success and expansion of ADI (Science).¹⁸

With Bletchley Park at its nucleus, the SIGINT network also grew dramatically during 1940–41, with ‘Y-Stations’ (military listening posts) being established up and down the eastern half of Britain.¹⁹ Cheadle was the co-ordinating unit for low/mid-grade GAF intercepts.²⁰ Nearby RAF Stations at Chicksands Priory and Stanbridge (near Leighton Buzzard) were other collection points for intercepts – the latter in the centre of a ring of intercept stations across the Dunstable Downs. There was also a large RAF Y-Station at West Kingsdown (highest point in Kent), established essentially to house the growing Y-Service personnel who were operating at RAF airfields and being bombed during the

¹⁷ CCAC ROCO 2/A.1 & RVJO B.157, ‘War in the Ether, Europe 1939–1945: Radio Countermeasures in Bomber Command’, 29 September 1945; see also Brettingham, *Beam Benders*, pp. 11–12; Shelford Bidwell, ‘Deception in War’, *RUSI*, 124: 3 (September 1979), 75, in review of Martin Streetly, *Confound and Destroy: 100 Group and the Bomber Support Campaign* (London: Macdonald and Jane’s, 1978).

¹⁸ TNA AIR 41/46, ‘No.80 Wing Royal Air Force Historical Report, 1940–1945’, written by E. B. Addison and dated 11 January 1946.

¹⁹ The Scarborough Irton Moor Wireless Station, for example, was opened as late as December 1943: Muriel Davison, *A Wren’s Tale: The secret link to Bletchley Park, Memoirs of a radio mechanic at Scarborough Listening Station in the Second World War* (Reigate: Mark Davison, 2011), p. 7: TNA ADM 223/463, ‘Wireless Intelligence’. There were Royal Navy listening-stations at Scarborough and Winchester, and Army Y at Fort Bridgelands (near Chatham). From March 1941, Beaumanor Hall (near Loughborough) became the War Office’s ‘elaborate intercept station’ created to ‘house an enlarged Chatham’: TNA HW 3/92, ‘History of the Y-Service, Chapter III’, p. 10; Aldrich, *GCHQ*, p. 63. An Intelligence School was established at Beaumanor, which allowed Harpendon and Bletchley to recruit and train additional personnel: TNA HW 3/92, ‘History of the Y-Service, Chapter III’, p. 10. The War Office Wireless Group (WOYG) at Chatham became known did not officially move into Beaumanor Hall until October 1941. Another notable Y-Service requisition was Rothampstead Manor in Harpenden where the station known as ‘Y2’ listened for GAF ground-to-air transmissions and for enemy establishments transmitting Enigma-coded messages; the former were then passed onto RAF Cheadle, the latter to Bletchley Park: Hugh Skillen, *Knowledge Strengthens the Arm* (Ipswich: Ipswich Book Co., 1990), pp. 175–6. A point often overlooked is that the Y-Service was the ‘ears’ of Bletchley Park without which GC&CS could not have functioned: Pether, *Funkers and Sparkers*, p. 20.

²⁰ Denniston, ‘The Government Code and Cypher School Between the Wars’, 68; Peter Wescombe, *Bletchley Park and the Luftwaffe*, Bletchley Park Trust, Report No.8, September 2009, p. 10; Arthur Bonsall, *An Uphill Struggle*, Bletchley Park Trust New Edition Report No.21 (August 2011), p. 4.

Battle of Britain.²¹ Kingsdown became the R/T collecting centre for the Home Defence Units (HDU), the more distant Y-Stations, which sent intercepts by teleprinters using the GPO communications network.²² Some 4,000 personnel served in the Y-Stations—most of them female.²³ Such Y-Service expansion inevitably meant extension of MI8 (SIS Section responsible for implementing interception policy, dissemination of low-grade SIGINT, and operational control of fixed Y-Stations in the UK). Considerable reorganisation of MI8 was undertaken in February/March and August of 1941. Crucially, MI8 in conjunction with the No.80 Wing formed Special Wireless Sections, formed of experts in sophisticated radio and radar ‘jamming’ techniques.²⁴

By April 1941 PI also had a new stately home in Medmenham on the Marlow-Henley road.²⁵ Danesfield House was acquired by the RAF to accommodate their new Central Interpretation Unit (CIU), which absorbed the Photographic Interpretation Unit at Wembley and the Farnborough RAE Modelling Section.²⁶ The CIU was to act as a clearing house for aerial photographs from all sources.²⁷ Because the Admiralty were ‘very keen’ on PI, they applied

²¹ Clayton, *The Enemy is Listening*, pp. 42–4.

²² Arthur Bonsall, ‘Bletchley Park and the RAF Y Service: Some Recollections’, *Intelligence and National Security*, 23: 6 (December 2008), 828; Hinsley *et al*, *British Intelligence in the Second World War, Volume I*, p. 327; Bletchley Park Trust, *The Secrets of Bletchley Park: Official Souvenir Guide*, 8.

²³ TNA HW 43/1, ‘History of the Y-Service’, Chapter VIII; see also Clayton, *The Enemy is Listening*.

²⁴ See Hugh Skillen, *Spies of the Airwaves: A History of Y Sections during the Second World War* (Pinner: Hugh Skillen, 1989) for ‘considerable reorganisation’, see p. 111; for the formation of 201 Special Wireless Section (based at Lyndhurst), see p. 117.

²⁵ TNA AIR 41/6, AHB, ‘Photographic Reconnaissance, Volume I: To April 1941’, p. 248; Downing, *Spies in the Sky*, p. 80.

²⁶ RAE did, however, continue to remain the co-ordinating centre for the work of the trade experts, the film designers, chemicals and lenses: The Medmenham Collection (hereafter TMC) DFG 5784, Harry Stringer interviewed by Constance Babington Smith, 6 September 1956.

²⁷ TNA AIR 41/6, AHB, ‘Photographic Reconnaissance, Volume I: To April 1941’, pp. 248–9. Wing Commander Douglas Kendall, who headed Medmenham, was the only officer who was informed of the ULTRA secret. Although he claimed there was ‘never sufficient A 1 information’, Kendall believed that PR evidence was ‘an A source’, even though the reliability of photographic intelligence was limited by the intermittent misinterpretations: TMC MDM622, Douglas Kendall’s unpublished

significant influence for the PRU to be placed directly under HQ Coastal Command.²⁸ Such PR/PI organisation was not before time.²⁹

By June 1941, more than ever before, science and technology applied to war was deemed essential to improve Britain's difficult war situation. It also served as the fundamental means to understand Britain's enemies, and appreciate their strength and intent, in order to at least counter-attack until combat readiness could be attained. In the meantime, as the British were still unable to attack their enemies in any significance, they could at least attempt to confuse them. Radio, for example, already used extensively as a vehicle for communication, was used clandestinely for subversive warfare, and was also used heavily for propaganda, and required major technical capacity.³⁰ All of this scientific and technological intelligence, combined with the immense importance and mobility of the GAF, inspired reorganisation (and expansion)

memoirs entitled 'A War of Intelligence', pp. 47–53; Campbell, *Target London*, p. 160. Kendall specifically referred to ADI (Science) as one of 'a large number of agencies' that 'could ask for copies' of aerial photographs 'to illustrate a point which they were studying'.

²⁸ TMC DFG 5773, Spencer Ring interviewed by Constance Babington Smith, 3 May 1956.

²⁹ During the invasion scare of 1940, Churchill had been well aware of the importance of such technology. He wrote: 'Remember that the photographic machines are of tremendous value in enabling us to find out if any expedition is preparing in the German Harbours and river mouths. We are greatly dependent upon their reconnaissance reports, and also upon photographs which far exceed what the human eye can discern: CCAC CHAR 4/198/2, Churchill to Beaverbrook, 11 June 1940. See also TMC MDM622, 'A War of Intelligence', unpublished memoirs by Douglas Kendall, p. 63.

³⁰ John Pether, *Black Propaganda*, Bletchley Park Trust New Edition Report No.12 (January 2011).

This type of radio activity was seen as an alternative radio war: see D. Cameron Watt, 'The Sender der deutschen Freiheitspartei: A First Step in the British Radio War against Nazi Germany?', *Intelligence and National Security*, 6: 3 (1991), 621–6. The BBC Monitoring Service received and recorded much of the radio broadcasting emanating from the Continent, and importantly shared the data with the USA from early 1942, and served MI5, MI7, and MI9 extensively with Open Intelligence (OPINT) throughout the war: see Laura M. Calkins, 'Patrolling the Ether: US-UK Open Source Intelligence Co-operation and the BBC's Emergence as an Intelligence Agency, 1939–1948', *Intelligence and National Security*, 26: 1 (February 2011), 1–22. For the wartime use of newspapers, see Isabelle Tombs, 'Scrutinizing France: Collecting and Using Newspaper Intelligence during World War II', *Intelligence and National Security*, 17: 2 (Summer 2002), 105–26.

within Air Intelligence during April 1941. New Directorates were created for PR, Y, and scientific intelligence.³¹

Jones recalled this (for him) long-awaited reorganisation of his department with enduring disappointment. He firmly believed that his release from MAP two months previously had been on the condition that he would head a Directorate as a Deputy-Director of Intelligence (DDI) – a promotion of ‘three grades over that of Senior Scientific Officer’ to which he had been promoted in November 1940. In the event, as Jones recalled, such ‘dramatic elevation was too much for the Civil Service’, which gave him instead ‘a promotion of only one grade’ to Principal Scientific Officer. Jones’s characteristic obstreperousness shone through once more. He felt short changed, and that his promotion was ‘far less rewarding’ than he deserved. He believed he had a ‘very good case’ were he to press his claim against such poor treatment. Concerned that he ‘might acquire a reputation as being a man with a grievance’, he chose not to pursue his claim.³² Nevertheless, his promotion was important for scientific intelligence for it meant he could slowly expand his team as circumstances dictated. After the war, Jones emphasised that the larger establishment of his team, ‘gave scope for the bringing in of further scientists, but in many ways it was too late’ for ‘the best men had long before been absorbed by the Research Directorates, who would not release them’.³³

³¹ Hinsley *et al*, *British Intelligence in the Second World War, Volume I*, pp. 284–5; Davies, *MI6 and the Machinery of Spying*, pp. 98–174, for specific ADI (Science) content see pp. 105–7.

³² Jones, *Most Secret War*, p. 182.

³³ CCAC RVJO B.83 & TNA AIR 40/1532, ADI (Science) official history ‘Air Scientific Intelligence in War, 1939–45’, 1 April 1946, p. 10; AHB, ‘Air Ministry Intelligence’, p. 293.

Official historians remarked that, in his new role as an independent scientific Assistant-Director of Intelligence, Jones was 'given a small group of scientists to assist him'.³⁴ Davies provided evidence which expanded this possibility further: 'as Ild's work expanded, it acquired a growing staff of scientists that were organised into various informal teams by Jones to handle the specific scientific topics as they emerged'.³⁵ These are exaggerations. Including Jones and Frank there were only three doctoral-trained scientists in ADI (Science) throughout the war. Jones himself recalled with amazement how his team, 'with its widely mixed background' and with only Frank and himself as 'straightforward scientists', could 'have functioned as effectively as it did'.³⁶

Scientists, engineers, and technicians were increasingly being drawn into air-related operational problems, and, by 1942, as Jones recalled, were 'being scattered throughout the Air Ministry and various air force commands'.³⁷ Science and technology for the British however, was not always directed with the future in mind — the defensive urgency of the day often took the immediacy out of any offensive planning. In no other scientific and technological organisation was this more obvious than in offensive radar instrumentation, and was one of the key reasons why Bomber Command was

³⁴ Hinsley *et al*, *British Intelligence in the Second World War, Volume I*, p. 284.

³⁵ Davies, *MI6 and the Machinery of Spying*, p. 106. Davies's source for this information is a confidential informant designated i-03.

³⁶ CCAC RVJO B.342, Jones to Irving, 10 July 1964.

³⁷ Jones, *Most Secret War*, p. 206. Arthur Harris spoke of 'a body of brilliant young civilian scientists and technicians at Bomber Command headquarters who did work of inestimable value' in subjecting all aspects of operations to impartial scrutiny: Harris, *Bomber Offensive*, p. 131. Sir George Thomson, head of the Maud Committee investigating the possibilities of a British atomic bomb, was requested to act as Chief Scientific Adviser to the Air Ministry: Zuckerman, *From Apes to Warlords*, p. 336; Clark, *Rise of the Boffins*, p. 87. Sir Thomas Merton (the only MI6-employed scientist during the First World War) became a full-time scientific adviser for MAP in September 1942, and devised a highly effective gun-sight to allow RAF pilots to shoot down the V1 flying-bombs: Joubert, *Rocket*, p. 117.

still navigating by sextant and stars. A wartime report on science relative to war (specifically regarding RDF) highlighted the problem succinctly:

The great success of the complicated technical war fought by the RAF in the Battle of Britain had two effects, one good and one bad. The good one, which outweighs the bad entirely, is that it turned the *Luftwaffe* back and saved the island. The bad one is that the very success of the highly organised and undeniably cumbersome mechanism of radar and communications and airplanes and control centres which was the Fighter Command in 1940 and 1941 tended to freeze the thinking about radar along the lines of static defense against air attack.³⁸

In his memoirs, Jones took a fascinating philosophical view when comparing the differences between the British and German scientific mentalities in respect of their radar requirements. The German navigational beams had shown the German mind-set to be predominantly offensive, in contrast to the British who had necessarily adopted a defensive posture.³⁹

Concentrating military force in the East meant that German forces in the west were placed on a defensive footing. Only then did the GAF 'intensify its intelligence activities'; essentially because of the principal theory that 'the

³⁸ CCAC ROCO 2A 2/1, *Radar: A Report on Science and War*, released by the Joint Board on Scientific Information Policy for the Office of Scientific Research and Development, for the US War Department and the US Navy Department (London: HMSO, 1945), p. 13.

³⁹ Jones, *Most Secret War*, pp. 198–9. Jones posited that this had much to do with the British considering radar as a means to economise on fighters—Britain's 'most precious commodity'. What stemmed from British radar development, which was crucial to Britain's survival and which contributed considerably to eventual victory, was the 'interchange at the working level' between scientists, engineers, and serving officers. In contrast, the Germans did not produce the same close working relationships. Jones commented that when radar became a technical possibility, 'the German services drew up specifications which the scientists and engineers then tried to satisfy'. In consequence, 'German radar was much more like a scientific instrument both in stability and in precision of performance', and was 'much better engineered than British radar'.

defender is usually weaker than the attacker'.⁴⁰ Repair of such weakness entails much deeper understanding of enemy capability and intent, essentially derived through radar, low-grade signals, and espionage. Jones recalled that it was for these very reasons that nearly two years of the war passed before he saw any real German appreciation of radar at the working level.⁴¹ With scientific intelligence firmly established as one tiny component within the extensive British war machine, and with the 'Battle of the Beams' behind them, the growing team of scientific intelligencers also went on the offensive—with German defensive radar their quarry.

Understanding DT

In April 1940, Jones posited that it was 'natural to expect' German RDF, but no evidence had come to light of any likely transmissions.⁴² The following month, he reported the German RDF intelligence he had acquired to date: Bainbridge-Bell's *Graf Spee* evidence, Oslo Report references, and the various POW acronyms/synonyms. In SIR No.7, Jones recommended three ways of defeating German RDF: overloading it with large numbers of small bomber formations; attacking at night and/or in 10/10 cloud; and intentional jamming.⁴³ These were perhaps relatively obvious, but showed the contemporary technological mentality, as first Germany and then Britain adopted the first two methods, with both fearing retaliatory consequences of

⁴⁰ Horst Boog, 'A Luftwaffe View of the Intelligence War' in *Air Intelligence Symposium*, Bracknell Paper No. 7 (Royal Air Force Historical Society, 1997), 61.

⁴¹ Jones, *Most Secret War*, p. 199. Jones wrote that this 'was in North Africa', where *Flieger Führer Afrika* (probably Lieutenant-General Hoffman von Waldau) said he needed more DT 'so as to economise in fighters'.

⁴² CCAC RVJO B.5, 'Monthly Report to D.S.R. No.1 for April, 1940', 30 April 1940, p. 4.

⁴³ CCAC RVJO B.6 & TNA AIR 20/1622, Air Scientific Intelligence Report No.5 'Indications of New German Weapons to be used against England', 23 May 1940, p. 4.

the third. In mid-July 1940, Jones stated that 'it was safe to conclude' that the Germans had an RDF system; that experience of *Knickebein* showed the Germans had ample technique and accurate methods of D/F on CHL; and that they had combined some form of RDF with IFF and *Knickebein* to give *Wotan*'. The convincing evidence for such conclusions was ULTRA data about *Freya* at Lannion and Cap de la Hague. In SIR No.7, Jones and Frank speculated that *Knickebein* and *Wotan* might have been vulnerable to 'other forms of interference' such as reflecting transmitters attached to British aircraft.⁴⁴ This would prove to be a sound prediction, although they were still unclear on the physical nature of detection, positing visual, sound, infra-red, or some type of RDF as possibilities.⁴⁵

In *Most Secret War*, Jones relayed a logical narrative placing ADI (Science) central to the collation process of gathered intelligence on the GAF defence. This narrative commenced Part Two of his memoirs and, aside from a small selection of thoughts and recollections on other related activities, comprised of over 100 pages, equating to approximately one fifth of his memoirs. He summarised this narrative with the following statement:

The whole investigation, starting with the radar on the Channel coast, had drawn on our resources to the full. It had been a much more difficult Intelligence problem than the beams, where we had had prisoners and equipment presented to us, as it were, and where we could solve most of our problems without moving outside England. With the German night defences,

⁴⁴ CCAC RVJO B.9 & TNA AIR 20/1624, Air Scientific Intelligence Report No.7 'The Edda Revived', 17 July 1940, pp. 3-5.

⁴⁵ CCAC RVJO B.12 & TNA AIR 20/1625, Air Scientific Intelligence Report No.8 'Freya', 14 August 1940, pp. 1 & 3.

by contrast, we had to go out to get information by every conceivable means; and the risks run by the patriots in the Low Countries, by our photographic and listening air crew, and at Bruneval, will have been obvious from my account.⁴⁶

It was; but when the surface of his narrative is scratched, what is truly obvious by its omission from Jones's story is the extensive effort of the other intelligence organisations that were also heavily involved, through application of their varied methods, in understanding the GAF defence system. Jones mentioned human intelligence (HUMINT) in the form of 'patriots', but not the meticulous work undertaken by ADI(K) in POW and refugee interrogation. He constantly referred to Technical Intelligence (TECHINT) from brave photographic aircrew, but rarely from the dedicated photographic interpreters. He mentioned SIGINT from 'listening aircrew' but not listening ground crew (except in criticism). Finally, he mentioned the glory of Bruneval, but not the extensive work undertaken by TRE thereafter. Often ADI (Science) collaborated with these other organisations, sometimes they simply utilised their products. In contrast to the picture Jones provided in *Most Secret War* however (that he and his team were crucial to defeating the German air defence), ADI (Science)'s contribution was simply one of many which provided the full picture. It is this part of Jones's story therefore that requires the most rigorous deconstruction.

Following their great success in unravelling the intelligence puzzle behind the German navigational beams, ADI (Science) experienced something of a lull in activity. This is evident upon close examination of the SIRs they produced for

⁴⁶ Jones, *Most Secret War*, p. 286.

high level dissemination in the first half of 1941. In May 1941 ADI (Science) released SIR No.11, detailing intelligence on German research into a Photoelectric Steered Bomb – a report Jones defined as a ‘miscellany of technical matters’ inspired by the Oslo Report.⁴⁷ In July, ADI (Science) distributed SIR No.12, their full appreciation of German beam policy.⁴⁸ Only when SIR No.13 was released (in January 1942) were ADI (Science) able to provide significant intelligence of GAF defence.⁴⁹ During this period, they produced only one interim report detailing radio aids to German nightfighters, thereby assisting Bomber Command in their newly-invigorated task.⁵⁰ The process of understanding the GAF defence was a protracted experience which actually began before the discovery of *Knickebein*, involved many organisations throughout the intelligence services and the armed forces, and did not cease until after the final defeat of Germany in May 1945.

Jones provided a completely contrasting account in *Most Secret War*. He painted a glorious and seamless picture of success after success by ADI (Science): over the beams, the GAF defence, and onto the next victories. Evidently he was narrating a story that needed to be exciting, and some egoistic exaggeration is expected and occasionally excusable. Nevertheless, in understanding DT (the essence of GAF defence), ADI (Science) became much more integrated into Britain’s large and ever-expanding war machine than Jones relayed. ADI (Science) was a component no more important than

⁴⁷ CCAC RVJO B.21, Air Scientific Intelligence Report No.11 ‘The Photoelectric Steered Bomb in Germany’, 13 May 1941; for ‘miscellany of technical matters’, see Jones, *Most Secret War*, p. 205.

⁴⁸ CCAC RVJO B.23, Air Scientific Intelligence Report No.12 ‘German Beam Policy’, 23 July 1941.

⁴⁹ CCAC RVJO B.24, Air Scientific Intelligence Report No.13 ‘D.T.’, 10 January 1942.

⁵⁰ CCAC RVJO B.22, Air Scientific Intelligence Interim Report ‘Radio Aids to German Nightfighters’, 15 June 1941.

any of the others, and yet just as vital (a mechanism stops working if it loses one component and so each component is essential to the whole).⁵¹ In the DT chase, there were no critical meetings with Churchill and, although lives were still at risk as a consequence of failure, it was not enacted under intense duress of bombing as had been the case in the Battle of the Beams. ADI (Science)'s contribution was also no more sensational than that of any other organisation, nor did they deserve any more credit for eventual successes.

Not surprisingly, all of Jones's literary recollections portray events showing him in the best light. This is exemplified in *Most Secret War* through his narration of the British intelligence attack on GAF defences. In his concluding summary of wartime events, for example, Jones remarked that it was obvious from his account that ADI (Science)'s work had been 'exhilarating', and that he had experienced 'moments of tremendous excitement'.⁵² In assessment of the birth of scientific intelligence this is a crucial point: when constructing his memoirs Jones selected only those moments of exhilaration, and only those which directly involved him. In the case of the Battle of the Beams this was an acceptable method of presenting the essence of truth largely because it was him and him alone who was central to the events. But by mid-1941, not only did he have a small team of officers working for him (some of which are rarely mentioned in *Most Secret War*), but also there was an impressive intelligence network parallel to ADI (Science), often investigating the same intelligence

⁵¹ There have been three definitions provided for the acronym DT: *Dezimeter Telegraphie*, *Dete Gerät*, and *Detektor*. See respectively Clayton, *The Enemy is Listening*, pp. 93; CCAC RVJO B.12 & TNA AIR 20/1625, Air Scientific Intelligence Report No.8 'Freya', 14 August 1940, p. 4; post-war technical reports; and Hinsley *et al*, *British Intelligence in the Second World War, Volume II*, p. 244. In SIR No.8, Jones suggested that the 'Dete' in 'Dete Gerät' was perhaps short for 'detector'.

⁵² Jones, *Most Secret War*, p. 532.

puzzles; perhaps from different perspectives, often in harmony, sometimes not, but all working towards the same over-arching objective.⁵³

In the Air Intelligence reorganisation of April 1941, Charles Medhurst had been assigned ACAS(I), and ADI (Science) thereafter reported directly to him.⁵⁴ Upon his appointment, according to Jones, Medhurst requested ADI (Science) to focus upon analysing German night defences (specifically radar) because 'he was sure that it was a problem that demanded a scientific mind'.⁵⁵ They were not the only organisation to be so instructed. Three months earlier, when it was appreciated that PR/PI was of first-class strategic importance, Claude Wavell was appointed to devote his attention to interpretation of enemy W/T installations, and given two WAAF assistants.⁵⁶ These three interpreters formed 'G-Section', one of Medmenham's specialised sections for Third Phase Interpretation. As the importance of W/T and radar grew as the war progressed, G-Section expanded to a total of thirty-two people.⁵⁷ Wavell's interest in 'maths and wireless' made him ideal to train others to interpret wireless masts and radar installations in aerial

⁵³ It is important to add here that Jones did dedicate a small paragraph at the end of *Most Secret War* (pp. 532–3) in tribute to 'the multitude of men and women, every one of whom played an essential part'. However, he tainted this tribute by quoting Wellington after Waterloo – 'I don't think it would have done if I had not been there' – and stating 'conscientiously' that there were many occasions in the Second World War where he could say the same. It begs the question: if Jones had had the misfortune to lose his life in the London Blitz, would the Allies have still won the war?

⁵⁴ Medhurst's daughter Rozanne began work at Bletchley Park at the age of 19, while Medhurst was still ACAS(I). Selected because she could speak fluent Italian, Rozanne Medhurst was put to work decoding Italian signals for the RAF Section in Hut A. This provided yet another link between Bletchley and scientific intelligence: for more on Rozanne Colchester (née Medhurst), see www.bletchleypark.org, accessed 15 June 2012.

⁵⁵ Jones, 'Emotion, Science, and the Bomber Offensive', 908; Jones, *Most Secret War*, p. 183.

⁵⁶ TNA AIR 41/7, *Photographic Reconnaissance, Volume II: May 1941 to August 1945*, p. 34. The two WAAF assistants were S/O Weston and S/O Mortimer.

⁵⁷ TMC MHP 468, Staff list in History of 'G' Section, undated although this History was compiled for the 50th Anniversary of the RAF (which dates it at 1967).

photographs.⁵⁸ He became the leading expert in his field, specialising in finding German radio masts and radar-related objects, which appeared on aerial photographs only through stereoscopes as miniscule dots.⁵⁹ Stereoscopes provided three-dimensional images, but in interpreting masts and radar-arrays the importance lay in the shadows cast by the object under scrutiny. ‘Size, shape, shadow, and tone and associated features’ were the mantra of the Medmenham PIs.⁶⁰

The ‘first glimmerings of an answer’ to the many clues which materialised, claimed Jones, were Wavell’s ‘various curiosities’. Jones recalled that in January 1941, on a photograph of a French town called Auderville, Wavell found such tiny dots which appeared through the stereoscope as cattle feeding troughs or ‘cow-bins’.⁶¹ These discoveries were integral to the creation of G-Section—a fact Jones entirely neglected to recall. Unless the PIs knew what to look for, interpretation could be a slow and very laborious process. ADI (Science) therefore came to be seen as ‘the authority responsible for issuing information to “G” Section on the types and functions of stations’ they wished to ‘have located’.⁶² For Jones, this arrangement

⁵⁸ TMC MED/DFG 5794, Claude Wavell interviewed by Constance Babington Smith, 24 May 1956.

⁵⁹ Babington Smith, *Evidence in Camera*, p. 73.

⁶⁰ Christine Halsall, ‘Women with a Secret: Photographic Interpretation’ in Lee and Strong (eds.), *Women in War*, p. 151.

⁶¹ Jones, *Most Secret War*, pp. 189–90. Archive evidence shows that the date of the PR sortie for this photograph was some two months earlier, on 22 November 1940: TMC MHP 468, History of ‘G’ Section; TNA AIR 41/6, AHB, ‘Photographic Reconnaissance, Volume I: To April 1941’, p. 266.

⁶² TMC MHP 494, ‘Interpretation of Wireless Apparatus’, p. 14. In places this lengthy document refers to ADI (Science) as an individual (namely Jones), yet in other places ADI (Science) is referred to collectively as an intelligence organisation.

meant that Wavell was then 'recognised as [his] interpreter', one who was 'definitely established as [his] contact with photographic reconnaissance'.⁶³

It was no slippage that Jones referred to photographic 'reconnaissance' here, rather than 'interpretation', for throughout *Most Secret War* interpretation of photographs was portrayed as his or Frank's domain. The discovery of the shadows of the Auderville DT apparatus is a perfect example. Jones narrated that he and Charles Frank examined the photographs in turn, whereupon 'Charles spotted the vital clue that the shadows were of different widths in successive photographs'.⁶⁴ In complete contrast, Wavell recalled that he himself had discovered that 'the shadows from the aerial was thin and then thick, suggesting that the frame aerial was rotating'.⁶⁵ Further evidence corroborates Wavell's claim. At Medmenham after the event, G-Section trainee interpreters were informed that 'Wavell was able to show from photographs above, that thickening of a shadow thrown by an object within an emplacement represented the movement of a framework. Immediately a pilot went out briefed to find wireless'.⁶⁶

Wavell was also credited with the discovery of the shadows in the *The Secret War* episode 'To See for a Hundred Miles', in which Jones was a key

⁶³ CCAC RVJO K.476, transcript for 'To See for a Hundred Miles', p. 23. See also 'To See for a Hundred Miles', the second episode in *The Secret War* television series, written and produced by Brian Johnson in 1976, aired on 12 January 1977; Jones, *Most Secret War*, p. 189. Before these declarations Jones had admitted in interview that defining Wavell as his interpreter was 'an overstatement really': CCAC RVJO B.341, 'Note on interview with Prof. R.V. Jones, at 25 Elgin Mansions, London W.9, from 7.00pm 6th January 1963 to 1.00am on the 7th', p. 2. This interview actually took place in January 1964, an early New Year typing mistake by the interviewer David Irving.

⁶⁴ Jones, *Most Secret War*, p. 190.

⁶⁵ TMC MED/DFG 5794, Claude Wavell interviewed by Constance Babington Smith, 24 May 1956.

⁶⁶ TMC MHP 494, 'Interpretation of Wireless Apparatus', p. 6.

interviewee.⁶⁷ If he was absolutely certain that it was Frank who spotted the shadows, it contradicts what was stated in the television production. Moreover, in the producer's accompanying book (published 'with corrections' two years after the programme was aired), Jones evidently put Frank forward as the shadow-spotter.⁶⁸ Downing also noted this difference of opinion, but did not venture his findings further.⁶⁹ Comparative analysis of the DT SIR does at least provide a plausible explanation to this post-war mix-up; and at the same time highlights a potential early ADI (Science) failure. SIR No.13 stated that after PR sortie H/458 of 22 November 1940:

C.I.U. (then P.I.U.) noticed two unexplained small circles about 20 feet in diameter and a little to the west of Auderville. The coincidence with earlier information rendered the objects worthy of close study; two successive photographs did not form a perfect stereoscopic pair, and close examination showed that the imperfection was due to the fact that the shadows associated with one of the circles had changed slightly in the nine seconds between exposures.⁷⁰

Wavell had further recalled that Jones 'had had a ground report on Auderville' which had led him to investigate further.⁷¹ Jones wrote in his memoirs that,

⁶⁷ CCAC RVJO K.476, Transcript for 'To See for a Hundred Miles', no date, p. 23. There is an interesting sentence on this page of the transcript that was cut from the aired programme. Jones said: 'Well of course we had photographs and we looked and we looked and we looked, but nothing was visible at all and this was a puzzle but the only inference was that if the radar was still there, of course photographs were taken a week or two later, that it was so small that we couldn't see it on the quality of picture that we were then getting, and so the matter had to be left'. It is hardly surprising that this rather jumbled quotation was edited out, but it is an interesting methodological insight. It also emphasises the rudimentary nature of PR technology at the time.

⁶⁸ Johnson, *The Secret War*, p. 103.

⁶⁹ Downing, *Spies in the Sky*, p. 377.

⁷⁰ CCAC RVJO B.24, Air Scientific Intelligence Report No.13, 'D.T.', 10 January 1942, p. 5. Jones provided these enlarged images of these photographs in *Most Secret War* (Figs. 9a & 9b), and stated that the photographs 'on which the differences in the shadows was recognized by F. C. Frank' was one quarter of the enlarged reproduction.

⁷¹ TMC MED/DFG 5794, Claude Wavell interviewed by Constance Babington Smith, 24 May 1956.

after Wavell mentioned the photographs, the name Auderville rang a bell, for it was the name of the village where a *Freya* five months previously had been instrumental in the sinking of HMS *Delight*. This was evidently Jones's 'ground report' Wavell had recalled, and as such it came in the form of an Enigma decrypt not mentioned by Jones.

The 29 July 1940 sinking of the British convoy escort destroyer *Delight*, had indeed been the first physical sign that Germany had extended its net of defensive radar into occupied France.⁷² Jones later deduced that *Delight* had been detected from a range of approximately 60 miles by a *Freya* apparatus, and that as *Delight* had neither barrage balloons, nor air escort, the *Freya* apparatus must have detected *Delight* directly.⁷³ On 10 July 1940 GAF Enigma revealed information of a *Freya* north of Lannion and, more importantly insofar as *Delight* is concerned, on 14 July 1940 of a *Freya* at Cap de la Hague.⁷⁴ That Jones received this intelligence is confirmed in SIR No.8.⁷⁵ In his August 1940 Monthly Summary, Jones wrote regarding *Delight* that there was 'a curious but reliable indication that some form of coastal detector apparatus on a headland some 550 feet high played a part in the sinking of a British destroyer about fifty miles away'. Jones stated that it was

⁷² Data on the D-Class destroyer H-38 HMS *Delight* is sparse. What is clear is that *Delight* had left Portland to return to her Mediterranean war station, when she was detected by German radar at Cherbourg, and subsequently attacked by *Luftwaffe* Stuka dive-bombers. Severely damaged, *Delight* crawled back to England, only to sink in Portland Harbour early the next morning. See www.uboat.net/allies/warships, and www.naval-history.net, both accessed 23 March 2012.

⁷³ Jones, *Most Secret War*, p. 122.

⁷⁴ Hinsley *et al*, *British Intelligence in the Second World War, Volume II*, p. 246.

⁷⁵ CCAC RVJO B.12, Air Scientific Intelligence Report No. 8 entitled 'Freya', p. 1 where it is stated that 'signals told us that on 10.7.40 a FREYA-GERÄT was north of Lannion, and that on 14.7.40 there was a FREYA-GERÄT on the CAP DE LA HAGUE'.

not 'definitely an R.D.F. apparatus', but it appeared 'most probable' that the apparatus was 'coincident with a known German R.D.F. station'.⁷⁶

If Jones believed in the Oslo Report as much as his post-war narratives suggest, then there does appear to be some back-tracking in his early SIRs over the *Delight* issue. Millar wrote that, at the beginning of the hunt for German DT, 'Jones had not forgotten the 'radio detection stations along the North Sea Coast' mentioned in the Oslo Report'.⁷⁷ Evidently he did in this instance. It was also reported in this monthly summary that a large amount of evidence had materialised regarding the 'communications side of the German R.D.F. system in France'.⁷⁸ After August 1940 of course, the beams chase took precedent. As the Oslo Report had alluded to distances of 120km in which the Germans could see British aircraft, it must be asked, in light of the Cap de la Hague decrypt, why naval vessels were not warned to keep their distance from known *Freya* locations. Even allowing for the fact that aircraft recognition is not the same as ship recognition (although there is very little physical difference), this could arguably be the first scientific intelligence blunder of the war.

Perhaps this is the reason why Jones failed to mention important ULTRA evidence in the chase for *Freya* within his memoirs.⁷⁹ In his defence, there

⁷⁶ CCAC RVJO B.13, 'Air Scientific Intelligence Monthly Summary No. 5 for August, 1940', 31 August 1940, p. 1.

⁷⁷ Millar, *The Bruneval Raid*, p. 123.

⁷⁸ CCAC RVJO B.13, 'Air Scientific Intelligence Monthly Summary No. 5 for August, 1940', 31 August 1940, p. 1.

⁷⁹ Jones wrote that on '14th July we learnt that there was something called a Freya-Gerät' and so deduced that 'Freya appeared to be associated with air defence': Jones, *Most Secret War*, p. 121. For his two mentions of HMS *Delight*, see *Most Secret War*, pp. 122 & 190. There is no reference to *Delight* in any of his other post-war literature.

was insufficient contemporary information on German RDF to determine such high technical efficiency, and the verdict on the eventual sinking of *Delight* probably would have been one of chance encounter.⁸⁰ Such lack of knowledge was confirmed by the early 1940 airwave search that found inexplicable 80cm wavelength transmissions emanating from the French coast, although these were not at the time linked to *Freya*. Jones later claimed that had he not insisted on that airwave search, the 80cm-wavelengths 'would otherwise have remained undiscovered for a long time'.⁸¹ Perhaps then the blunder was not Jones's, but due to the lack of significant scientific intelligence organisation.

According to SIR No.13, ADI (Science)'s vague interpretation of the Auderville *Freya* derived predominantly from POW interrogation reports, which provided various acronyms for German radar developments. 'D.T.' was the most prominent, even linked to 'Englisches D.T.' in references to British CH. It was these leads, provided by AI1(k), that led ADI (Science) to surmise that it was 'therefore likely that the truest German equivalent' of British RDF was DT.⁸² Plausibly then, based on the decrypt, on the knowledge of the sinking of HMS *Delight*, and data from AI1(k), Jones contacted Wavell asking for him to investigate any photographs of the Auderville area. Once these had been analysed stereoscopically, Wavell then contacted Jones about his discovery

⁸⁰ There is an unconfirmed account in Brian Johnson's television programme 'To See for a Hundred Miles' that the sinking of *Delight* was reported by the GAF using Enigma. This report was supposedly intercepted by the RAF Y-Service and, when decoded at Cheadle, the message told how *Delight* had been sunk by *Freya*. Again this part of the programme was not included in Johnson's book of the series: CCAC RVJO K.476, Transcript for 'To See for a Hundred Miles', p. 23.

⁸¹ Jones, 'Temptations and Risks of the Scientific Adviser', 443.

⁸² CCAC RVJO B.24, Air Scientific Intelligence Report No.13 'D.T.', 10 January 1942, p. 3. Also added was that the explanation of the initials (or acronyms), 'and of nearly all other names' of German radar developments derived from POWs by ADI(k) and provided to ADI (Science) during 1941, was 'not known'. This report incorrectly dated the sinking of *Delight* as 'on 23.7.40'.

of the Auderville shadow differentiation. This was partially confirmed by Babington Smith:

It all started back at Wembley, when a young scientist named R. V. Jones, one of Churchill's advisers on "the Wizard War", came out to "Paduoc House" in connection with cover of a certain point on the French coast where a beam transmitter was suspected. He and Wavell at once made friends, and from then on a close partnership grew up, with Wavell giving almost his entire time to this special work, while Jones briefed him and followed up his reports.⁸³

This excerpt shows the early signs of science and technology applied to intelligence, while reference to 'Wizard War' demonstrates the influence of Churchill's war memoirs. If Jones and Wavell were such good friends, as it seems they were during the war at least, then it appears doubtful that Wavell would later try to claim undue credit. Without Frank's version of events however, a plausible explanation is all that can be produced. Jones's recollections have been reproduced constantly, before and after the publication of *Most Secret War*.⁸⁴ Wavell's account has been published only twice.⁸⁵ This has much to do with the fact that the history of Medmenham has been woefully neglected.⁸⁶ It is clear though, that Jones's recollection of

⁸³ Babington Smith, *Evidence in Camera*, pp. 167–8. 'Paduoc House' was an acronym for the Photographic Development Unit, of the Aerial Operating Company, the forerunner to Medmenham, which operated from offices in an industrial unit in Wembley: see Downing, *Spies in the Sky*, pp. 61–2.

⁸⁴ Price, *Instruments of Darkness*, p. 76; Jones, 'Auld Acquaintance', p. 9.

⁸⁵ Babington Smith, *Evidence in Camera*, pp. 167–70; Powys Lybbe, *The Eye of Intelligence*, p. 181. Powys Lybbe was certainly convinced that *Freya* was Wavell's discovery, but Babington Smith was vague on the issue. Documentation confirms that Babington Smith interviewed Jones after Wavell, who wrote to Babington Smith in reassurance: 'Dr. Jones is an extremely nice man and I am sure he is full of understanding of your difficulties in compiling your great history, so have no fear of him on that score. When I last heard from him he stressed how nice it would be for him to see you again'; see TMC DFG 3677/3, Wavell to Babington Smith, 1 February 1957. Jones chose not to mention Babington Smith at all in his book nineteen years later.

⁸⁶ The heritage of Medmenham is now preserved by dedicated volunteers. The Medmenham Collection is scattered across the country: a small archive at RAF Brampton (soon to be housed at RAF Wyton); a small museum at the MOD base for The Intelligence Corps at Chicksands; there is another small

radar's involvement in the sinking of HMS *Delight* and the subsequent unravelling of the mysterious objects at Auderville are yet two more examples of his memory composure through time. AI1(k)'s involvement in ADI (Science)'s eventual understanding of *Freya* was crucial, and yet Jones barely mentioned their contribution to the DT intelligence collation in his memoirs.⁸⁷ Wavell was his Medmenham contact, and he mentioned no other PIs by name. Given that Jones used the SIRs to compile his memoirs, this neglect was perhaps an attempt to place his own importance in events above that of other intelligence organisations.

In contrast, Jones was immensely reverent of the courage shown by the PR pilots. Following the shadow discovery, and knowing the danger to low-flying Spitfire pilots on reconnaissance duty, Jones apologetically requested low-oblique photographs of the 'Cow-bins' (taken on 21 February 1941).⁸⁸ Irrespective of post-war differences of opinion, the results of this early-to-mid wartime PR/PI and ADI (Science) co-operation cannot be understated. The initial photographs were the direct result of important improvements to aerial cameras.⁸⁹ Just as importantly, it was a demonstration of close co-operation between pilot, interpreter, and intelligence officer.⁹⁰

museum (private collection) at Muckleborough; while the wartime photographs have been moved from Keele University, and are now in Edinburgh, held by the Royal Commission for Ancient and Historic Monuments of Scotland. Danesfield House is now a Five Star Hotel. There is also TARA – The Air Reconnaissance Archive.

⁸⁷ The official history did at least rectify this, again through reference to ADI (Science)'s Air Scientific Intelligence Report No.13 'D.T.': Hinsley *et al* in *British Intelligence in the Second World War, Volume II*, p. 246.

⁸⁸ Jones, *Most Secret War*, p. 191. The original Cap de le Hague photographs of 22 November 1940, and 21 February 1941 (low-oblique) can be found in The Medmenham Collection archive at REP 203 and REP 204.

⁸⁹ TMC MHP 468, Draft History of 'G' Section.

⁹⁰ ADI (Science) later wrote that in 'general, the closer the collating officer can get to the actual source, be he pilot, interpreter, secret agent, cryptographer, intercept operator, prisoner interrogator or

Before these photographs confirmed the existence of rotating early warning *Freya*, other evidence on German radar defences had been acquired by ADI (Science). The Oslo Report had referred to an 'Aircraft Warning Device' and an 'Aircraft distance-measuring Instrument' (in the Official History as 'Air Raid Warning Equipment' and 'Aircraft Range-Finder').⁹¹ Authenticity of the Oslo Report was still largely untested. Only in the chase for *Y-Verfahren* had it shown some merit as a valuable source of intelligence. Reference to 'Aircraft Warning Device' spoke of a form of radar (other than *Freya*) – paraboloidal aerials (or dishes) operating on 50cm-wavelengths.⁹² Bainbridge-Bell's discovery of a range-finding aerial on the mast of *Graf Spee* was also taken into consideration by ADI (Science), although this was not recalled by Jones in *Most Secret War*.⁹³ GC&CS also supplied scientific intelligence with snippets of information about German defence radar and, once again, Enigma was the definitive source of confirmation. Two messages, decrypted in January and February 1941, spoke of *Freya* and 'Würzburg Gerät' being shipped to the Axis countries of Romania and Bulgaria. Not only did this important evidence anticipate (by several months) Germany's invasion of

equipment examiner, the greater the enthusiasm of the source, and the better the appreciation by the collating officer': CCAC RVJO B.83 & TNA AIR 40/1532, ADI (Science) official history, 'Air Scientific Intelligence in War, 1939–45', 1 April 1946, p. 12; AHB, 'Air Ministry Intelligence', p. 295.

⁹¹ AIR 40/2572, 'The Oslo Report'; Jones, *Reflections on Intelligence*, pp. 334–5; Hinsley *et al*, *British Intelligence in the Second World War, Volume II*, pp. 509–10.

⁹² Jones, *Reflections on Intelligence*, pp. 266 & 344; Jones, *Most Secret War*, p. 192; Hinsley *et al*, *British Intelligence in the Second World War, Volume II*, p. 245.

⁹³ CCAC RVJO B.6 & TNA AIR 20/1622, 'Indications of New German Weapons to be used against England', 23 May 1940, p. 4; CCAC RVJO B.24 & TNA AIR 20/1629, 'D.T.', 10 January 1942, p. 3; Hinsley *et al*, *British Intelligence in the Second World War, Volume II*, p. 244. The two mentions of Bainbridge-Bell's *Graf Spee* radar discovery in *Most Secret War* (pp. 93 & 136) are relative to the beams issues only.

Russia (through German protection of the Ploesti oilfields),⁹⁴ but it also allowed ADI (Science) to make an important breakthrough in mathematical analysis from all of the received information.⁹⁵

These two distinct types of apparatus were, according to Hinsley *et al*, 'probably the two described in the Oslo Report'—and indeed they were.⁹⁶ Moreover, as the Oslo Report had stated that these apparatus transmitted 50cm-wavelengths then, if ADI (Science)'s calculations of distance were accurate the pulse rate had to be 3750 pulses per second (or 37.5mc/s).⁹⁷ This gave them an airwaves frequency to tune into, and the ability to hear any transmitting *Würzburgs* in suspected continental locations.

After the war, Jones was highly critical of the low-grade signals listening services tasked to locate alien transmissions in the airwaves. After the war, he claimed that 'the Auderville Freya photograph was obtained almost the same day as that on which one of the ADI (Science) officers himself intercepted the transmissions', and that 'this problem proved too difficult for the Y-Service of the day by itself, and was only solved by a scientific officer familiar with both

⁹⁴ 'Puzzling at the time', wrote ADI (Science) in 1942, but 'obvious' in hindsight: see CCAC RVJO B.24 & TNA AIR 20/1629, Air Scientific Intelligence Report No.13 'D.T.', 10 January 1942, p. 31.

⁹⁵ This mathematical analysis was as follows: 'If F be the range of Freya and W that of Würzburg, the minimum values of F and W, just to give continuous cover, are determined by $2F + 2W = \text{Coast length of Rumania} = 260\text{km}$ [and] $4W = \text{Coast length of Bulgaria} = 150\text{km}$. whence F should be greater than 92.5km., and W greater than 37.5km. As Freya was already expected to have an operational range of 100km., it appeared reasonable to expect that Würzburg would have a range of about 40km., and therefore represented a shorter range, though apparently newer equipment. It was therefore now possible to resolve two distinct types of apparatus, although neither had been seen nor heard': CCAC RVJO B.24, Air Scientific Intelligence Report No.13 'D.T.' 10 January 1942, p. 3; Jones, *Most Secret War*, pp. 192–3; Hinsley *et al*, *British Intelligence in the Second World War, Volume II*, p. 244.

⁹⁶ Hinsley *et al*, *British Intelligence in the Second World War, Volume II*, p. 244.

⁹⁷ Jones, *Most Secret War*, p. 193.

radar technique and the Intelligence problem involved'.⁹⁸ This officer was Derrick Garrard, who had been sent from TRE by Air Marshal Joubert to assist Jones. This was typical of Joubert, one of the few key Air Ministry technocrats. Joubert had initially been Air Adviser to CombinedOps but was then assigned a supervisory role of the organisation created by the urgency of the beams in June 1940.⁹⁹ This was the reason behind the arrangement for Garrard to leave TRE for ADI (Science) in November. In *Most Secret War*, Jones wove a tale of Garrard having little to do when he arrived at Broadway and so, under his own initiative, 'acquired a suitable radio receiver and took it in his own car down to the south coast to see if he could find the missing *Freya* transmissions since the official listening service had failed'.¹⁰⁰ Another source added plausibly, that the Y-Service had detected the signals, but mistook them for British RDF transmissions.¹⁰¹

Upon receiving the DT transmissions, Garrard visited RAF Hawkinge to watch them displayed on cathode-ray tubes. On 24 February 1941, a meeting was arranged in Joubert's office. There was only one item on the agenda—to 'discuss the existence of German radar'. Jones attended this meeting armed with the photograph, and Garrard's evidence of DT transmissions. Jones recalled that he let the meeting 'run on a little to let the doubters say that they did not believe that the Germans had any radar', and then he produced the

⁹⁸ CCAC RVJO B.83 & TNA AIR 40/1532, ADI (Science) official history 'Air Scientific Intelligence in War, 1939–45', 1 April 1946, p. 12; AHB, 'Air Ministry Intelligence', p. 295.

⁹⁹ Jones, *Most Secret War*, p. 95. Joubert did not mention R. V. Jones or ADI (Science) in any of his post-war memoirs/histories: see Philip Joubert, *The Fated Sky: An Autobiography* (London: Hutchinson, 1952); *The Third Service: The Story behind the Royal Air Force* (London: Thames and Hudson, 1955); *Rocket* (London: Hutchinson, 1957); *Fun and Games* (London: Hutchinson, 1964).

¹⁰⁰ Jones, *Most Secret War*, p. 191.

¹⁰¹ Johnson, *The Secret War*, p. 103. Johnson's researchers interviewed many of the individuals involved. It was therefore much more than, as Jones described, 'a most valuable individual effort': Jones, *Most Secret War*, p. 192.

evidence. Apparently Joubert asked how long Jones had had the evidence, suspecting that it had been up his sleeve all along, and that he was withholding it to 'make fools of the doubters'.¹⁰² This story was the source of amusement within scientific intelligence circles, and featured in a G-Section report for trainee interpreters.¹⁰³ The key significance of these events (and accounts of events) however, lies not in their amusement, nor in their validity. What must be questioned is why ADI (Science) deemed it necessary to act on their own volition in obtaining the evidence of DT transmissions, and why Jones felt the need after the war to elaborate upon ADI (Science) involvement to the detriment of the other intelligence organisations.

The initial poor quality of intelligence derived from Britain's Listening Service, was a matter Jones had raised in late-1939. Through enquiry, he had proven there to be 'no systematic observation of evidence' indicating German use of radar. He suggested four improvements: ground and air observation of suspicious transmissions; examination of evidence of German interception of British raids; examination of W/T messages exchanged between German observation posts and aircraft; and examination and mapping of suspected structures seen in Germany.¹⁰⁴ Little did Jones know at the time that such methods would be his primary undertaking some two years later. His 1939 concerns had been the rudimentary nature of the British Y-Service; what he later defined in *Most Secret War* as 'a weakness in [British] Intelligence cover' because in Britain 'no proper listening service existed'.¹⁰⁵ This was far too

¹⁰² Jones, *Most Secret War*, pp. 191–2.

¹⁰³ TMC MHP 494, 'Interpretation of Wireless Apparatus', p. 6.

¹⁰⁴ CCAC RVJO B.106, 'A Scientific Intelligence Service', 7 December 1939, p. 8.

¹⁰⁵ Jones, *Most Secret War*, pp. 74 & 191.

critical of what proved to be, during the Second World War, an exemplary early-warning service. Moreover, it is historically unfair to the 8,000 personnel who committed themselves to the highly tedious (often bi-lingual) task of trawling the airwaves to find, and then listen intently to, suspicious transmissions which meant very little to the operators individually.¹⁰⁶

There can be only one explanation for Jones's continual criticisms of the Y-Service, and that is to enhance his and ADI (Science)'s technological watchdog efforts above that of others. It is probable that Jones allowed his 1940 difference of opinion with Blandy (head of RAF low-level SIGINT), and Lywood (Deputy Director of Y-Signals (DDSY)), over the existence of GAF navigational beams, to affect his judgement in the DT chase. Blandy was not mentioned in *Most Secret War* again after Jones narrated the collusion between Blandy and Eckersley over the *Kleve* Enigma message.¹⁰⁷ Jones had been particularly hostile toward Lywood, who far outranked Jones. Nor were either of Lywood's wartime successors mentioned in *Most Secret War*. When writing his memoirs therefore, Jones allowed personal animosity to distort the reality of past events. Jones more or less confirmed this himself later, when he spoke of a 'mixed relationship' between ADI (Science) and the Y-Service, and explained why:

¹⁰⁶ The figure of 8,000 includes Y-Personnel for all three Services, the Foreign Office, and the GPO: Pether, *Funkers and Sparkers*, p. 20.

¹⁰⁷ Blandy was replaced by Gr/Cpt Fitch in April 1943: John Stubbington, *BMP Reports by the German Section*, Bletchley Park Trust Report No.29 (March 2012), p. 14.

Some degree of difficulty was inevitable, for if the Y Service was responsible for signals intelligence and we for scientific intelligence, whose was the primary responsibility for investigating any German development that involved a new application of science to signalling?¹⁰⁸

This statement openly suggests that Jones saw himself, and by association ADI (Science), in direct competition with the Y-Service. It leads to all manner of connotations and conflicts of interest: who would find the missing puzzle piece; which service was better trained and equipped to undertake the tasks; which service was right (or wrong); and above all, which service would take the credit? The latter would have mattered to Jones especially, for he was a young man thrown into a situation not of his making, and he still had much to prove, both personally and scientifically. Jones remarked that it was he who 'had conceived Scientific Intelligence, with its constant vigil for new applications of science to warfare by the enemy, as the first watchdog of defence'.¹⁰⁹ The competition within this statement was explicit, and it is perhaps likely that Jones's post-war memory, over time, insisted that scientific intelligence had to be seen as the first watchdog, even the most important watchdog. This reasoning does not however account for his continued immature attitude towards the wartime Y-Service, which also ironically illustrates the importance of Jones's personality to the birth of scientific intelligence. Jones recalled:

¹⁰⁸ Jones, 'The Intelligence War and the Royal Air Force', 17.

¹⁰⁹ Jones, 'Scientific Intelligence', 354.

At one of the more difficult periods in our relationship I happened to read in *The Times* of the engagement of the second-in-command of DDI4 – the Air Intelligence Branch responsible for the Y-Service; he was Wg CDR Claude Daubeny, and so I telephoned him anonymously and rendered what I could of the Mendelssohn Wedding March on a mouth-organ. Being in signals intelligence he succeeded in tracing the call and, as he later told me, decided that I could not be so unco-operative as some of his colleagues claimed me to be. So, on being appointed a few months later to take over as head of RAF 'Y', he telephoned asking if he could come to see me. On arrival he said, 'I am now DDI4. I have served as deputy to two previous DDI4s and I saw them do everything to get you out of a job; they did not succeed; I want you to know that I am not as clever as they are, and so I am not going to try!' This was the start of the warmest of friendships.¹¹⁰

By May 1942 the awkward working relationship between ADI (Science) and DDI4 reached such difficulty that Jones felt the need to act. He wrote an eleven-point minute to Medhurst spelling out what he believed should be the appropriate division of duties between ADI (Science) and DDI4 that would augment harmony. DDI4 were 'primarily concerned with the study of the enemy's Air Signals organisation in all its aspects, and advising the Air Staff Branches on technical matters connected with such organisations': ADI (Science) were 'primarily concerned with the study of the enemy's Air Application of scientific devices in all their aspects, and advising the Air Staff Branches on all matters connected with such application'.¹¹¹ For Jones this meant overlap on any subject that involved scientific application to signals. In principle, the primary responsibility for such subjects could be allocated to either branch. DDI4's duties however, were dual nature, for it intercepted

¹¹⁰ Jones, 'The Intelligence War and the Royal Air Force', 17–18.

¹¹¹ CCAC RVJO B.121, Jones to Medhurst, 27 May 1942.

enemy wireless signals and controlled a listening service. DDI4 therefore also acted as a source of information.

Here lay the crux of the problem. Since much information was from intercepted enemy communication techniques, Jones believed it essential that special officers should be placed in 'close contact with the interception service' to 'study the signals'. Jones provided as example the properties of radio waves, which was an obvious allusion to Y-Service's inability to recognise DT signals in 1941.¹¹² In effect, Jones was appealing for an officer in AI4 to sift and interpret listening results preliminary to ADI (Science) correlation, similar to the arrangement he had with Medmenham. Jones saw the division of duties to be that of collector and collator, an arrangement that would enact desired peace and efficiency between DDI4 and ADI (Science).

The net result of Jones's appeal was an ACAS(I) memorandum that spelt out the definitions of the two intelligence organisations, that expressed most of Jones's concerns regarding technical overlap and confusion of responsibilities, and made official declaration of the necessary amendments to previous arrangements. Of key significance was Medhurst's explanation that ADI (Science) was to be responsible for short and long term studies on DT, for advice on their results, and being particularly responsible for all general reports on the subject. DDI4 for its part was to ensure that relevant extracts from ADI (Science) reports were transmitted to units without delay. DDI4 would be the normal channel for enquiries from units regarding DT that

¹¹² CCAC RVJO B.121, Jones to Medhurst, 27 May 1942.

affected flying operations, and were to refer to ADI (Science) for advice and additional information.¹¹³ If Jones saw the Y-Service as a less-competent rival to the technical brilliance of ADI (Science) in respect of DT transmissions, then he certainly saw DDI4 as an intelligence provider, rather than an organisation equal in intelligence collation.

Jones was unhappy regarding the obvious compromise made by Medhurst. Without 'undue boasting', Jones believed he could make 'relevant extracts' himself, and more competently than DDI4, and informed Medhurst that he did not require a 'middleman' to interpret scientific intelligence to the RAF, and resented 'very strongly' any implication that he was to be regarded unduly as DDI4's scientist to 'be kept on tap' while he was consulted by units as the expert on DT. In short, he did not have the necessary confidence in DDI4's present arrangements to ensure smooth working between them. Jones 'regretfully' asked that he be relieved of his duties if Medhurst rested upon the decision that DDI4 should assume the proposed extent of control.¹¹⁴ Jones did find Lywood's successor, Gr/Cpt Fitch, much easier to work with, although he did not confirm this in *Most Secret War*.¹¹⁵ It is clear that Jones allowed personal awkwardness with Lywood (and Blandy) to interfere with smooth working relationships.

¹¹³ TNA HW 43/2 'History of British SIGINT, 1914–1945, Volume II', p. 545; CCAC RVJO B.121 & RVJO B.129, memorandum ACASI/332/42 entitled 'Division of Duties between D.D.I.4 and A.D.I. (Science) – 1.6.42', signed by C. E. F. Medhurst, and dated 1 June 1942.

¹¹⁴ CCAC RVJO B.121, note attached to Minute written by Jones to Medhurst, 27 May 1942.

¹¹⁵ Jones chose not mention the DDI4 post again in *Most Secret War* after he made Lywood 'effectively disappear' from his story. In the same reference however, Jones did add a brief note of acknowledgement to Lywood's Typex encoding machine invention as a consolation for presenting him 'in an unfavourable light': Jones, *Most Secret War*, p. 211.

The Y-Service's primary task had originally been to search the airwaves for W/T, or Morse traffic. In early 1940 RAF Y-Stations were instructed to listen for and record any non-Morse signals and Radio Telephony (R/T) traffic emanating from the GAF.¹¹⁶ There is no evidence to confirm whether this had anything to do with Jones's December 1939 recommendations, but it is possible. Still, the Y-Service's early war success provided a 'very valuable service to Fighter Command during the Battle of Britain and the Blitz, often giving advance warning that enemy raiding aircraft were preparing to take off from their airfields'.¹¹⁷ By the end of the summer in 1940, Air Ministry Intelligence had an almost complete picture of the *Luftwaffe's* order of battle (particularly for Western Europe), and almost all derived from the Y-Service. RAF Cheadle, for example, could trace 'with ever-growing accuracy the whereabouts, movements and operational strengths of GAF units', thereby supplementing and providing convenient cover for the strategic intelligence derived from Enigma.¹¹⁸ Moreover, by eavesdropping on every aspect of *Luftwaffe* traffic, the Y-Service had appreciated the fact that the GAF worked with an entirely different aircraft control system than did the RAF.¹¹⁹

¹¹⁶ Clayton, *The Enemy is Listening*, p. 28.

¹¹⁷ Stubbington, *BMP Reports by the German Section*, p. 8. Aileen Clayton recalled the toil and the rudimentary nature of British Y during the Battle of Britain: 'We WAAF operators monitoring the traffic became exhausted from recording page after page in our log-books and listening to every kind of German accent. Our hands were cramped from writing, and our heads ached; and we could well have used another dozen linguists': Clayton, *The Enemy is Listening*, p. 42. There is no question that the Y-Service was seriously over-worked during the Battle of Britain and the Blitz. As WAAF operative Margaret Tabor recalled, 'operators on the out-stations were divided into four shifts to cover every period of 24 hours: 1-6 p.m., 6 p.m. to midnight, midnight to 8 a.m. and 8 a.m. to 1 p.m. We had four operators on every shift supported by two male W/T operators who also handled D/F bearings': Skillen, *Knowledge Strengthens the Arm*, p. 184.

¹¹⁸ Hinsley *et al*, *British Intelligence in the Second World War, Volume I*, p. 319.

¹¹⁹ Clayton, *The Enemy is Listening*, pp. 49 & 89.

For Jones, in recollection, the problem with Y during the war was that the Service was initially expected to do something it was not capable of doing—it was too ‘classic’. Morse and telephonic communications, he explained, were different from radio navigation because the former were sent by the human brain, whereas the latter were sent electronically.¹²⁰ Ineptitude as a reason seems hard to believe, as all accounts of the Y-Service (primary and secondary) emphasise the hi-tech nature of the Service’s capability. It is much more likely that the Y-Service was swamped by R/T and inundated with requests during the Battle of Britain, the Blitz, and the Battle of the Beams. During winter 1940–41 the most important problem was the defence of Britain, and the most important intelligence contributions were those giving notice of the GAF ‘target for tonight’.¹²¹ During this period, Clayton remembered ‘a steady stream of visitors’ to Kingsdown from the Air Ministry, TRE, 80 Wing, and other organisations, ‘including ‘R.V. – as Dr Jones was known’. Clayton had fond memories of Jones, referring to him as Lindemann’s brilliant young pupil, and saw him as one of the visiting ‘boffins’ (namely Jones, Cockburn, Frank, and Eckersley).¹²² In a solitary note of praise for the DDI product, Jones singled out Kingsdown for its ‘excellent Y Service’.¹²³

In September 1940 the BBC ‘accidentally’ intercepted R/T traffic of GAF ground-controlled nightfighters, although its importance was not appreciated at the time.¹²⁴ Then, in October 1940, a young WAAF at Kingsdown heard a GAF pilot refer to a ‘*kleine schraube*’ (‘little screw’), followed by other most

¹²⁰ Jones, ‘The Intelligence War and the Royal Air Force’, 17.

¹²¹ Hinsley *et al*, *British Intelligence in the Second World War, Volume I*, p. 322.

¹²² Clayton, *The Enemy is Listening*, pp. 49, 63 & 86.

¹²³ Jones, *Most Secret War*, p. 300.

¹²⁴ Hinsley *et al*, *British Intelligence in the Second World War, Volume I*, p. 322.

unusual signals – ‘parlour’, ‘garden-shed’, ‘church-tower’, ‘lantern’. It was the duty of the Y-Service to listen and log, and then send the messages by written record or telephone depending on the urgency. Clayton recalled that each morning ‘a despatch rider rushed a copy of the ‘little screw’ logs to Dr Charles Frank’; another copy went straight to Station X at Bletchley for their analysis and each day she would telephone Rowley Scott-Farnie at the Air Ministry.¹²⁵

The *Kleine Schraube* proved to be radio beacons around which GAF nightfighters would fly. In his memoirs, Jones played down the significance of this intelligence by stating that ADI (Science) ‘ultimately realized’ that *kleine schraube* was ‘nothing more than a code-name for the radio beacon which the nightfighter was to orbit’.¹²⁶ In contrast, Clayton recalled that:

By early November sufficient messages had been recorded from this ‘Little Screw’ traffic for it to become the subject of serious, urgent research by the Air Ministry, by Bletchley and by the TRE scientists at Worth Matravers, who thought at first the intercepts indicated a use of airborne radar. By 3 January 1941, Dr Jones and Dr Cockburn were able to issue a preliminary report outlining how it was believed the system worked.¹²⁷

This is a fascinating contrast. It suggests that Y-Service traffic was more useful to the British understanding of DT than Jones himself either appreciated at the time, or later recalled. Moreover, it accentuates the intricacy of the network Jones and ADI (Science) were part of. During the summer of 1941, many *Würzburg* transmissions had been intercepted, mostly

¹²⁵ Clayton, *The Enemy is Listening*, p. 91.

¹²⁶ Jones, *Most Secret War*, p. 265.

¹²⁷ Clayton, *The Enemy is Listening*, p. 95. The 3 January 1941 report has proved elusive.

by the new RAF 'pathfinding' 109 Squadron.¹²⁸ By 1942, RAF Cheadle was also intercepting the 'little screw' traffic, and W/Cdr John Stubbington has recently confirmed that this information allowed the possibility of the British establishing a relationship between the geographical locations of the beacons, their times of activity, and the routes of Allied bombers. Stubbington clarified that such intelligence was 'of great significance to the progressive understanding of the German Ground-Controlled Intercept (GCI) system'.¹²⁹

Nor should TRE's input be underestimated, yet relative to the DT chase, they rarely got a mention in *Most Secret War*. Where Jones did choose to refer to the TRE watch on GAF radar, it was in reference to his own determined effort to initialise such investigations, rather than to praise the tireless efforts of the technicians involved.¹³⁰ Official historians did at least highlight TRE's efforts in locating DT transmissions.¹³¹ Listening to pulses, and often flying along occupied territory coastlines, TRE located *Freya* transmissions and heard the so far unidentified 53cm-wavelengths. They reported a large amount of aether activity in this regard. ADI (Science) confirmed that aerial surveys by TRE had 'established the existence of a whole chain' of DT on the enemy-occupied coastline and mainland of North-West Europe, while other information

¹²⁸ Hinsley *et al*, *British Intelligence in the Second World War, Volume II*, p. 248.

¹²⁹ Stubbington, *BMP Reports by the German Air Section*, p. 14; see also John Stubbington, *Bletchley Park Air Section Signals Intelligence Support to RAF Bomber Command: Combined Bombing Offensive, 1943–1945 with the 8th US Army Air Force*, (Minerva Associates, 2007), particularly Chapter 6; and John Stubbington, *Kept in the Dark: The Denial to Bomber Command of Vital Enigma and Other Intelligence Information during World War II* (Barnsley: Pen & Sword Aviation, 2010).

¹³⁰ Jones, *Most Secret War*, p. 136. Jones singled out two TRE technicians for particular praise – Derrick Garrard and Eric Ackermann both of whom joined ADI (Science) anyway.

¹³¹ Hinsley *et al*, *British Intelligence in the Second World War, Volume II*, p. 247.

indicated that the 53cm-wavelength variety was almost as widespread as *Freya* 'found from Kirkenes to Crete, and from Brest to Mariupol'.¹³²

Important contemporaneously to ADI (Science), but not it seems to Jones in hindsight. Instead of describing all of the intelligence derived from all other sources available to ADI (Science), he preferred to narrate methods of his own initiation—a prime example of which occurred during the *Freya* chase. Across the road from Jones's Broadway office, was a large block of flats called Queen Anne Mansions, inside which was based an Army Signals Interception Unit of the Home Forces. ADI (Science) gained knowledge that this Army Unit were intercepting German coded radio traffic, and arranged to try to break the codes themselves. Jones narrated that the codes were not complex (presumably due to their low importance) and so Frank and Garrard found them simple to decipher. By some strange quirk of fate these signals turned out to be plots by the same coastal radar stations that ADI (Science) were in the process of appreciating.

The German plots presented ADI (science) with much opportunity. They deduced that the RAF could fly their own aircraft in sorties towards any particular radar station identified, coming in at various heights to see when they would be first detected. They could then chart the extent of the German radar cover, investigate the accuracy of their plotting, and ascertain German reactions to raids. From this data, the RAF could build up a minute-by-minute

¹³² CCAC RVJO B.24, Air Scientific Intelligence Report No.13, 'D.T.', 10 January 1942, p. 5.

picture of what the German fighter controller was seeing.¹³³ With this intelligence, ADI (Science) arranged with the C-in-C Fighter Command for a plotting table to be set up alongside the main (and by now famous) plotting table at Fighter Command HQ at Bentley Priory, so that comparisons could be made between what the British and German radar systems saw. In this task scientific intelligence was assisted by two 'girls': Mary Francis, a mathematician from TRE, and 'Ginger' Parry.

It would be wrong, commented Clayton, 'to underrate the value of the great mass of traffic that was intercepted in lower-grade codes', as each of the Services had their own monitoring facilities – Air had AI4, Army had MI8, and Navy had NID – and 'all were closely linked from the start of the war'.¹³⁴ Why ADI (Science) deemed it necessary to decode their own messages is inexplicable, and so it can only be surmised that it was due to Jones's earlier distaste for Lywood, Blandy and Eckersley. There was nonetheless a high level of luck involved in their being able to access the exact signals required to understand the GAF GCI plotting system. Irrespective of good fortune, and in contrast to Clayton's comment, it is clear that the deeper these issues are researched the more obvious become the signs of dysfunction within the early-to-mid-war service intelligence organisations.

It is evident from Clayton's and Jones's accounts of events that the Y-Service did not work entirely in tandem with ADI (Science) following resolution of the beams intelligence issues. This brings new light to the conundrum that British

¹³³ Jones, *Most Secret War*, pp. 195–6.

¹³⁴ Clayton, *The Enemy is Listening*, p. 125.

intelligence were 'long unable to give Bomber Command much practical assistance' in reducing their losses due to the efficiency of the GAF defences.¹³⁵ Sections within sections of both the armed services and the intelligence services were amassing enormous quantities of their own data during 1941 and 1942 without much liaison. For example, Bletchley had two Index sections (one each for the RAF and army) that 'registered everything, from every possible source'.¹³⁶ There was the Bletchley German Book Room which compiled every transcript verbatim with a record of action taken; other sections within Bletchley were amassing their own respective data.¹³⁷ Clayton showed that the Y-Service was undertaking its own intelligence research.¹³⁸ Each section of CIU had card indexes (G-Section had one on the geographic positions of GAF DT and W/T).¹³⁹ Medmenham also designed a system of transparent traces of each mission which could be laid over appropriate maps to determine the target of PI interest.¹⁴⁰ Even as late as 1943/1944, and in preparation for D-Day, NID23 was amassing European coastal defence intelligence in card-index form.¹⁴¹

¹³⁵ Hinsley *et al*, *British Intelligence in the Second World War, Volume II*, p. 244.

¹³⁶ Millward, 'Life in and out of Hut 3', p. 24–5.

¹³⁷ Bletchley's departmentalisation was necessary for Ultra security reasons, as Hut 6 Code-breaker Susan Wenham explained: 'It was a very curious organisation. We were very departmentalised. You never discussed your work with anyone but your little group that you worked with. I hadn't a clue what was going on in the rest of the Park and nobody else had a clue what we were doing, except the real high-ups. It was a curious world of its own': see Smith, *Station X*, pp. 36–7.

¹³⁸ See for example Clayton, *The Enemy is Listening*, p. 105, where Clayton stated that Blandy issued a report, along with a map, which was of great operational value to all RAF Commands, that showed the ranges and heights at which aircraft were liable to be detected by German radar.

¹³⁹ See TMC MHP 468, Draft History of Medmenham's G Section, p. 4. G Section also compiled dossiers based on a Map grid reference system including all ground information, two years' of AI1(k) and other organisation extracts, as well as 'Omnibus dossiers of stations verified photographically, classified according to class, and containing photographs and all necessary information'.

¹⁴⁰ Stanley, *V-Weapons Hunt*, p. 40.

¹⁴¹ TNA ADM 223/84, 'Section Twenty-Three: NID (23)', no date.

All of this isolated activity was not (aside from specific incidences) due to animosities, or lack of uniformity of purpose, but simply a result of the enormity of wartime expansion without precedent. Moreover, Intelligence (and Deputy) Directorates acted as filters for much of the data sent to the respective service commands, and often this caused its own problems. A very good example of this was the fact that Bomber Command were not party to certain aspects of intelligence derived from ULTRA at least until 1944 (held back by DDI4), and that the work of the Bletchley German Air Section suffered as a consequence of 'need to know'.¹⁴² Much of the latter type of information is only now coming to light due to recent releases of SIGINT archive material. The story of Second World War SIGINT is still (albeit slowly and subtly) altering historical perception. This is likely to continue for some time to come.

Although the Y-Service was hugely successful during the war, it also had its problems, not least being that the deeper the Allied bomber offensive moved into Germany, the less GAF R/T was audible. Constant altering of beacon call-signs and frequencies also placed an 'onerous burden' upon Cheadle, which restricted their ability of early warning when the *Luftwaffe* used beacons to raid the British Isles.¹⁴³ Another concern was when the GAF gradually switched their transmissions from high-frequency (HF) to very high-frequency (VHF) wavelengths.¹⁴⁴ Insofar as the nightfighter R/T which ADI (Science) had taken upon themselves to encode and plot, as the Y-Service were unable to assess the traffic the Air Intelligence Branch delegated the responsibility to

¹⁴² Stubbington, *BMP Reports by the German Air Section*, pp. 18, 40 & 30.

¹⁴³ Hinsley *et al*, *British Intelligence in the Second World War, Volume II*, p. 241.

¹⁴⁴ Stubbington, *BMP Reports by the German Air Section*, p. 14; although Clayton in *The Enemy is Listening* (p. 61) stated that Kingsdown were equipped to listen to VHF.

the GC&CS Air Section. In favour of the Y-Service, GC&CS Air Section reported the GAF nightfighter R/T traffic to be one of the most tedious and ‘toughest intelligence problems ever tackled’.¹⁴⁵

Another source of intelligence used by scientific intelligence in the hunt for German DT was HUMINT. It took a while for this type of intelligence to commence its slow trickle to Britain after the Fall of France, but it was inevitable given the ruthlessness of the Nazi regime in control of the western European occupied countries.¹⁴⁶ In a post-war analysis of scientific intelligence within SIS, Jones wrote that when the embryonic espionage network was destroyed by German occupation of Western Europe, it nevertheless provided scientific intelligence with ‘a better opportunity for gathering information’, because the Germans then necessarily had to deploy much of their secret technical equipment in territory more accessible to British agents’.¹⁴⁷ In his memoirs, Jones was rich in praise for these agents—defining them as brave patriots who ‘risked torture and death for scientific intelligence’.¹⁴⁸ In the chase for DT, the intelligence gathered by Thomas Sneum for example, was remarkable, as was the bravery shown in ensuring that British intelligence received the product of his efforts.

¹⁴⁵ Hinsley *et al*, *British Intelligence in the Second World War, Volume II*, p. 253.

¹⁴⁶ A doctoral thesis is currently being researched by Christian Bak at the University of Cambridge (Pembroke College), investigating Anglo-Danish relations during the Second World War. Wartime scientific and technical intelligence derived from French, Belgian, Norwegian, and Dutch espionage would also make good subjects for future analysis.

¹⁴⁷ CCAC RVJO B.113, ‘Scientific Intelligence in the S.I.S., 1939–45’, circa 1945, p. 1

¹⁴⁸ Jones, *Most Secret War*, Dedication to Jeannie Rousseau (French), Leif Trondstad (Norwegian), Thomas Sneum (Danish), Hasager Christiansen (Danish), A. A. Michels (Dutch), Jean Closquet (Belgian), Henri Roth (Luxembourger), Yves Rocard (French), Jerzy Chmielewski (Polish), and the author of the Oslo Report. See Plate 22c in Jones, *Most Secret War*, for a photograph of Sneum. Michels did not feature in the main text of *Most Secret War*, but was included by Jones in his ‘Dedication’ because he had ‘mentioned a national from the other principal Resistance countries’; CCAC RVJO B.441, Jones to Kramish, 22 November 1985.

Sneum's epic story has been adequately narrated (by himself and by Jones), although there is much more to be discovered.¹⁴⁹ Its importance, insofar as the study of scientific intelligence is concerned, is twofold. The first is the most obvious, which is the very nature of source itself. As a Danish Fleet Air Arm pilot, Sneum was frustrated that he was unable to physically fight for his country against the Nazis. He was eager therefore to help the Allies in any way he could. Sneum became aware of strange technological anomalies near his home which he initially sketched and sent to the British Legation in Stockholm. Sneum followed up his delivery by visiting the Stockholm Embassy in person, whereupon he was requested by Captain Denham, the Naval Attaché, to obtain better quality (and more convincing) intelligence using cinefilm. Sneum agreed, did so, and then contrived to escape to England, where he hoped he would be able to physically fight by joining the RAF. His plan involved flying across the North Sea in an old First World War Hornet Moth bi-plane, which had lain derelict in a nearby farm. Sneum and his friend flew the decrepit aircraft to England only to be appropriately arrested as spies upon their arrival, and taken to an MI5 holding centre for aliens to be prepared for interrogation. When it was realised that Sneum had film in his possession of possible German radar stations Felkin's A11(k) was assigned to carry out the interrogation. Felkin's office promptly called Jones.¹⁵⁰

¹⁴⁹ Jones, *Most Secret War*, pp. 200–2; Mark Ryan, *The Hornet's Sting: The Amazing Untold Story of Britain's Second World War Spy Thomas Sneum* (London: Piatkus Books, 2009).

¹⁵⁰ See Ryan, *The Hornet's Sting*, pp. 7–93; Jones, *Most Secret War*, p. 200. There is a slight discrepancy between these accounts regarding the location of the London Holding Centre: Jones stated Wandsworth (p. 200), Ryan said Unity Street in Battersea (p. 97). The Royal Victoria Patriotic School for Orphan Girls was situated in Wandsworth, and was a London Reception Centre in the command of Colonel Pinto: see www.rvpb, accessed 23 June 2012.

Jones recalled that the reason why he had been drawn into the Sneum affair was because of the undeveloped film which had been found in Sneum's possession, which had been taken by MI5 to the GPO for processing and 'between them they had ruined nearly all of it'. There were just two frames left from which Jones could see 'very definitely' two *Freyas* in operation. Upon seeing this evidence Jones immediately appreciated that Sneum was genuine as well as gallant, and 'very definitely had filmed two *Freyas* in operation'.¹⁵¹ This was clear visual evidence of the existence of *Freya* in Denmark, providing the second significance of the Sneum affair. That early in the war, the geographical size and social organisation of Denmark made it an exceptionally difficult place to carry out militant resistance operations.¹⁵² Although PR had good photographs of Danish airfields the PIs had not discovered any radar arrays (nor were they looking). Nor could low-grade SIGINT listen to R/T so far away; only W/T intercepts could be forthcoming of such intelligence, which it was not. Receipt of such first-class intelligence that proved German DT undoubtedly existed in Denmark, was an intelligence windfall of the highest order for ADI (Science). This must have significantly raised the profile of scientific and technical HUMINT within Broadway at that time. Sneum also provided intelligence on German anti-aircraft batteries in

¹⁵¹ Jones, *Most Secret War*, p. 201. Sneum's recollections also provided valuable insight into the characters of Jones and Frank. He remembered that the first time he saw Jones it was the image of a 'gentle giant', a man who had a 'calm aura around him, which helped to diffuse some of the hostility still in the room'. Arguably Jones would have seemed like the good policeman, yet Sneum added that Jones 'treated everyone as though they had some good in them, and it was his job to find it'. In contrast, the only point Sneum recalled about Frank, who had accompanied Jones that day, was that he appeared to be a 'man who looked as though he enjoyed a good argument'. Rare insights; although many contemporaries might have argued that Sneum had the characteristics of the two scientists mixed up: Ryan, *The Hornet's Sting*, pp. 103–4.

¹⁵² See Anonymous, 'Review of Jorgen Haestrup, *Kontakt Med England 1940–1943 and Hemmelig Alliance 1943–1945* (Copenhagen: Thaning og Appels Forlag, 1959)', *Studies in Intelligence*, 6: 4 (Fall 1962), A63–A66. The authors of this review article added that clandestine communications with Denmark and Sweden were of 'considerable intelligence value to the Allies' during the war because of their close proximity (and thereby access) to Germany. See also David Lampe, *The Savage Canary* (London: Corgi Books, 1976).

Denmark, and provided sketches of Danish airfields being used by the occupiers.¹⁵³ Sneum's scientific and technical espionage career had only just begun, for he would bravely return to Denmark as an SIS agent.

One other, much less significant, source of DT intelligence referred to in *Most Secret War* was the humble pigeon. Carrier pigeons were used with relative success by British intelligence services during the Second World War, essentially as another link to Resistance movements in the occupied territories, but also to obtain specific intelligence.¹⁵⁴ Rarely, however, did the 'homing' pigeons return home.¹⁵⁵ Some 16,500 pigeons were parachuted into the occupied territories during 1941–45 and less than an eighth of them returned home.¹⁵⁶ They were, as a post-war report on pigeons as carriers of intelligence summarised: 'low-risk, low-stakes, little return': low-risk and low-stakes because 'carrier pigeons do not possess national characteristics, are resistant to interrogation, and once in a loft would be indistinguishable from local birds'.¹⁵⁷ ADI (Science) arranged for pigeons to be dropped where there

¹⁵³ Ryan, *The Hornet's Sting*, p. 101. Although Sneum was not mentioned again by Jones in *Most Secret War*, the two men did write to each other after the war: see CCAC RVJO B.535; CCAC RVJO B.575; CCAC RVJO B.583; CCAC RVJO B.598; CCAC RVJO B.600; CCAC RVJO J.336; CCAC RVJO J.370.

¹⁵⁴ See Hinsley *et al*, *British Intelligence in the Second World War, Volume I*, p. 187 for the use of pigeons during the Battle of Britain. See also Jock Haswell, *British Military Intelligence* (London: Weidenfeld & Nicolson, 1973), pp. 68–9 & 123–7.

¹⁵⁵ Successful (and especially courageous) birds were awarded the Dicken Medal, the animal equivalent of the Victoria Cross. There is a small but dedicated Pigeon Archive preserved in Bletchley's Hut 8 which includes a History of the Special Section Royal Signals to which members of the National Pigeon Service volunteered their services and their birds. This history contains a complete List of Returns, and a Roll of Loft Owners, and a history of 'Special Section, Royal Signals 1940–1945'. For more information on pigeons at war, see www.rpra.org, accessed 30 May 2012.

¹⁵⁶ Jilly Cooper, *Animals at War* (London: Heinemann, 1983), p. 81.

¹⁵⁷ T. J. Betts, 'Operation Columba', *Studies in Intelligence*, 5: 2 (Spring 1961), A36. Such methods did however mean a cull of predatory hawks, falcons, and kestrels nesting on the cliffs of England's east coast. In Operation *Columba* pigeons were dropped by parachute in crates which broke upon impact with the ground. It was hoped (in vain) that the birds would return with messages of German troop movements in western France before the Allied invasion of Normandy. Betts defined Operation *Columba* as an intelligence failure, although the Germans did meticulously register any British pigeons

were gaps in DT knowledge, by parachute in time-release containers with the following message attached: 'Are there any German radio stations in your neighbourhood with aerials which rotate?' By late-1943, pigeons provided ADI (Science) with three previously unknown locations of DT stations.¹⁵⁸ In a post-war report, ADI (Science) assessed that pigeons were 'a minor source of Air Intelligence, that could only be used in 'special circumstances', but that 'an Intelligence officer in a future war should bear in mind their possibilities'.¹⁵⁹

ADI (Science)'s steadily-growing understanding of DT emanated from a wide array of sources, even though in some instances they rejected certain available sources and replaced them with the products of their own methods. Crucially the DT chase was in variance to the sound foundations Jones had built during his Battle of the Beams apprenticeship. In 1940, he had demonstrated what could be done if the entire range of intelligence sources were carefully co-ordinated.¹⁶⁰ By 1941 however, he had allowed personal animosities and organisational jealousies to steer scientific intelligence away from important co-ordination with certain sections of the British wartime intelligence machinery which had served so well previously.

Nevertheless, in mid-June 1941, ADI (Science) presented their first report dedicated to assisting the British bomber offensive. This interim report laid out collated intelligence regarding GAF radar, derived from various sources.

found, and so the birds inadvertently contributed to the deception plan of Operation *Fortitude*. See also Hinsley *et al*, *British Intelligence in the Second World War, Volume III, part II*, p. 28.

¹⁵⁸ Jones, *Most Secret War*, p. 279. According to Jones, the Air Ministry had its own Pigeon Service (pp. 507–8). Hinsley *et al* stated that 'the pigeon service was operated by the RAF and SIS', *British Intelligence in the Second World War, Volume III, Part 1*, p. 309.

¹⁵⁹ CCAC RVJO B.85, ADI (Science) memorandum 'Pigeons', no date.

¹⁶⁰ Hinsley *et al*, *British Intelligence in the Second World War*, pp. 323–4.

Although it presented a fairly confident indication that the GAF were operating a GCI-type radar defence system, based on intelligence from POWs and R/T activity, this report was still very limited in scope and understanding. ADI (Science) even posited the theory that the GAF were using beams to direct their fighters to raiders. Crucially however, the report referred to the *Kleine Schraube*, and while due credit was presented to the Y-Service it was recommended that airborne listening to R/T should commence.¹⁶¹

Only one further SIR followed that year, which narrated the Battle of the Beams.¹⁶² This is not to suggest that ADI (Science) were sat on their laurels for the remainder of 1941, and they were certainly not expecting the lull in activity they enjoyed.¹⁶³ This brief respite was exactly what they required in order to effectively carry out Medhurst's request to seek intelligence on GAF night defence. With the varied intelligence sources forthcoming (due to increased POWs and refugees, improvements to PR/PI methods and technology, and expansion of HUMINT and SIGINT networks), ADI (Science) were able to report extensively on DT by January 1942, and demonstrate the value of scientific collation of technological intelligence. The reverence they paid to German technological proficiency and order is striking. They believed that German RDF would be of good quality, with simple principles, and thorough execution. ADI (Science) evidently admired the GAF radar

¹⁶¹ CCAC RVJO B.22, Air Scientific Intelligence Interim Report on 'Radio Aids to German Nightfighters', 15 June 1941.

¹⁶² CCAC RVJO B.23, Air Scientific Intelligence Report No.12 entitled 'German Beam Policy', 23 July 1941.

¹⁶³ Jones later explained: 'Little happened in the way of active radio warfare during the latter months of 1941. The German bomber Force, scheduled to start coming back from Russia some six weeks after the opening of the eastern offensive, stayed there': CCAC CHUR 4/398 F, annotated draft of 'The Radio War' by R. V. Jones, 11 April 1946. The un-annotated full draft can be found at CCAC RVJO J.1.

equipment and methods they discovered. Such respect for their technological quarry bred enthusiasm for the task at hand, and inspired collection and collation of every aspect of data on their latest technological puzzle.

All of this was wholly demonstrated in SIR No.13. They wrote confidently of two different types of RDF equipment and separated their purpose – *Freya* (2.5metre DT) and *Würzburg* (53cm GCI equipment).¹⁶⁴ Appendix 2 of SIR No.13 listed 32 confirmed and suspected DT stations in the western occupied territories coastal chain.¹⁶⁵ Five were in presumed areas (unconfirmed coordinates), three were vague reports, five were reported by refugees (one circumstantially), twelve had been confirmed by photography, and five had been heard (thus confirmed). All but one were believed to be of the 2.5cm-type (*Freya*), with the remaining one possibly having a 53cm-type (*Würzburg*) attached. Two *Freya* stations possibly also had *Würzburg*, and one probably. Although ADI (Science) were satisfied with their fairly extensive knowledge of *Freya*, they were less so with *Würzburg*, especially as they were unsure of its appearance. A photograph had been taken showing a *Würzburg* connected to the Cap d'Antifer DT station. 53cm transmissions had also been heard in that vicinity. This was the closest they had got to the elusive paraboloidal range-finder mentioned over two years previously in the Oslo Report.¹⁶⁶

¹⁶⁴ CCAC RVJO B.24, Air Scientific Intelligence Report No.13, 'D.T.', 10 January 1942.

¹⁶⁵ In *Most Secret War*, Jones wrote that his 'guess' at the time was that there were about 150 *Freyas*, and that by the end of 1941 ADI (Science) had 'actually located more than 50'. Were this the case they would have been included in Appendix 2 of this SIR.

¹⁶⁶ CCAC RVJO B.24, Air Scientific Intelligence Report No.13, 'D.T.', 10 January 1942. The photograph was taken on 5 December 1941.

ADI (Science) paid due tribute to the sources which ‘provided the many clues’ upon which scientific intelligence conclusions had been based—the Y-Service, AI1(k), PRU, Medmenham, No.80 Wing, TRE, and ‘Secret Sources’. Their contributions had ‘varied from the brilliant photographs’, and ‘cine pictures of a secret source’, to the ‘exacting work’ of PIs, the ‘sustained vigilance’ of AI1(k), the ‘immense amount of information’ from the ‘Secret Sources’, and ‘enthusiasm of the Y3 unit of Home Forces in taking the W/T plots’, while TRE and No.80 Wing contributions included ‘an aircraft and personnel lost in the cause of Intelligence’.¹⁶⁷ Such extensive tribute is a far cry from that presented in *Most Secret War*. Of particular note was the generous references to the Y-Service, TRE, and AI1(k), all who were significantly short-changed in Jones’s memoirs relative to the DT hunt. Nevertheless, it represented (and represents) acknowledgement of the tremendous coming together in Britain of science, technology, and the military with solitary purpose in mind. It could be argued that the ingenuity of harnessing science and technology to the British armed forces, and especially to British intelligence, and later encouraging US infiltration into such extensive organisation, was Britain’s greatest contribution to the war effort. Hardly comparable to American productive capacity, or to the might of the Red Army, yet integral to Allied victory nonetheless.

¹⁶⁷ CCAC RVJO B.24, Air Scientific Intelligence Report No.13, ‘D.T.’, 10 January 1942, p. 42. Only thirteen copies of this SIR were produced and distributed. One for Lindemann (now Lord Cherwell), one for each of the Navy’s and Military Intelligence Directorates, one for AI1(k), one for Rowe at TRE, one for No.80 Wing, one for Tizard, and the remaining five for Chiefs within the Air Ministry. Compared to most SIRs, this was a limited and select distribution, but one emphasising the great importance attached to appreciating DT in light of plans for forthcoming offensives.

Chapter V: ADI (Science) and the Allied Strategic Bombing Offensive

During the winter of 1941/42, GAF navigational beams were still of great concern to the British. ADI (Science) anticipated some form of additional beam activity, but were unaware of potential modifications applied to GAF radio beam technology that could pose a new threat. After the war, Jones spoke of a 'second and more intense Battle of the Beams'.¹ He later recalled in his memoirs that, because of the extent of *Knickebein* and *Benito* stations emerging along the European western coast, it 'looked as though the Germans hoped to bludgeon their way through' the jamming countermeasures being hastily produced and positioned by No.80 Wing.² In certain areas of Britain they were unable to site countermeasures effectively; the horrific attack upon Plymouth on 26/27 March 1941 by bombers, led by beam-guided pathfinders of KGr100, was a prime example.³ The following month Plymouth was devastated with five practically unhindered night attacks during 21–29 April.⁴ Jones claimed that raids on the English south coast were direct responses to beam countermeasures, for the *Luftwaffe* had to concentrate on either short range targets, or those with easily recognisable features. This claim rejects the probability that beams were still used for navigation by the *Luftwaffe* in these raids, and that these beams were not countered.⁵

¹ CCAC RVJO J.1, 'The Radio War', p. 6.

² Jones, *Most Secret War*, p. 203.

³ Clayton, *The Enemy is Listening*, p. 122.

⁴ Ray, *The Night Blitz*, p. 218.

⁵ R. V. Jones, 'Navigation and War', *The Journal of Navigation*, 28: 1 (January 1975), 13. This is the only item from all of Jones's post-war literature in which he referred to the bombing of Plymouth. Yet

During 1941, raids on the south coast of England were stark evidence of the crippling effects extreme amounts of beam-led bombing could have upon Britain. There is evidence that Jones spoke to Lindemann about these concerns. That summer, there was alarm at the highest level that British RCMs would be overwhelmed, and that the whole *Luftwaffe* bomber force would return to bomb Britain equipped with improved radio receivers. In a draft memo to Churchill, Lindemann wrote that, although certain Air Staff affected to ‘despise the danger of the beam system’, there should nevertheless be ‘no effort spared to counter the radio beams once again’. Lindemann informed Churchill that No.80 Wing could not provide the necessary radio equipment until January 1942, but that, as the required RCMs were ‘fairly straightforward’ and similar in design to commercial practice, attempts should be made to obtain RCMs from America ‘in the course of the next three months’. With such measures, Lindemann hoped that it would be possible to man the 20–30 stations necessary for effective national cover.⁶ The following day Churchill drafted a memo to similar effect; adding that ‘the dark and cloudy nights’ were the ‘main danger’, and that every preparation should be made ‘to deal with the enemy beams whose positions and wavelengths’ were known.⁷ This was at a time when British GCI was still infantile, and the psychological wounds from the Blitz were still gaping.

Deception – or ‘spoof’ as it was then often called – played a key role in what has often been referred to as the ‘Radio War’. GAF early deceptions included

while on average the population of Britain lost one percent of its population to German bombing during the Second World War, Plymouth lost five percent, perhaps due to GAF beam-bombing.

⁶ CCAC CHAR 20/258C/246, Lindemann to Churchill, 9 July 1941. Lindemann’s reference to ‘certain Air Staff’ was perhaps alluding to Harris.

⁷ CCAC CHAR 20/258C/247, Churchill memo, 10 July 1941. The recipient is not specified.

transmitting *Knickebein* beams when there was no intention of operational use, and/or directing beams towards southern Britain and then raiding north (and vice-versa).⁸ Beam stations therefore became important RAF targets. G-Section was assigned the task of compiling target material data for the offensive operations codenamed 'Rhubarb' and 'Circus'.⁹ Rarely have these operations been discussed at length by historians, yet they played an important role in blunting the sporadic convoy and port attacks by the remainder of the *Luftwaffe* left in the west while the bulk of the fighting arm of the GAF were active above Soviet territory.¹⁰ *Rhubarb* and *Circus* operations were of interest to ADI (Science) at the time, yet feature little in *Most Secret War*.¹¹ Evidence of these air offensive activities can be found throughout the War Cabinet papers, and in the official history of the Allied Strategic Air Offensive.¹² Further documentation confirms that the beam stations were still

⁸ TNA AIR 41/46, 'RAF No.80 Wing Historical Report, 1940–1945', p. 32; Hinsley *et al*, *British Intelligence in the Second World War, Volume II*, pp. 240 & 511.

⁹ TMC MHP 468, 'Section "G" (Wireless) Summary of Activity during the Year 1942', January 1943.

¹⁰ Of the few historical references to these offensive RAF operations, S. P. Mackenzie drew upon evidence which confirmed that *Rhubarb* operations were low-level fighter sweeps designed to 'harass the enemy on the ground': S. P. Mackenzie, *Bader's War: 'Have a Go at Everything'* (Stroud: Spellmount, 2008), p. 100. John Terraine spoke of 'compulsions of alliance' between Fighter Command and Bomber Command in extended *Rhubarbs* in operations called *Circuses*: John Terraine, *The Right of the Line: The Royal Air Force in the European War 1939–1945* (Ware: Wordsworth Editions, 1998), pp. 282–8. See also Jonathan Glancey, *Spitfire: A Biography* (London: Atlantic Books, 2007), pp. 89 & 96–8; Nigel Cawthorne, *The Complete Illustrated Encyclopedia of the Spitfire* (Wigston: Southwater, 2011), p. 192.

¹¹ Jones noted that one of the key aims of *Rhubarb* was for the attacking RAF forces to draw the GAF into the skies to fight, with the eventual intention of reducing GAF superiority: Jones, *Most Secret War*, pp. 242–3. The only other reference to *Rhubarb* and *Circus* operations in Jones's memoirs is a rather amusing tale which demonstrates vividly the extensive lack of knowledge of radar capability even within the RAF. In late February 1942 Jones was asked to attend a meeting at No.11 Fighter Command HQ at Uxbridge to assist them with a puzzle over their *Rhubarb* fighter sweeps. The RAF believed that GAF radar could differentiate between RAF bombers and fighters. As it turned out, when the fighters were on *Rhubarb* missions and were not accompanying bombers they were flying at fighter speed, and therefore the GAF radar operators could easily notice the difference.

¹² See for example, TNA CAB/66/22/42, 'War Cabinet Weekly Résumé of the Naval, Military and Air Situation from 0700 February 26th, to 0700 March 5th, 1942', p. 6, where it is detailed that Fighter Command flew 198 sweeping daylight Sorties over enemy occupied territory. The Official History stated that these co-ordinated fighter and bomber operations were 'the hinge upon which the whole of the daylight bombing plan now turned': Webster and Frankland, *Strategic Air Offensive against Germany, Volume I*, p. 236. Air Vice-Marshal Bottomley's Bomber Command Directive for these operations, dated 9 July 1941, stipulated that 'it will on occasion be necessary to make diversionary

causing significant concern in the summer of 1941, and that ADI (Science) requested PR pilots to listen for transmitted signals, which were then recorded daily in what were called 'Landfall' Reports.¹³

Beam-led GAF bombers did return, but not in the conventional manner that was expected. The much-vaunted 1942 Baedeker Raids were Hitler's retaliation for Bomber Command's raids on Lübeck and Rostock, carried out on England's most historic cities and cultural centres – places given three stars in Baedeker guide books.¹⁴ For each raid *X-Verfahren* beams were modified to include an additional 15KHz modulation signal. This modulation was lower than Britain's technical listening service's audio bandwidth and so the signals were not heard. *Bromide* jammers were accordingly altered but not in time.¹⁵ For Jones, this was a 'simple trick' the GAF 'counted on' to defeat British jamming of their beams; and one the GAF 'derived some value from'.¹⁶

In a short chapter of *Most Secret War*, Jones laid bare the technical difficulties: that he had informed No.80 Wing of the supersonic frequency modulation, who 'scrupulously obeyed' his instructions and added supersonic modulation to *Bromide* jammers 'in good time', but receiver designers failed to adequately modify the circuits thus allowing operators 'no chance' of detecting

attacks on objectives, the destruction of which is of immediate importance in the light of the current situation': Webster and Frankland, *Strategic Air Offensive against Germany, Volume IV*, p. 137.

¹³ TMC MHP 468, 'Section "G" (Wireless) Summary of Activity during the Year 1942', January 1943.

¹⁴ Overy, *The Air War*, p. 120; Juliet Gardiner, *The Blitz: The British Under Attack* (London: HarperPress, 2010), pp. 284–5; Hinsley *et al*, *British Intelligence in the Second World War, Volume II*, p. 267; John Killen, *The Luftwaffe: A History* (Barnsley: Pen & Sword, 2003), p. 239. The English cities chosen were, in the order bombed between 23 April and 4 May 1942, Exeter, Bath, Norwich, York, and Cowes. Hull, Poole, and Grimsby were also attacked during this period: Webster and Frankland, *The Strategic Air Offensive against Germany, Volume I*, p. 475.

¹⁵ See www.duxford-update.info, accessed 20 July 2010.

¹⁶ CCAC RVJO J.1, 'The Radio War', p. 6.

the transmissions.¹⁷ This account had altered from one provided three years earlier, in which Jones claimed that despite prior notice from ADI (Science), ‘those responsible for countermeasures had failed to use broad-band receivers to detect the ultrasonic signal’.¹⁸ In complete contrast, immediately after the war they blamed the ‘blind man of the party’, generically defined as the ‘technical listening service’ for failure to detect the supersonic modulation frequency of the revised *X-Verfahren*, ‘despite a five months’ warning of the exact frequency which the Germans would use’. ADI (Science) believed the Baedeker Raid RCM technical difficulty was one of many faults for which ‘Technical Listening’ was to blame.¹⁹

Technology in the service of No.80 Wing was at fault in not reducing the extent of bomb damage caused during the first two weeks of the Baedeker Raids. The official scientific intelligence post-war history confirms however, that ineffective collaboration between all intelligence organisations, services, and equipment designers was ultimately responsible. The manner in which Jones blamed equipment designers for technical inefficiency in *Most Secret War* was simply a literary mechanism designed to deflect blame from his organisation and their ineffectual collaboration with others. After somewhat sanguinely calculating the death toll caused by the lack of countermeasures, Jones then commented in his memoirs that the official history did not record the specifics of the Baedeker Raids.²⁰ This was partially rectified by Hinsley *et*

¹⁷ Jones, *Most Secret War*, p. 252.

¹⁸ Jones, ‘Navigation and War’, 13.

¹⁹ CCAC RVJO B.83 & TNA AIR 40/1532, ADI (Science) official history ‘Air Scientific Intelligence in War, 1939–45’, 1 April 1946, p. 18; AHB, ‘Air Ministry Intelligence’, p. 301.

²⁰ Jones, *Most Secret War*, p. 253. Jones referred directly to TNA AIR 41 ‘The Air Defence of Great Britain’, in which it is recorded that after 4 May ‘almost everything went wrong for the attackers’. The

a/ who closely followed Jones's version of events. The only significant addition was that before raiding, the GAF moved bombers into position at low altitude and with complete W/T silence—in effect British intelligence 'lost the chief means of determining the enemy's operational intentions which had stood it in good stead during the Blitz of 1940–41'.²¹ The Baedeker Raids heralded a new phase of bombing in which the radio war would play a crucial role.²²

The radio war is the predominant theme for the next two chapters. The current chapter examines one of the most significant episodes in scientific intelligence history—the Bruneval Raid: the first modern example of a small behind-enemy-lines incursion for which scientific and technical intelligence was the prime objective. The prize was a *Würzburg* which ADI (Science) knew existed but were unsure of its capacity. Fully appreciating *Würzburg* allowed them to become an integral component of the Allied strategic air offensive. An unexpected reliance fell upon them to provide the answers to questions regarding GAF day and night defences, which perhaps deflected scientific intelligence focus from other issues – those highlighted by the Oslo Report (missiles and rockets), and the more feared scientific threats of atomic, chemical, and biological character. Chapter VI continues the theme of their extensive DT chase through D-Day to the end of the war, and argues that, irrespective of deflected focus and fractious organisational relations due to

Baedeker Raids are discussed in the appropriate official history: see Collier, *The Defence of the United Kingdom*, pp. 305–11, 321, 431, & 513–14.

²¹ Hinsley *et al*, *British Intelligence in the Second World War, Volume II*, pp. 239–40.

²² For the best assessments of the Radio War, see CCAC RVJO J.1, 'The Radio War'; CCAC ROCO 1/1 & CCAC RVJO B.158, Robert Cockburn, 'The Radio War'; TNA AIR 41/46, 'RAF No.80 Wing Historical Report, 1940–1945'.

awkward personalities, the appreciation of German air defence by scientific intelligence firmly established it as a permanent fixture in British intelligence.

The Bruneval Raid

By autumn 1941, scientific intelligence on the GAF defensive radar system was still rudimentary. Their understanding of DT was good, and by far the best of any British authority, but there were still holes in their knowledge, particularly relative to GAF night defence. ADI (Science) had an inkling, however, that the mysterious 53cm *Würzburg* was somehow central to new developments in GAF defence, even though its purpose was unknown. At first, *Würzburg* was thought to be for flak control, but supposition was insufficient.²³ Their attempt to understand *Freya* had shown impressive intelligence collation. With *Würzburg* it would take scientific analysis of received intelligence to fully appreciate the elusive paraboloidal DT apparatus. Once again Jones and Frank would demonstrate the importance of scientific thought at the heart of British intelligence.

It all pivoted upon radio frequencies and pulse repetition rates. If ADI (Science) could determine the correct frequency they would then be able to arrange for precise transmissions to be heard, after which purpose and range of transmissions could be deduced. Plenty of evidence was forthcoming from the extensive activity applied, but the clinching factor remained ambiguous. During the latter half of 1941 they scanned photographs of known *Freya* sites for any possible signs of *Würzburg*, while TRE and 109 Squadron (the

²³ CCAC RVJO B.83 & TNA AIR 40/1532, ADI (Science) official history 'Air Scientific Intelligence in War, 1939-45', p. 14; AHB, 'Air Ministry Intelligence', p. 297. This initial supposition was not referred to by Jones in *Most Secret War*.

offensive arm of No.80 Wing) participated in impressive collaborative electronic intelligence (ELINT) efforts to intercept *Würzburg* transmissions from the air.²⁴ On one occasion 109 Squadron reported that upon hearing the transmission 'a powerful light was directed' towards their Wellington 'with good accuracy'.²⁵ On another they plotted nine separate transmissions of the 570 Mc/s (53cm) type emanating from Brittany.²⁶ A September 1941 Enigma decrypt referred to DT apparatus having radius range of 60km.²⁷ This confirmed earlier similar allusions, which had led ADI (Science) to speculate on the range circumference of *Würzburg*.²⁸

A photograph of paraboloidal radar equipment situated on top of a specially-constructed flak tower inside Berlin Zoo had been taken in May 1941 from the US Embassy overlooking the *Tiergarten*. This photograph did not reach Jones until September, for it went through US channels before being handed to Air Ministry Intelligence by their Washington Liaison codenamed RAFDEL (RAF Delegation).²⁹ The significance of the photograph 'was not at first realised, beyond the fact that it was obviously an R.D.F. apparatus', possibly 'working somewhere between 5 and 50cms'.³⁰ In his memoirs, Jones wrote that the

²⁴ Jones, *Most Secret War*, p. 223; Hinsley *et al*, *British Intelligence in the Second World War, Volume II*, p. 248; Millar, *The Bruneval Raid*, p. 143. Millar referred to these flights as 'Ferrets'.

²⁵ Price, *Instruments of Darkness*, p. 78.

²⁶ Millar, *The Bruneval Raid*, p. 143.

²⁷ See Jones, *Most Secret War*, p. 223; Hinsley *et al*, *British Intelligence in the Second World War, Volume II*, p. 248. The evidence for this is extremely vague – Hinsley *et al* referred to this being from Enigma but said no more and did not allude to source. Jones stated 'we heard of another nightfighter circle, this time of 60 kilometres range, centred near Bad Kreuznach', asked Wavell for PR cover, but although the area was carefully photographed, the Kreuznach station was 'never found'.

²⁸ CCAC RVJO B.37 & TNA AIR 20/1663, Air Scientific Intelligence Report No.I 'German Nightfighter Control', 29 December 1942, p. 2.

²⁹ CCAC RVJO B.83 & TNA AIR 40/1532, ADI (Science) official history 'Air Scientific Intelligence in War', p. 15; AHB, 'Air Ministry Intelligence', p. 298; Hinsley *et al*, *British Intelligence in the Second World War, Volume II*, p. 249.

³⁰ CCAC RVJO B.37 & TNA AIR 20/1663, Air Scientific Intelligence Report No.I 'German Nightfighter Control', 29 December 1942, p. 3; CCAC RVJO B.83 & TNA AIR 40/1532, ADI

photograph was 'indistinct', there was 'no indication of scale', and that he thought it was 'a searchlight with some sort of control box mounted on its back', so therefore remained 'an unsolved problem'.³¹ Stereoscopic interpretation by Frank of a photographed *Freya* station at Cap d'Antifer showed two of the usual 'cow-bin' emplacements, but with a track running from a large house to the edge of a cliff, that ended in a loop at which there was a small black object.³² Closer inspection showed that the loop stopped at the black object.³³ Once they had established that it was 'a promising speck' which deserved closer inspection, Jones arranged for a low-oblique photograph to be taken of the object, and informed Wavell of the request so that he could 'look out for the photographs'.³⁴

While ADI (Science) were waiting for this low-oblique, they received oral evidence from a Chinese scientist who had worked in Berlin, which persuaded them to examine the *Tiergarten* photograph again in December 1941.³⁵ Jones

(Science) official history 'Air Scientific Intelligence in War, 1939–45', p. 15; AHB, 'Air Ministry Intelligence', p. 298; Jones, *Most Secret War*, p. 224; Price, *Instruments of Darkness*, p. 79.

³¹ Jones, *Most Secret War*, p. 224.

³² CCAC RVJO B.31 & TNA AIR 20/1631, Air Scientific Intelligence Report No.15 'The Intelligence Aspect of the Bruneval Raid', 13 July 1942, p. 2; TMC MHP 468, 'History of 'G' Section', 1967. The photograph was taken by taken by PRU pilot Gordon Hughes on 12 August 1941 (Sortie T/953, photograph 02Y). There is some discrepancy in the sources regarding the date of this Sortie. As cited, the Medmenham History of G Section has the date for the oblique photograph at 12 August 1941. It also states that it was the naval authorities which had requested aerial photography 'of short wave transmitters of a Radar nature'. The PRU pilot who obtained the oblique recalled taking the photograph 'sometime in July'; see TMC DFG 5697, Gordon Hughes interviewed by Constance Babington Smith on 6 December 1956. Ken Ford in *The Bruneval Raid: Operation Biting 1942* (Oxford: Osprey Publishing, 2010), p. 12, claimed the sortie to have been on 15 November.

³³ Jones, *Most Secret War*, p. 225. The black object was so indistinct that Jones and Frank examined several photographs to confirm that it was an object and not a speck of dirt on the negative.

³⁴ Jones, *Most Secret War*, p. 225. For 'a promising speck' see CCAC RVJO B.83 & TNA AIR 40/1532, ADI (Science) official history 'Air Scientific Intelligence in War, 1939–45', p. 14; AHB, 'Air Ministry Intelligence', p. 297. Conflicting evidence suggests that the unidentified object on the cliff-top near the village of Bruneval was discovered by Medmenham's Army Photographic Interpretation Service (APIS): see H. B. Eaton (ed.), *APIS, Soldiers with Stereo: An Account of Army Air Photographic Interpretation* (The Intelligence Corps Museum, 1978), p. 24.

³⁵ CCAC RVJO B.83 & TNA AIR 40/1532, ADI (Science) official history 'Air Scientific Intelligence in War, 1939–45', p. 15; AHB, 'Air Ministry Intelligence', p. 298. This Chinese physicist returning

showed the Chinaman this photograph, and asked him if he had seen anything similar, to which he replied that he had seen a paraboloid of mesh consistency. Upon receipt of this fresh *Würzburg* evidence from this unexpected source, Jones requested from Wavell any photographs Medmenham had of the *Tiergarten* tower. These were forthcoming, and from these ADI (Science) were able to determine the diameter of the dish, which was 'surprisingly to be at least 20 feet'.³⁶ This evidence confirmed that there had to be two different types of *Würzburg*, however, for 20ft diameter paraboloids would certainly have been interpreted in the many photographs examined. They had already deduced, based on airborne ELINT from TRE and 109 Squadron, that *Würzburg* transmitted at 3700 pulses-per-second (a precision rate much greater than needed for aircraft reporting), giving a maximum range of 40km.³⁷ This, combined with a September decrypt alluding to 60km radius range, made the 20ft diameter feasible only if there were two different types of *Würzburg*.

Further confirmation came in December 1941, when PR pilot F/Lt Tony Hill reported that although he had been unable to take photographs due to camera failure, he had seen 'an electric bowl fire about ten feet across'.³⁸ The following day, he flew another sortie and was successful in obtaining low-

home to China via Ankara when he was convinced by the resident British Naval Attaché to visit London to report any useful information he might have. Upon arrival in London he and his wife experienced even worse treatment at the hands of MI5 than Sneum had some six months before, although under the duress of war, it was at least understandable: see Jones, *Most Secret War*, p. 224.

³⁶ CCAC RVJO B.37 & TNA AIR 20/1663, Air Scientific Intelligence Report No.I 'German Nightfighter Control', 29 December 1942, p. 3. It is useful to note that there is again a distinct slippage between 'us' and 'I' in Jones's recollection of this deduction.

³⁷ CCAC RVJO B.24 & TNA AIR 20/1629, Air Scientific Intelligence Report No.13 'D.T.', p. 10.

³⁸ Hinsley *et al*, *British Intelligence in the Second World War, Volume II*, p. 248; Downing, *Spies in the Sky*, p. 259; Price, *Instruments of Darkness*, p. 80; Millar, *The Bruneval Raid*, p. 146. From these accounts, only Price was accurate with the date of 4 December 1941.

oblique photographs of the *Würzburg-Gerät* on the Cap d'Antifer cliff-tops, near the village of Bruneval.³⁹ Babington Smith remarked that really good low-obliques were 'a most compelling form of intelligence' and that Hill's low-obliques of Bruneval were 'magnificent'.⁴⁰ Jones later declared the photographs to be 'among the classics of the War'.⁴¹ Hill's sorties from which they were obtained were instigated by Wavell; a story much-narrated, and which proved to be yet another encouraging tale of adventure told to the trainee PIs for the remainder of the war.⁴² Credit must also go to Frank for his painstaking efforts of stereoscopic interpretation of batches of photographs Wavell's G-Section were passing to ADI (Science).

In all of his post-war literature and broadcasts, Jones was adamant that it had been Frank who spotted the *Würzburg* on the Bruneval cliff-top, and this seems unlikely to be a false claim (similar to that of the Auderville *Freya* shadow).⁴³ Jones referred to Frank's discovery as 'the vital observation that was ultimately to clear everything up' in respect of *Würzburg*.⁴⁴ From the photographs, G-Section were able to measure the bowl-fire (as it was known

³⁹ CCAC RVJO B.31 & TNA AIR 20/1631, Air Scientific Intelligence Report No.15 'The Intelligence Aspect of the Bruneval Raid', 13 July 1942, p. 2. This sortie was afterwards designated A/30. Due to the 'unofficial' nature of Hill's two low-oblique sorties, the Air Ministry banned all unauthorised visits by PRU to Medmenham thereafter: Andrew J. Brookes, *Photo Reconnaissance* (Shepperton: Ian Allan, 1975), p. 133. There is a perfect copy of the low-oblique photograph taken by Hill preserved by the Airborne Assault Museum Archives (hereafter AAMA) in file 4D2/2/2/4.

⁴⁰ Babington Smith, *Evidence in Camera*, p. 171.

⁴¹ Jones, 'Scientific Intelligence', 359.

⁴² TMC MHP 468, 'Interpretation of Wireless Apparatus', p. 9; Jones, *Most Secret War*, p. 225; Brookes, *Photo Reconnaissance*, p. 133; Downing, *Spies in the Sky*, pp. 258–9; Babington Smith, *Evidence in Camera*, p. 170; Millar, *The Bruneval Raid*, pp. 145–6. See also TMC DFG 5697, Gordon Hughes interviewed by Constance Babington Smith on 6 December 1956. Hughes recalled that he had wanted to fly the 'dicing' sortie, but that Hill as Flight Commander had the pick. Hughes added that Hill knew Jones, who briefed Hill 'most enthusiastically as he was longing for close obliques'.

⁴³ Perhaps discovery of the same unidentified object by APIS was a coincidence that further emphasises the extensive 1941 multiplication of effort amongst British scientific and technical intelligence services: Eaton, *APIS: Soldiers with Stereo*, p. 24.

⁴⁴ Jones, *Most Secret War*, p. 225.

thereafter), and confirm a three-metre diameter.⁴⁵ For ADI (Science), these photographs were a fillip; for British offensive means, they were invaluable. They added to British knowledge of DT technique, set new standards in oblique aerial photography, and led directly to discussion between Air Staff and CombinedOps about the possibility of a commando/airborne raid designed to snatch the *Würzburg*.⁴⁶

Exactly how the photographs led directly to the suggestion of a raid is unclear. Winterbotham stated that Jones 'was the instigator of the raid'.⁴⁷ Jones thereafter enthusiastically encouraged this notion, and the more he told the story, the more elaborate it became. Two reports were produced by ADI (Science) on the Bruneval Raid – a swiftly produced report for wide distribution directly following the raid, and later a thoroughly detailed SIR.⁴⁸ Neither of these reports confirmed who was responsible for the raid; nor was Jones's instigation mentioned in his 1947 *RUSI* article. Twenty years later, Price wrote that it was 'difficult to establish who first suggested that it might be a good idea to pilfer the 'bowl-fire' from Bruneval', although the notion was 'such an obvious one' due to the position of the DT station so close to the coast 'that the idea may well have occurred to several people at once'.⁴⁹ Seven years after this, in a letter to Millar for his book on *The Bruneval Raid*, Jones presented the idea as his, with the words, 'Charles, we could get in

⁴⁵ Brookes, *Photo Reconnaissance*, p. 133.

⁴⁶ CCAC RVJO B.31 & TNA AIR 20/1631, Air Scientific Intelligence Report No.15 'The Intelligence Aspect of the Bruneval Raid', 13 July 1942, p. 2.

⁴⁷ Winterbotham, *Secret and Personal*, p. 143. Winterbotham added that this was a raid on the 'first German radar'. In his position he really ought to have known better.

⁴⁸ TNA PREM 3/73/6-16, TNA DEFE 40/2 & CCAC RVJO B.150, 'The Intelligence aspect of the Bruneval Raid', 4 March 1942. Churchill's copy (in the PREM papers) was dated, but the other two copies (in DEFE and RVJO) were not dated at all. CCAC RVJO B. 31 & TNA AIR 20/1631, Air Scientific Intelligence Report No.15 'The Intelligence aspect of the Bruneval Raid', 13 July 1942.

⁴⁹ Price, *Instruments of Darkness*, p. 80.

there; there's a beach only a few hundred yards away from the objective'.⁵⁰ Three years later, in the television series *The Secret War*, Jones himself revealed in similar words that it had been his idea all along.⁵¹ Jones's memoirs have often been accepted since as the definitive version of these events.⁵²

Price was correct. It really could have been anyone. For example, on 16 January 1942 Cockburn suggested to Rowe that samples of the latest German equipment might be captured by a commando raid. Rowe then passed the idea to Tizard, who sent a minute to Portal referring specifically to commando raids on the Cherbourg peninsular with 'the capture of enemy RDF equipment' as an objective.⁵³ Further evidence suggests that TRE personnel (including Garrard) and a 'very interesting photograph' led to the raid.⁵⁴ Documentation provides other possibilities.⁵⁵ Some military history sources have since presented Lord Mountbatten as the man responsible for

⁵⁰ Millar, *The Bruneval Raid*, p. 154.

⁵¹ CCAC RVJO K.476, Transcript for 'To See A Hundred Miles', p. 25; Jones, *Most Secret War*, p. 236; Johnson, *The Secret War*, p. 106.

⁵² See as examples Ford, *The Bruneval Raid*, p. 13; Cherry, *Striking Back*, p. 182; Rankin, *Churchill's Wizards*, p. 404; John Maynard, 'Pickard: Hero of Amiens', *Aeroplane Monthly*, April 1994, 21; www.combinedops.com/Bruneval, accessed 20 June 2011; 'The Bruneval Raid', an episode of the television series entitled *Secrets of World War II*, produced by Jonathan Martin for Nugus/Martin Productions, 1998. This hour-long documentary is good for contextual film footage and narrative of the raid itself, and includes edited versions of the 1977 Jones interviews for *The Secret War*. See also episode two of Gordon Corrigan's *Daring Raids of the Second World War*, entitled 'Radar Beam Raiders', and produced by Scott Tankard for Channel Five Television.

⁵³ Clark, *Tizard*, p. 304. Millar followed Clark on this, in that Tizard had independently had the same idea as Jones at a later stage; Millar, *The Bruneval Raid*, p. 154.

⁵⁴ Reg Batt, *The Radar Army: Winning the War of the Airwaves* (London: Robert Hale, 1991), p. 120; Jones, *Most Secret War*, p. 236.

⁵⁵ TNA PREM 3/73/17, letter to the Prime Minister dated 2 March 1942 signed J. P. This letter refers to W/Cdr Laro Manvey being responsible for suggesting the raid. Evidence also points to Major-General Browning being the plan originator: see TNA AIR 2/7689, 'Operation Biting', Report by Major-General F. A. N. Browning, D.S.O. Commander, The Airborne Division, 25 March 1942; RAFM AC 732348, 'The History of Airborne Forces', RAF Monograph, no date, 56; Air Ministry, *The Second World War 1939–1945, Royal Air Force: Airborne Forces* (London: AHB, 1951), p. 57.

the idea of Operation *Biting*.⁵⁶ Without convincing evidence for any of these possibilities the instigation of Operation *Biting* will remain one of the minor mysteries of the Second World War; one that Jones perhaps elaborated to enhance the glory of his war memoirs, following Price's published realisation of muddiness on the issue.⁵⁷ Zuckerman found it an 'extraordinary thing' that Jones wrote 'as though he was the only person who had this idea', for the 'whole of TRE had been working trying to get at the actual mechanism of the Wurzburg and any other item within the German radar system'.⁵⁸

While analysis of further memory composure by Jones is integral to the purpose of placing ADI (Science) into wartime context, it should not however detract from the importance of the Bruneval Raid. The raid has been narrated

⁵⁶ See as examples Max Arthur, *Men of the Red Beret: Airborne Forces 1940–1990* (London: Hutchinson, 1990), p. 19; David Reynolds, *The Paras, Fifty Years of Courage: A Tribute to the Airborne Forces* (London: Express Newspapers, 1990), p. 27; 'Operation Biting', www.paradata.org, accessed 10 May 2010. It is a fascinating coincidence that at the time, CombinedOps, reinvigorated by Mountbatten's command, were seeking new targets for raiding to show their worth, so high-level desire for collaboration of growing British airborne forces and CombinedOps may well have inspired the Bruneval Raid: see CCAC CHUR 4/268/159, 'The Raid on the Radar Station at Bruneval', with accompanying letter dated 5 January 1950; TNA AIR 2/7689, 'Operation Biting', Air Force Commander's Report by Group Captain Sir Nigel Norman, O.C. 38 (A.C.) Wing, no date; MOI, *Combined Operations*, pp. 64–5; Richard Garrett, *The Raiders* (Newton Abbot: David & Charles, 1980), p. 104. One source remarked that when Mountbatten submitted plans of the raid to the three Defence Chiefs of Staff, Admiral Pound, General Alanbrooke, and Air Marshal Portal they were unenthusiastic, and in contrast Churchill 'was all for it!': AAMA 4D2/2/2/2, Captain Frederick Cook, 'Operation "Biting" (The Naval Story of the Bruneval Raid 27/28 February 1942)', pp. 2–3; Ford, *The Bruneval Raid*, p. 15.

⁵⁷ Had Jones been so convinced that the Bruneval Raid was his idea, he might well have remarked upon it when assisting with Churchill's war memoirs, yet Churchill's account simply states that 'a Commando raid was planned accordingly': Churchill, *The Hinge of Fate*, p. 234. For drafts of the Bruneval inclusion into Churchill's war memoirs, see CCAC CHUR 4/268/15–25. The only reference Jones made to Churchill regarding the origins of the raid was 'The newly-photographed equipment was only some 400 yards from a convenient beach and so urgent was it for us to find out about the detailed nature of this equipment that the possibility of a commando raid was an obvious proposal': CCAC CHUR 4/398 B, annotated draft of the 'intelligence story behind the Bruneval raid', no date. It is interesting to note that Churchill's error in defining the Bruneval Raid as 'a commando raid' was read with 'shock' by Browning and he felt compelled to write to Henry Pownall: CCAC CHUR 4/57A, 'Boy' (Browning) to Henry Pownall, 9 August 1951.

⁵⁸ UOEA SZ/2/GEN, 'Draft letter to Lord Chalfont' written by Solly Zuckerman, no date, p. 5.

many times, and this thesis is not the place to do so again.⁵⁹ In summation, it is enough to relay the specifics of the raid provided to the War Cabinet during that week in 1942:

On the night of the 27/28th an operation was directed against the [German] radio-location Station at Bruneval (12 miles North of Havre). A parachute force of 120 officers and men of the Airborne Division was dropped by 12 Whitleys and complete surprise was achieved. Heavy casualties were inflicted on the defending troops and three prisoners were taken. While [British] light naval forces were lying offshore two [German] destroyers and two E-boats passed within 2 miles but failed to observe the operation. The operation and withdrawal were successfully completed and all naval vessels and aircraft safely returned. [British] casualties were six soldiers killed, five wounded and six missing'.⁶⁰

Although some secondary sources have assessed the importance of the intelligence aspect of the Bruneval Raid, the event is still regarded as nothing more than a 'pin-prick' within the grand scale of the war. The significance of the raid therefore has been understated. ADI (Science) recalled after the war that the much-acclaimed Bruneval Raid was 'one sign of a change' which had come over British intelligence methods.⁶¹ ADI (Science) saw the Bruneval

⁵⁹ For the MOD reports on the Bruneval Raid, see TNA DEFE 2/100, TNA DEFE 2/101, TNA DEFE 2/103, TNA AIR 39/1; the latter two files hold good photographs of pre-raid training and post-raid recovery. For published narratives, see Millar, *The Bruneval Raid*, especially from Chapter 15 onwards; Ford, *The Bruneval Raid*; Clark, *Rise of the Boffins*, pp. 175–82; Christopher Buckley, *Norway, The Commandos, Dieppe* (London: HMSO, 1951), pp. 195–202; Brian Austin, *Schonland: Scientist and Soldier* (Bristol: Institute of Physics Publishing, 2001), pp. 236–41; Cherry, *Striking Back*, pp. 180–232. See also 'The Bruneval Raid', an episode of the television series *Secrets of World War II*, produced by Jonathan Martin.

⁶⁰ TNA CAB/66/22/42, 'War Cabinet Weekly Résumé of the Naval, Military and Air Situation from 0700 February 26th, to 0700 March 5th, 1942', p. 2.

⁶¹ CCAC RVJO B.83 & TNA AIR 40/1532, ADI (Science) official history 'Air Scientific Intelligence in War, 1939–45', 1 April 1946, p. 20; CCAC RVJO J.1, 'The Radio War', p. 8; AHB, 'Air Ministry Intelligence', p. 303.

Raid as the pivot upon which they shifted the weight of scientific intelligence investigations from defensive to offensive. Although Jones stated in his memoirs that this transformation took place with the shift from battling the beams to chasing DT, it was the Bruneval Raid which epitomised the change.

Operational planning for the raid was immense and impressive. Through SIS and SOE contacts the Air Ministry arranged for local French Resistance operatives to reconnoitre the target area.⁶² Colonel Gilbert Renault-Roulier was the founder and key underground network leader of the French intelligence network, *Confrérie de Notre-Dame (CND)*.⁶³ Using his 'battle-name' of *Col Rémy*, SOE contacted Renault-Roulier on 24 January 1942 and asked if he could send urgently 'all possible information' about the Bruneval DT station, with emphasis on specific questions, such as 'how many machine-gun positions defended the station', and 'the location, number, and state of preparedness of German defences in the vicinity'. *Rémy* passed the signal to his Le Havre recruit Roger Dumont, code-named *Pol*, who, with Charles Chauvenau (*Charlemagne*), provided a dossier 'complete in all details, illustrated with plans', which 'after several hours of labour' was condensed into a carefully-worded cypher message and transmitted to London on a secret radio set.⁶⁴ The intelligence gathered by these Frenchmen significantly

⁶² Hinsley *et al*, *British Intelligence in the Second World War, Volume II*, p. 249.

⁶³ M. R. D. Foot, *Resistance* (London: Granada Publishing, 1979), p. 242; K. G. Robertson, *War, Resistance & Intelligence: Essays in Honour of M.R.D. Foot* (Barnsley: Leo Cooper, 1999), pp. 173–4. For first-hand accounts of the *Confrérie de Notre-Dame* Resistance work, see Rémy, *Memoirs of a Secret Agent of Free France, Volume I: The Silent Company* (London: McGraw-Hill, 1948); *Volume II: Courage and Fear* (London: McGraw-Hill, 1950); and *Volume III: Ten Steps to Hope* (London: McGraw-Hill, 1960).

⁶⁴ TNA AIR 2/7689, Geoffrey Myers, 'Why France Commemorates the Bruneval Raid', *Daily Telegraph*, February 1947; Rémy, *Memoirs of a Secret Agent of Free France*, pp. 262 & 272; Jones, *Most Secret War*, pp. 236–7; Ford, *The Bruneval Raid*, pp. 18–19. See also Rémy, *Bruneval: Opération coup de croc* (London: Editions France Empire, 1968).

contributed to the success of the Bruneval Raid, and their 'detailed coverage' was 'probably the most important intelligence' which derived from the *CND* in 1942.⁶⁵ MI9 were also involved in preparations for Operation *Biting*, essentially as safeguard. They lectured on escaping from captivity, and provided 'Escape' rations and battle-dress with 'escape' equipment.⁶⁶ Flight Sergeant Charles Cox, who was the radar specialist on the raid, recorded that he had been 'given the names of a number of people in France' whom he 'could approach for help'.⁶⁷

Crucial to Air Ministry raid preparations were PRU flights over the site taking photographs from all angles. From these photographs APIS analysed and recorded all terrain specifics of the Bruneval site.⁶⁸ This information was then passed to Medmenham's V-Section which employed painters, engravers, and other artists to construct miniatures of proposed battlefield or bombing sites. They produced a 1/5000 scale model of Bruneval village to the beach.⁶⁹ A smaller model (1/750 scale) was also made of the paraboloid and the adjoining villa.⁷⁰ ADI (Science) was also involved in planning Operation *Biting*.

⁶⁵ Jeffery, *MI6*, p. 395; Jones, *Most Secret War*, p. 237; Millar, *The Bruneval Raid*, p. 77 & 95. For a contemporary appraisal of the *CND* intelligence see AAMA 4D2/2/2/2, Captain Frederick Cook, 'Operation "Biting"', p. 15.

⁶⁶ TNA AIR 2/7689, 'Operation Biting', Report by Major-General Browning, Commander of the Airborne Division, 25 March 1942, Appendices A & B.

⁶⁷ TNA DEFE 2/101 & AAMA 4D2/2/2/1, 'Flight Sergeant C.W.F. Cox's Personal Account of Operation Biting', p. 2. Cox's preliminary account of the raid can be found in TNA AVIA 7/1759.

⁶⁸ Powys-Lybbe, *The Eye of Intelligence*, p. 122.

⁶⁹ Medmenham's V-Section was formed on 23 May 1941 and constructed over 1400 models of all types for every branch of the three Services: See TMC, 'Organisation and Functions of ACIU', p. 5; TMC MDM622, Kendall, 'A War of Intelligence', p. 56; Christine Halsall, 'Women with a Secret: Photographic Interpretation' in Celia Paul and Paul Edward Strong (eds.), *Women in War* (Barnsley: Pen & Sword, 2012), 155; Downing, *Spies in the Sky*, pp. 117–20; Alexander Hamilton, *Wings of Night: The Secret Missions of Group Captain Charles Pickard, DSO and two bars, DFC* (London: Crecy Books, 1993), p. 60.

⁷⁰ TNA DEFE 2/101 & AAMA 4D2/2/2/1, 'Appendix "D" (Air) Intelligence'. See also TMC DFG 5800, Ted Wood interviewed by Constance Babington Smith, 7 December 1956; TNA AIR 39/1, photographs of the three different types of models made by V-Section; MOI, *Combined Operations*,

Airborne Division's Operation Orders were: 'collect scientific data and photographs regarding the working' of *Würzburg*, and 'capture any German personnel who on cross-examination' could 'disclose' how the set worked.⁷¹ Readers of these orders were directed to Appendix "A", clearly written by ADI (Science), comprising a list of items to be retrieved.⁷²

ADI (Science) further requested examination of the paraboloid to see if it could 'tip up' and, if time allowed, for investigation of the larger twin station some 750 yards north of the house.⁷³ A last minute conference was held with ADI (Science), the Royal Engineers, and the accompanying technician to 'settle special issues'.⁷⁴ Jones also wrote a minute stating that he deemed it desirable to make all possible arrangements for the most efficient examination of acquired enemy radio equipment. From an intelligence perspective, the items requiring close examination were articles of equipment; documents and labels; prisoners; and observations (sketches and/or photographs) of the raiders 'regarding the apparatus in situ'.⁷⁵

insert alongside p. 65. The 1/5000 model of the Bruneval Raid site is on permanent display in the Airborne Assault Museum at RAF Duxford. Every parachutist involved in the Bruneval Raid studied the model closely in pre-raid preparation: TNA DEFE 2/101 & AAMA 4D2/2/2/1, 'Major J. D. Frost's Personal Account of Operation Biting', p. 1. Frost recalled in his memoirs that when he jumped out of the aircraft he was able to recognise the ground as being identical with that depicted by the model, maps and photographs; John Frost, *A Drop Too Many* (London: Sphere Books Ltd., 1988), p. 50.

⁷¹ TNA DEFE 2/101 & AAMA 4D2/2/2/1, 'Airborne Division Operation Order No.1', p. 1.

⁷² The items listed were: (1) The box behind the paraboloid; (2) All panels, switchboards, etc.; (3) All spare parts – or samples of them, particularly valves; (4) The safe, or its contents, if there is one; (5) THE SCREEN on which grid squares or a map may be traced Cathode ray tubes. Take care to preserve fluorescent powder; water spoils it; (6) Any scales in miles or Kms on the switches; (7) All diagrams – circuit diagrams especially, and manuals; (8) Aerial complete (this is probably in the centre of the paraboloid); (9) The aerial probably connects to "something". Bring me the "something"; (10) Prisoners who have worked the apparatus to be captured alive; (11) All maps: TNA DEFE 2/101 & AAMA 4D2/2/2/1, 'Airborne Division Operation Order No.1', Appendix "A".

⁷³ TNA DEFE 2/101 & AAMA 4D2/2/2/1, 'Airborne Division Operation Order No.1', Appendix "A".

⁷⁴ TNA AIR 2/7689, 'Operation Biting', report written by R. J. Schonland, 3 March 1942.

⁷⁵ IWM HTT 19/48, minute detailing ADI (Science) arrangements for the dispersal of intelligence derived from the Bruneval Raid, 23 February 1942. Arrangements were made for the equipment and 'probably the documents' to first go to the office of the Air Ministry's Director of Radar for ADI (Science)'s 'preliminary inspection and allocation'. Prisoners were to be collected by MI9 and then

Garrard was expected to continue his liaison between TRE and scientific intelligence to aid the investigation; evidently he was still not officially a member of ADI (Science). It was deemed essential (due to the expected disconnection between intelligence branches and service organisations) that a 'composite and correlated report' be produced by scientific intelligence rather than for each branch to issue 'a disconnected dribble'. Jones proposed that all reports should be channelled through ADI (Science) instead of being independently issued, so that they could be correlated and then issued as a joint report.⁷⁶ This made sense, although it could be argued that Jones sought monopoly on the intelligence aspect of the Bruneval Raid. As it was, not all reports were channelled through ADI (Science) as Jones had requested.

Two days after the raid a conference took place where it was agreed that captured technical equipment was to be of 'great value', and was therefore to be examined secretly by ADI (Science), TRE and ADRDE.⁷⁷ After initial inspection by ADI (Science), the equipment was delivered to TRE. As liaison, Garrard was deemed the ideal bearer of the equipment to Swanage. He was provided with a receipt and a cover note, informing the recipient that the equipment did 'not belong to MAP' (the Ministry responsible for TRE), but belonged to 'the Intelligence Division of the Air Ministry'.⁷⁸

'presumably handed' to AI1(k). Captured equipment would normally have been handled by AI2(g), who would pass it on to RAE. But owing to the 'specialised nature' of the equipment hoped for, it was arranged that TRE would receive it following preliminary inspection. It was thought necessary for any cathode-ray tubes captured to be 'sub-contracted to specialised firms for analysis'.

⁷⁶ IWM HTT 19/48, minute detailing ADI (Science) arrangements for the dispersal of intelligence derived from the Bruneval Raid, 23 February 1942.

⁷⁷ TNA AIR 2/7689, 'Operation Biting', report written by R. J. Schonland, 3 March 1942.

⁷⁸ TNA AVIA 7/1759, F. E. Smith to Rowe, 7 March 1942; Document entitled 'Description of Equipment brought away – by Mr. Garrard, A.D.I. (Science).

To ADI (Science)'s credit the scientific intelligence derived from the Bruneval Raid was essentially confirmatory: that *Würzburg* operated on 53cm-wavelengths, operated as both transmitter and receiver, that the GAF had anticipated British RDF in this design (the earliest sample captured was dated November 1939), and that it was 'thoroughly, indeed beautifully', and efficiently made, using die-castings for easy dismantling and servicing. The captured DT operator was of limited technical capability and understanding. As he was drafted from a concentration camp he was eager to talk, although he had still been in the process of learning how to operate DT equipment.⁷⁹ ADI (Science) surmised that *Würzburg* was 'probably capable of good technical performance, but in the hands of an operator such as the prisoner, its functions would be seriously degraded'. Nevertheless, ADI (Science), through AI1(k), were able to learn much from the one POW who had been interrogated in time for production of the preliminary report. This GAF prisoner willingly provided useful information on communication methods and mechanical workings of *Würzburg*, and although his technical knowledge was sparse, he knew enough about the one item of *Würzburg* the raiders were unable to capture to further assist scientific intelligence.⁸⁰

⁷⁹ TNA DEFE 40/2, TNA PREM 3/73/6-16 & CCAC RVJO B.150, 'The Intelligence Aspect of the Bruneval Raid', 4 March 1942. See TNA AIR 2/7689, 'Operation Biting', Report by Major-General F. A. N. Browning, D.S.O. Commander, The Airborne Division, 25 March 1942, for confirmation that the POW had been incarcerated in a concentration camp.

⁸⁰ This report does not mention which component of the *Würzburg* the raiders were unable to capture. Nor does *Most Secret War*, even though Jones did note that 'one important component had been left behind, an achievement all the more impressive because they had only ten minutes at the *Würzburg* instead of the thirty which had been planned' (p. 244). See CCAC RVJO B.31 & TNA AIR 20/1631, Air Scientific Intelligence Report No.15 'The Intelligence Aspect of the Bruneval Raid', 13 July 1942, p. 5, where the missing item is described as 'the presentation gear'. Ford in *The Bruneval Raid* (p. 72) acknowledged this evidence. According to the pre-raid list, however, another item was not captured – the aerial within the paraboloid reflector itself. As the paraboloid provided good defence for the raiders, particularly the dismantlers, failure to capture the aerial was not surprising.

The ADI (Science) preliminary report was produced on 4 March. Even by then they had established two crucial weaknesses in GAF use of *Würzburg* to help Bomber Command to overcome such equipment. That *Würzburg* could only see aircraft within five degrees of its principal directive at any one time, coupled with the fact that *Würzburg* was not switched on until operators were warned by long-range *Freya*, facilitated defeat of *Würzburg* 'by manoeuvre alone'. The second and most important factor was that *Würzburg* possessed no anti-jamming provision. With these two weaknesses in mind, they deduced (that it appeared at first sight) 'that almost any technical countermeasure would be successful'. Also, that it was 'certain that the device of dropping suitable reflectors, such as sheets of tinfoil' would be 'successful against operators of the calibre of the prisoner'. This preliminary report ended with a reminder that such a device had been proposed by Churchill to the ADRC of the CID in 1937.⁸¹ This particular reference to a simple countermeasure device that would eventually play a crucial role in later Allied bombing developments has been overlooked until now.⁸²

⁸¹ TNA DEFE 40/2, TNA PREM 3/73/6–16 & CCAC RVJO B.150, 'The Intelligence Aspect of the Bruneval Raid', 4 March 1942. It was no coincidence that the Bruneval interim report recalled this submission by Churchill, nor was it a coincidence that Jones's 1937 proposal for reflecting dipoles to counter RDF would be vigorously researched by TRE following the Bruneval Raid. Jones was ever-eager to claim that the invention of *Window* was his: Jones, *Most Secret War*, pp. 39–41. A researcher at Bawdsey recalled however, that towards the end of 1937 he had just finished a series of experiments in jamming British RDF as preparation for 'enemy jamming if it happened', see E. C. Williams, 'The Origin of the Term "Operational Research" and the Early Development of the Military Work', *OR*, 19: 2 (June 1968), 111. Jones paid his first visit to Bawdsey in June 1937, and may well have obtained the idea that RDF could be jammed with oscillating wires from the Bawdsey research. Jones wrote that the only evidence he had that it was his idea was his own memory, and cited a note drafted by Lindemann as his only documentary evidence; see also Price, *Instruments of Darkness*, p. 113. Churchill's copy of ADI (Science)'s interim report on the intelligence aspect of the raid has the 'tinfoil' reference highlighted: TNA PREM 3/73/9, 'The Intelligence Aspect of the Bruneval Raid', 4 March 1942, p. 4.

⁸² The link between the Bruneval Raid and eventual use in July 1943 of the British countermeasure known as 'Window' has been noted many times. Because the use of *Window* was not approved for well over a year later however, the importance of the Bruneval Raid has often been defined as the first-step towards the use of *Window*. Some German sources have stated that earlier British use of *Window* could

Churchill demonstrated an even keener interest in the results of the raid than he had in its planning. Two days after the raid, he was informed that the '75% of all the equipment that it was possible to get' had been captured, and this, together with the POW stories, would enable British experts to 'secure a complete reconstruction of the equipment' sufficient to show what it could do and what countermeasures could be applied. Churchill was also informed that the Germans had 'nothing new in the way of technique'.⁸³ Three days after this, Churchill received the requested preliminary report on the intelligence aspect of the raid produced by ADI (Science).⁸⁴ This came complete with a technical plan of *Würzburg* drawn by Smith, the low-obliques taken by Hill, and photographs of the captured *Würzburg* components – transmitter receivers, frequency amplifiers, and pulse generators.⁸⁵

AI1(k) produced two reports of their own. The first and most detailed report formed Appendix II of the CombinedOps post-raid report. This was not intelligence collation, but verbatim interrogation data from all three POWs. Of particular note was intelligence derived from the captured DT operator, which included two sketches drawn by the prisoner, one of *Würzburg* (inside and out), and the other of the screen of the cathode-ray tube. It was expressed that this particular prisoner was of limited technical intelligence, for he was

have made significant impact upon GAF night defences at a time when they were still relatively weak. This was not to be. Perhaps scientific intelligence derived from the Bruneval Raid should have been heeded sooner. Official historians remarked that 'at a time when the Bomber Command offensive was rapidly gaining momentum in the face of heavy and increasing casualties and at a time when the German offensive was diminishing to negligible proportions, a cardinal weapon, favouring the bombers and hindering the defences, was cast aside for more than another whole year': Webster and Frankland, *The Strategic Air Offensive against Germany, Volume I*, p. 401.

⁸³ TNA PREM 3/73/18, T. L. Rowan to Churchill, 2 March 1942.

⁸⁴ TNA PREM 3/73/4, D. A. Parry to T. L. Rowan, 6 March 1942.

⁸⁵ TNA PREM 3/73/6-16, 'The Intelligence Aspect of the Bruneval Raid', 4 March 1942.

‘unable to cope with Morse during his training’ and even after two months of *Würzburg* operation, still believed it saw aircraft in some way and was therefore less effective in bad weather. The other two prisoners provided sketches of their interpretation of the raid action, of the cliff defences, and of military and DT communication in the immediate area to which they were posted.⁸⁶ Felkin was asked by Beachford, Director of Intelligence (Security) (DI(S)), to provide a description of the Bruneval Raid from the German side, based on POW information.⁸⁷ For Beachford, the Bruneval Raid had not been the success everyone else seemed to think it was – ‘something went wrong’ he remarked to Jones.⁸⁸ It had; the errors were slight, but because they were operational they could easily have culminated in mission failure.

Ultimate success in the Bruneval Raid was testament to the courage and quick-thinking of the men involved, and resulted in the eventual complete appreciation of *Würzburg-Gerät*. In their full SIR on the intelligence aspect of the raid, ADI (Science) credited those involved for the ‘unusual success’ of the raid, and for individual contributions to the newly acquired technological understanding of DT. Specifically mentioned were PRU and CIU for discovery of the station, to CombinedOps for the raid’s successful planning and

⁸⁶ TNA DEFE 2/101 & AAMA 4D2/2/2/1, ‘Appendix II’, consisting of ‘Interrogation of P/W Operator’ and reports of interrogations of P/W Tewes and P/W Schmidt.

⁸⁷ CCAC RVJO B.151, Felkin to Beachford, 20 March 1942. This report detailed the raid objective, GAF personnel, defences (including a single-strand 5ft barbed wire fence surrounding the *Würzburg*), security (interestingly *Freya* operatives were forbidden to speak to *Würzburg* operatives about their work), engagement both at the DT site and at the ‘Bruneval Strong-point’ where there was a garrison consisting of Coastal Defence Company, ten men in the vicinity of the DT station, 30 men in reserve in the village of Bruneval and the remaining 70 men at *Kompanie* HQ in the larger village of La Poterie several miles away. Most of the garrisoned men on site had been asleep (and of low morale) when the British paratroopers landed. AII(k) surmised that the element of surprise was achieved because of ‘poor defence’ and ‘recent changes’ in ‘low quality’ personnel. ADI (Science) were sent this AII(k) report by Beachford who was dismayed at the inability of the British forces to ‘clean up the hut and bring away papers’.

⁸⁸ CCAC RVJO B.151, Beachford to ADI (Science), 21 March 1942.

execution, to AI1(k) for effective POW examination, and TRE for examination of the equipment.⁸⁹ Once again this is contemporary credit which Jones did not later reflect in his memoirs. He recalled instead that ADI (Science) extracted much information from the POW by taking the captured equipment to Felkin's HQ before it went to TRE for detailed examination, then 'sitting on the floor' with the erstwhile *Würzburg* operator 'fitting the various pieces together, and listening to his comments'.⁹⁰ That was the extent of Jones's reference to TRE and AI1(k)'s involvement in the post-raid intelligence collation process, adding slight mention of Medmenham's role in producing the photographs and superb models of the site for training the paratroopers. Even Winterbotham, who by the time of the raid had been replaced by Medhurst, was more praising of PRU and CIU in his memoirs.⁹¹

While ADI (Science) did not directly mention the impressive terrain model in their full Bruneval Raid SIR, they were keen to highlight TRE's scrutiny of captured equipment, and AI1(k)'s interrogation of the *Würzburg* operator, in a specially-headed section entitled 'examination of the booty'. This flagged TRE report 6/R/25 and AI1(k)'s report No.46/1942, the latter was attached to the SIR as Appendix 3. ADI (Science) then collated the evidence, and assessed and suggested counter-measures before providing an overall conclusion.⁹² Before examining these in closer detail, the TRE reports deserve acknowledgement which they have not until now received.

⁸⁹ CCAC RVJO B.31 & TNA AIR 20/1631, Air Scientific Intelligence Report No.15 'The Intelligence Aspect of the Bruneval Raid', 13 July 1942, p. 23.

⁹⁰ Jones, *Most Secret War*, p. 244.

⁹¹ Winterbotham, *Secret and Personal*, p. 143.

⁹² CCAC RVJO B.31 & TNA AIR 20/1631, Air Scientific Intelligence Report No.15 'The Intelligence Aspect of the Bruneval Raid', 13 July 1942, p. 5.

Report 6/R/25 was the Final Technical Report superseding the 24 March 1942 interim TRE Report D.1841 on 'Technical Results of the Raid on Bruneval'. This interim report assessed the pre-raid position, raid objectives and results, and the evidence obtained by the TRE Enemy Investigation Group, and concluded with raid success estimates.⁹³ To have reported so soon after the raid demonstrates their eagerness to appreciate DT. A separate accompanying report to 6/R/25, entitled 'Report on the Investigation of Enemy Short-Range RDF Stations', received the widest distribution and subsequent recognition, and combined TRE technical examination with AI1(k) report No.46/1942.⁹⁴ It provided detailed technical explanations of their dismantling, testing, and reconstructing experiments upon *Würzburg*. It confirmed that the Telefunken valves were significantly robust, providing minimum/maximum amperage and voltage they could accept. Also that the cathode-ray tube (manufactured by Loewe Radio) was similar in design to the British VCR91 with the same green screen, that the frequency stability of the oscillator was very high due to the 'extremely specialised form of construction', and that the lightness of the amplifier's construction perhaps meant that it was initially designed for airborne apparatus. Of key concern was that the valves, with their parallel wire grids (defined by TRE technicians as 'Squirrel cages'), a heavily-finned anode, and higher than expected frequency limit and maximum anode voltage, led to the deduction that German valves were superior in design and capability than British valves. The report confirmed the suspected

⁹³ TNA AVIA 7/1759, 'Interim Report on the Technical Results of the Raid on Bruneval', 24 March 1942, p. 8. The conclusion to this report stated that from the technical point of view, there was 'no doubt' that the raid was very well worthwhile.

⁹⁴ This can be found in TNA AVIA 7/1759, is entitled 'German R.D.F. Station – Cap D'Antifer' and is dated 5 March 1942.

reporting process, in that the nearby 240cm *Freya* handled long-range early warning, whereupon aircraft reporting would be transferred (via landline) to the connected *Würzburg* for further plotting.⁹⁵

TRE Report 6/R/25 adhered rigidly to technical specifics, and did not indulge in any suppositions. For example, the point about the transference of plotting from *Freya* to *Würzburg* hints at the probability that the latter would then synchronise with a means of attack – flak, searchlight, or fighter control. But such possibilities were not alluded to by TRE at all. Only in the concluding paragraph was there any notion of operational discussion, one which seriously infringed upon the scientific intelligence recommendation of widespread use of dipoles for jamming purposes. A primary interest for TRE when examining the equipment was to discover easy jamming means. Although the prospect for this was ‘not very hopeful’, for it was ‘not possible to change the radio frequency at all quickly’, it was ‘nevertheless possible to tune over a wide range’.⁹⁶

ADI (Science) requested a copy of TRE’s Interim Report on 27 March, although interestingly this request had to go through official Air Ministry

⁹⁵ TNA AVIA 26/1872, TRE Report 6/R/25 ‘Final Technical Report on the German RDF Equipment Captured at Bruneval on 28th February 1942’, 8 May 1942. This is the full report with 22 photographs attached of the valves, oscillators, receivers, transmitters, labels of the equipment, and one graph showing the capability of the Telefunken valve LS50 No.2. Four other 6/R/25 TRE Reports are deposited in TNA; AVIA 26/291 with attached 17 circuit diagrams, one-dimensional sketches, and graphs, plus one photograph of *Würzburg*’s transmitter; AVIA 7/1759, amongst many other TRE related documentation including the covering letters to the recipients of the report; AVIA 26/2132 which has no attachments; and AIR 20/1546 which was sent upon request to Squadron Leader Butler of Air Ministry (AI4) on 28 February 1943.

⁹⁶ TNA AVIA 26/1872, TRE Report 6/R/25 ‘Final Technical Report on the German RDF Equipment Captured at Bruneval on 28th February 1942’, 8 May 1942.

channels.⁹⁷ Jones received his personal copy of TRE Report 6/R/25 in June.⁹⁸ Only then did ADI (Science) write their full SIR. In light of TRE evidence, they retracted their key interim report recommendation that spurious reflectors could confuse *Würzburg* operators. They determined that *Würzburg* was used in several ways – height measurement, short-range early warning, gun-laying and searchlight-laying, and made some contribution to GCI. Of the latter two applications, their knowledge of operational details was limited.

Acutely aware of their role as scientific and technical watchdogs however, ADI (Science) made it clear that the ultimate object of collecting intelligence was to make use of knowledge gained of the enemy ‘by the taking of countermeasures and the exploitation of weak points’. They therefore highlighted again the fact that *Würzburg* was not equipped with anti-jamming devices, and instead of the abandoned metallic strips idea they offered the possibility that if British bombers switched on their IFF sets over occupied territory the combined effect may confuse *Würzburg*, and therefore ‘spoil’ German gun-laying and GCI.⁹⁹ Such a notion had derived from TRE experiments in which radiation from British IFF sets directly affected the aerial and power leads of *Würzburg*, and upset its intermediate frequency amplifier. This was because British IFF swept through the frequency of 25Mc/s, which was the same as the intermediate amplifier of the *Würzburg*. ADI (Science) were keen to emphasise that exact estimates of success in this regard

⁹⁷ TNA AVIA 7/1759, (Highly Secret) Instruction from D.C.D. to Rowe, 27 March 1942.

⁹⁸ TNA AVIA 7/1759, cover letter from TRE to Jones, 7 June 1942.

⁹⁹ CCAC RVJO B.31 & TNA AIR 20/1631, Air Scientific Intelligence Report No.15 ‘The Intelligence Aspect of the Bruneval Raid’, 13 July 1942, pp. 15 & 19–20.

awaited more thorough investigation, but also that such a countermeasure could only have been devised 'as the result of the raid'.¹⁰⁰

ADI (Science) were also able to gain understanding of German systems of technological application from the labels on the captured equipment. These provided 'a gratifying demonstration of Teutonic method' and were 'typical as tabloid sources of information'. Each label contained a serial design number; names of designer and manufacturer (both Telefunken in this case); name and designation of the appropriate item of equipment; individual works number; and GAF Signals order number.¹⁰¹ ADI (Science) provided TRE photographs of the equipment as appendices to SIR No.15 and referred to them throughout the discussion.¹⁰² Many facts were deduced from these labels, the most important emanating from the works numbers and inspection dates.¹⁰³ From these ADI (Science) generated a graph charting the production rates of all of the *Würzburg* components.¹⁰⁴

¹⁰⁰ CCAC RVJO B.31 & TNA AIR 20/1631, Air Scientific Intelligence Report No.15 'The Intelligence Aspect of the Bruneval Raid', 13 July 1942, pp. 20–21.

¹⁰¹ CCAC RVJO B.31& TNA AIR 20/1631, Air Scientific Intelligence Report No.15 'The Intelligence Aspect of the Bruneval Raid', 13 July 1942, pp. 9–11.

¹⁰² CCAC RVJO B.32, Air Scientific Intelligence Report No.15, Photographs and Figures, 13 July 1942. The labels could be clearly seen in the photographs, and read with a magnifying glass.

¹⁰³ CCAC RVJO B.31 & TNA AIR 20/1631, Air Scientific Intelligence Report No.15 'The Intelligence Aspect of the Bruneval Raid', 13 July 1942, p. 10.

¹⁰⁴ CCAC RVJO B.32, Air Scientific Intelligence Report No.15 Photographs and Figures, 13 July 1942, Figure 3. ADI (Science) calculated that production started in October 1940, and reached a rate of approximately 200 complete sets of units per month by July 1941. They were keen to restrain alarm by pointing out that this did not mean there were 200 *Würzburgs* erected per month for a large proportion would be set aside as spares. This, they thought, was a principle of German design – facilitate ready servicing by making units easily replaceable, so that defective units could be returned to central repair depots, and substituted anew. ADI (Science) estimated therefore that some fifty percent of production was for spares. This still meant a *Würzburg* production rate of 100 per month, which was 'impressive' even if this number were divided between aircraft reporting and flak fire control. A production date of October 1940 also confirmed the Germans to be ahead of the British in centimetric radar design, for the British did not achieve ranges of 40km on 50cm-wavelengths until 1941: CCAC RVJO B.31 & TNA AIR 20/1631, Air Scientific Intelligence Report No.15 'The Intelligence Aspect of the Bruneval Raid', 13 July 1942, pp. & & 10; Price, *Instruments of Darkness*, p. 86; Ford, *The Bruneval Raid*, p. 73; Hinsley *et al*, *British Intelligence in the Second World War, Volume II*, p. 249.

SIR No.15 was an inspired piece of intelligence collation. It spanned 43 pages in all (23 intelligence assessment, five post-raid reports by participants and AI1(k), and fifteen photographs and figures). It laid out the intelligence derived, detailing DT as a whole, before moving into specifics of the *Würzburg* components. From the Oslo source through to Hill's Cap d'Antifer photograph, the report brought all intelligence to the fore, and, inadvertently but importantly, emphasised how technology applied to British intelligence organisations was producing results. Crucially it also highlighted that intelligence overlap (inevitable with so many organisations examining so many different aspects of the German war machine) could only be fully appreciated by expert intelligence collators with a sole purpose on their agenda. Such collators (ADI (Science) in this case) could then direct other intelligence organisations to consider their specific targets or objectives.

In direct contrast to Jones's memoirs, which present the intelligence aspect of the Bruneval Raid as his success (with nominal assistance from Frank, Garrard, and Hill), SIR No.15 shows that the Bruneval Raid was a combined effort, not just in ADI (Science), but also between them, AI1(k), Medmenham, PRU, and especially TRE. The report further emphasises the bravery of those involved in obtaining the end result. This Jones was keen to highlight in his memoirs (perhaps unsurprisingly given that he had been integral to the 25th anniversary Bruneval reunion, which coincided with Jones's pre-publication preparation of *Most Secret War*). SIR No.15 concluded with countermeasure suggestions, repercussion predictions, and appreciation of the raid's importance from an intelligence-gathering perspective. In effect SIR No.15

was a perfect intelligence report, presenting method, evidence, deductions, and predictions based on all sources of derived intelligence.

A further result of the Bruneval Raid was that personnel at DT stations near the coast became conscious of their vulnerability. Many erected large barbed-wire fences around perimeters, which meant they could be more easily spotted by PIs.¹⁰⁵ For ADI (Science) it proved beneficial in their task of cataloguing DT stations, for after the onset of 'the wiring panic' more stations became conspicuous due to foliage and rubbish gathering under and around the fences. Jones recalled this to be a 'delicious consequence' of the raid, after which the Germans 'obligingly surrounded their sites with wire'.¹⁰⁶ A similar reaction occurred in Britain however, due to the expectation of German retaliation.¹⁰⁷ These fears were acute with regard to TRE at Worth Matravers, situated a mile from coastal cliffs near Purbeck in Dorset.¹⁰⁸

From the grand-strategy perspective of the Second World War, the Bruneval Raid has been defined as a 'useful raid' – its 'use' being the capture of 'secret equipment' from a German radar station for British scientific examination.¹⁰⁹ At the time MOI defined the raid as an 'experiment in radio-dislocation'.¹¹⁰ It was so much more than useful however, and meant so much more than

¹⁰⁵ Powys-Lybbe, *The Eye of Intelligence*, p. 131.

¹⁰⁶ CCAC RVJO B.31 & TNA AIR 20/1631, Air Scientific Intelligence Report No.15 'The Intelligence Aspect of the Bruneval Raid', 13 July 1942, p. 21; Jones, *Most Secret War*, p. 246.

¹⁰⁷ CCAC RVJO B.31 & TNA AIR 20/1631, Air Scientific Intelligence Report No.15 'The Intelligence Aspect of the Bruneval Raid', 13 July 1942, p. 21.

¹⁰⁸ John Murphy, *Dorset at War* (Wincanton: Dorset Publishing Company, 1979), p. 104. Rowe recalled being informed that there was 'seventeen train-loads of German parachute troops on the other side of the English Channel preparing to attack' TRE and that 'a whole regiment of infantry arrived to protect' TRE personnel: Rowe, *One Story of Radar*, p. 128. In *Most Secret War*, Jones relayed a story of how TRE's 1942 move to Malvern was essentially to his credit: Jones, *Most Secret War*, p. 247.

¹⁰⁹ J. R. M. Butler, *Grand Strategy, Volume III, part II* (London: HMSO, 1964), p. 516.

¹¹⁰ MOI, *Combined Operations*, pp. 65–70.

simple dislocation of a DT station. The Bruneval Raid proved the worth of special forces, was a successful joint air, sea, and land operation (not the first but the first successful one), French Resistance provided key intelligence, the raid was a 'shot in the arm for public morale', and crucially, it provided vital technical equipment.¹¹¹ It was this latter attribute – the primary objective – which made all the difference to the importance of the raid, and is the main reason why the Bruneval Raid has featured in so many Second World War histories and memoirs. Of course the Bruneval DT station, once discovered, could have been eradicated by Bomber Command, but then the opportunity would have been missed entirely to gather valuable scientific intelligence.¹¹² Royal Engineers were pleased to report that the 'scientific experts were highly delighted with the specimens' captured, the completeness of which exceeded 'their wildest hopes'.¹¹³

Commenting on French Resistance involvement, the Director of Military Intelligence commended SIS for its contribution to the Bruneval Raid success, commenting that their provision was 'a very remarkable piece of first-class intelligence such as is rarely obtainable'.¹¹⁴ Perhaps more importantly in this regard, this British raid was a sign to French Resistance of Britain's intent not to neglect their plight, and that Free French assistance was desperately needed whenever Britain planned operations in or over France. The Bruneval Raid was the first landing on French soil since Dunkirk, and as such was 'a

¹¹¹ AAMA 4D2/2/2/2, Fax Transmission from Regimental HQ to Alistair McQueen, no date.

¹¹² For 'eradicated by Bomber Command', see Hamilton, *Wings of Night*, p. 61.

¹¹³ TNA WO 199/3230, 'R.E. Aspects of the Bruneval Raid', 14 March 1942.

¹¹⁴ Hinsley *et al*, *British Intelligence in the Second World War, Volume II*, p. 17.

counterblow' that strengthened French morale 'very considerably'.¹¹⁵ The raid occurred when the war was at its darkest depths for the French, and has become symbolic of the beginning of the great fight for liberty.¹¹⁶ It was always believed by the German High Command that if and when Allied invasion of France occurred it would arrive in the sector between Calais and Le Havre. Persistent raids in that sector beginning with Bruneval, and culminating in the much larger (but disastrous) raid at Dieppe, encouraged that train of thought. Arguably the June 1944 deception plan of Operation *Fortitude* that twinned *Overlord* began in February 1942 at Bruneval.

The Bruneval Raid was a good example of a special operation in the intelligence role – dismantle a radar station, bring parts of it away, and photograph the remainder. Such a target was a model type for Special Forces, not in the interdiction, but in the intelligence role.¹¹⁷ It was also prime example of what could be accomplished with close inter-connection in the intelligence-gathering role between armed forces, scientists, and intelligence operatives. TRE operative Donald Preist, who accompanied the Royal Navy on the raid, took a radio receiver with him and, before he was slowly transported to the beach under heavy commando guard to inspect the captured DT equipment, he used the receiver to listen to 53cm transmissions

¹¹⁵ Rémy, *Memoirs of a Secret Agent of Free France*, pp. 262. The importance of the raid from the French perspective is vividly evident in the large monument erected on the cliff-top and unveiled by Charles de Gaulle in 1947, the regular Anglo-French commemorations of the raid, and the fact that the road from the cliff to Bruneval was named after Mountbatten, and the road leading from nearby Le Presbytère to La Poterie being named Rue du Major Frost. The Lord Louis Mountbatten Road was named in the 40th Anniversary of the Bruneval Raid: See 'Bruneval Raid Memorial', *The Times*, 31 March 1947, 5; AAMA 4D2/2/2/2, '40th Anniversary of the Bruneval Raid 20 June 1982 Planning Instruction', dated 8 June 1982.

¹¹⁶ AAMA 4D2/2/2/2, 'Return to Bruneval 28th February 1987'. No greater tribute could be found than in the fact that Charles de Gaulle started his political party at Bruneval shortly after the war.

¹¹⁷ Hackett, 'The Employment of Special Forces', 29.

from offshore while the raid took place. When Cox cut the feed onshore, he severed the signal Preist was tuned into, thereby confirming without doubt that *Würzburg* transmitted on 53cm-wavelengths.¹¹⁸ Upon arrival in Britain, Preist immediately informed ADI (Science) of this discovery. They in turn added this crucial knowledge to their intelligence collation.¹¹⁹ Combined lateral thinking also surmised that operational intercommunication between *Freya* and *Würzburg* suggested that if British bombers flew very low across the Channel they might cross under *Freya* beams and remain undetected, and that by the time the more precise *Würzburg* registered the aircraft, without pre-warning from *Freya* it would be too late to avoid detection.¹²⁰ One other intelligence-service combination established as a direct effect of the Bruneval Raid was Medmenham's R-Section, which served to provide PI support to CombinedOps until Operation *Torch* in November 1942.¹²¹

The Bruneval Raid was a perfect example of a mission to obtain both material and verbal intelligence. The former confirmed doubtful pre-existing knowledge through capture of unknown DT hardware, while the latter acted as psychological confirmation through appreciation of man/machine interaction and usage intent of *Würzburg*. While such intelligence was not a strength magnifier on the scale of SIGINT, it was a crucial component in British understanding of German DT technology; a component that served well as an auxiliary element in Bomber Command's forthcoming battles. While not

¹¹⁸ Donald Preist cited in Colin Latham and Anne Stobbs, *Pioneers of Radar* (Stroud: Sutton Publishing, 1999), pp. 45–6.

¹¹⁹ CCAC RVJO B.31 & TNA AIR 20/1631, Air Scientific Intelligence Report No.15 'The Intelligence Aspect of the Bruneval Raid', 13 July 1942, p. 11.

¹²⁰ Ford, *The Bruneval Raid*, p. 74.

¹²¹ Eaton, *APIS: Soldiers with Stereo*, p. 23; TMC, 'Organisation and Functions of ACIU', p. 5.

providing all the answers to GAF GCI, capturing DT technology did at least provide the British with first-hand knowledge of the level of radar technology being applied to the GAF nightfighter system.¹²² And that was all important. With persistent decisions to withhold the usage of the spurious dipoles RCM however, Britain failed to immediately capitalise on the success of Bruneval by not optimising their resources to full effect.¹²³ This largely boils down to whether the consumer chooses to use the intelligence provided or not.

Gr/Cpt Leonard Cheshire praised the Bruneval Raid as the 'most marvellous thing', for 'it saved thousands of lives of Bomber Command crew'.¹²⁴ Churchill's memoirs stated that Britain 'became the possessors of vital portions of a key piece of equipment in the German Radar defences and gathered information which greatly helped our air offensive'.¹²⁵ Although such grand statements confirm the raid's contemporary importance, they are unquantifiable without evidence. What is clear however, is that the intelligence collation by ADI (Science) provided Britain with the radio war initiative, and further established their own importance and reputation within Broadway, Whitehall, and probably most importantly with the services. They remarked in SIR No.13 that the British may 'find a time' when they were 'ahead on navigational aids, and behind on R.D.F'.¹²⁶ Capturing *Wurzburg* went some way to proving the latter part of the statement, but would significantly contribute to the former. ADI (Science) would play their own role in both.

¹²² Hinsley *et al*, *British Intelligence in the Second World War, Volume II*, p. 17.

¹²³ For the principles of intelligence behind this summary, see David Kahn, 'An historical theory of intelligence', *Intelligence and National Security*, 16: 3 (Autumn 2001), p. 81.

¹²⁴ Personal conversation with Wing Commander David Mallam at RAF Duxford, August 2011.

¹²⁵ Churchill, *The Hinge of Fate*, pp. 234–5.

¹²⁶ CCAC RVJO B.24, Air Scientific Intelligence Report No.13 'D.T.', 10 January 1942, p. 37.

Strategic Air Offensive and the Kammhuber Line

On 17 July 1940, Colonel Josef Kammhuber was promoted to Major-General and ordered to form a GAF nightfighter division to cover France and the Lowlands, and stop any RAF incursion into Third Reich airspace. A man of powerful organisational skills, Kammhuber was ideal for the position. By early-August 1940, he established his Command Staff, his Zeist castle headquarters in Utrecht, and had remodelled his first small division into XII *Fliegerkorps* consisting of two *Staffels* of Me-110s, one of Do-17Zs and a flak searchlight regiment.¹²⁷ His command was initially subordinated to *II Luftflotte*, commanded by Albert Kesselring who at the time was preparing his air-fleet to attack Britain. When Kesselring's command moved east in late-May 1941, Kammhuber's command stayed behind to 'continue with a holding war' against Britain.¹²⁸ In addition to enemy engagement, organisation, and training, Kammhuber's duties entailed technical and tactical development.¹²⁹ This Kammhuber did with aplomb.¹³⁰

In effect, German GCI was approximately a year behind the British.¹³¹ *Luftwaffe* POWs captured in 1941 believed themselves far ahead of the

¹²⁷ Josef Kammhuber, 'Development of Nightfighting' in David C. Isby (ed.), *Fighting the Bombers: The Luftwaffe's Struggle against the Allied Bomber Offensive* (London: Greenhill Books, 2003), p. 62. Alfred Price held that Kammhuber's first Nightfighter Command constituted some thirty-five aircraft in all, and some, he believed, were Me-109s and Ju-88s: see Price, *Instruments of Darkness*, p. 63.

¹²⁸ TNA AIR 41/10, *The Rise and Fall of the German Air Force*, p. 96.

¹²⁹ Kammhuber, 'Development of Nightfighting', p. 63.

¹³⁰ Post-war understanding was that Kammhuber and his staff, largely drawn from flak organisation had no pre-knowledge of radar: TNA AIR 41/10, *The Rise and Fall of the German Air Force*, p. 186.

¹³¹ Kammhuber recalled that initially there was no radar to be obtained, and added that 'German planners had not expected the possibility of bombing attacks during the night' and so 'only a few Freya sets existed' built for the *Kriegsmarine*. Even when the first *Würzburg* set assigned for nightfighting purposes arrived in Holland in October 1940, initial trials 'failed as nobody was able to operate the set', and there were 'no clear conceptions whatever about its tactical application and purpose': Kammhuber, 'Development of Nightfighting', pp. 66 & 70. Moreover, there was (surprisingly) a significant lack of

British in AI developments, although ADI (Science) speculated that they were 'probably wrong', and that Britain had 'the lead by several months'.¹³² Given British defensive urgencies during 1939–41 this is hardly surprising. Jones referred to British RDF requirements as 'extreme' in the first two years of the war, and highlighted that a 'vigorous programme of development sprang from a single source'.¹³³ It can only be speculated upon whether GAF GCI was implemented through embarrassment of being surprised by the RAF in May 1940, expediency due to continued retaliatory British bombing tactics during the Blitz, or determined defence of the west in preparation for *Barbarossa*. Perhaps it was all three, although the end result is the most important factor, the tale of which has been told many times.¹³⁴ The beginnings of GAF night defence marked the period defined as the 'collapse of the *Luftwaffe*' which, as a primary arm of offense, was blunted to defensive strategic activities.¹³⁵

Official historians stated that, at the beginning of 1942, British Air Staff knew of the existence of GAF GCI, and that by May of that year 'the picture was almost complete'.¹³⁶ This is one of only a few mentions of GAF night defences

technical ability, 'no properly trained personnel for fitting and repairs', and often, 'after gaining sufficient experience' such personnel 'were drafted into the Army': CCAC ROCO 2A 2/1, 'German Views on British Radar', from an official document issued by the Ministry of Information, published in *Electronic Engineering*, September 1945, 686.

¹³² CCAC RVJO B.24 & TNA AIR 20/1629, Air Scientific Intelligence Report No. 13 'DT', 10 January 1942, p. 14. In the same report (p. 28), ADI (Science) warned that if Germany were 'driven to the defensive' then their RDF output would soar past that of the British, at the expense of the GAF's more aggressive applications of radio.

¹³³ CCAC RVJO B.24 & TNA AIR 20/1631, Air Scientific Intelligence Report No.13 'D.T.', 10 January 1942, p. 33.

¹³⁴ The best examples are TNA AIR 41/10, *The Rise and Fall of the German Air Force*, especially Chapters 8 and 12; Neillands, *The Bomber War*, especially Chapter 6; Price, *Instruments of Darkness*, especially Chapter 2;

¹³⁵ Winston S. Churchill, *The Second World War, Volume Five: Closing the Ring* (London: Reprint Society Ltd. 1954), p. 402; Overy, *The Air War*, p. 78.

¹³⁶ Webster and Frankland, *The Strategic Air Offensive, Volume I*, pp. 399–400. Webster and Frankland added that this was 'perhaps optimistic', for by August 1942 it was still not known whether German searchlights were radar-controlled or not, and that it was only surmised that 53cm gun-laying was used

throughout the four-volume history. In review of this influential history, Jones was highly critical of the omission of what he believed were factors 'vital' to the sustenance of the British air offensive that constituted 'the widest ranging Intelligence attack ever conducted'. He was amazed the name of Kammhuber – ADI (Science)'s 'chief opponent' – was 'not to be found anywhere in the twelve hundred pages of text'. Jones balked at the few statements made about British knowledge of GAF radar devices, because they were 'substantially in error'. Jones's prime concern was that the efforts of his organisation deserved 'to stand in the Official History alongside the gallantry of [British] bomber crews', and keenly emphasised that scientific intelligence, inspired by Portal and Medhurst 'well before Bomber Command came to appreciate its importance', involved secret agents (especially in Belgium), photographic pilots and interpreters, radar operators, parachute forces, cryptographers, and many others.¹³⁷ Jones was right to emphasise that their devotion to the Allied cause deserved its place in history too.

In writing his own 'history' seventeen years later however, Jones would also brush aside the devoted work of many others involved, but through egoism rather than lack of knowledge. Failings from both of these histories were corrected in a sense by Hinsley *et al*, but their history lacked both personality and context. The three histories combined have nonetheless produced an adequate picture of specifics from their different perspectives. Most histories

to direct unseen AA fire. As late as 1943, they noted, it was not certain whether *Würzburg* was used for fighter or flak control.

¹³⁷ R. V. Jones, 'Bombs Gone!', *The Listener*, 5 October 1961, 514. As Jones specified, Kammhuber's name did appear once in Webster and Frankland's *Strategic Air Offensive*, 'mentioned solely in a footnote to one of the annexes, where the date of his posting is inaccurately given'.

since have followed their lead.¹³⁸ What is required here then is not a re-telling of the story these histories narrate, but examination of what is missing from the picture presented so far through analysis of SIRs from the Bruneval Raid through to the end of the war. Although this slightly breaks the chronological order of the thesis, it allows the radar aspect of wartime scientific intelligence to be brought to a logical conclusion.

Another SIR was not produced until October 1942, predominantly due to ADI (Science) amassing and collating evidence on the GAF AI system. Notes and interim reports were distributed throughout the process and are discussed below. Here it is appropriate to examine SIR No.16, which was an assessment of German knowledge on 'Window'. This was the name given to the spurious dipoles often referred to in the SIRs.¹³⁹ Cockburn's RCM group at TRE, now designated 'Group 5', consisted of 19 technicians (one of whom, Eric Ackermann, would join ADI (Science) shortly after). Cockburn had convinced Rowe that a 'radio war' was taking place, in which RCMs were required to manage DT developments. As well as researching RCMs against GAF navigational beams, TRE's Group 5 served a dual purpose by examining offensive RCM potentialities. There is no definite confirmation of date for when research into DT-jamming RCMs began, but in most sources it is estimated at late-1941. Cockburn himself was vague on time specifics in this regard, although in recollection he noted a key event as the beginning of British RCM appreciation:

¹³⁸ See as examples: Hastings, *Bomber Command*; Neillands, *The Bomber War*.

¹³⁹ Cockburn re-presented the spurious dipoles idea to Rowe and asked him to consider a relevant codename. Rowe replied by asking why it was so necessary all the time to 'try to be clever' about codenames, then looked around the room, fixed his eyes upon a window and said 'why not call it Window?': Price, *Instruments of Darkness*, p. 115; Hartcup, *The Challenge of War*, p. 150.

The period from the spring of 1941 until the spring of 1942 was largely one of consolidation and mental gestation; the latter was terminated on 12th February 1942 by the escape of the *Scharnhorst* and *Gneisenau* up the English Channel from Brest under cover of a heavy jamming attack against British radar equipment.¹⁴⁰

The so-called 'Channel Dash' constituted another example of a complete intelligence failure of a scientific and technological nature.¹⁴¹ This is not to suggest that ADI (Science) were at fault because they were not—prediction failure does not necessarily mean problems with intelligence organisations or their sources.¹⁴² There are exceptions to this rule however, such as when evidence is available but misinterpreted. Eve Holiday, a contemporary first-phase PI at Benson PRU, later recalled her frustration that day. She felt that photographic evidence of a planned breakthrough had been disregarded.¹⁴³ A second-phase PI also remembered reports of the battleships' movement but that 'too little was made of them'.¹⁴⁴ Another exception is when the sources relied upon to provide adequate warnings are technological and they fail for technical reasons.

¹⁴⁰ CCAC ROCO 1/1 & CCAC RVJO B.158, Robert Cockburn, 'The Radio War', p. 24.

¹⁴¹ A definitive account of the Channel Dash has yet to be written. Useful accounts of the Channel Dash are Killen, *The Luftwaffe*, pp. 186–96; and Richard Hargreaves, 'Our Worst Nightmares': The Channel Dash', *Navy News*, February 2012, i–iv and 'Channel Dash Remembered', *Navy News*, February 2012, 8. The latter articles were published in commemoration of the 70th anniversary of the event; see also www.channeldash.org, accessed 25 March 2012. See also Peter Jarvis, *The German Battleships*, Bletchley Park Trust New Edition Report No.15 (September 2011), pp. 12–13.

¹⁴² Michael I. Handel, 'Intelligence and the Problem of Strategic Surprise', *Journal of Strategic Studies*, 7: 3 (September 1984), 245. See also Ariel Levite, *Intelligence and Strategic Surprises* (New York: Columbia University Press, 1987).

¹⁴³ TMC DFG 5691, Eve Holiday interviewed by Constance Babington Smith on 9 August 1956.

¹⁴⁴ TMC DFG 5663, David Brachi interviewed by Constance Babington Smith on 25 July 1956.

In the Channel Dash, there was a combination of airborne RDF instrument malfunctions, and technical misinterpretations, by coast-watching RDF stations.¹⁴⁵ Utilising airborne RCM to suppress British RDF, the two German battleships (and the cruiser *Prinz Eugen*) escaped from Brest and produced a tactical surprise that caused public uproar in Britain.¹⁴⁶ It was also ‘a hard blow’ for France at a time when French morale was already very low.¹⁴⁷ Importantly, this incident was not the first time the GAF had applied jamming measures against RDF, for they made ‘half-hearted attempts’ to jam British RDF during the Battle of Britain.¹⁴⁸ Jones should have been well aware of this and should have expected additional GAF jamming. There was also much focus on the two battleships docked at Brest following the sinking of *Bismarck*. They were under constant surveillance by RAF Commands and French Resistance (*CND* specifically), and break-out by the battleships (which implied significant air cover) was expected. Far too much reliance was placed on still relatively limited RDF technology, and not enough attention was applied to the possibility of German forces using RCMs to shield their weaponry.

Although ADI (Science) were only on the fringes of the Channel Dash, Jones’s version, first given to Churchill’s war memoir syndicate in 1950 and then confirmed in *Most Secret War*, has since clouded the history of the radar

¹⁴⁵ Jones only committed six paragraphs (two pages) to the event and did not define the failure as important, perhaps to highlight that he knew that radar was susceptible to jamming all along: Jones, *Most Secret War*, pp. 234–5. In contrast Hinsley *et al* in *British Intelligence in the Second World War, Volume II* dedicated nine (seven complete) pages (pp. 179–88) to this technical intelligence failure of mid-February 1942. Watson-Watt made narrated this event in defence of the reputation of his beloved radar: Watson-Watt, *Three Steps to Victory*, pp. 334–48.

¹⁴⁶ See as example the Mass Observation entry by Henry Novy on 15 February 1942: ‘The Far East is bad enough, but when you hear the English Channel is a clear passage to three German battleships...well!’: Sandra Koa Wing, *Mass-Observation: Britain in the Second World War* (London: The Folio Society, 2007), p. 126.

¹⁴⁷ Rémy, *Memoirs of a Secret Agent of Free France*, p. 262.

¹⁴⁸ Price, *Instruments of Darkness*, p. 88.

aspect of this event.¹⁴⁹ In essence, Jones used the Channel Dash story as an ideal dampening prelude to the morale-boosting (and for Jones ego-boosting) radar snatch on the Cherbourg peninsular. Ever one to apportion blame, Jones laid it threefold: firstly and most importantly, slow RDF-jamming had taken place over a period through subtle increases in intensity by German radar stations on the French coast; secondly, what Jones referred to as a 'comic' error by a duty officer who failed to pass on a report on 11 February that the German warships had loosed from their docks; and thirdly, a faulty airborne radar set in a Coastal Command aircraft failed to locate the ships when it should have done. Overall, Jones's assessment was that 'had the watching system been on its toes and perhaps not lulled into dullness by months of waiting, some reserve arrangement might have been brought into operation'.¹⁵⁰ Aside from the contemporary furore caused by the Channel Dash, it importantly emphasised the point that radar was far from infallible, and that technically it was highly susceptible to simple jamming. Moreover, according to Jones, it 'destroyed all British prejudice against jamming'.¹⁵¹

There can be no doubt that it was also a major contributing factor to the need for TRE's Group 5 to research similar offensive RCMs. Group 5 worked hard in testing the effectiveness of *Window* and produced reports accordingly. In January 1942, Cockburn produced TRE Report 5/49/RC which discussed

¹⁴⁹ CCAC RVJO J.1, 'The Radio War', p. 7; Churchill, *The Hinge of Fate*, pp. 104–5. These two accounts are identical regarding the radar aspect of the Channel Dash. The subtle jamming story had derived from Jones's post-war interview with General Wolfgang Martini, who had been the GAF Director General of Air Signals.

¹⁵⁰ Jones, *Most Secret War*, pp. 234–5. See also R. V. Jones, 'Intelligence as an Academic Discipline' in Jon Sigurdson and Yael Tägerud, *The Intelligent Corporation: The privatisation of intelligence* (London: Taylor Graham Publishing, 1992), p. 74. This train of thought from Jones has been reproduced: See as examples, Michael I. Handel, 'Intelligence and Deception', *Journal of Strategic Studies*, 5: 1 (March 1982), 125; Handel, 'Intelligence and the Problem of Strategic Surprise', 247; Breuer, *Secret Weapons of World War II*, pp. 106–9.

¹⁵¹ CCAC RVJO J.1, 'The Radio War', p. 7.

possible methods of countering *Würzburg*, with a preliminary survey of the *Window* method. He concluded that spurious echoes could be produced in RDF installations by suitable objects jettisoned from aircraft. This report led to Joan Curran (the only female TRE scientist) being assigned the task of further investigation.¹⁵² In March 1942, she produced Report 5/57/JEC, which summarised initial *Window* experiments, and confirmed that *Window* was practicable but required more development.¹⁵³

Another key figure in *Window* development was skilled nightfighter radio operator, F/Lt Derek Jackson, who was attached to TRE in 1942.¹⁵⁴ Jackson had been Lindemann's Clarendon protégé.¹⁵⁵ As a senior figure in the 1930s Clarendon regime, Jackson played a significant role in Jones's doctoral experience.¹⁵⁶ In the *Window* issue of 1942 however, much to Jones's chagrin, Jackson was in opposition to ADI (Science). This has been written about in detail elsewhere.¹⁵⁷ The importance here lies in the manner to which Jones allowed scientific intelligence to be drawn into operational arguments based on his personal desire to see his invention utilised to maximum effect. This is not to suggest that Jones was overly wrong in doing so. With outstanding scientific intelligence being produced on GAF DT and GCI the

¹⁵² Mrs Joan Curran was a talented scientist and mathematician. So too was Joan's husband, a Cavendish man who worked on the development of the proximity fuse and later became one of the many scientists involved in the Manhattan Project: see Reg Batt, *The Radar Army*, p. 72.

¹⁵³ CCAC ROCO 1/1 & CCAC RVJO B.158, Robert Cockburn, 'The Radio War', Appendix I, p. 8.

¹⁵⁴ Rowe, *One Story of Radar*, p. 153.

¹⁵⁵ Cherwell and Jackson wrote to each other for many years, before, during and after the war: see OUNP CP D.116 & D.117, correspondence between Lindemann and Jackson, 1924–52.

¹⁵⁶ For Jones's own reference to Jackson's influence upon his undergraduate and postgraduate educations, see R. V. Jones, 'Through Music to the Stars: William Herschel, 1738–1822', *Notes and Records of the Royal Society of London*, 33: 1 (August 1978), 42.

¹⁵⁷ Jones, *Most Secret War*, pp. 294–7; Jones, 'Lord Cherwell's Judgement', 325; Birkenhead, *The Prof in Two Worlds*, pp. 240–4; Price, *Instruments of Darkness*, pp. 116–49.

delay of *Window* must have seemed to Jones a ludicrous waste of resources, and personal time and effort.

As Jones was keen to show in *Most Secret War*, he was proved right eventually on all counts. Nevertheless, his determination in this matter led ADI (Science) to encroach into operational considerations not in their remit. This was something Jones realised much later on, when he wrote that ‘complication arises’ when intelligence organisations, if doing their job properly, will be the first to realise actual or potential vulnerability of an opponent, for intelligence knows where and how the enemy can best be hindered by deception, sabotage, or overt military action. Jones referred to his *Window* experience as the example that stood out from others, and then stated that once he had made a technical or tactical suggestion for action the responsibility for its implementation belonged to the operational staff.¹⁵⁸ With *Window* he was unable to allow the operational responsibility to be passed through the correct channels, perhaps because he had vested interest in the success of the very principle of *Window* itself.

In October 1942, SIR No.16 on German knowledge of *Window* was circulated. This was based on intelligence received, from a dubious second-hand HUMINT source (supposedly a woman employed at a German GCI station) who detailed occurrences at the station after British aircraft dropped aluminium dust and then changed altitude. The SIS agent was informed that

¹⁵⁸ Jones, *Reflections in Intelligence*, pp. 47–8. Jones added that although he stood for intelligence being independent from operations, both covert and overt, to the highest possible level in government organisation, he also recognised the need for the greatest possible understanding between intelligence and operational staffs.

detectors (or predictors) at the GCI station directed GAF nightfighters to the dust cloud, and one even fired into it.¹⁵⁹ The reporting agent dismissed the intelligence as merely 'careless talk'. ADI (Science) were less dismissive, and presented three possibilities: the statement was genuine and fairly accurate; the source had been 'inspired', and was a 'plant'; the agent invented a good story to get a good price. The third possibility was rejected instantly, for agents had 'not proved good inventors', but also because some data was adequate enough to show limited GCI knowledge. If the source had been inspired it meant Germany were gifting the *Window* principle on a plate, which seemed unlikely. If the source was genuine, it meant one of three things: the British had used *Window* effectively; British *Window* development had been penetrated by German intelligence; or GAF personnel were being warned of the potential use of such spurious dipoles. ADI (Science) did not hazard a guess but instead presented 'major conclusions' with certainty statuses.¹⁶⁰

ADI (Science) concluded SIR No.16 by stating that whatever other security considerations were aroused by the report, 'German knowledge of *Window* must have a profound effect' upon British policy. They also acknowledged SIS's contribution to this intelligence via Medhurst as A11(c), and had hoped that SIR No.16 would spur dissenters into realising that if Germany had

¹⁵⁹ CCAC RVJO B.35 & TNA AIR 20/1632, Air Scientific Intelligence Report No.16 'German Knowledge of "Window"', 24 October 1942, Hinsley *et al*, *British Intelligence in the Second World War, Volume II*, p. 518.

¹⁶⁰ These 'major conclusions' were: (i) The Germans knew of the *Window* principle (certain); (ii) The Germans knew of the British intention to use *Window* (certain, but for an extremely remote chance); (iii) Sufficient stir had been caused for all ranks to be aware of *Window* (almost certain); (iv) The information came from British POWs (probable); (v) *Window* had been tried by at least one British aircraft (rather less probable); (vi) It was successful (same as (v)); (vii) British *Window* security had been penetrated by German agents (possible); (viii) Indiscreet W/T signals had been made regarding the use of *Window* (possible): CCAC RVJO B.35 & TNA AIR 20/1632, Air Scientific Intelligence Report No.16 'German Knowledge of "Window"', 24 October 1942.

knowledge of *Window* then the whole basis of their argument was crushed.¹⁶¹

Jones recalled in *Most Secret War* that this was ‘an extraordinary Intelligence situation’, one ‘unique’ in his experience.¹⁶²

Germany certainly knew about the *Window* principle because they had been experimenting with their own equivalent spurious dipoles, codenamed ‘Düppel’.¹⁶³ German technicians were also contemporaneously testing what they called ‘Aphrodite’; balloons filled with metal strips designed to protect U-boats from ASV detection. Perhaps *Düppel* and/or *Aphrodite* experimentation had somehow inspired the SIS source, used so effectively in SIR No.16, although *Düppel* or *Aphrodite* were not then known to the British.¹⁶⁴ Even without such knowledge, Jones believed he had sufficient evidence to press for immediate use of *Window* in order to help reduce the unsustainable losses being experienced by Bomber Command at that time.

Aside from his initial disbelief in the GAF beams, Cherwell had supported Jones in all previous scientific intelligence matters. In the matter of *Window*, however, Cherwell disagreed with the stance taken by scientific intelligence. This was not total discord, for Cherwell wholeheartedly believed in the *Window* principle (that he had pressed Churchill into suggesting it to the

¹⁶¹ CCAC RVJO B.35 & TNA AIR 20/1632, Air Scientific Intelligence Report No.16 ‘German Knowledge of “Window”’, 24 October 1942.

¹⁶² Jones, *Most Secret War*, p. 293.

¹⁶³ *Düppel* was named after experiments carried out on an estate of that name near Berlin although the name also suggested the word ‘dipole’ in English: Sir Robert Cockburn in Latham & Stobbs, *Pioneers of Radar*, p. 191; Hartcup, *The Challenge of War*, p. 150; Jones, *Most Secret War*, p. 299.

¹⁶⁴ *Aphrodite* was first revealed to the Allies through *Kriegsmarine* Enigma on 15 June 1943, but remained a mystery until another decrypt disclosed the workings of the *Aphrodite* balloons. NID/DSD9 then realised that *Aphrodite* was an application of the *Window* principle: see Hinsley *et al*, *British Intelligence in the Second World War, Volume II*, p. 519. ADI (Science) reported on *Aphrodite* the following month: see CCAC RVJO B.49 & TNA AIR 20/1661, Air Scientific Intelligence Report No.IV ‘Early German Reactions to Window’, 3 August 1943.

ADRC in 1937 is testament to this). Cherwell's concerns in 1942 were much the same as all the other dissenters – that if *Window* was used against Germany, they in turn could use it against British RDF with calamitous consequences.¹⁶⁵ It was for this reason that Cherwell had recommended Jackson be attached to TRE. While Group 5 investigated the effect *Window* (and other RCMs) could have upon DT, and TRE produced and stock-piled *Window*, Jackson undertook trials on the effect *Window* could have upon British RDF and GCI.¹⁶⁶ In September 1942, Jackson produced Fighter Command Report PC/S.2864/RDF-Plans which summarised his trials at Coltishall airfield the previous month, and provided conclusions and recommendations based on his findings.¹⁶⁷

Jackson's 'ominous' conclusions showed that British radar was highly susceptible to spurious dipoles. This further exacerbated Cherwell's fears that a few bombers saved was scant justification for 'premature release to the enemy of a device' that was highly effective even against Britain's latest RDF.¹⁶⁸ Jackson's evidence was advanced by the widely-distributed December 1942 Fighter Command Report No.FC/S.28647/Sigs.J, which specified the quantitative use of *Window* with particular reference to

¹⁶⁵ Jones later stated that this was a prime case of Cherwell being 'remarkably defensive minded': CCAC RVJO B.341, 'Note on interview with Prof. R.V. Jones, at 25 Elgin Mansions, London W.9, from 7.00pm 6th January 1963 to 1.00am on the 7th' by David Irving, p. 17.

¹⁶⁶ Birkenhead, *The Prof in Two Worlds*, pp. 240–6. See also C. P. Snow, *A Postscript to Science and Government* (London: OUP, 1962), p. 31. Snow suggested that Cherwell arranged for Jackson to be responsible for *Window* trials so that, if successful, Cherwell would gain the credit.

¹⁶⁷ CCAC ROCO 1/1 & CCAC RVJO B.158, Robert Cockburn, 'The Radio War', Appendix I, p. 8.

¹⁶⁸ Price, *Instruments in Darkness*, p. 117.

Würzburg.¹⁶⁹ It was in response to this quantitative data that Jones led scientific intelligence into operational waters.¹⁷⁰

Bomber Command's Operational Research Section (ORS), established in October 1941 and led by Basil Dickens, also independently produced its own findings regarding the use of *Window*.¹⁷¹ The purpose of OR sections within RAF Commands (as defined by DCAS in October 1941) was to provide Commanders-in-Chief with trained scientific staff capable of collecting, researching, and analysing data of technical, tactical and general operational factors. From this data, new scientific staffs would draw 'deductions and lessons' that would 'serve to guide the Commanders-in-Chief and their staffs in the conduct of future operations'.¹⁷² Jones had significant issues with these arrangements and wrote at length to Medhurst expressing his concerns. In essence, the problem was in the wording of the arrangement, for Jones doubted there was any distinction between his scientific intelligence methods, and OR as laid out in the DCAS memorandum. Jones saw the specification of duties of scientific intelligence (or even ordinary intelligence) as 'almost

¹⁶⁹ CCAC ROCO 1/1 & CCAC RVJO B.158, Robert Cockburn, 'The Radio War', Appendix I, p. 8.

¹⁷⁰ Jackson's 11 December report expressly stated that figures presented for amounts of *Window* required to render DT ineffective, were of the 'extreme upper limit'. ADI (Science) believed these figures to be grist to the mill for *Window* dissenters, based as they were on little use of the knowledge scientific intelligence had presented on DT. They therefore endeavoured to produce their own figures, making use of the knowledge they had of DT technique: CCAC RVJO B.39, ADI (Science) memorandum 'The Effect of "Window" on German R.D.F. Defences', 4 January 1943. As Jones wrote in *Most Secret War*, Jackson's figure for how much *Window* was required to disable DT was 84 tons, but to render British RDF ineffective required only one ton. Jones and Frank believed Jackson's case scenario to be 'of the worst kind', and in light of ADI (Science)'s 'special knowledge' of DT were able to reduce Jackson's figure to 12 tons: Jones, *Most Secret War*, p. 295.

¹⁷¹ For the foundations of Bomber Command OR section, see TNA DEFE 40/2, Memorandum CS.10956 entitled 'Operational Research' written by Bottomley (DCAS), 2 October 1941, and Minute confirming Dr Basil Dickens from DSR staff as Operational Research Officer, 7 September 1941. See also F. L. Sawyer, A. Charlesby, T. E. Easterfield, E. E. Treadwell, 'Reminiscences of Operational Research in World War II by Some of its Practitioners', *The Journal of the Operational Research Society*, 40: 2 (February 1989), 115–36. OR employed 35 to 40 scientific analysts at its peak.

¹⁷² TNA DEFE 40/2, Bottomley (DCAS) to Medhurst (ACAS(I)) with attached Draft Memorandum from DCAS entitled 'Operational Research', 20 September 1941.

identical' to those defined, and used as example GAF searchlight reactions to IFF sets in British bombers, which was a 'matter of intelligence as well as of direct operational interest'. Jones was concerned that his newly-formulated ADI (Science) would lose authority soon after obtaining it, saw it his duty to advise the Commander-in-Chiefs through proper intelligence channels, and believed his proposed arrangements would eradicate this duty.¹⁷³

Medhurst stated his opinion that the success or otherwise of Command ORS largely depended upon the scientific and other information which intelligence could provide on GAF defensive measures. 'Side by side', wrote Medhurst, with the Command ORS should be 'a similar organisation to deal with the enemy'. This was 'to some extent' being carried out by Jones and by the research section in DDI3 responsible for operational and organisational intelligence on all foreign air forces. Medhurst felt, however, that if Air Intelligence was to 'get full value' from their own investigations and those of the OR research sections, then Jones's section should be enlarged, 'in order to give him full scope to concentrate a portion of his staff on the German defensive system'. 'At the same time', Medhurst proposed, 'Jones would correlate his work closely with the research section' in DDI3.¹⁷⁴

Jones replied that he 'was rather disturbed' by it all. He agreed with DI(O) that the whole ORS concept would 'have many undesirable consequences for the Air Ministry', 'may lead to rival schools of thought and divided counsels', too much unnecessary overlapping and duplication of work, and even 'difficulty in

¹⁷³ TNA DEFE 40/2, Jones to Medhurst, 25 September 1941.

¹⁷⁴ TNA DEFE 40/2, Medhurst (ACAS(I)) to Payne (Director of Intelligence (Operations) (DI(O))), 22 September 1941.

obtaining qualified personnel to man their research sections'. The implication was made that 'Jones's branch', and not the Command ORS, had to 'be the authority for all air intelligence regarding the enemy' obtained 'by research methods'.¹⁷⁵ Medhurst proposed amendments to Bottomley's original 'Operational Research' paper and sent them to DI(O) for approval.¹⁷⁶ Heeding Medhurst's and Jones's appeals, DI(O) in effect rescued ADI (Science) from at best operational ambiguity and at worst obscure definition of duties. Medhurst thereafter emphasised intent to strengthen ADI (Science) to accommodate ORS, and confirmed that provided lines of investigation embarked on by OR were fully known to ADI (Science), then the latter could direct activities towards collecting information that ORS required.¹⁷⁷

The official memorandum, which marks the commencement of RAF ORS, was circulated on 2 October 1941. The alteration of most importance to ADI (Science) was regarding potential overlap of information on the enemies' methods and intentions. The document stipulated that it was 'the duty of the Intelligence staff at the Air Ministry to provide this information'.¹⁷⁸ This in effect ensured that no ORS could constitutionally encroach on intelligence-related matters or pursue intelligence gathering methods. Of particular note is that the presence of scientific intelligence within Air Intelligence had shaped the very essence of OR relative to air matters. In many respects this was a milestone in scientific intelligence history, for it not only spelt out its importance, but also

¹⁷⁵ TNA DEFE 40/2, Payne to Medhurst, 23 September 1941. In a handwritten footnote, Payne added that Inglis agreed and had provide a useful additional point, namely that documented information, which was extensively used in research work, was available at the Air Ministry but not at Commands.

¹⁷⁶ TNA DEFE 40/2, note from Payne to Medhurst, 24 September 1941.

¹⁷⁷ TNA DEFE 40/2, Medhurst to Bottomley, 25 September 1941.

¹⁷⁸ TNA DEFE 40/2, Memorandum CS.10956 entitled 'Operational Research' written by Bottomley (DCAS), 2 October 1941.

confirmed to RAF Commands that ADI (Science) was a permanent and highly-regarded component within the Air Intelligence wartime structure.

This, controversially, commenced awkward relations between ADI (Science) and ORS, particularly Bomber Command ORS and between Jones and Dickens. In every incident, friction stemmed from Jones, for he never truly accepted OR as an operational construct. From its inception, he regarded OR as an infringement upon his work and upon the organisation he had grown to value. Operational difficulties were described by Jones in *Most Secret War*, but his objections to OR were not made explicit. He did add however, that he was invited onto the Operational Research Committee, which was perhaps the contemporary appeasement required in order to allow Jones to satisfactorily defend his scientific intelligence corner.¹⁷⁹

Bomber Command's ORS were initially 'lukewarm' regarding *Window* usage, positing that this attitude 'may have reflected the tension that existed' between them and TRE.¹⁸⁰ Close examination of Bomber Command's ORS Reports however, suggests that organisational tensions were the least of their concerns. It has been argued that *Window* was 'much-anticipated' by Bomber Command ORS, which viewed the combination of the radar-jamming device, concentration formation, and 'Monica' (a new airborne RDF device designed to warn of approaching aircraft) as the means to reduce Bomber Command

¹⁷⁹ Jones, *Most Secret War*, pp. 208–9; see also pp. 329, 377, 388–9 & 419.

¹⁸⁰ Joseph F. McCloskey, 'British Operational Research in World War II', *Operations Research*, 35: 3 (May–June 1987), 459.

losses.¹⁸¹ From November 1941, Dickens's ORS produced convincing evidence that concentration bombing was the best defence against searchlights and AA guns.¹⁸² They further deduced that to make the most out of the eventual use of *Window*, British bombers should continue to fly in concentrated formation.¹⁸³

Bomber Command ORS carried out its own investigations into how much *Window* would be needed to be dropped to satisfactorily cover extreme concentrations of bombers from the 'eyes' of DT. Jones believed that Dickens 'cautiously waited' until Jackson and Jones had submitted their bids before producing his own of 48tons of *Window*.¹⁸⁴ This statement from Jones however, showed no respect for the meticulous scientific examinations that Bomber Command ORS were undertaking at that time. Perhaps Jones saw Dickens as yet another scientific rival for high-level attention.

ADI (Science) balked at Fighter Command's supposition that DT was 100 times more immune to *Window* than British RDF, and declared that both systems may well 'prove almost equally vulnerable'. They based this supposition on the fact that although Germany were 'in a better position' than Britain (on account of their narrower beams), they were behind in transmitter

¹⁸¹ Randall T. Wakelam, *The Science of Bombing: Operational Research in RAF Bomber Command* (London: University of Toronto Press, 2009), pp. 111–2.

¹⁸² See TNA AIR 14/396, Bomber Command Operational Research Section (BC ORS) Report No. 9, 'Preliminary Note on the Relation between Concentration in Time over a Target and Bomber Losses', 1 November 1941; BC ORS Report No. 29, 'An Investigation into the Effect on Bomber Losses of Concentration in Time at the Target and the Duration of Attack' 11 March 1942; BC ORS Report No.34, 'Preliminary Note on the Effect on Bomber Losses on Concentration in Space en Route', 30 May 1942. See also TNA AIR 14/206, Tactical Committee Report TC31, 'Tactical Countermeasures to Combat Enemy A.A. Searchlights and Guns', February 1943.

¹⁸³ Wakelam, *The Science of Bombing*, p. 141.

¹⁸⁴ Jones, *Most Secret War*, pp. 295–6.

powers and presentation devices. They further deduced that clouds of *Window* would sink at assumed rates of 300ft/min (equalling 3.4mph). They recommended a 'leading formation' of twenty bombers to act as 'specialist Window-droppers', which could create a high concentration from outset, allowing sufficient time for the remainder of the bomber formation to pass GCI stations or AA positions.¹⁸⁵ From summer 1942 British bomber formations were either concentrated through Kammhuber's line of DT defences or around it. The GAF response was to bolster the line with new boxes which 'spread ivy-fashion' over the whole of western Germany and the occupied territories – Berlin to Ostend and Skagerrak to Marseilles.¹⁸⁶

'Moonshine' was the first widely-used RCM designed to protect against the all-seeing eye across north-west Europe. Jones claimed credit in the development of *Moonshine*. He wrote that, while advising Fighter Command on their *Rhubarb* query, he also advised No.11 Group on the principles behind, and technical feasibility of, detecting DT pulses and reflecting echoes to provide spurious impressions that one aircraft was many. He recommended that Fighter Command press for its production, which they did and the result was *Moonshine*.¹⁸⁷ Two other RCMs entered Bomber Command service in December 1942 – 'Mandrel' (for jamming *Freya*) and 'Tinsel' – an airborne transmitter that broadcast aircraft engine noise to block ground-to-nightfighter

¹⁸⁵ CCAC RVJO B.39, ADI (Science) memorandum 'The Effect of "Window" on German R.D.F. Defences', 4 January 1943.

¹⁸⁶ CCAC RVJO J.1, 'The Radio War', p. 13.

¹⁸⁷ Jones, *Most Secret War*, pp. 243–4

R/T. German response to *Tinsel* was to advance their R/T to VHF, but by July 1943 TRE developed 'Cigar' to jam the VHF transmissions.¹⁸⁸

Mandrel had the same effect on DT as unscreened car ignitions had upon the early versions of domestic televisions, and also used the crudest form of jamming known as 'noise jamming'.¹⁸⁹ Designed by Group 5 and rushed into production during summer 1942, jamming of *Freya* began in December using airborne screening by Fighter Command Defiants.¹⁹⁰ Ground-stations were also created consisting of six Type 1431 transmitters, the first being completed by July 1942.¹⁹¹ By February 1943, *Mandrel* transmitters were operating from RDF ground-stations at Dover, Fairlight, Worth, and Ventnor. TRE also constructed an RCM station in Dunwich for the purpose of locating and jamming the frequencies used by GAF AI. This was called 'Grocer' and became operational in April 1943.¹⁹² The introduction of these RCMs enhanced arguments for further delay of *Window* on grounds that time should be given for the GAF to master them first.¹⁹³ On 29 March, based on ULTRA intelligence, ADI (Science) were able to report on the successes of *Mandrel*. Protection of the 'most secret source' in SIR No.III is fascinating and worth reproduction in full:

¹⁸⁸ Webster and Frankland, *Strategic Air Offensive against Germany, Volume IV*, p. 21.

¹⁸⁹ Price, *Instruments of Darkness*, p. 111.

¹⁹⁰ CCAC ROCO 1/1 & CCAC RVJO B.158, Robert Cockburn, 'The Radio War', p. 28; Jones, *Most Secret War*, p. 295; Price, *Instruments of Darkness*, p. 111.

¹⁹¹ TNA AIR 41/46, 'RAF No.80 Wing Historical Report, 1940–1945', p. 86.

¹⁹² Webster and Frankland, *Strategic Air Offensive against Germany, Volume IV*, p. 21. An *Airborne Grocer* was also later developed.

¹⁹³ Price, *Instruments of Darkness*, p. 127.

One of our most delicately placed sources recently managed to see, and take notes of, some reports of jamming from a number of German R.D.F. stations on the coast of Northern France. It is improbable that she will be able to repeat the performance; nevertheless in view of the position and prospects of obtaining other and more vital information it is absolutely essential that the present report be used with the utmost discretion. From past performance the reliability of the source can be guaranteed.¹⁹⁴

This was the only feminine reference to ULTRA by ADI (Science). They compiled results of *Mandrel* from the many Enigma decrypts from 1–3 March. Completed compilations provided them with the idea to mask the source by referring to her seeing reports ‘in the form of a simple proforma return, made in quadruplicate’. They summarised their findings by stating that both ground and airborne *Mandrel* transmitters were technically able to cause very successful interference with GAF 120Mc/s DT. Because *Mandrel* only jammed *Freya*, however, ADI (Science) believed it was only valuable if it prepared ground for future ‘bluff and subtlety’ (reference to *Window*) in jamming *Würzburg*. They deduced that the chief tactical advantage *Mandrel* provided was in the ‘small degree of nerve-strain on defence personnel in France, who cannot relax as freely in the evenings as they could if their early warning system were in perfect order’.¹⁹⁵ They were to be proved right in this matter, for captured documents later revealed that *Mandrel* did affect GAF GCI stations, but did not appreciably reduce their effectiveness as *Würzburg-Riese*

¹⁹⁴ CCAC RVJO B.47 & TNA AIR 20/1665, Air Scientific Intelligence Report No.III ‘Mandrel Results’, 29 March 1943. This SIR was the third in a series of higher security distribution reports. This was denoted by the Roman Numerals replacing the Arabic referencing.

¹⁹⁵ CCAC RVJO B.47 & TNA AIR 20/1665, Air Scientific Intelligence Report No.III ‘Mandrel Results’, 29 March 1943.

(Giant Würzburg) was able to search successfully (but with less range) without the aid of *Freya*.¹⁹⁶

Jones was concerned that the name *Tinsel* would lead to German supposition that Britain had some form of withheld jamming device made of metal strips.¹⁹⁷ In their effects of *Window* report, ADI (Science) even suggested *Window* to be 'the more reliable method' of jamming *Freya*, recommending one packet of one and one quarter metre length strips to be dropped every two minutes.¹⁹⁸ *Window* for Jones, and by association ADI (Science), was above and beyond all other RCM concepts. Time and effort spent by them on the effects of *Window* report were wasted, for *Window* was officially shelved again in a reconvened meeting of 2 April 1943. In discussing this meeting in *Most Secret War*, Jones brought numerous personalities into play, notably his argument with Watson-Watt (his 'coldly calculating opponent').¹⁹⁹

Irrespective of whether or not Jones was drawing ADI (Science) into the realms of operational interference, the extent of knowledge they had amassed and collated during the sixteen months of *Window* controversy must be appreciated. Shortly before the Bruneval Raid, they were provided with a Belgian Resistance report detailing 'a large wire-net paraboloid, about 22–5 feet in diameter', recently erected at Cumptich near Tirlemont in central Belgium, and some 5km from St. Trond where there was known to be a GAF

¹⁹⁶ CCAC RVJO B.57 & TNA AIR 20/1640, Air Scientific Intelligence Report No.23 'Control and Plotting at a German G.C.I. Station', 28 February 1944, p. 8.

¹⁹⁷ Jones, *Most Secret War*, p. 295.

¹⁹⁸ CCAC RVJO B.39, ADI (Science) memorandum 'The Effect of "Window" on German R.D.F. Defences', 4 January 1943.

¹⁹⁹ Jones, *Most Secret War*, pp. 296–7. For the other side of the argument see Watson-Watt, *Three Steps to Victory*, p. 419.

nightfighter airfield.²⁰⁰ In *Most Secret War*, Jones stated that from the description of the object it 'seemed to be a Freya', but this conflicts with the report to Medhurst which specified a paraboloid.²⁰¹ Moreover, Jones somewhat misleadingly referred to Major Jempson (never by his Christian name) as his organisation's Belgian Resistance liaison.²⁰²

Major Frederick Jempson was much more than a liaison. He was head of Broadway's Belgian Section, although a month after handing this report to ADI (Science), Jempson found his section in dire straits.²⁰³ He had been informed by Dansey that 'unless drastic steps were taken' his section would 'be without any agents left in Belgium'. Providing the specific coordinates of the first known GAF nightfighter-controlling DT was not only valuable intelligence, but was also timely. Jempson's agents followed this intelligence with more, the next month, from Domburg on the Island of Walcheren in the Scheldt Estuary. This was perfectly situated for PRU fly-overs, so Jones informed Hill he would be putting in an official request for a sortie.²⁰⁴ Jones acknowledged these Belgian Resistance reports, noting that Jempson had produced two 'valuable reports', and adding that, as most British bomber attacks were routed to the Ruhr through Belgium, Jempson's territory constituted 'an important section of the main German air defence system', and the more that was known about them, the less casualties Bomber Command would suffer.²⁰⁵ It seems strange that Jones did not mention his defence of Jempson and his Belgian Section in

²⁰⁰ CCAC RVJO B.27, ADI (Science) to ACAS (I), 6 April 1942; Jeffery, *MI6*, p. 521.

²⁰¹ CCAC RVJO B.27, ADI (Science) to ACAS (I), 6 April 1942.

²⁰² Jones, *Most Secret War*, p. 227.

²⁰³ For a rare insight on Jempson, his Belgian Section of SIS, and its contribution to Allied victory, see Jeffery, *MI6*, pp. 481, 520–3, & 542–4.

²⁰⁴ Jones, *Most Secret War*, p. 227.

²⁰⁵ Jeffery, *MI6*, p. 521.

Most Secret War, preferring instead to mention him three times in passing, while accentuating the ‘tremendously active’ agency of the Belgians—which by D-Day had become an ‘excellent’ espionage network.²⁰⁶

Much Belgian data on GAF GCI was concealed by agents among coals in the tender of the Brussels-Lyon express. Not only did this allow relatively safe passage of the intelligence to French Resistance, but also allowed incriminating evidence to be shovelled into steam train furnaces in the event of trains being searched by German soldiers, although as far as ADI (Science) were aware no information was lost this way. Of the best items of intelligence that reached them through the Brussels-Lyon express were a series of brilliant sketches showing construction of a radio station for controlling nightfighters. Jones confirmed that, by the end of 1942, Belgian agents had provided information on almost every component of the GAF nightfighter defences deployed throughout their territory.²⁰⁷ Although the Belgians were ‘almost automatically inclined to espionage’, they were not, however, without feeling. An agent code-named ‘VNAR2’ of the Belgian network ‘Service Marc’ sent a microfilm message, commenting that although they had been requested to seek unusual radio installations it was odd that when such stations were reported the British did not destroy them. He added in appeal that it would be helpful to know to what extent British intelligence services were interested, for he and his fellow agents had worked ‘so long in the dark’ that any reaction from London would be welcome. VNAR2 concluded that he hoped the British

²⁰⁶ Jones, *Most Secret War*, pp. 227, 266–7, 383 & 403.

²⁰⁷ CCAC RVJO B.113, ADI (Science) post-war report ‘Scientific Intelligence in the S.I.S., 1939–45’, circa 1945, pp. 3 & 4. This post-war assessment by Jones began an enduring admiration for the wartime Belgian Resistance that he expressed in many of his war remembrance activities, and in much of his defence-based literature.

would not resent his plea, and that whatever happened they could rely on the 'entire devotion' and life sacrifice of the Belgian agents.²⁰⁸ After the war, Jones discovered that VNAR2 was André Mathy, a 30 year-old Belgian doctor, who was caught by the Gestapo on 13 March 1943 and executed at Halle on 21 June 1944.²⁰⁹

Oblique photographs from PRU sorties over DT stations (highlighted by Belgians) arrived much quicker than Hill's eventual Domburg low-oblique. From these ADI (Science) ascertained that because no flak emplacements existed in the vicinity of the large wire paraboloid, then it was 'probable' that the Tirlemont DT apparatus was for nightfighter control. The Domburg obliques revealed two large paraboloids, two standard *Würzburgs* and a *Freya*. ADI (Science) deduced that German GCI depended upon accurate knowledge of British bomber positions, and that the large paraboloids produced narrow beams to this effect. Although further elucidation of characteristics awaited listening evidence and low-oblique photographs, they deemed it prudent to consider 60km circles of radius around Domburg as GAF nightfighter areas.²¹⁰ Hill's low-oblique photographs were taken on 2 May 1942, and were indeed the best of the war insofar as radar was concerned.²¹¹ In the meantime, in the continental inland areas, British bomber

²⁰⁸ Jones, *Most Secret War*, p. 269; Jones, *Reflections on Intelligence*, p. 218.

²⁰⁹ UOB DM1310/J.120, Jones to Frank, 14 May 1984; Jones, *Reflections on Intelligence*, p. 218.

²¹⁰ CCAC RVJO B.27, ADI (Science) to ACAS (I), 6 April 1942.

²¹¹ CCAC RVJO B.38, 'Giant Würzburg at Domburg', photograph taken on 2 May 1942. The best photograph (No. 38-A/701) was taken while an operator was about to climb the ladder leading into the cabin of a *Würzburg-Riese*, which truly emphasised the scale of the apparatus. This photograph led to Operation *Bellicose*, bombing of the Zeppelin factory at Friedrichshafen on Lake Constance on 22 June 1943. In the photograph the 'trellis work construction' resembled the skeletons of the old Zeppelin airships. This link provided another discrepancy of recollection between Jones and Wavell as to who was responsible for the intelligence that the Giant *Würzburgs* were made at the Zeppelin factory. Wavell claimed that he informed Churchill personally when the Prime Minister visited Medmenham on

crews were reporting dense deployment of searchlights, and unidentifiable pulse transmissions on 53cm-wavelengths.²¹²

G-Section PIs made the next breakthrough discovery of *Würzburg-Riese*, one not mentioned in *Most Secret War*. ADI (Science) reported to Medhurst in June 1942 that CIU had located 'a new large' *Würzburg* 600 yards north of the village of Moulon, some 12 miles south-west of Paris. As this DT site was still under construction when photographed ADI (Science) guessed that perhaps the GAF were intending to defend Paris with nightfighters, consequent upon recent raids in the area (probably referring to the March 1942 Billancourt Renault factory raid). ADI (Science) regarded this discovery as 'a lucky chance', for it was found in the last photograph of a sortie unconcerned with locating DT stations. They were keen to emphasise that this provided another example of the value of allowing PRU aircraft to expend their films, and not merely cover their immediate objectives.²¹³

Intelligence provided by AI4(c) formed the foundation of ADI (Science)'s next report. 'Notes on German Nightfighters' was intelligence derived from intercepted call-signs demonstrating (albeit tentatively) expansion of GAF nightfighter activity. It reported a total strength of some 250 nightfighters, and laid out known Unit distribution and some technical specifics of Ju-88s and

14 June 1943, while Jones claimed that he showed the evidence to Cherwell. Again, Taylor Downing has noted this discrepancy: see Downing, *Spies in the Sky*, pp. 260–1 & 377; Jones, *Most Secret War*, p. 230; TMC MED/DFG 5794, Claude Wavell interviewed by Constance Babington Smith, 24 May 1956; Babington Smith, *Evidence in Camera*, p. 173.

²¹² CCAC RVJO B.43 & TNA AIR 20/1633, Air Scientific Intelligence Report No.17 'The German Controlled Nightfighter System', 12 February 1943, p. 4.

²¹³ CCAC RVJO B.27, ADI (Science) to ACAS (I), 9 June 1942. ADI (Science) first reported this intelligence on 2 June.

Me-110s. From listening to GAF nightfighters with assistance from AI4(c), ADI (Science) were able to piece together pulse frequencies, ranges, bearings, and elevations of *Freya*, *Würzburg*, and *Würzburg-Riese* with which nightfighters were communicating. This in turn provided information of GAF airborne communications equipment. They also considered the possibility that GAF GCI stations had to have some form of computer to vector fighters to intruding bombers. Also that FuG-25, while useful for flak recognition, was proving unsatisfactory for AI due to its limited range. ADI (Science) were still unsure at this stage whether two *Würzburg-Riese* were required for GAF GCI—one for the fighter, one for the aircraft.²¹⁴ There was still much to learn.

That ADI (Science) constantly extended tentative knowledge-seeking probes (predominantly to TRE, AI4(c) and CIU) was wholly evident in two interim reports produced in July and November 1942. The late-July interim report detailed German coast-watching stations, and relied entirely on photographic intelligence. Low-obliques produced evidence of *Freya* arrays mounted in octagonal tower constructions near harbours in France and Holland. TRE and Y-Service reports established that these types of *Freya* were operating at 370Mc/s, which differed from the aircraft-watching *Freya* that transmitted at 120–130Mc/s. ADI (Science) deduced the 370Mc/s *Freya* were coastal watch arrays, and that the octagonal towers were blast towers. This was hardly new intelligence however, for the first *Freya* was heard by TRE in October 1940.

²¹⁴ CCAC RVJO B.30, ADI (Science) memorandum 'Notes on German Nightfighters', 24 June 1942.

With successful CombinedOps raids on the French coast still fresh in mind, along with extensive preparations being undertaken for the imminent large raid on Dieppe, ADI (Science) deemed this coast-watching DT intelligence 'of great importance'. They speculated that all German occupied harbours were defended by similar stations, and that 'subject to comment by more competent bodies', ranges of detection were likely to be of the order of 25miles for large ships, and 10–15miles for MTBs. They made notice that six of the towers had been found by PRU and CIU 'without the aid of any other Intelligence such as D/Fs', which was not only 'testimony to the probable extent of the chain' constructed by the Germans, but also to 'the skill' of CIU.²¹⁵

The November report introduced a new type of *Freya* array into the intelligence picture. This was what the Germans code-named 'Mammut' (Mammoth) due to its size, and what Jones called 'Hoardings' after seeing a photograph of *Mammut* that 'resembled the kind of erection on which large bill posters are displayed on major roads'.²¹⁶ On 14 June 1942, 'a source' (presumably a Belgian agent) had reported the existence of a 'square steel construction' some ten metres high and 35 metres long. Its locale was near a suspected *Freya* station at Kijkduin, and on 21 August CIU reported that camouflaged erections thought to contain *Freyas* had disappeared, and that a long raised girder had been erected nearby.²¹⁷

²¹⁵ This interim report had a relatively wide dispersal (31 copies in all) spanning all three services, MAP, four to CombinedOps, and one also to the Noise Investigation Bureau (NIB) further demonstrating the importance of listening services to continued investigation into DT appreciation: CCAC RVJO B.33 & TNA AIR 20/1676, Air Scientific Intelligence Interim Report 'German Coast Watching R.D.F. Stations', 28 July 1942.

²¹⁶ Jones, *Most Secret War*, p. 229.

²¹⁷ CCAC RVJO B.36 & TNA AIR 20/1677, Air Scientific Intelligence Interim Report 'Hoardings', 21 November 1942; Hinsley *et al*, *British Intelligence in the Second World War, Volume II*, p. 251.

CIU reported similar framework construction at Pointe de Primel in Brittany on 18 September. An AI4 D/F van in Cornwall listened to and recorded transmissions emitted from the Primel station, and when these were reduced by NIB the transmissions were established to be of abnormal strength. On 19 July, through a breach in GAF fighter security, the Y-Station at Beachy Head had heard the word 'Mammut' in R/T traffic. PRU photographed two others, at Cap Griz Nez and at the known *Freya* station at Domburg. ADI (Science) deduced that *Mammut* replacements in specific locations were due to *Freya* oversaturation, and emphasised that although *Mammut* was a considerable advance on *Freya*, it was much more conspicuous. Lack of *Mammut* mobility was also seen as a weakness, particularly in light of the fact that the Germans avoided capture of *Freya* in Africa.²¹⁸ In March 1943, based on Enigma decrypt assessment, ADI (Science) further reported that both *Freya* evolutions – *Hoardings* and *Mammut* – could be effectively jammed by *Mandrel*.²¹⁹

The 'Hoardings' interim report concluded with appreciation of intelligence organisations involved in the complementary source correlation. In this instance ADI (Science) went so far as to record with satisfaction that correlation between sources had been 'unusually smooth'.²²⁰ This was perhaps in reference to previous relations between ADI (Science) and the Y-Service, and it is notable that Jones did not mention AI4(c)'s involvement in

²¹⁸ CCAC RVJO B.36 & TNA AIR 20/1677, Air Scientific Intelligence Interim Report 'Hoardings', 21 November 1942.

²¹⁹ CCAC RVJO B.47 & TNA AIR 20/1665, Air Scientific Intelligence Report No.III 'Mandrel Results', 29 March 1943, p. 4.

²²⁰ CCAC RVJO B.36 & TNA AIR 20/1677, Air Scientific Intelligence Interim Report 'Hoardings', 21 November 1942.

the discovery of *Mammut* in *Most Secret War* at all. Instead, Jones wrote that once his organisation had discovered existence of *Mammut*, he directed TRE's attention to it, whereupon 'they listened for it', and found its characteristics to be similar to *Freya*. The higher-performance of *Mammut* was obtained through extra directing-power of the larger aerial array. Jones criticised TRE's 'expert' opinion that *Mammut* was intended for precision long-range bombing, and although he found it 'not easy to challenge the experts on matters of technical detail' Jones was proved correct. Jones concluded that by this time he 'had come to have a 'feel' for the way the Germans did things'.²²¹

It would be fairer to correct Jones by stating that it was ADI (Science) that had a 'feel' for GAF technology during the latter months of 1942. Just before New Year 1943 they were ready to officially report on German nightfighter control. Comprising forty-four pages (excluding two appendices), SIR No.I was the culmination of what was perhaps ADI (Science)'s finest intelligence collation. After relaying the growth of intelligence concerning GAF nightfighters since previous reports, SIR No.I spelt out exact technical specifics of equipment, deployment, employment, organisation, scale of effort, degree of success, policy, and the weak points within what Frank named the 'Kammhuber Line': what ADI (Science) defined as the 'backbone of the western defence system of the Reich', comprising a 'Main Belt' some 70–100km wide in which 60km radius stations were spaced at 30km. It was these 60km radius 'boxes' within the Main Belt of air defence that led the Kammhuber Line to be known in GAF

²²¹ Jones, *Most Secret War*, pp. 229–30.

circles as 'Himmelbett' (four-poster bed), and were what the RAF saw as 'a worrying initiative' for their air war opponents.²²²

These boxes were in addition to coastal stations as the main belt was roughly 140km inland. Each box was controlled by a GCI station, and each of these was divided into two parts: the detecting station and the fighter control station. The former controlled two (sometimes one) *Würzburg-Riese*, a *Freya*, power generators, quarters for crews, and stores. Fighter control stations consisted of T-shaped huts (conspicuous from the air) which contained communication and presentation systems, the fighter control officer, communications staff, and staff quarters. Fighters were Me-110s, Ju-88s, and Do-217s. Each aircraft was equipped with *Lichtenstein* (German IFF), although little was known regarding the performance of this instrument. Ground-to-air communication was enacted through R/T, and DT control used a 'Benito' form of ranging in which aircraft were directed to interception using *Würzburg* beams which simultaneously provided ground stations with range and bearing measurements. Station-control did not utilise cathode-ray tubes as in the British system (they were unclear as to why), but instead employed a 'form of lights moving over a large glass disc around which the T-shaped huts were designed.'²²³ ADI (Science) believed this presentation system to be 'a very cumbersome and extravagant piece of apparatus to use merely to convert range

²²² CCAC RVJO B.37 & TNA AIR 20/1663, Air Scientific Intelligence Report No.I 'German Nightfighter Control', 29 December 1942; John Pimlott, 'The Theory and Practice of Strategic Bombing' in Colin McInnes and G. D. Sheffield, *Warfare in the Twentieth Century: Theory and Practice* (London: Unwin Hyman, 1988), p. 130.

²²³ CCAC RVJO B.37 & TNA AIR 20/1663, Air Scientific Intelligence Report No.I 'German Nightfighter Control', 29 December 1942. The presentation system was known as 'Seeburg' Tables and had the odd full title of 'Flugsicherungstischs' (Flight Safety Service Tables): CCAC RVJO B.57 & TNA AIR 20/1640, Air Scientific Intelligence Report No.23 'Control and Plotting at a German G.C.I. Station', 28 February 1944, p. 13. ADI (Science) suggested that the reason for the odd official name for the *Seeburg* Table was that it was a 'mild form of camouflage used for security reasons'.

and bearing into fighter grid plots'.²²⁴ As GCI stations could only manage one aircraft at a time, waiting aircraft were ordered to orbit radio beacons (three to each 60km radius box). This explained the 'little screw' R/T traffic. Bruneval-type small *Würzburg* controlled flak and searchlights (where still operative).²²⁵

Three additional items of intelligence were integral to this extensive appreciation of German GCI. The first was an 'interception of outstanding interest' by Fighter Command, which tracked and plotted airborne action between an RAF Beaufighter and GAF nightfighter. The latter, controlled by the newly-located Domburg DT station, remained rigidly within its controlled 60km radius 'and the combat developed into mutual frustration'.²²⁶ This item of intelligence was not mentioned in *Most Secret War*. The second was an item of 'tremendous value'. This was a map Jones was directed to on a top shelf in Jempson's office when Jones visited him seeking further clues.²²⁷ Belgian agent *Tégal* 'contrived to remove' from a GAF GCI station-headquarters a map showing deployment of searchlight regiments covering 90km along the Kamhuber Line.²²⁸ Jones recalled this map to be 'one of the most vital clues in the entire Intelligence picture'.²²⁹ It provided many locations of Kamhuber Line GCI stations which had replaced removed searchlight stations. ADI (Science) presented a section of the map with SIR No.I, centred

²²⁴ CCAC RVJO B.80 & TNA AIR 20/1650, Air Scientific Intelligence Report No.33 'Benito Control of Fighters and Egon Control', 20 April 1945, p. 10. The GAF later came to the same conclusion so that by April 1945 ADI (Science) could report that 'on some sites' Seeburg Tables had 'been removed and replaced by simple plotting arrangements'.

²²⁵ CCAC RVJO B.37 & TNA AIR 20/1663, Air Scientific Intelligence Report No.I 'German Nightfighter Control', 29 December 1942.

²²⁶ CCAC RVJO B.37 & TNA AIR 20/1663, Air Scientific Intelligence Report No.I 'German Nightfighter Control', 29 December 1942.

²²⁷ Jones, *Most Secret War*, p. 267.

²²⁸ CCAC RVJO B.37 & TNA AIR 20/1663, Air Scientific Intelligence Report No.I 'German Nightfighter Control', 29 December 1942; Jones, *Most Secret War*, p. 269.

²²⁹ Jones, 'Scientific Intelligence', pp. 360.

upon St. Trond to aid quick understanding.²³⁰ Jones also took the map to PRU which took low-oblique photographs of many of the stations indicated.²³¹

The final 'great step' in discovering Kammhuber Line secrets was provided through Enigma decrypts of 8/9 September. SIR No.I reported that one source 'established a temporary foothold at a point where he could see copies of some of the German nightfighting reports'.²³² In reality, GC&CS had broken into the Enigma key of *Fliegerkorps XII* and Jones had requested 'anything that might be associated with nightfighter activities'.²³³ This breakthrough significantly reinforced the scientific intelligence attack upon the GAF nightfighter system.²³⁴ ADI (Science) correlated the decrypt data with Bomber Command raid tracks of that night of 8/9 September. This confirmed that the Sectors referred to in the decrypts were in southern Belgium, which amazingly coincided with the area shown in the stolen map. They were able to correlate the decrypts, the bomber raid tracks, and the map, and were able to pinpoint headquarters of nightfighter Sectors.²³⁵ This was the moment when the Kammhuber Line appeared to Jones 'in a flash'. In *Most Secret War* Jones placed great emphasis on this moment to ensure that the idea was accredited to him – as Frank was sat opposite him, Jones telephoned Medhurst who

²³⁰ CCAC RVJO B.38, 'A box reproduced from a German map of the searchlight belt'.

²³¹ Jones, *Most Secret War*, p. 268. Jones recalled that he always took PRU pilots completely into his confidence, and even 'perhaps a little more than an interpreter, because he had to go up and take his pictures': CCAC RVJO B.341, 'Note on interview with Prof. R.V. Jones', p. 3.

²³² CCAC RVJO B.37 & TNA AIR 20/1663, Air Scientific Intelligence Report No.I 'German Nightfighter Control', 29 December 1942, p. 9.

²³³ Jones, *Most Secret War*, p. 271.

²³⁴ TNA HW 43/2, 'History of British SIGINT, 1914–1945: Volume I, British SIGINT, 1914–1942' written by Frank Birch, p. 714.

²³⁵ CCAC RVJO B.37 & TNA AIR 20/1663, Air Scientific Intelligence Report No.I 'German Nightfighter Control', 29 December 1942, p. 9–10; Jones, *Most Secret War*, p. 273. Sector 6 HQ was an *Ecole des Cadets* at Aelst; Sector 7 HQ was a Jesuit Novitiate in the form of an altered and extended large country house at Florennes; Sector 8 HQ was at Juvincourt. Sectors 6 and 8 were close to large nightfighter aerodromes, and a similar aerodrome was being constructed at Florennes.

advised him to tell Harris, then Jones showed the work to Cherwell, who applied Prime Ministerial pressure on the Air Staff to stress importance of finding the airborne radar wavelengths.²³⁶ Credit for discovery of the Kammhuber Line can indeed be assigned to Jones.

The reason for Medhurst's recommendation that Jones present his findings to Harris was because Jones's discovery of the Kammhuber Line showed there to be one key element missing. This was the GAF airborne AI instrument. ADI (Science) knew how the GCI stations were controlling the fighters, they also had some understanding of the apparatus, but they were unable to recommend effective RCMs without knowledge of the characteristics. In April 1941 a POW had disclosed *Lichtenstein* as airborne nightfighter apparatus, but ADI (Science) found nothing in R/T traffic from AI4(c) confirming this. All they found were persistent reference to code-words 'Emil Emil'. By July 1942 they had established that *Emil Emil* was a form of airborne detection equipment. By September 1942 they had satisfactorily connected *Lichtenstein* with *Emil Emil*. POWs told of aerials protruding from noses of their fighters, and a Belgian agent reported that a fighter had been seen with two forward-firing guns removed and replaced by a 28x30cms rectangular frame. ADI (Science) deduced that this perhaps meant the GAF were using 53cm *Würzburg* for AI. TRE made searches from the east coast of Britain for airborne transmissions at 53cm-wavelengths in the Flushing area, and found what they strongly suspected to be transmissions at 61cm-wavelengths with

²³⁶ Jones, *Most Secret War*, pp. 272–4.

pulse rates of 30Mc/sec.²³⁷ ADI (Science) required more convincing proof before they could report their intelligence. This would require a British bomber equipped with necessary receivers, to be pursued by a GAF fighter so that the receiver operator could confirm *Lichtenstein's* characteristics.

When Jones relayed this scientific intelligence, Harris remarked that it was a sure sign that Bomber Command were hurting the Nazis—to which Jones replied that if enough was not done, ‘then it would be Bomber Command that would be hurt’.²³⁸ These were brave words from a young man to an Air Marshal if indeed Jones truly did warn Harris in this fashion. When Jones requested two Mosquitoes for the task required, Harris passed Jones onto Vice-Marshal Robert Saundby, a sociable, amiable man who ‘would talk to anybody’.²³⁹ From Jones’s personal recollection of his first official meeting with Saundby he was a man much more suited to Jones’s temperament, and after an afternoon together, Saundby agreed to Jones’s request. Two months went by however, without a Mosquito sortie happening, so Jones appealed through Cherwell to Churchill, ‘who demanded vigorous action’ which resulted in a Wellington being arranged for the task instead.²⁴⁰

Jones commented that this was much riskier, for Wellingtons were slow in comparison to GAF fighters. This seems a rather weak argument, for the Wellington provided was operational anyway, and additional receiver

²³⁷ CCAC RVJO B.37 & TNA AIR 20/1663, Air Scientific Intelligence Report No.I ‘German Nightfighter Control’, 29 December 1942, p. 11–12. Once again there is no reference to TRE locating the transmissions in *Most Secret War* – Jones preferred instead to relay that ‘we could pick up the nightfighter transmissions on listening equipment ground-base in Suffolk’ (p. 280).

²³⁸ Jones, *Most Secret War*, p. 281.

²³⁹ Harris, *Bomber Offensive*, p. 71.

²⁴⁰ CCAC RVJO J.1, ‘The Radio War’, p. 6; Jones, *Most Secret War*, pp. 281–4.

installation did not heighten the risks already experienced by the bomber crew. Jones emphasised these risks by relaying the story of the bomber being shot by a pursuing nightfighter. According to SIR No.I however, Wireless Investigation Flight 1474 'went out many times before hearing the *Lichtenstein* transmissions'.²⁴¹ On the night of 2/3 December 1942 signals were heard with 'oversaturating intensity' that matched those TRE had heard from Suffolk. From these, ADI (Science) deduced that the aerials described by the Belgians were 'reflectors of two small arrays for operating forms of horizontally and vertically switched transmissions' in a manner similar to British AI'.²⁴² In *Most Secret War* Jones hinted at the needless risk the Wellington crew had been exposed to that night for the want of two Mosquitoes, but also paid great credit to the men concerned. It had, wrote Jones, been 'an epic of cool observation, great gallantry, and resourceful doggedness'.²⁴³

In late-December 1942, ADI (Science) were pleased to report that this discovery 'closed the last major gap in the analysis of the German nightfighter defences'. They expressed that in their analysis of GAF nightfighter control 'every known method of Intelligence' had been employed. They praised the risks taken by crews of Flight 1474 and PRU; they declared the contributions from Belgian agents as 'among the greatest'; they claimed that TRE observations had 'always been necessary'; they noted the 'efforts' of the

²⁴¹ CCAC RVJO B.37 & TNA AIR 20/1663, Air Scientific Intelligence Report No.I 'German Nightfighter Control', 29 December 1942, p. 44; Jones, *Most Secret War*, p. 285.

²⁴² CCAC RVJO B.37 & TNA AIR 20/1663, Air Scientific Intelligence Report No.I 'German Nightfighter Control', 29 December 1942, pp. 11–12.

²⁴³ Jones, 'Scientific Intelligence', 360; Jones, *Most Secret War*, pp. viiii & 285–6. See also Jones, *Reflections in Intelligence*, pp. 233–4. *Most Secret War* was co-dedicated to Harold Jordan, the receiver operator that night. Jones and Jordan corresponded with each other on occasion after the war: see CCAC RVJO A.166; RVJO A.168; RVJO B.206; and RVJO J.339. War-related correspondence with Jordan was kept by Jones in a box-file entitled 'Angels'.

Pigeon Service. Although POW intelligence was less than in the days of the radio-navigational assault, AI1(k) were still commended by ADI (Science) for their efforts in the DT and GAF GCI investigations; as was the US Embassy and the Chinaman. Special mention was given to AI4(f) for interpretation of R/T intercepts, and CIU for interpretation of photography. ADI (Science) importantly noted the contributions of their superiors, namely DDI2 (responsible for aircraft industries, airfields, and technical Intelligence), DDI3 (foreign air forces), and (perhaps surprisingly), head of the Y-Service DDI4. ADI (Science) stated that the investigation had 'extended the versatility' of intelligence 'to a degree never known before'.²⁴⁴

In their post-war official history, ADI (Science) singled out the key intelligence sources as the searchlight map, other agents' reports, British bomber combat reports, air photographs, R/T intercepts, and reports from pigeons. All were combined 'together with several lucky guesses to give a very satisfactory picture of the whole German night defence system', and 'by a headquarters section of not more than four officers, collating the information from, and directing the activities of, a large number of sources of different types'. Jones stated it unfair 'to claim more than a small share of the credit on behalf of this nucleus of four', and that 'credit should be particularly go to the Belgian agents' and the PRU pilots, and 'to the appropriate sections' of Medmenham

²⁴⁴ CCAC RVJO B.37 & TNA AIR 20/1663, Air Scientific Intelligence Report No.I 'German Nightfighter Control', 29 December 1942, pp. 12 & 44; Hinsley *et al*, *British Intelligence in the Second World War, Volume II*, p. 256.

and GC&CS, although the investigation showed what could 'be accomplished by a small and wieldy staff'.²⁴⁵

This was a far cry from Jones's later accreditation in *Most Secret War* which stated that the investigation had drawn 'resources to the full', mentioning specifically only photographic and listening aircrews, Belgian 'patriots', and Bruneval participants.²⁴⁶ This is remarkable evidence of Jones's recollections of scientific intelligence altering over time, due to the more 'glorious' events taking precedent and allowing personal animosities to fester. Aside from Jones's selective memory however, investigation into the GAF GCI showed ADI (Science) at their wartime best. Although they did not miss the opportunity to press *Window* again in SIR No.I, they provided sound advice in that 'Kammhuber's greatest fear' was 'flexibility' in the British bomber offensive.²⁴⁷ This SIR was intelligence-based throughout and demonstrated how effective ADI (Science) had become as a SIGINT, HUMINT and TECHINT correlating organisation. It is worth noting the difference in sources used in this investigation compared to earlier intelligence puzzles. Reduced POW intelligence was replaced with much more reliable HUMINT source from local secret agents, loyal to the Allies because of the tyrannical regime increasingly suppressing their nations. Use of high-grade SIGINT was also limited in this investigation, although excellent low-grade SIGINT (from TRE and the Y-Service) supplemented the ULTRA morsels. Above all, PI had become absolutely essential to scientific intelligence investigations. Built from

²⁴⁵ CCAC RVJO B.83 & TNA AIR 40/1532, ADI (Science) official history 'Air Scientific Intelligence in War, 1939-45', p. 21; AHB, 'Air Ministry Intelligence', p. 304.

²⁴⁶ Jones, *Most Secret War*, p. 286.

²⁴⁷ CCAC RVJO B.37& TNA AIR 20/1663, Air Scientific Intelligence Report No.I 'German Nightfighter Control', 29 December 1942, p. 43.

humble 1939 beginnings, it had by 1942 become a mainstay within the British intelligence war machine, and later the Allied intelligence factory.²⁴⁸

A primary component of this vast Allied intelligence production was the intelligence harvest emanating from GC&CS, both high-grade and low-grade SIGINT. From June 1942, a large percentage of GAF GCI R/T traffic was analysed by Bletchley's Hut 3, where Day and Night Sections were formed to assess large volumes of incoming SIGINT. AI4(f), the German Air Section (which also analysed Italian SIGINT), was principally concerned with 'unravelling in detail' GAF GCI and 'examining developments in 'enemy equipment and night-fighting technique', performing in effect a similar role to ADI (Science), but exclusively from SIGINT sources.²⁴⁹ BMP Reports (named after the three originators – Bonsall, Moyes, and Prior) from the Night Section, were available to ADI (Science) and proved valuable assets.

Twenty-one copies of SIR No.1 were circulated amongst the RAF Commands, MAP, and Cabinet Office.²⁵⁰ A much shorter appraisal of the GAF nightfighter system, SIR No.17, followed some two months later, and was in essence a summary of SIR No.1 with more operational consideration both in the text and

²⁴⁸ American PIs began to infiltrate Medmenham from August 1942, and on 1 May 1944 CIU became the Allied Central Interpretation Unit (ACIU): see Downing, *Spies in the Sky*, pp. 229 & 235.

²⁴⁹ TNA HW 43/2, 'History of British SIGINT, 1914–1945: Volume I, British SIGINT, 1914–1942' written by Frank Birch, p. 718.

²⁵⁰ A GC&CS veteran, (now Sir) Arthur Bonsall, recalled SIR No.17 as 'an illuminating report': Bonsall, 'Bletchley Park and the RAF Y Service', 835. Large SIRs produced on DT and GAF GCI like this were sometimes criticised on grounds that information was held up while reports were being compiled. ADI (Science) remarked after the war that, while it was undeniable that reports took a long time to write, they dealt with large subjects. Moreover, in the process of fact assembly, gaps in their knowledge were realised, and 'many finer points hitherto unappreciated were readily seen' once all the facts were brought together: CCAC RVJO B.83 & TNA AIR 40/1532, ADI (Science) official history 'Air Scientific Intelligence in War, 1939–45', 1 April 1946, p. 22; AHB, 'Air Ministry Intelligence', p. 305. For the historian interested in the bomber war and the radio war (both so characteristic of the Second World War) the large SIRs are of particular value.

in the attachments.²⁵¹ SIR No.17 is noteworthy for its absence of significant intelligence analysis. In fact no SIR on radar would again be produced with such meticulous intelligence assessment as SIR No.1. As the war status of the Allies progressively improved from 1943 onwards, so intelligence analysis in SIRs decreased. This probably reflects the assumption that intelligence was continually becoming easier to acquire. Notable additions to SIR No.17 were that *Würzburg-Riese* – ‘the central ornament of German G.C.I.’ – was also coming into use by the GAF Aircraft Reporting Service. Also that ‘little screw’ beacons inside each nightfighter box were known to be situated fifteen miles in front, four miles in front and eighteen miles behind *Würzburg-Riese*, front and rear beacons used depending on whether bombers were outward or homeward bound, central beacons used (perhaps) for a reserve fighter.²⁵²

Weaknesses in the GAF nightfighter system as detailed in SIR No.17 mattered the most at the time. ADI (Science) stressed that although it was not usually the function of intelligence to devise countermeasures, to evolve tactics, or to decide policy, it was the duty of intelligence to call attention to enemy weaknesses so that advantage may be taken. Following Tactical Committee Paper No.29 closely, they recommended tactical countermeasures of saturation through concentration formations of no more than twelve mile fronts so that all bombers flew through one box, routing by flying through the

²⁵¹ For example, in a pocket attachment to SIR No.17 was a map detailing the known areas and controls of the Kammhuber Line. It was explained that these areas and controls were rapidly expanding: see CCAC RVJO B.43 & TNA AIR 20/1633, Air Scientific Intelligence Report No.17 ‘The German Controlled Nightfighter System’, 12 February 1943, p. 17. This map was superseded some six months later and the new map resent to all recipients of SIR No.17: see CCAC RVJO B.50, ‘Amendment to Air Scientific Intelligence Report No.17’, 6 August 1943.

²⁵² CCAC RVJO B.43 & TNA AIR 20/1633, Air Scientific Intelligence Report No.17 ‘The German Controlled Nightfighter System’, 12 February 1943, pp. 6 & 9.

middle or the boundaries of boxes, flying lower than 1500ft. Interception would therefore be improbable, due to the *Würzburg-Riese* 3.5° angle of elevation, evasive action to throw off pursuing fighters, high speed, and alertness.²⁵³

SIR No.17 provided interesting concluding statements: GAF GCI was founded upon extensive use of well-designed and accurate detection equipment, upon cumbersome methods of data display, and rigid regimentation of control and administration. Under the right conditions, it could be a highly successful system and was 'undoubtedly the gravest obstacle' to the Allied bomber offensive; and that the reduction in bomber losses called for 'elasticity in planning', worthwhile and possible only when plans were accurately and skilfully carried out by every bomber crew.²⁵⁴ SIRs No.1 and No.17 were the culmination of extensive scientific intelligence groundwork drawn from many sources employing many varied talents. In the process and in consequence ADI (Science) had expanded accordingly. Full appreciation of the GAF GCI did not, however, provide Jones and his team with a lull period as had been experienced after the Battle of the Beams. In complete contrast, it was fortuitous that scientific intelligence had expanded owing to the GAF DT and GCI hunts, for they were to encounter further DT evolutions, and face an even wider variety of scientific intelligence puzzles through to the end of the war.

²⁵³ CCAC RVJO B.43 & TNA AIR 20/1633, Air Scientific Intelligence Report No.17 'The German Controlled Nightfighter System', 12 February 1943, pp. 14–16.

²⁵⁴ CCAC RVJO B.43 & TNA AIR 20/1633, Air Scientific Intelligence Report No.17 'The German Controlled Nightfighter System', 12 February 1943, p.16.

Chapter VI: The Wider Radio War

With the Nazi glare still turned eastward moving into spring 1942, ADI (Science) were expected to continue their DT and GAF nightfighter intelligence-gathering responsibilities, both with the Allied air offensive and future continental invasion preparations in mind. Jones defined this scientific intelligence attack as ADI (Science)'s 'main work throughout 1942'.¹ The SIRs of that year confirm this to be true, although many other German scientific and technological applications were considered along the way. Some were of vital significance to Britain's defence, others less so. Understanding GAF AI was crucial to the Allied air offensive. Even though this was arguably technical intelligence, many applied instruments were integral to the GAF nightfighter system, and so fell into the scientific intelligence remit. German airborne instrumentation also led ADI (Science) into naval aspects of the radio war. Nazi atomic research was another ADI (Science) investigation from late-1942, a time when ADI (Science) also experienced the beginnings of the famous intelligence attack upon German rocket and jet research.

In effect, ADI (Science) had become such an authority on the airborne radio war that other matters, which perhaps ought to have been investigated by the main body of scientists in British intelligence, were instead distributed to other experts, in other organisations. Following the Quebec Agreement of August 1943, for example, the Office of Scientific Research and Development

¹ Jones, *Most Secret War*, p. 255.

(OSRD) and the OSS took the predominant lead in atomic intelligence from SOE and the Directorate of Tube Alloys.² Of much less of concern but still potential threats, were chemical and biological weapons. Defensive (and offensive) issues of this nature were collaboratively investigated by the War Cabinet's Bacteriological Warfare Committee, MEW, Chiefs of Staff Inter-Services Committee on Chemical Warfare, JIC's Sub-Committee on Biological Warfare, SOE's Physiological Section, and the Chemical Defence Experimental Station at Porton Down.³ MI10 (responsible for military technical intelligence) were also frequently involved in chemical warfare intelligence.⁴ The way in which scientific intelligence came to be defined therefore rested on ADI (Science)'s operational responsibilities in the radio war rather than any scientific danger to Britain. This chapter charts these operational requirements through to the end of the war and, in doing so confirms that ADI (Science)'s appreciation of German air defence firmly established scientific intelligence as a permanent fixture in the structure of British intelligence, irrespective of whether the intelligence was actually technical or scientific.

Atomic Distractions

The primary role for intelligence organisations is to provide timely warning of imminent threats. There are always threats, but if they are not imminent then the intelligence role reverts to data collection. For much of the war this was

² Jones was 'shocked' when he read the Anglo-American signals sent to Broadway relaying details of the 19 August 1943 Quebec Agreement, which was specifically entitled 'Articles of Agreement Governing Collaboration between the Authorities of the U.S.A. and the U.K. in the matter of Tube Alloys'. He claimed that it 'signed away' Britain's 'birthright in the post-war development of nuclear energy': CCAC RVJO B.354, Jones to Clark, 4 June 1960, pp. 5–6; Jones, *Most Secret War*, p. 474; Ronald W. Clark, *The Greatest Power on Earth: The Story of Nuclear Fission* (London: BCA, 1980), p. 151. See also Reynolds, *In Command of History*, pp. 482–3.

³ Boyce and Everett, *SOE: the Scientific Secrets*, pp. 80–8.

⁴ Hinsley *et al*, *British Intelligence in the Second World War, Volume II*, pp. 674–6.

the situation with the atomic energy problem which, by the end of 1941, had been transferred from MAP to the autonomous body of Tube Alloys. Following correspondence between Churchill and Roosevelt on these issues, Anglo-American intelligence collaboration was also established parallel to a co-ordinated nuclear experimental research programme.⁵ In May 1942, Eric Welsh, head of SIS's Norwegian Section, was assigned to Tube Alloys, and ADI (Science) were instructed to assist wherever and whenever possible.⁶ Welsh headed Operation *Epsilon*, the British intelligence attack upon German deuterium oxide (heavy water).⁷

This coincided with a period during which the already strained resources of ADI (Science) were 'stretched to the limit' investigating many of the issues discussed in this chapter.⁸ This led to appeals by Jones to Medhurst for additional staff. It is doubtful however, that ADI (Science) expansion would have inspired high-level confidence in Jones's team being responsible for atomic intelligence. It is perhaps for this reason that no SIR was produced on

⁵ There is a fascinating document in the A. V. Hill Papers which confirms that American interest in Uranium-235 was accelerating as early as May 1940. Hill wrote that a 'large number of American physicists' were 'working on or interested in the subject'; that the USA had 'excellent facilities and equipment'; and that the US physicists were 'well disposed' towards Britain and felt that it would be 'much better that they should be pressing on' with Uranium research, than that Britain 'should be wasting their time' on what was 'probably a wild goose chase': CCAC AVHL I 2/7, Memorandum entitled 'Uranium - "235"', written by Hill, 16 May 1940.

⁶ Hinsley *et al*, *British Intelligence in the Second World War, Volume II*, p. 124. Welsh was another scientist in Broadway, holding a BSc in Chemistry. Directly before the war, he had been manager of a factory owned by the Imperial Paint Company: Jones, *Most Secret War*, p. 205. Goodman argued that Welsh 'had no formal scientific qualifications', and provided further evidence to the effect that Jones and Welsh clashed directly after the war over the future of atomic intelligence and its relationship with scientific intelligence: Goodman, *Spying on the Nuclear Bear*, pp. 12, 19 & 135. For Jones's compliments on Welsh's wartime efforts, see R. V. Jones, 'Thicker than Heavy Water', *Chemistry and Industry* (September 1967), 1419-24. This article was an essay review of David Irving, *The Virus House* (London: William Kimber, 1967).

⁷ Deuterium oxide decelerated neutron activity, and was manufactured by the removal of hydrogen from ordinary water through electrolytic conversion. Operation *Epsilon* actually commenced in 1941 and ran through to the end of the war: see Jeffery, *MI6*, p. 375; Overy, *Why the Allies Won*, p. 236.

⁸ Jones, *Most Secret War*, pp. 318-31.

atomic issues. The wartime scientific intelligence niche had been satisfied in radar, and intelligence on the possibility of Germany developing an atomic bomb was far too great to be left in the hands of young SIS upstarts. Jones recounted an incident late in the war in which he expected captured atomic science documents to be examined by ADI (Science). He found however, that Welsh and Michael Perrin (also of Tube Alloys) had advised the Americans that, even though Jones was a member of the 'special' Anglo-American Intelligence Committee formed by Major-General Leslie Groves (military chief of the Manhattan Project) and British physicist John Anderson in November 1944, ADI (Science) 'were not secure enough'.⁹ Nevertheless, from January 1944, ADI (Science) enjoyed direct OSRD liaison through Princeton physicist Howard Robertson and, from 1942 through to the end of the war, there were occasions when ADI (Science) were involved in atomic issues.¹⁰

The first and most famous of these atomic incidences involved raids on the Norsk Hydro factory at Vemork, near Rjukan in central Norway.¹¹ This resulted from Jones's interview with Leif Tronstad, professor of chemistry at

⁹ Jones, *Most Secret War*, pp. 479–81.

¹⁰ Robertson served as science advisor to General Alfred M. Gruenther (Supreme Allied Commander, Europe), and later General Spaatz (among others), and 'moved freely among defense and foreign advisory positions in the United States: Ronald E. Doel, 'Scientists as Policymakers, Advisors, and Intelligence Agents: Linking Contemporary History with the History of Contemporary Science' in Thomas Söderqvist (ed.), *The Historiography of Contemporary Science and Technology* (Amsterdam: Harwood Academic Publishers, 1997), pp. 226–7.

¹¹ These raids were later made famous by cinematic representation, and various books and television programmes, and need not be discussed in detail here: see *The Heroes of Telemark*, produced by S. Benjamin Fisz for Benton Films Limited in 1965; Clark, *The Greatest Power on Earth*, p. 84; Foot, *SOE*, pp. 210–11; Knut Haukelid, *Skis against the Atom* (Minot: North American Heritage, 1989); Thomas Powers, *Heisenberg's War: The Secret History of the German Bomb* (London: Jonathan Cape, 1993), pp. 196–213; David Stafford, *Secret Agent: The True Story of the Special Operations Executive* (London: BBC, 2000), pp. 105–24; Ray Mears, *The Real Heroes of Telemark: The True Story of the Secret Mission to Stop Hitler's Atomic Bomb* (London: Hodder & Stoughton, 2003). This is a very brief televisual clip of Jones discussing the Vemork raids featured in episode five of Gordon Corrigan's *Daring Raids of the Second World War*, entitled 'Stopping Hitler's A-Bomb', and produced by Scott Tankard for Channel Five Television.

Trondheim University and member of the Skylark-B Resistance network.¹² Documentation confirms that US authorities pressed British Air Intelligence to destroy the 'main European source of heavy water' at Vemork, that bombing was discussed but deemed impractical due to inclement weather and tactical difficulties, and that the sabotage alternative was passed to CombinedOps and SOE.¹³ The unsuccessful British-Norwegian CombinedOps/SOE collaborative commando raid (Operation *Freshman*) of 19 November 1942 led to the more successful (*Gunnernside*) raid of 27/8 February, which achieved some demolition of the electrolysis chambers. For the Americans this was the 'first positive action' in the 'race with Germany' for atomic power, and 'one of the minor Allied triumphs of the war'.¹⁴ Jones was informed after the war by German 'experts' that the sabotage prevented them from 'doing the vital experiment which might have convinced them that the atomic bomb was possible'.¹⁵ By August 1943 however, SIS discovered that the damage had been repaired by April, which convinced the Allies that Germany was determined to proceed with atomic research.¹⁶ The Vemork plant never produced anything approaching industrial quantities of deuterium oxide, however, and Germany never came close to creating the ultimate weapon.

¹² CCAC RVJO B.354, Jones to Clark, 4 June 1960, p. 2; Jeffery, *MI6*, p. 375.

¹³ TNA AIR 8/1767, 'SOE Attacks on Heavy Water Plant at Vemork, Norway'. For 'main European source of heavy water' see Jones, *Most Secret War*, p. 306; Overy, *Why the Allies Won*, p. 236.

¹⁴ Samuel A. Goudsmit, *ALSOS: The Failure in German Science* (London: Sigma Books, 1947), p. 8. Foot claimed that if 'SOE had done nothing else', *Gunnernside* would have given 'claim enough on the gratitude of humanity'; Foot, *SOE*, p. 211. Hugh Dalton, Minister for Economic Warfare, wrote that *Gunnernside* was by 'far the most important' operation carried out by SOE during the war; Hugh Dalton, *The Fateful Years: Memoirs 1931–1945* (London: Muller, 1957), p. 376; Stafford, *Secret Agent*, p. 105.

¹⁵ Jones, 'Scientific Intelligence', 364; Foot, *Resistance*, p. 282; Mark Wheeler, 'The SOE Phenomenon', *Journal of Contemporary History*, 16: 3 (July 1981), 514.

¹⁶ Hinsley *et al*, *British Intelligence in the Second World War, Volume II*, p. 127; Jones, *Most Secret War*, pp. 307–8; Stanley, *V-Weapons Hunt*, p. 227.

Jones had little to say about his time as Welsh's Tube Alloy intelligence liaison in *Most Secret War*. This probably had much to do with him being 'relegated to a support role'.¹⁷ Perhaps it was also because the task was complex and rarely successful. SIGINT was silent on atomic issues, and PR required other sources to notify locations before photographs could be taken.¹⁸ HUMINT was the only fluid source of intelligence in atomic matters, and would continue to be so for decades to come. The irony is that the production of nuclear weaponry, from the Maud Committee to the 'Manhattan Project', from laboratory to vast industrial production, was always an air warfare programme.¹⁹ From this perspective, ADI (Science) had very reasonable claim upon atomic intelligence.

Following receipt of agents' reports in autumn 1944, describing Werner Heisenberg working in a large country house at Hechingen (near Stuttgart), Jones 'briefed' Kendall on the matter and requested PI searches of the area.²⁰ ADI (Science) provided a sketch of what a German atomic bomb plant might look like, and stressed that for the production of atomic explosives, there would be 'considerable supplies of electric power, and an abundance of water'.²¹ Due to the high security Kendall was unable to inform PIs of the

¹⁷ Powers, *Heisenberg's War*, p. 524. For more on Heisenberg and his involvement in German atomic science, see Cathryn Carson, 'New Models for Science in Politics: Heisenberg in West Germany', *Historical Studies in the Physical and Biological Sciences*, 30: 1 (1999), 115–71.

¹⁸ Hinsley *et al*, *British Intelligence in the Second World War, Volume II*, p. 124–5.

¹⁹ Richard Overy, 'Total War II: The Second World War' in Charles Townshend (ed.), *The Oxford History of Modern War* (Oxford: OUP, 2005), p. 151.

²⁰ Jones, *Most Secret War*, p. 478. Kendall's recollections regarding this request are that he was 'summoned to a highly secret meeting' at which the 'fantastic new development of the Allies' was explained to him, and he was 'instructed to set in motion an investigation to find if the Germans had any similar programmes'. He thereafter discovered that research of two German professors had moved from the Kaiser Wilhelm Institute to a country house in the Stuttgart area: TMC MDM622, Kendall, 'A War of Intelligence', p. 125.

²¹ CCAC RVJO B.348, Kendall interviewed by David Irving on 30 November 1965, p. 2.

purpose of their searches, which covered all industrial plants within a 100-mile radius of Stuttgart.²² Their search took some three months, after which Medmenham reported that ‘there was no indication from aerial photographs’ that the Germans were working on atomic bomb production.²³ Jones thought that ‘nuclear intelligence had really taken off’ when photographs showed possible research establishments near Hechingen. He informed Cherwell (who warned Churchill), but Kendall eventually realised the structures were little more than shale oil installations.²⁴

The discovery of the Hechingen plants caused ‘rather a scare’.²⁵ This episode emphasises Jones’s contemporary eagerness for ADI (Science) to be involved in nuclear intelligence rather than them being pigeon-holed as DT experts. But it was not to be, for Samuel Goudsmit’s US-established ALSOS missions from spring 1944, ensured that ADI (Science) remained inconsequential in the atomic sphere.²⁶ Jones claimed that he considered creating his own parallel atomic field mission connected to ALSOS, but was

²² TMC MDM622, Kendall, ‘A War of Intelligence’, p. 125.

²³ TMC DFG5701, Douglas Kendall interviewed by Constance Babington Smith on 15 November 1956; TMC MDM622, Kendall, ‘A War of Intelligence’, pp. 124–6; Powys-Lybbe, *Eye of Intelligence*, pp. 175–6; Stanley, *V-Weapons Hunt*, p. 229. The village of Hechingen did become the main centre for German atomic research in early 1945, where some German atomic scientists occupied a wing of a large textile factory. Their atomic pile laboratory was in caves in the nearby town of Haigerloch: Goudsmit, *Alsos*, p. 174.

²⁴ TMC MDM622, Kendall, ‘A War of Intelligence’, p. 125; CCAC RVJO B.348, Kendall interviewed by David Irving on 30 November 1965, pp. 4–6; Jones, *Most Secret War*, p. 478; Hinsley *et al*, *British Intelligence in the Second World War, Volume III, Part I*, pp. 590–1.

²⁵ CCAC RVJO B.354, Jones to Clark, 4 June 1960, p. 4. General Leslie R. Groves recalled something similar, claiming the discovery as the ‘biggest scare to date’ in the atomic race against Germany: Leslie R. Groves, *Now it can be told: The Story of the Manhattan Project* (London: Andre Deutsche, 1963), p. 218; Powers, *Heisenberg’s War*, p. 376.

²⁶ ALSOS is Greek (’ΑΣΟΣ:) for ‘a sacred grove’. Goudsmit’s mission was to follow closely behind the Allied invading forces in 1944 to locate and seize personnel, documents and material concerned with the German atomic bomb programme: see Charles Frank, *Operation Epsilon: The Farm Hall Transcripts* (Bristol: Institute of Physics Publishing, 1993), p. 1; Goudsmit, *ALSOS*, p. 14. Jones later explained that, up until the summer of 1944, British intelligence was ‘producing nearly all the information to the western Allies’. After that, ‘the Americans jumped in’ with the ALSOS mission and British intelligence ‘had rather to play second fiddle to them’: CCAC RVJO B.354, Jones to Clark, 4 June 1960, p. 4.

informed that, in the interests of Anglo-American relations, he could only seek US permission to join ALSOS and become 'very much the junior partner'.²⁷

Jones and Frank were never satisfied with this instruction. In the Frank Papers there is a note attached to scientific data relative to the 'Theory of a U-235 Bomb' which states a 'fundamental maxim' of scientific intelligence: that 'an enemy cannot be relied upon to follow the advice' of British 'experts (unless that advice is based on a fundamental and absolute law of nature)', and that there was 'no fundamental proof that methods of isotopic separation much more efficient' than those known at the time could 'never be discovered'.²⁸ When documents captured by ALSOS revealed Heisenberg's research to be undeveloped beyond the experimental stage, Jones reported to Churchill that the German Tube Alloy weapon could 'probably not be made for some time', and had 'a priority below oil repairs and fighter production'.²⁹

The escape of atomic physicist Niels Bohr from occupied Denmark (and possible imminent Gestapo arrest) in October 1943, was a matter that Jones was also involved in, although perhaps less so than he later expressed. Eleven months after Welsh's December 1942 'dragooning' of British physicist James Chadwick to advise Bohr to flee to England and assist the Allies atomic programme, necessary arrangements were made.³⁰ Jones later wrote of his meetings with Bohr, and of his welcoming treatment by British

²⁷ Jones, *Most Secret War*, p. 478.

²⁸ UOB DM1310/C.230, Note attached to Frank's unpublished Paper entitled 'Theory of a U-235 Bomb (according to Heisenberg)', no date.

²⁹ Hinsley *et al*, *British Intelligence in the Second World War, Volume III, Part I*, p. 591.

³⁰ Jones, *Most Secret War*, pp. 308 & 472; Margaret Gowing, *Britain and Atomic Energy, 1939-1945* (London: Macmillan & Co. Ltd., 1964), p. 247. Transport arrangements for Bohr's escape were made by the Directorate of Tube Alloys and the Secret Service.

authorities following Bohr's clever and daring extraction from Denmark.³¹ Jones was convinced he was responsible for arranging the meeting between Bohr and Churchill in which Bohr recommended sharing atomic secrets with the Russians. This meeting only resulted in Bohr himself being 'suspect'.³² Initially sceptical about atomic bomb possibilities, Bohr's perception radically altered following his visit to Los Alamos. One author claimed that only then did Bohr convince Jones that German scientists were attempting to produce an atomic bomb, although closer reading shows that Bohr's primary concern was the effect nuclear explosives would have upon post-war world stability.³³

The Uranium Club (*Uranverein*) research facilities at Hechingen were captured by ALSOS in late-March 1945.³⁴ The scientists were initially held in an American internment camp in France as part of the 'dustbin' programme.³⁵ The Americans had no legal arrangement to detain the scientists however, and high-level transatlantic discussion ensued. Their incarceration in France became 'embarrassing', for not only had they had been captured from a

³¹ R. V. Jones, 'Meetings in Wartime and After' in A. P. French and P. J. Kennedy (eds.), *Niels Bohr: A Centenary Volume* (London: Harvard University Press, 1985), pp. 278–87; Jones, *Most Secret War*, pp. 474–5.

³² Jones, 'Meetings in Wartime and After', pp. 284–5; Jones, *Most Secret War*, pp. 476–7; Margaret Gowing, 'Niels Bohr and Nuclear Weapons' in French and Kennedy (eds.), *Niels Bohr*, pp. 266–77. Gowing's official history showed that a letter from Sir Henry Dale, President of the Royal Society, was ultimately responsible for Churchill meeting Bohr: Gowing, *Britain and Atomic Energy*, pp. 353–5. Jones acknowledged this but was still adamant that it was his 'persuasion that was decisive'.

³³ Bohr was 'completely amazed' when he 'saw the progress that was being made in America': CCAC RVJO B.348, Jones to David Irving, 12 November 1965, p. 2; Jones, *Most Secret War*, p. 475; Powers, *Heisenberg's War*, p. 245; Arthur Steiner, 'Scientists, Statesmen, and Politicians: The Competing Influences on American Atomic Energy Policy 1945–46', *Minerva*, 12 (Winter 1974), 485; Finn Aaserud, 'The Scientist and the Statesmen: Niels Bohr's Political Crusade during World War II', *Historical Studies in the Physical and Biological Sciences*, 30: 1 (1999), 1–47.

³⁴ Hinsley *et al*, *British Intelligence in the Second World War, Volume III, Part I*, p. 592.

³⁵ Jones, *Most Secret War*, p. 481. *Dustbin* was an Anglo-American interrogation centre specifically for German scientists. First situated at Chesnay, near Versailles, and in Kransberg castle near Frankfurt from June 1945, *Dustbin* was designed to hold ninety scientists, but peaked at some 5000 specialists and their families: Maddrell, *Spying on Science*, pp. 17–21; Sean Longden, *T-Force: The Race for Nazi War Secrets, 1945* (London: Constable and Robinson Ltd., 2009), pp. 238–9, 243, & 254–5.

section of the front that should have been overrun by French forces, but France also had interest in atomic energy.³⁶ Frank and Jones later claimed that Welsh mooted that the scientists were to be shot, whereupon Jones intervened by suggesting to C that the vacated SOE/MI6 country house called Farm Hall in Godmanchester near Huntingdon be used for their 'accommodation', and that the house be fitted with hidden microphones in order to surreptitiously obtain German reaction to the Manhattan project.³⁷ Menzies agreed, and ten German atomic scientists experienced a six-month 'Babylonian captivity', during which every word they uttered was recorded.³⁸ Jones stated that there was 'no dignity in denying' existence of the transcripts.³⁹ As Frank was particularly involved in Operation *Epsilon*, the Farm Hall transcripts became the subject of his only scientific intelligence publication, following Royal Society pressure on the British Government to declassify the material.⁴⁰

Another distraction for ADI (Science) was GAF AI – the emergence of which had the potential to negate reliance upon the Kamhuber Line system of nightfighter control. Entitled 'Germonica', SIR No.18 reported intelligence derived from AI1(K), AI4, and captured equipment examined by AI1(g), which

³⁶ Frank, *Operation Epsilon*, p. 1.

³⁷ CCAC RVJO B.354, Jones to Clark, 4 June 1960, p. 3; CCAC RVJO B.322–B.338, 'Farm Hall' related material; Jones, *Most Secret War*, p. 481; Frank, *Operation Epsilon*, p. 1; Powers, *Heisenberg's War*, pp. 428–9 & 435. See also Jeremy Bernstein (ed.), *Hitler's Uranium Club: The Secret Recordings at Farm Hall* (New York: Copernicus Books, 1996), pp. xviii & 53.

³⁸ Powers, *Heisenberg's War*, pp. 428–9. The ten scientists were Heisenberg, Otto Hahn, Max von Laue, Walter Gerlach, Paul Harteck, Carl Friedrich von Weizsäcker, Karl Wirtz, Erich Bagge, Horst Korsching, and Kurt Diebner; Bernstein, *Hitler's Uranium Club*, pp. 141–6. For more on Otto Hahn's Farm Hall experience, see R. Spence, 'Otto Hahn. 1879–1968', *Biographical Memoirs of Fellows of the Royal Society*, 16 (November 1970), 299.

³⁹ Jones, *Most Secret War*, p. 482.

⁴⁰ The Royal Society petition was signed by Jones and Frank, amongst thirteen other scientist and historian signatories including Zuckerman, Nicholas Kurti, Rudolf Peierls, and Hugh Trevor-Roper (Lord Dacre); Frank, *Operation Epsilon*, pp. 10–15; Powers, *Heisenberg's War*, pp. 571–2.

led to suppositions that the GAF were experimenting with AI. Enigma decrypts also spoke of *Lichtenstein-Gerät* (FuGe202), which furthered notions of GAF airborne DT.⁴¹ Perhaps again due to Jones's personal interest, ADI (Science) regularly reported on German use of infra-red, what they contemporaneously defined as 'the Cinderella of applied military physics'.⁴² ADI (Science) were also concerned about DT in the air-sea war, and in January 1943 relayed POW intelligence that *Lichtenstein* had been fitted to U-boats.⁴³

German use of ASV was another matter considered by ADI (Science) during 1942/3. Jones first appreciated experimental *Luftwaffe* airborne ASV technology in March 1940, and proposed a method be devised 'of homing onto any machine using it'.⁴⁴ This was exactly what the GAF did to the British in 1943 once they had realised the wavelength of H2S. In June 1942, ADI (Science) reported that although no technical details were available, some form of German ASV was entering service. They believed this report heralded German entry into the field of AI, which they warned 'may be expected in due course'.⁴⁵ Ahead of the Allied invasion of Sicily, ADI (Science) received information of intercepted signals believed to be related to German use of

⁴¹ CCAC RVJO B.45 & TNA AIR 20/1634, Air Scientific Intelligence Report No.18 'Germonica', 27 February 1943. It was almost always 'Brown' and 'Cockroach' traffic that told of DT and GAF airborne instrumentation: See TNA HW 14/85, Report by William F. Friedman, 12 August 1943; Campbell, *Target London*, p. 108. Friedman was famous for cracking the Japanese cipher 'Purple'.

⁴² CCAC RVJO B.28 & TNA AIR 20/1630, SIR No.14, 'German Applications of Infra-Red', 10 June 1942, p. 1. For further examples of ADI (Science) discussion on infra-red, see CCAC RVJO B.3, 'Scientific Intelligence Report No.3', 14 February 1940, p. 2; CCAC RVJO B.5, 'Monthly Report to D.S.R. No.1 for April 1940, p. 7; CCAC RVJO B.12 & TNA AIR 20/1625, SIR No.8 'Freya', 14 August 1940, p. 3; CCAC RVJO B.22 & TNA AIR 20/1674, Interim Report 'Radio Aids to German Nightfighters', 15 June 1941; CCAC RVJO B.30, 'Notes on German Nightfighters', 26 June 1942, p. 4; CCAC RVJO B.52, SIR No.19 'Spanner', 27 November 1943; CCAC RVJO B.75, SIR No.251 'German Infra-Red Development', 25 January 1945, pp. 8 & 10.

⁴³ CCAC RVJO B.40 & TNA AIR 20/1678, Air Scientific Intelligence Interim Report 'German R.D.F. in Air/Sea Warfare', 21 January 1943, p. 2.

⁴⁴ CCAC RVJO B.4, Scientific Intelligence Note 'Night Detection of Aircraft', 14 March 1940.

⁴⁵ CCAC RVJO B.29 & TNA AIR 20/1675, Air Scientific Intelligence Interim Report 'German A.S.V.', 20 June 1942.

ASV in the Mediterranean.⁴⁶ This was probably requested by ADI (Science) following receipt of interrogation reports from (now designated) AIK, in which a KG26 POW spoke of flying 'Hohentweil' (FuGe200) aircraft to locate British convoys. AI2(g) also reported their examination of a crashed Ju-88 which contained FuGe200. ADI (Science) deduced that *Hohentweil* was probably an earlier version of *Lichtenstein*, known to be in service for ASV purposes, for which wavelengths had yet to be determined.⁴⁷ *Hohentweil* was not mentioned in *Most Secret War*, and would have made a worthy addition to Jones's story of the chase for *Lichtenstein*. Jones preferred instead to tell of how he manipulated Saundby's penchant for angling and model railways to obtain the two Mosquitoes required to listen to *Lichtenstein* transmissions.⁴⁸

Despite being at 'full stretch' however, none of these other issues and activities distracted ADI (Science) too much from the main agenda of maintaining British initiative in the radio war, appreciating GAF technical capability, and defeating the Kamhuber Line. *Window* was vital to almost all

⁴⁶ CCAC RVJO B.48 & TNA AIR 20/1680, Air Scientific Intelligence Interim Report 'Enemy A.S.V. Investigation', 22 April 1943.

⁴⁷ CCAC RVJO B.50 & TNA AIR 20/1682, Air Scientific Intelligence Interim Report 'German A.S.V. Hohentweil', 18 August 1943. The official history confirmed that *Hohentweil* was indeed GAF ASV: Hinsley *et al*, *British Intelligence in the Second World War, Volume III, Part I*, pp. 516–7.

⁴⁸ Jones, *Most Secret War*, pp. 280–6. Jones also abused Saundby's love of model railways in a 'rather less than honest' manner regarding his continued and obvious obsession with *Window*. Jones believed that for Bomber Command to benefit most from the eventual dropping of *Window*, crewmen should be lectured beforehand on GAF nightfighter specifics. This would 'acquaint' them with the scientific principles and intelligence reasons behind *Window*, and enable them to 'use it to best advantage'. Jones planned to have Edward Wright (his new recruit) and Smith lecture bomber crews, but knew this would be difficult for Harris 'strongly resisted' any contact between his Command and the Air Staff. Jones therefore telephoned Saundby for permission to lecture bomber crews on *Window*, and mentioned that Smith was also a model railway maker. Saundby replied by saying that as Smith was 'that sort of chap' he was welcome to lecture his crewmen. Smith was indeed that sort of chap. Daisy Mowatt recalled fond memories of Frank 'watching in quiet amusement the antics of Hugh [Smith], flat on his stomach on the floor, operating a model railway system' in the room they shared with Jones on the third floor of the Broadway building. Jones recalled that Smith and Wright spent a 'hectic fortnight' lecturing at two or three Bomber Command stations each day: UOB DM1310/A16, Daisy Mowatt to Charles Frank, 17 January 1984; CCAC RVJO B.83 & TNA AIR 40/1532, ADI (Science) official history 'Air Scientific Intelligence in War, 1939–45', 1 April 1946, p. 27; AHB, 'Air Ministry Intelligence', p. 310; Jones, *Most Secret War*, p. 298.

matters in this regard, and was an issue never far from the minds of the wartime scientific intelligence officers.

***Window* – Effects and further Controversy**

At a Defence Committee (Technical Devices) Conference on 23 June 1942, Jones was introduced as the Chief of Air Staff's authority on the probable effect of *Window* upon GAF GCI.⁴⁹ This conference resulted in the decision to restrain *Window* usage until a Sicilian beachhead had been obtained.⁵⁰ Jones wrote that he had 'never been able to follow the logic of this argument', even though in 1967 reasoning was provided that if the GAF responded by using *Düppel* to support their air operations upon outset of Operation *Husky*, it could have jeopardised the invasion altogether.⁵¹ Perhaps Jones did not wish to follow the implemented logic of further delays in the use of *Window*.

Throughout his memoirs, Jones was critical of Watson-Watt over *Window* – often hinting that Watson-Watt was behind almost every decision to delay its operational use. Jones believed Watson-Watt had a 'bridge on the River Kwai' attitude towards radar in that 'it hurt him emotionally to think of radar being neutralised'.⁵² Even Churchill noted the continuing argument over whether Britain should have used *Window* earlier.⁵³ For Jones, the only 'good argument for withholding *Window*' was the one he had given in his main

⁴⁹ CCAC RVJO B.83 & TNA AIR 40/1532, ADI (Science) official history 'Air Scientific Intelligence in War, 1939–45', 1 April 1946, p. 26; AHB, 'Air Ministry Intelligence', p. 309.

⁵⁰ CCAC RVJO J.1, 'The Radio War', p. 16; Jones, *Most Secret War*, p. 298; Price, *Instruments of Darkness*, p. 141; Churchill, *Hinge of Fate*, p. 242. Churchill recalled that the Staff Conference was convened on 22 June.

⁵¹ Jones, *Most Secret War*, p. 297; Price, *Instruments of Darkness*, p. 141.

⁵² CCAC RVJO K.476, Post-Production script for 'To See for a Hundred Miles', no date, p. 31; Jones, *Most Secret War*, p. 290; Johnson, *The Secret War*, p. 116.

⁵³ Churchill, *Hinge of Fate*, p. 243.

report on DT – to wait until the introduction of *Window* would have its greatest effect.⁵⁴ Indeed, ADI (Science) had written that when the correct time had arrived, there should have been ‘no hesitation’, and that it was ‘unwise to be squeamish about taking countermeasures against any enemy development because of the danger of reciprocation’.⁵⁵

The critical nature of precisely when to introduce new weaponry is a problem related to the study of technological surprise.⁵⁶ Throughout the *Window* controversy Jones ‘was sure’ that the delay was ‘too long’.⁵⁷ Harris agreed in a much more sanguine manner by stating that there could be ‘little doubt’ that had Bomber Command been allowed to use the *Window* ‘weapon’ in the first months of 1943 it would have ‘saved hundreds of aircraft and thousands of lives’ and would have ‘much increased the accuracy’ of British bombing.⁵⁸ Ironically, this was one of the reasons *Window* restraint was lifted, as the then Fighter Command C-in-C, Trafford Leigh Mallory, ‘very decently gave the opinion that even though his defences might be neutralised he was now convinced that the advantage lay with saving the casualties in Bomber Command’.⁵⁹ Other reasoning was that MI15 had revealed increases to flak-gun and searchlight deployment and comparable concentrations ‘in the Reich

⁵⁴ Jones, *Most Secret War*, p. 293.

⁵⁵ CCAC RVJO B.24 & TNA AIR 20/1629, Air Scientific Intelligence Report No.13 ‘DT’, 10 January 1942, p. 40.

⁵⁶ Handel, ‘Intelligence and Deception’, 134.

⁵⁷ Jones, *Most Secret War*, p. 293.

⁵⁸ Arthur Harris, *Bomber Offensive* (Barnsley: Pen & Sword, 2005), p. 134.

⁵⁹ Jones, *Most Secret War*, p. 297; Richard Overy, *Why The Allies Won* (London: Jonathan Cape, 1995), p. 119.

at the expense of other theatres'; without alternative techniques or tactics against enemy defences, *Window* was used a last resort.⁶⁰

Window was finally approved for operational use on 15 July 1943. Although Jones and Harris had their own differing reasons for criticising *Window* restraint, the delay did allow for centimetric developments in the British GCI system, namely Air Ministry Experimental Stations (AMES) Type 13 and Type 14, the powerful directional beams from which were designed to manage the jamming techniques of *Düppel*. This being said however, RDF stations affected by *Düppel* were not entirely knocked out, GAF *Düppel* operational execution was poor, and raiders were unable to capitalise on any confusion caused.⁶¹ Watson-Watt, no fan of the effects of spurious dipoles, was still happy to report that Jackson 'did a first class job on the Secret trials of *Window*'.⁶² This praise emanated from the important aspect of Jackson's findings – *Window* would not affect the new microwave system that was slowly being implemented into the British RDF system.⁶³ Rightly or wrongly, delay in the use of *Window* provided valuable time for Fighter Command to implement new responsive technology. Irrespective of Jones proving Jackson (and Watson-Watt) wrong over the *Window* issue, Jackson did his share to

⁶⁰ Hinsley *et al*, *British Intelligence in the Second World War, Volume II*, p. 517. The total AA in Germany and the Western Front was 14,949 in January 1943, which rose to 20,625 by January 1944. Searchlights in the same theatre of war totalled 3,726 in January 1943, which rose to 6,880 by January 1944: see Webster and Frankland, *The Strategic Air Offensive, Volume II*, pp. 295–6.

⁶¹ Colin Dobinson, *Building Radar: Forging Britain's Early-Warning Chain, 1935–1945* (London: Methuen, 2010), pp. 516–18. After the war Jones had to correct the final reprint Volume IV of Churchill's war memoirs regarding the use of *Düppel*. He wrote that 'the Germans certainly did use "Window" some time'. Jones recalled that it was 'two or three months' after the British first used it, and that it was 'almost an exact copy' of British *Window*, with the 'only apparent difference being the length, which of course had to be different to respond to the frequencies' of British radar stations': CCAC CHUR 4/57 B, Jones to Denis Kelly, 29 August 1950.

⁶² Watson-Watt, *Three Steps to Victory*, p. 419. Alastair Battersby, who was eight years old during the British *Window* trials, recalled 'a whole tangle' of foil coming down the chimney of his house in Reading: transcript of interview undertaken on 14 April 2007.

⁶³ Clark, *Rise of the Boffins*, p. 201.

avoid technological embarrassment for Britain in the radio war. When the GAF did eventually use *Düppel*, on the night of 7/8 October, the effect was negligible in comparison to the chaos *Window* caused to GAF GCI.⁶⁴

Hamburg was raided six times between 24/5 July and 2/3 August 1943 – at night by Bomber Command, by 8th USAAF during the day.⁶⁵ *Window* was used in all four night attacks. While Wright and Smith were lecturing bomber crews, Jones, Frank, and Garrard went to Kingsdown each day to hear German reactions to the *Window* spoof, revealed by GAF nightfighter R/T transmissions.⁶⁶ Based on these reactions, on the day that followed the last night attack, ADI (Science) produced SIR No.IV.⁶⁷ In effect, it was a means to show ADI (Science)'s superiors that Jones had been right all along.

The remarkable success of *Window* was not ignored by ADI (Science); neither was it the centrepiece. They spelt out technical effects based on the 40–50tons used, for the duration of fifty minutes, from a height of 10,000 feet, in the four respective raids on Hamburg. The tonnage used actually favoured Dickens's earlier estimate, and was probably the reason for Jones's comment about Dickens waiting for Jackson and Jones to report their estimate before

⁶⁴ According to Alfred Price, the Japanese Imperial Navy developed a similar RCM which they called *Giman-shi* (deceiving paper), first used in May 1943 to suppress US Navy gun-laying radar sets in order to protect Japanese naval night bombers in attacks on Guadalcanal. Price discussed this with Jones, and given the pre-*Window* timing of this supposed event, Jones's reply is fascinating. He told Price that he would be interested to know when Japanese use of *Giman-shi* was first reported to Washington, and what happened to the information thereafter, because such information certainly had not reached him: Price, *Instruments of Darkness*, p. 142. There is no mention of *Giman-shi* in any ADI (Science) documentation, or in any of Jones's post-war literature.

⁶⁵ Jones, *Most Secret War*, p. 302; Hastings, *Bomber Command*, pp. 206–8; Hinsley *et al*, *British Intelligence in the Second World War, Volume II*, p. 292.

⁶⁶ CCAC RVJO B.83 & TNA AIR 40/1532, ADI (Science) official history 'Air Scientific Intelligence in War, 1939–45', 1 April 1946, p. 27; AHB, *Air Ministry Intelligence*, p. 310. ADI (Science) noted that this 'was a case where close contact with the original source was important'.

⁶⁷ This SIR had an extremely limited distribution and only seven copies were made.

submitting his own. ADI (Science) announced changes made to the Kammhuber Line during the *Window* delay – large and rapid increases to the GCI stations within the Line, indications of GAF adoption of the IFF principle, and the *Benito* control system – all of which led to future possible ineffectiveness of *Window*.⁶⁸ *Benito* pylons had been photographed by PRU and interpreted by CIU as early as autumn 1942, although ADI (Science) were unclear as to the significance of the *Benito* principle to GAF nightfighting at that time.⁶⁹ ADI (Science) criticised premature use of *Mandrel*, which by July had been negated through *Freya* frequency alteration (120Mc/s to 140Mc/s), and reported that the *Window* principle was known in Germany and that secret sources were beginning to show GAF adoption of ‘freelance’ nightfighting that was possibly less-reliant on *Würzburg*. The message expressed by ADI (Science) was that tactical advantage was gained by *Window*, but that a high price was caused by delay. On the nights in question, flak was temporarily paralysed and reduced to barrage fire, and the controlled nightfighter system rendered blind. ADI (Science) stressed that tendencies to break concentration formation on homeward bound journeys be rectified to maintain bomber loss reduction, and that all 140Mc/s *Freya* be neutralised.⁷⁰

One particular German reaction to the chaos caused to DT by *Window* was received by pigeon-post. In their post-war report on pigeons, ADI (Science) wrote that one ‘lucky pigeon happened to be picked up by a patriot’, probably

⁶⁸ CCAC RVJO B.49 & TNA AIR 20/1661, Air Scientific Intelligence Report No.IV ‘Early German Reaction to Window’, 3 August 1943.

⁶⁹ CCAC RVJO B.80, TNA AIR 8/831 & TNA AIR 20/1650, Air Scientific Intelligence Report No.33 ‘Benito Control of Fighters and Egon Control’, 20 April 1944, p. 11.

⁷⁰ CCAC RVJO B.49 & TNA AIR 20/1661, Air Scientific Intelligence Report No.IV ‘Early German Reaction to Window’, 3 August 1943.

by a British secret agent who had been watching a GAF nightfighter control station at la Croix Caluyau, a few days after the inception of *Window*.⁷¹ Perhaps due to data received after the event, Jones's telling of the facts behind this story altered over time. In *Most Secret War*, the secret agent was instead 'perhaps' a 'cleaner' in the nightfighter control station, while the pigeon had altered from being 'lucky' to 'gallant'. But it was the message itself that was of importance. This very lengthy detailed message expressed reactions of the German commanding officer of la Croix Caluyau nightfighter station, who spent all night of 24/25 July 1943 'trying to intercept 700 separate bombers without being able to locate one', whereupon 'he asserted that he would rather be attacked by a hundred bombers than submit to the torrent of papers'.⁷² Jones recalled that since no source could be compromised by this message he was able to circulate it through Bomber Command, by whom it was widely appreciated.⁷³ In his memoirs Jones chose not to add that, at the time, circulation of such intelligence around Bomber Command was 'of extreme value', precisely because of its low security grading.⁷⁴ Pigeons were indeed sometimes useful.

An interim report released by ADI (Science) in October 1943 summarised the contents of SIR No.IV for lower security distribution. Once again the issue of how much *Window* should have been used was raised. The figure provided had been reduced to 50tons, and although ADI (Science) claimed this to be

⁷¹ CCAC RVJO B.85, ADI (Science) note 'Pigeons', no date; Hinsley *et al*, *British Intelligence in the Second World War, Volume II*, p. 309.

⁷² CCAC RVJO B.85, ADI (Science) note 'Pigeons', no date; CCAC RVJO B.113, ADI (Science) post-war report 'Scientific Intelligence in the S.I.S., 1939-45', p. 5; Jones, *Most Secret War*, p. 305.

⁷³ Jones, *Most Secret War*, p. 305.

⁷⁴ CCAC RVJO B.85, ADI (Science) note 'Pigeons', no date.

seemingly high, they emphasised that 50tons was far lower than figures provided by Jackson on behalf of Fighter Command. ADI (Science) reported that the Germans had responded quickly to *Window*, despite finding deceased cattle which initially caused a scare of arsenic poisoning. Of most importance was intelligence that the GAF had partially abandoned the Kamhuber Line principle of nightfighting. ADI (Science) stated that if GAF detection equipment remained neutralised, then the British problem of getting bombers through the extemporised Kamhuber Line lay with the tactician. *Window*, they declared (no doubt with much pleasure on Jones's part) had fulfilled its function 'even better than could be hoped'.⁷⁵

In later reflection of this sentiment, Churchill declared that during the 24/25 July Hamburg raid the first trial of *Window* 'surpassed expectations'.⁷⁶ Cherwell wrote the section on *Window* for Churchill's war memoirs, yet it was Jackson and not Jones that Cherwell turned to for editing advice in relaying both development and use of *Window*. This probably disappointed Jones immensely, particularly as he was keen to present the idea that he invented the principle.⁷⁷ Documentation confirms that Jackson was yet another adviser

⁷⁵ CCAC RVJO B.51 & TNA AIR 20/1683, Air Scientific Intelligence Interim Report 'The Effect of Window on German Night Defences', 4 October 1943; Jones, *Most Secret War*, pp. 382–3. For an online account of the effects of *Window*, see 'Chaff (& Radar)', www.vectorsite.net, accessed 15 October 2010.

⁷⁶ Churchill, *Hinge of Fate*, p. 243.

⁷⁷ Following publication of *Most Secret War*, Jackson wrote a letter of protest against Jones's *Window*-related claims. This letter was published in the *Sunday Telegraph*, as was Jones's lengthy reply. Within his reply Jones again took full credit for *Window*. As Zuckerman explained to Chalfont in his draft letter, *Window* experiments at TRE were 'obviously done without any reference to Jones at all', and that 'the idea of confusing a radar system was known by many people in the radar world from the very start'. Even the eminent scientist John Cockcroft, who had very little to do with radar, had been approached by Watson Watt in 1938 to discuss possibilities of spurious dipoles affecting RDF: see UOEA SZ/2/GEN, Draft letter to Chalfont written by Solly Zuckerman, no date, pp. 3–4. Zuckerman added (perhaps unkindly) that 'Cockcroft was an infinitely more brilliant scientist than Jones, as was also Derek Jackson'. Zuckerman also pointed out that Jones's name does not appear in either Watson-Watt's book or Rowe's book in regard to *Window* and that, upon re-reading these two books, he could

to Churchill's Second World War history – one that slipped past David Reynolds's otherwise meticulous analysis of Churchill's syndicate.⁷⁸

The Kammhuber Line never recovered from *Window*. Extensive GAF GCI on which 'untold industrial and military effort had been spent' became 'an expensive and useless luxury overnight'. It therefore 'became necessary to reorganize the whole system of night fighter defence'.⁷⁹ The *Benito* control system and *Lichtenstein* AI (initially considered as worthy additions to the Kammhuber Line), contributed to what became known to GAF personnel as *Zahme Sau* (Tame Boar), a semi-controlled nightfighting method. British RCM success also provided opportunity for expansion of the German Y-Service. The largest addition was *Flugwegverfolgung* (Raid-Tracking Organisation), whose primary function was to seek out and listen to British R/T and W/T in order to determine bombing intent.⁸⁰ After *Window*, the GAF had to adapt each principle as best they could against the seemingly relentless Allied air onslaught. In effect, the 'simplest of tactical innovations' crushed the backbone of the Third Reich's air defence.⁸¹

On 15 September Kammhuber was ordered to disband his centralised command and place nightfighter squadrons at the disposal of area *Luftlottens*

understand why Jackson was 'irritated' by Jones's claim, and why Cockburn read Jones's 'Window' chapter 'with distaste'.

⁷⁸ OUNC CP D.117/34, Cherwell to Jackson, 14 April 1950; OUNC CP D.117/35, Jackson to Cherwell, 21 April 1950; OUNC CP D.117/36, Jackson to Cherwell, 23 April 1950; OUNC CP D.117/36, Jackson to Cherwell, 31 October 1950; Reynolds, *In Command of History*.

⁷⁹ AHB cited in John Terraine, *The Right of the Line: The Royal Air Force in the European War 1939-1945* (Ware: Wordsworth Editions, 1998), p. 546.

⁸⁰ CCAC RVJO B.66 & TNA AIR 20/1652, Air Scientific Intelligence Report No.73 'Raid-Tracking Organisation (Flugwegverfolgung)', 13 July 1944.

⁸¹ For 'simplest of tactical innovations', see Overy, *Why the Allies Won*, p. 119.

responsible for overall defence of the Reich.⁸² He resigned some two months later and was posted to Norway.⁸³ Interestingly, Kammhuber informed Jones after the war that British timing in operational use of *Window* was exactly right. Any earlier and the German radio industry would have been able to produce new equipment to defeat *Window*, but by July 1943 German manufacturing capacity was incapable of recovery. In contrast, Kammhuber's successor, General Josef 'Beppo' Schmidt, believed that had *Window* been used six months earlier the German radio industry still would not have recovered. Not surprisingly, Jones agreed with Schmidt, particularly as the GAF had 'time to develop their defences in several new directions'.⁸⁴

The GAF had already introduced freelance methods of night fighter defence, the *Wilde Sau* (Wild Boar), in the Cologne raid of 3 July 1943.⁸⁵ Using R/T, ground-controllers plotted impending raids and directed nightfighters to predicted targets. Sometimes these predictions were inaccurate and, as *Wilde Sau* tactics required powerful transmitters and, as the GAF paid little regard to R/T security, the interceptions heard and recorded at Kingsdown proved highly valuable to both Bomber Command ORS and to Bletchley's 'Technical Listening Party'.⁸⁶ *Wilde Sau* tactics were first used *en masse* in the Bomber Command raid on Peenemünde of 17/18 August 1943 (discussed more appropriately in Chapter VIII). These tactics did not last long, for although

⁸² Killen, *The Luftwaffe*, p. 239.

⁸³ TNA AIR 41/10, *The Rise and Fall of the German Air Force*, p. 418; CCAC RVJO J.1, 'The Radio War', p. 17. Jones held that Kammhuber had been removed from the night fighter command, and commented that if ADI (Science) 'could get Kammhuber the sack' then it was a criterion that ADI (Science) 'were winning': Jones, *Most Secret War*, p. 387.

⁸⁴ CCAC RVJO J.1, 'The Radio War', p. 17.

⁸⁵ Kammhuber, 'Development of nightfighting', p. 73; Price, *Instruments of Darkness*, p. 146.

⁸⁶ Hinsley *et al*, *British Intelligence in the Second World War, Volume III, Part I*, p. 311.

nightfighter pilots enjoyed a period of independence (some hailed as heroes), *Wilde Sau* threw GAF nightfighter organisation into chaos.⁸⁷ Perhaps it was for this reason that *Wilde Sau* tactics were rarely discussed by ADI (Science) throughout the remainder of the war, but also presumably because *Wilde Sau* was (while it lasted) an operational rather than intelligence problem.⁸⁸

Bomber Command's first logical reaction to *Wilde Sau* was to shorten attacks to some 15–20 minutes – bombers in effect leaving designated areas before nightfighters gathered in force.⁸⁹ Another important reaction was creation of RAF No.100 (Bomber Support) Group for 'investigating further enemy radar developments and co-ordinating the application of all possible radio and tactical counter-measures against them'.⁹⁰ In essence, No.100 Group was involved with the scientific and technological edge of bombing.⁹¹ When the GAF shifted to *Zahme Sau* tactics in late-autumn 1943, No.100 Group patrols comprised of Mosquitoes equipped with 'Serrate' (designed to home onto *Lichtenstein-Gerät*), and targeted GAF nightfighters circling *Benito* beacons, based on intelligence from ADI (Science) among other sources.⁹² No.100 Group also flew US Flying Fortresses laden with bulky hi-tech jamming equipment.⁹³ ADI (Science) later reported that No.100 Group were 'worrying' GAF nightfighters so much that some were carrying 'Neptun' (FuGe216)

⁸⁷ Killen, *The Luftwaffe*, p. 240.

⁸⁸ This might be why Jones referred to *Wilde Sau* only once in *Most Secret War*, when relaying the story of British bombers in the 27/28 July Hamburg raid, during which bombers were attacked by *Wilde Sau* fighters using the glare of the Hamburg firestorm to see their targets: Jones, *Most Secret War*, p. 301. Jones translated *Wilde Sau* as 'Wild Sow'.

⁸⁹ TNA AIR 41/10, *The Rise and Fall of the German Air Force*, p. 278.

⁹⁰ Hinsley *et al*, *British Intelligence in the Second World War, Volume III, Part I*, p. 553–4.

⁹¹ Harris, *Bomber Offensive*, p. 189.

⁹² Hinsley *et al*, *British Intelligence in the Second World War, Volume III, Part I*, p. 553–4.

⁹³ Harris, *Bomber Offensive*, p. 189.

early-warning DT apparatus previously fitted to tails of bombers.⁹⁴ There was also Operation *Corona*, Kingsdown's contribution to the radio war which, from October 1943, broadcast spurious idiomatic transmissions that mimicked GAF ground controllers thereby confusing nightfighter pilots.⁹⁵

In addition to radio beacons, ADI (Science) reported widespread GAF use of visual beacons, whereby nightfighters were directed from one searchlight-lit beacon to another and guiding them to predicted targets. ADI (Science) also provided maps which pinpointed all known visual beacons.⁹⁶ Created by ADI (Science), these maps were based on flight documents captured from a downed GAF nightfighter by Belgian agent Jean Closquet – another whom Jones favoured in his *Most Secret War* dedication. The intelligence arrived at Broadway in microfilm format some six weeks after the aircraft crashed. Jones believed it was 'a marvellous piece of opportunist Intelligence'.⁹⁷

GAF *Zahme Sau* tactics would target the densest concentrations of *Window* as ideal interception points.⁹⁸ Nightfighters would be directed to shrouded bomber streams by ground control, whereupon they became reliant on visual interception and *Lichtenstein* if not completely negated by *Window* clouds. When additional airborne radiation-detection devices (as described below) were applied to *Zahme Sau* tactics, they became the 'ultimate counter to

⁹⁴ CCAC RVJO B.64, Air Scientific Intelligence Report No.107 'German Radar Progress', 29 June 1944, p. 4.

⁹⁵ Webster and Frankland, *Strategic Air Offensive against Germany, Volume IV*, p. 23; Bonsall, 'Bletchley Park and the RAF Y Service', 836; Ruth Ornstein-Tosek interviewed in 'To See for a Hundred Miles', the second episode of *The Secret War*; CCAC RVJO K.476, transcript for 'To See for a Hundred Miles', p. 23; Johnson, *The Secret War*, p. 114.

⁹⁶ CCAC RVJO B.52, ADI (Science) memorandum 'German Nightfighter Beacons', 18 October 1943.

⁹⁷ Jones, *Most Secret War*, pp. viiii & 383–4; CCAC RVJO J.1, 'The Radio War', p. 19.

⁹⁸ Alfred Price, 'The Duel over Germany', *History of the Second World War*, 4: 14, 1734.

bomber tactics'.⁹⁹ While *Window* had seriously affected GAF flak and badly affected GAF nightfighters, the latter were still of significant concern for Allied bombers. In analysis of GAF nightfighter claims 'drawn from a captured series of Orders of the Day of Fliegerkorps XII' (presumably literary cover for Enigma decrypts), ADI (Science) realised with some concern that GAF claims of 59% of British home-based bomber losses was honest. They deduced that, although Bomber Command losses to nightfighters and flak had been reduced by *Window*, 'the percentage' of Bomber Command losses to nightfighters would have increased since the first use of *Window*. ADI (Science) added that 97% of victorious sorties in GAF claims analysed by ADI (Science) had been GCI-controlled.¹⁰⁰ This is an important point, not only because it emphasises how reliant the GAF was upon the Kammhuber Line, and the effect *Window* had (and perhaps could have had for much longer), but also because it leads to thought about the usage of the Kammhuber Line after *Window*.

Almost 300 GCI stations were created under Kammhuber's leadership, which was some 60% of planned development.¹⁰¹ Moreover, automatic transmissions between *Würzburg-Reise* and *Seeburg* tables were still in development.¹⁰² In SIR No.23 of February 1944, ADI (Science) reported intelligence, based on a typewritten GAF GCI station instruction manual (captured in Sicily), that the 'Seeburg procedure' (replacement phrase for the

⁹⁹ Hinsley *et al*, *British Intelligence in the Second World War, Volume III, Part I*, p. 314.

¹⁰⁰ CCAC RVJO B.55 & TNA AIR 20/1637, Air Scientific Intelligence Report No.21 'Bomber Losses and German Claims from December 1942 to May 1943'. No specific date is given for this SIR, but it was certainly distributed in autumn 1943.

¹⁰¹ CCAC RVJO B.57 & TNA AIR 20/1640, Air Scientific Intelligence Report No.23 'Control and Plotting at a German GCI Station', 28 February 1944; Kammhuber, 'Development of nightfighting', p. 72.

¹⁰² Kammhuber, 'Development of nightfighting', p. 72.

Kammhuber Line) was 'still used whenever possible'. Opportunities consisted of straggler interception, co-operation with new DT equipment not upset by *Mandrel* or *Window*, and most importantly, in controlling *Benito* day and nightfighters.¹⁰³ In addition, GAF technicians invented and developed anti-jamming devices for *Würzburg*. There were seven in all: *Wismar* (change of frequency); *Stendal A* (D/F on airborne jammers); *Stendal B/Goldammer* (polarisation perpendicular to jammer); *Nürnberg* (distinguishing between aircraft and *Window* by listening for propeller modulation); *Würzlaus* (similar distinction using Doppler effect); *Taunus* (differentiating circuit distinguishing genuine blips from *Window*); and *Fakir* (addition of left/right split presentation). ADI (Science) noted that while these devices could have been employed separately, a high proportion of DT apparatus was believed to be fitted with *Wismar*, *Nürnberg*, *Würzlaus*, and *Fakir*. Intelligence from a technical POW led to the belief that all *Würzburg-D* (used for flak control) were so fitted.¹⁰⁴

ADI (Science) saw these developments as desperate recovery of 'sunken capital' by modifying equipment to meet 'new conditions'.¹⁰⁵ Jones later remarked that *Window* could have been 'defeated by a thoughtful enemy' through frequency differentiation.¹⁰⁶ GAF boffins were either more desperate or more thoughtful than anticipated. In April 1944, ADI (Science) reported that a *Lichtenstein* evolution had been developed. 'Lichtenstein SN2' (FuGe220)

¹⁰³ CCAC RVJO B.57 & TNA AIR 20/1640, Air Scientific Intelligence Report No.23 'Control and Plotting at a German GCI Station', 28 February 1944, p. 2.

¹⁰⁴ CCAC RVJO B.65 & TNA AIR 20/1644, Air Scientific Intelligence Report No.27 'Würzburg Anti-Jamming Devices', 12 July 1944, p. 1.

¹⁰⁵ CCAC RVJO B.58, Air Scientific Intelligence Report No.101 'German Radar Development', 6 March 1944, p. 3.

¹⁰⁶ Jones, 'Intelligence and Deception', *Journal of the Royal Signals Institution*, 14 (1980), 132-3.

used longer wavelengths and was thereby 'free from Window'.¹⁰⁷ *Taunus* was then added to *Lichtenstein-SN2*, although ADI (Science) reported that as British RCMs were electrical *Taunus* modification to *SN2* 'cannot have been of much assistance'.¹⁰⁸ *Window* was then provided with effectiveness longevity following discovery that *SN2* could itself be jammed by longer strips of *Window*.¹⁰⁹ This radio war tit-for-tat was one example of many experienced. Success of *Mandrel* and *Window* led directly to British IFF being compromised, and for a long period of the war without correction. Jones dedicated a whole chapter to this problem in his memoirs, and entitled it 'Flames: Problems of Bomber Command'. He argued that he had foreseen that IFF was 'treacherous' and had 'warned strongly' to the effect in September 1941, but that Bomber Command dismissed his opinion. The essence of Jones's argument was that bomber crews needlessly lost their lives because they kept IFF sets switched on over occupied territory. Weighty evidence to the contrary suggested that IFF jammed GAF searchlights, and that bomber crews liked to think that it did.¹¹⁰ Jones failed entirely to mention the discrepancy that, following the Bruneval Raid, ADI (Science) had recommended the use of IFF to interfere with *Würzburg*.¹¹¹ Documents show that Bomber Command (and later ORS) had been examining the issue of IFF

¹⁰⁷ CCAC RVJO B.62 & TNA AIR 20/1657, Air Scientific Intelligence Report No.103 'German Radar Development', 25 April 1944, p. 3. ADI (Science) advised that, 'in the meantime long Window should satisfactorily upset it'.

¹⁰⁸ CCAC RVJO B.77, Air Scientific Intelligence Report No. 109 'Recent Developments in German Radar', 22 February 1945, p. 1.

¹⁰⁹ Hinsley *et al*, *British Intelligence in the Second World War, Volume III, Part I*, p. 558.

¹¹⁰ Jones, *Most Secret War*, pp. 210–11 & 388–90. The chapter entitled 'Flames: Problems of Bomber Command' runs from pp. 381–95; see also Hinsley *et al*, *British Intelligence in the Second World War, Volume III, Part I*, pp. 559–60; Hastings, *Bomber Command*, p. 167.

¹¹¹ See p. 283 in Chapter V of this thesis to clarify this discrepancy.

‘dousing’ searchlights since October 1940.¹¹² ORS undertook various experiments to determine validity of the bomber crew belief, and concluded in September 1942 that ‘since no evidence’ had ‘come to light’ indicating harmful effects, then ‘the psychological effect on the crews’ was ‘sufficient alone to justify its retention’.¹¹³

In recollection of this matter in *Most Secret War*, Jones gave the impression that he had been correct all along and that other scientists in other organisations ignored his pleas. There is however, one important point to consider. ADI (Science) reported in January 1944 that neutralisation of *Freya* and *Würzburg* by *Mandrel* and *Window* led the Germans to try locating British bombers by other means pending restoration of DT defences. Enigma decrypts (‘invaluable sources’) had shown that the *Lufnachrichten-Versuchs* (German Air Signals Experimental Regiment (GASER)) had established stations to observe British bombers and compile *Flammen* reports. From these reports, revealed by ULTRA, ADI (Science) deduced that because ‘Flames’ were not under the control of a ground station, and since they could be observed from great range, they had to refer to ‘some transmissions’ from British bombers. Ruling out all other possibilities, ADI (Science) concluded that it ‘appeared inescapable’ that IFF betrayed British bombers, and that the ‘legend’ about IFF effects on searchlights was ‘reaping a tragic harvest’,

¹¹² TNA AIR 14/600 & TNA AIR 14/601, Bomber Command ORS Reports on ‘The Effect of IFF on German Searchlights’ spanning October 1940 to September 1942.

¹¹³ TNA AIR 14/601, Bomber Command ORS Report No.50 on ‘The Effect of IFF on German Searchlights’, 8 September 1942. See also Richard Knott, *Black Night for Bomber Command: The Tragedy of 16 December 1943* (Barnsley: Pen & Sword Aviation, 2007), pp. 86–7.

positing that 'future tragedies' were only to be avoided by 'peremptory application of common sense to shatter quasi-scientific superstition'.¹¹⁴

Aside from this latest carping directed at ORS scientists, who Jones had already accused of the 'immoral practice of encouraging brave men to clutch at straws in their hour of greatest danger', this higher-secrecy SIR No.IV shows that the IFF problem only truly became such after *Mandrel* and *Window* had negated the Kammhuber Line.¹¹⁵ Confirmation of this point is in SIR No.107, in which ADI (Science) stated that IFF plotting was 'almost certainly stimulated by the neutralising effect of *Window*' on the normal GCI system, that GAF night defences largely relied on IFF plots thereafter, and that a wide network of plotting stations had consequently developed.¹¹⁶ Jones later wrote that the GAF 'were desperate to try any measure' to assist in locating British bombers, and so 'resolved to try the possibility of challenging and locating aircraft' with IFF.¹¹⁷ The IFF debate showed that in intelligence it is not opinion but evidence that is the convincing factor that improves a negative situation. As a result of SIR No.IV, British bomber crews were ordered not to switch on their IFF over occupied territory except in emergency.¹¹⁸ Without convincing proof, it was pointless for Jones to openly criticise ORS and lose valuable wartime scientific allies. It was even more pointless to criticise ORS scientists, to the extent he did, so long after the event. Wakelam's valuable assessment of Bomber Command ORS mentions this issue only fleetingly,

¹¹⁴ CCAC RVJO B.56 & TNA AIR 20/1668, Air Scientific Intelligence Report No.IV, "Flames", 8 January 1944.

¹¹⁵ Jones, *Most Secret War*, p. 389.

¹¹⁶ CCAC RVJO B.64, Air Scientific Intelligence Report No.107 'German Radar Progress', 29 June 1944, p. 5.

¹¹⁷ CCAC RVJO J.1, 'The Radio War', p. 20.

¹¹⁸ Price, *Instruments of Darkness*, p. 215.

which adds weight to the continued argument throughout this thesis that Jones took every opportunity to advance his own scientific prowess to the detriment of many other scientists of equal worth to Britain's war machine.¹¹⁹

Wilde Sau relied heavily upon effective AI apparatus and powerful early-warning DT.¹²⁰ For the duration of the war, much effort was spent by ADI (Science) to appreciate both of these technological evolutions. Because of their constant hunt for DT and determinations to understand GAF GCI, ADI (Science) required full knowledge of British (and later Allied) scientific and technological bombing and navigation aids. They were often drawn into issues surrounding progress of such developments, and sometimes drawn into intelligence aspects regarding secrecy of airborne instruments. In his memoirs, Jones produced rather exaggerated claims that he was partly responsible for some of the ideas and physical principles behind the applied technology, and often criticised technical developers for their lack of GAF RCM appreciation (much in the same vein as Watson-Watt's 'bridge on the River Kwai' attitude). ADI (Science) were generically integral to the wider radio war, although Jones's memoirs perpetuated the myth that British intelligence successes that resulted in Allied victory in the radio war were, in essence, Jones's individual triumphs. Such claims require closer examination.

Scientific Bombing and the Radio War

During summer 1941, Cherwell instructed his secretary David Butt to carry out an assessment of the effectiveness and accuracy of British bombing.

¹¹⁹ Wakelam, *The Science of Bombing*, pp. 30 & 49.

¹²⁰ For *Wilde Sau*, see Hinsley *et al*, *British Intelligence in the Second World War, Volume II*, pp. 310–11, and *Volume III, Part 1*, pp. 310–4 & 553–4; Price, *Instruments of Darkness*, pp. 146–7 & 167–72.

Historians have often credited the Butt Report as being the catalyst for scientific method being applied to the British bombing of Germany.¹²¹ Recent research has shown in contrast that British scientists had already been examining bombing operations, and from this nucleus Bomber Command ORS was formed.¹²² If the Butt Report was not the catalyst, however, it was certainly the trigger which caused the explosion of science and technology that fuelled Bomber Command for the war's duration. As Bomber Command was the primary opponent of the GAF (at least until late 1943 when 8th USAAF became potent), and as ADI (Science) was integral to the Allied bomber offensive, these issues are worth brief examination.

In all, TRE produced four navigation/bombing devices for Bomber Command. Gee (for Grid) involved location-finding techniques invented before the war, and comprised of three ground-stations, special airborne receivers, and allowed for accurate navigation for up to 300 miles.¹²³ *Oboe* relied on two ground-stations: one controlled navigation, while the other signalled bomb release.¹²⁴ *Oboe* (so named due to the sound it made) had similar range limitations as *Gee*, and had the additional problem of being only able to control one aircraft at a time.¹²⁵ Only with *H2S* was the problem of range overcome, for *H2S* was a self-contained airborne radar system which meant it

¹²¹ See for example Hinsley *et al*, *British Intelligence in the Second World War, Volume II*, p. 261; McCloskey, 'British Operational Research in World War II', 458.

¹²² Wakelam, *The Science of Bombing*, Chapter 3 entitled 'Boffins: September 1941', pp. 34–47; Gerald William Thomas, 'A Veteran Science: Operations Research and Anglo-American Scientific Cultures, 1940–1960', unpublished PhD dissertation, Harvard University, 2007.

¹²³ Wilson, *Churchill and the Prof*, p. 67.

¹²⁴ *Oboe* derived from British appreciation of the *Luftwaffe*'s 1940 use of Lorenz beams, and followed similar principles of blind bombing: CCAC RVJO J.1, 'The Radio War', p. 15; Webster and Frankland, *The Strategic Air Offensive against Germany, Volume IV*, p. 9; Harris, *Bomber Offensive*, p. 124.

¹²⁵ TRE developed and installed AMES Type 7000 stations for *Gee* and Type 9000 stations for *Oboe* on new or existing CH stations as geography dictated, and these projected beams for bombers to follow: Dobinson, *Building Radar*, p. 503.

was not reliant upon ground-stations in Britain, and thereby facilitated deeper penetration into Germany.¹²⁶ *G-H*, which in effect was a hybrid of *Gee* and *Oboe*, worked in principle like *Oboe* in reverse. The great advantage to *G-H* was that it could cope with more than one aircraft at a time.¹²⁷

ADI (Science) were unexpectedly drawn into development of *Gee* in August 1941 with an incident that resulted in their second high-security SIR (only five copies distributed including Cherwell's and Tizard's). On 13 August, Bomber Command's No.115 Squadron had (contrary to orders) flown three prototype-*Gee*-equipped aircraft over Germany and one had been shot down. On 20 August, an emergency meeting chaired by Tizard was held at Portal's request to discuss this 'crisis'.¹²⁸ Of key importance was that 78 personnel from 115 Squadron were missing-in-action, probably in POW camps, and so it was likely that the Germans knew of *Gee* and what to look for. Jones wrote that Bomber Command had 'thus repeated' the GAF's error of 1940.¹²⁹ ADI (Science) wrote at the time that 'German ADI (Science)' were for the first time on the defensive, and that sources available to them in their 'G' investigation would be POWs, captured equipment, labels, 'G' transmissions, photography, and agent reports.¹³⁰

¹²⁶ McCloskey, 'British Operational Research in World War II', 458–9; Dean, *The Royal Air Force and Two World Wars*, pp. 257–8. For a contemporary appreciation of the technicalities behind H2S, see TNA AIR 20/5804, 'The Theory of H.2.S. for Navigators', no date.

¹²⁷ Webster and Frankland, *The Strategic Air Offensive against Germany, Volume IV*, p. 15; see Harris, *Bomber Offensive*, pp. 225–8 for a good appraisal of *G-H*.

¹²⁸ CCAC RVJO B.42 & TNA AIR 20/1664, Air Scientific Intelligence Report No.II, 'J', 30 January 1943, p. 1; Jones, *Most Secret War*, pp. 217–8; Jones, 'Intelligence and Deception', 138.

¹²⁹ Jones, *Most Secret War*, p. 218

¹³⁰ CCAC RVJO B.42 & TNA AIR 20/1664, Air Scientific Intelligence Report No.II, 'J', 30 January 1943, p. 1.

An extensive deception plan was organised by ADI (Science) to deceive their supposed GAF counterparts in their 'G' investigation. The name 'G' was suppressed in order to prevent further publicity. As was Gee's type-number (R3000) which showed that it was a pulse receiver (which the Germans could have deduced if they possessed British IFF and ASV apparatus). Gee stations were made to look like RDF stations. ADI (Science) arranged for the phonetically-similar letter of 'J' to replace 'G' in all conversations, so that if German Y records were taken they might believe they had misheard references to 'G'. The type-number R3000 was replaced with TR1335, which suggested a standard communications transmitter/receiver. It was arranged for No.80 Wing to transmit beams at frequencies of 50Mc/s, what Jones called 'Jay beams', and to add further authentication, Bomber Command were encouraged to use Jay beams for navigational purposes. Finally, false information was fed to the *Abwehr* (using agents under MI5 control), through Broadway's MI5 contact whom Jones referred to as 'George'. This was Charles Cholmondeley of MI5's Section B1a, which specialised in double agent/double cross activities.¹³¹ The deception provided by Cholmondeley for ADI (Science) included RAF lectures by a bogus 'Professor Ekkerley' on the new 'Jerry' radio-navigational system which used Lorenz-type beams. ADI (Science) reported that there was 'every reason to believe that such items of information were much appreciated by the German S.I.S.'. Jones later

¹³¹ For more specific details on Section B1a and Cholmondeley, see Ewan Montagu, *The Man Who Never Was* (London: Evans, 1953); J. C. Masterman, *The Double-Cross System in the War of 1939 to 1945* (London: Yale University Press, 1972; Folio Society, 2007); Montagu, *Beyond Top Secret U*; Andrew, *Defence of the Realm*, pp. 248–58 & 284–300; Hinsley & Simkins, *British Intelligence in the Second World War, Volume IV: Security and Counter-Intelligence*; Howard, *British Intelligence in the Second World War, Volume V: Strategic Deception*; Macintyre, *Operation Mincemeat*; Ben Macintyre, *Agent Zigzag, The True Wartime Story of Eddie Chapman: Lover, Betrayer, Hero, Spy* (London: Bloomsbury, 2007), pp. 67–8; Campbell, *Target London*, pp. 261–2, 270 & 308. E. D. R. Harrison, 'J. C. Masterman and the Security Service, 1940–72', *Intelligence and National Security*, 24: 6 (December 2009), 769–804.

confirmed that this belief emanated from the fact that double agents had been 'enthusiastically thanked for their valuable information'.¹³²

Harris was much taken by Gee – claiming it to be 'one of the many brilliant things the scientists gave us' – declaring it the first 'real answer' both to the problem of formation concentration and to the unnecessary 'wastage' from crash-landing in England.¹³³ Gee was first used operationally in Bomber Command's 8 March 1942 raid on Essen.¹³⁴ RCM jamming was expected after three months but did not occur for five, the first signs appeared on 6/7 August, and was confirmed on Bomber Command's 9/10 August raid of Osnabruck. RCMs reduced the range of Gee by some 100miles which ruled out targets in Germany.¹³⁵ Nevertheless, Gee continued to be used for navigational purposes, as did the *Jay* beams.

Despite the panic, German intelligence did not obtain a Gee set until 29 March 1942, when a Wellington crashed relatively intact in the sea near Wilhelmshaven (seawater stopped detonation of the self-destruct mechanism fitted into the Gee device).¹³⁶ Allied POWs were still being questioned in July 1942 about 'J' however, which confirmed that ADI (Science)'s efforts had not

¹³² CCAC RVJO B.42 & TNA AIR 20/1664, Air Scientific Intelligence Report No.II, 'J', 30 January 1943, pp. 2–3; Jones, *Most Secret War*, pp. 216–20; Jones, 'Intelligence and Deception', 138–9; Jones, 'Navigation and War', 15–16; Price, *Instruments of Darkness*, pp. 100–3. Jones explained that only later did he discover that 'George' was 'the key man' in Montagu's *The Man Who Never Was*. For more on the use of double agents used in deception, see Thomas Hennessy & Claire Thomas, *Spooks: The Unofficial History of MI5 From Agent ZIGZAG to the D-Day Deception, 1939–45* (Stroud: Amberley Publishing, 2010); and F. M. Begoum, 'Observations on the Double Agent', *Studies in Intelligence*, 6: 1 (Winter 1962), 57–72.

¹³³ Harris, *Bomber Offensive*, pp. 76, 84 & 96. Harris emphasised that initially far more was expected from Gee than it could in fact achieve.

¹³⁴ RAFM AC 944633, 'Air Staff Operational Monograph No.1: Countermeasures to German R.D.F. Defences, May 1944, p. 16; Hinsley *et al*, *British Intelligence in the Second World War, Volume II*, pp. 266–7; Jones, *Most Secret War*, p. 221.

¹³⁵ Harris, *Bomber Offensive*, p. 124.

¹³⁶ Price, *Instruments of Darkness*, p. 102.

been futile. Their first 'attempt at spoof was thoroughly justified', and they praised Allied POWs for their discretion, especially compared to their German counterparts. In many ways this was a classic deception, for the *Abwehr* had been duped by information that fell too neatly into a single pattern that appeared to exclude other less reasonable possible courses of action.¹³⁷ Of no little significance was that ADI (Science) had shown that 'even modest spoof' could 'distract and waste enemy effort', whilst simultaneously saving British effort. 'With imagination', reported ADI (Science), 'the same principles could be applied to far bigger spoofs'.¹³⁸

From 1942 onwards it was ADI (Science)'s responsibility to gain intelligence of GAF countermeasures to RAF technological bombing applications. Gee was very quickly jammed by the GAF, and although the British never devised counter-jamming, Gee continued to retain navigational value for bombers returning to base, for the Germans could only jam it over occupied territory.¹³⁹ *H2S* was of much more concern, a 'double-edged weapon', for the GAF devised means to receive radiating emissions of *H2S* apparatus.¹⁴⁰ The receiver was code-named 'Naxos' (FuGe350) and was fitted inside GAF nightfighters so that they could home onto *H2S*. The GAF also established an effective way of listening to *H2S* sets, thereby recognising British raids before they had even reached the European coast. *H2S* designers were reluctant to believe these eventualities and sent Dee to ADI (Science) to investigate.

¹³⁷ Handel, 'Intelligence and Deception', p. 137.

¹³⁸ CCAC RVJO B.42 & TNA AIR 20/1664, Air Scientific Intelligence Report No.II, 'J', 30 January 1943, p. 5.

¹³⁹ Dean, *The Royal Air Force and Two World Wars*, p. 274; Webster and Frankland, *The Strategic Air Offensive against Germany, Volume IV*, p. 6.

¹⁴⁰ Webster and Frankland, *The Strategic Air Offensive against Germany, Volume IV*, p. 17.

Jones recalled that it took Dee only a morning of searching through confirming Enigma decrypts to be convinced. Jones was also startled by Lovell's inclination to discount the success of *Naxos*; he asked 'if it was not successful, why did the Germans build as many 1,500 *Naxos* receivers and progressively fit 700 of them into nightfighters?'.¹⁴¹

Naxos was originally designed to protect U-boats from *H2S*-equipped ASV.¹⁴² In May 1944, ADI (Science) reported that *Naxos* had been adapted by the GAF to target *H2S* and its 'Fishpond' derivative.¹⁴³ Used in conjunction with *Lichtenstein-SN2*, *Naxos* posed significant threat to Allied bombers, (irrespective of Lovell's doubt). In addition to *Naxos*, the GAF developed and perfected a device codenamed 'Korfu', which, using long-range directional aerials (such as *Mammut* and 'Wasserman' which is described below), could detect *H2S* from the ground. Although a late entry to the radio war, the GAF created a *Korfu* network spanning the length of western Germany's air defence system, where *H2S*-equipped bombers were detected as soon as they left the ground in Britain.¹⁴⁴ 'Naxos Z' (FuGe350Z) was also produced in small numbers, and was also designed to home in on *H2S* and *Fishpond*, but

¹⁴¹ Jones, 'Home Sweet Home', pp. 307–8. The Official History holds that all 1,500 were fitted to GAF nightfighters: Webster and Frankland, *The Strategic Air Offensive against Germany, Volume IV*, p. 17. See also Bernard Lovell, *Echoes of War: The Story of H2S Radar* (London: Adam Hilger, 1991).

¹⁴² C. H. Waddington, *O.R. in World War 2: Operational Research against the U-boat* (London: Paul Elek (Scientific Books), 1973), pp. 217–8 & 242. Waddington confirmed that by October 1943 'the fitting of 'Naxos' was 100% complete on boats' leaving the Bay of Biscay.

¹⁴³ CCAC RVJO B.63 & AIR 20/5804, Minute from ADI (Science) dated 4 May 1944; see also Hinsley *et al*, *British Intelligence in the Second World War, Volume III, Part I*, pp. 315 & 562.

¹⁴⁴ CCAC RVJO B.66 & TNA AIR 20/1652, Air Scientific Intelligence Report No.73 'Raid-Tracking Organisation (Flugwegverfolgung)', 13 July 1944; Webster and Frankland, *The Strategic Air Offensive against Germany, Volume IV*, p. 13; CCAC RVJO B.79, TNA AIR 8/831 & TNA AIR 20/1654, Air Scientific Intelligence Report No.83 'Recent Developments in German Route Tracking and RCM', 26 March 1945, p. 6.

equipped with visual indicators.¹⁴⁵ Utilising similar principles further down the frequency scale, was 'Samos' and 'Doppel Domeier'.¹⁴⁶ In addition, 'Flensburg' (FuGe227) was apparatus designed to home in on British *Monica* devices.¹⁴⁷ *Flensburg* and *Lichtenstein-SN2* became available for TRE examination when a Ju-88 landed intact at Woodbridge on 13 July 1944.¹⁴⁸ That very day, ADI (Science) revealed that the GAF Raid-Reporting Organisation were plotting no less than eight different types of bomber radiation transmissions, from W/T, R/T and also centimetric radar.¹⁴⁹

A clever method of camouflage from *H2S* was also devised by German boffins. This entailed radar-decoy buoys floated in harbours to disguise ground echoes with spurious reflections. Such 'corner reflector' devices were photographed by PRU on 18 September 1944 at Kiel, and on 21 November at Wilhelmshaven, and had been brought to the attention of ADI (Science) by NID23.¹⁵⁰ Wavell recalled that decoys 'appeared as white crosses on water' with upright poles protruding from their centres which he gauged at 3ft high.¹⁵¹

¹⁴⁵ CCAC RVJO B.64, Air Scientific Intelligence Report No.107 'German Radar Progress', 29 June 1944, p. 5.

¹⁴⁶ CCAC RVJO B.66 & TNA AIR 20/1652, Air Scientific Intelligence Report No.73 'Raid-Tracking Organisation (Flugwegverfolgung)', 13 July 1944.

¹⁴⁷ CCAC RVJO B.70, TNA AIR 8/831 & TNA AIR 20/1653, Air Scientific Intelligence Report No.79 'The Present Eclipse of the German Nightfighters', 16 November 1944, p. 5; TNA AIR 41/10, *The Rise and Fall of the German Air Force*, p. 278; Hinsley *et al*, *British Intelligence in the Second World War, Volume III, Part I*, pp. 563–4.

¹⁴⁸ CCAC RVJO B.67 & TNA AIR 20/1686, Air Scientific Intelligence 'Interim Report on the FuGe 220 and FuGe 227', 15 July 1944.

¹⁴⁹ CCAC RVJO B.66 & TNA AIR 20/1652, Air Scientific Intelligence Report No.73 'Raid-Tracking Organisation (Flugwegverfolgung)', 13 July 1944; Hinsley *et al*, *British Intelligence in the Second World War, Volume III, Part I*, p. 315.

¹⁵⁰ CCAC RVJO B.72, TNA AIR 8/831 & TNA AIR 20/1646, Air Scientific Intelligence Report No.29 'Camouflage against H2S', 5 December 1944.

¹⁵¹ TMC MED/DFG 5794, Claude Wavell interviewed by Constance Babington Smith, 24 May 1956. These decoys led to yet another discrepancy between the two organisational heads. Wavell remembered that Jones disagreed with his measurement of the poles and suggested them to be 10 to 12ft high. Wavell was 'naturally delighted when he had the chance of measuring one on the ground when he went over to Germany, and found 3ft was right'.

In relaying collated intelligence on these decoys, ADI (Science) added that before *H2S* had come into operation, Dee had investigated the possibility of *H2S* being affected by corner reflectors. ADI (Science) quoted some of Dee's conclusions, but expressed little concern over existence of the buoys — essentially because they posed no direct threat to *H2S* sets or their effectiveness. This was confirmed by PPI photographs taken upon bomb release, which showed no false echo at either Kiel or Wilhelmshaven. ADI (Science) were surprised by the buoys negative effect, for they knew the GAF were experimenting with captured *H2S*.¹⁵²

Enigma traffic did not show that *H2S* was known to the Germans until March 1944 and, as *H2S* was captured near Rotterdam in February 1943, ADI (Science) were significantly concerned about losing centimetric advantage.¹⁵³

Jones recalled that his initial interest was piqued when the decision was made to allow Bomber Command rather than Coastal Command to first use *H2S* operationally.¹⁵⁴ ADI (Science) warned of repercussions of this decision, before *H2S* was used operationally. Their primary concern was that loss of *H2S* jeopardised centimetric ASV, which, in turn, could pose critical concerns regarding the 'mortal threat of the U-Boats'. For this reason they believed it imperative that the Germans were not provided with *H2S* wavelengths.¹⁵⁵

¹⁵² CCAC RVJO B.72, TNA AIR 8/831& TNA AIR 20/1646, Air Scientific Intelligence Report No.29 'Camouflage against H2S', 5 December 1944; Hinsley *et al*, *British Intelligence in the Second World War, Volume III, part I*, p. 561. *H2S* was known as 'Rotterdam-Gerät' to the GAF because of their first capture of *H2S* from a crashed Stirling bomber on 3 February 1943 near the city of Rotterdam.

¹⁵³ Hinsley *et al*, *British Intelligence in the Second World War, Volume III, Part I*, p. 561.

¹⁵⁴ Jones, *Most Secret War*, pp. 319–20; Hastings, *Bomber Command*, p. 179; Jones, 'The Other Way Round', p. 472.

¹⁵⁵ CCAC RVJO B.41, ADI (Science) memorandum 'Repercussions of H2S on Air/Sea Warfare', 23 January 1943. Attached to this Minute was an interim report entitled 'German R.D.F. in Air/Sea warfare' in which ADI (Science) proposed camouflaging *H2S* by fitting British aircraft with 80cm or

That *H2S* was compromised (somewhat ironically) only three days after it was first used operationally in the Hamburg raid of 30/31 January 1943, fully confirmed these concerns. In February 1944, ADI (Science) reported that early loss of *H2S* ‘undoubtedly presented the enemy with P.P.I. technique’ and that although the GAF had not yet produced any new method based upon it, one ‘must be expected’.¹⁵⁶ Loss of other Allied airborne devices also caused ADI (Science) concern. In the same month a Gee set (German codename ‘Truhe’) was found in a downed *Luftwaffe* bomber, and so TRE had to investigate methods of jamming their own devices.¹⁵⁷ In August 1944, moreover, ADI (Science) warned of convincing evidence that the GAF had been experimenting with captured American IFF.¹⁵⁸

DT and D-Day

By early 1944, it had been estimated that between three to four thousand German ground radar stations were operative, stretching from Norway to Spain, and into Denmark and Germany.¹⁵⁹ For Jones, D-Day was ‘a most satisfactory episode of the Radio War’ – one that ADI (Science) had been ‘looking forward to’ for years because, through ‘all possible techniques’ of intelligence they could compile a complete picture of Channel coast DT

62cm ASV instead of new centimetric ASV thereby masking surprise attacks; see CCAC RVJO B.40, Air Scientific Intelligence Interim Report ‘German R.D.F. in Air/Sea Warfare’, 21 January 1943.

¹⁵⁶ CCAC RVJO B.57, & TNA AIR 20/1640 Air Scientific Intelligence Report No.23 ‘Control and Plotting at a German GCI Station’, 28 February 1944, p. 2. If, as Hinsley *et al* said, Enigma did not report that *H2S* had been revealed to the Germans until March 1944, and ADI (Science) reported the ‘early loss’ of *H2S* on 28 February 1944, then how ADI (Science) discovered the *H2S* loss is unclear.

¹⁵⁷ Hinsley *et al*, *British Intelligence in the Second World War, Volume III, Part I*, p. 576.

¹⁵⁸ CCAC RVJO B.67, TNA AIR 8/831 & TNA AIR 20/1687, Air Scientific Intelligence Interim Report ‘Enemy Use of American I.F.F.’, 9 August 1944.

¹⁵⁹ RAFM AC 944633, ‘Air Staff Operational Monograph No.1: Countermeasures to German R.D.F. Defences, May 1944, p. 1.

defences.¹⁶⁰ Although not entirely confusing ADI (Science)'s drive to understand and overcome the GAF nightfighter system, intermittent emerging evidence on alternate DT did complicate matters throughout their investigations. The easiest way to allay complication was to compartmentalise differing aspects of DT, which had the dual purpose of warning relevant responsible authorities. DT technicalities which did not correlate with GAF GCI intelligence were dispensed with through interim reporting and then filed for future reference.

By December 1943, and with *Overlord* preparations in mind, ADI (Science) produced SIR No.20, detailing German ground radar characteristics accumulated over the previous three years. Categories comprised *Freya*, *Gema Coastwatcher*, *Hoarding*, *Chimney*, Lorenz sets, *Würzburg*, *Würzburg-Reise*, and sea-watching *Würzburg*. Each was presented with technical specifics and in diagrammatical form.¹⁶¹ Just before D-Day ADI (Science) made useful comparisons: in '1940 the Germans regarded radar as a means of economising in Observer Corps'; in '1942 they used it to economise in fighters'; but in '1944 all signs of economy' had 'disappeared', and radar had become 'an end in itself'.¹⁶²

The second SIR in the series 'anticipating the re-opening of the First Front' was SIR No.22A (superseding No.20 and No.22), which pinpointed known

¹⁶⁰ CCAC RVJO J.1, 'The Radio War', p. 21.

¹⁶¹ CCAC RVJO B.54 & TNA AIR 20/1636, Air Scientific Intelligence Report No.20 'German Ground Radar Characteristics', 14 December 1943.

¹⁶² CCAC RVJO B.58, SIR No.101 'German Radar Development', 6 March 1944.

locations of coastal DT from Norway to the Spanish frontier.¹⁶³ SIR No.24 supplemented, first SIR No.20, and later SIR No.22A, by providing recognition through air and ground photographs and drawings of known DT.¹⁶⁴ SIR No.22A noted that both companion SIRs were to be accompanied by *Rhubarb* Appendix No.XII prepared by CIU.¹⁶⁵ Fighter Command's Appendix No.XII operational instructions had been a regular contribution throughout the war, jointly produced by CIU and ADI (Science).¹⁶⁶

Owing to fresh evidence and systematic attacks on previously reported locations, an Amendment List to SIR No.22A was also distributed.¹⁶⁷ List No.1 was expected to be the first of many but ADI (Science) did not produce further Amendment Lists. SIR No.22A was superseded on 10 December 1944 by SIR No.30 entitled 'The Location of German Radar and Special Radio Stations in Western Europe'. This listed pinpointed locations of GAF radar and radio stations including 'Elektra', *Benito*, 'Bernhard', and 'Erika' across Norway, Holland, Denmark, and Germany (excluding East Prussia).¹⁶⁸ The final SIR in the DT series, and indeed of the war, was SIR No.34, which presented all known DT characteristics up to April 1945 (data reproduced overleaf), and

¹⁶³ CCAC RVJO B.61 & TNA AIR 20/1639, Air Scientific Intelligence Report No.22A 'The Location of German Coastal Radar Between Skagen and Bayonne', 10 April 1944. Air Scientific Intelligence Report No.22 is not in the Jones archive, or in the National Archive. Nor is No.26 (if it existed). Perhaps these reports were produced but not circulated due to superseding intelligence.

¹⁶⁴ CCAC RVJO B.60 & TNA AIR 20/1641, Air Scientific Intelligence Report No.24 'Recognition of German Ground Radar', 21 March 1944. Figures 60–74 comprising illustrative stereo pairs are missing from this SIR, extracted contemporaneously for pilot briefings on destruction of the particular sites.

¹⁶⁵ CCAC RVJO B.61 & TNA AIR 20/1639, Air Scientific Intelligence Report No.22A 'The Location of German Coastal Radar Between Skagen and Bayonne', 10 April 1944.

¹⁶⁶ Jones mentioned this collaboration once, in which he described his 'Unit' and Wavell's 'Unit': Jones, *Most Secret War*, pp. 400–1.

¹⁶⁷ CCAC RVJO B.63 & TNA AIR 20/5804, 'Amendment List to Air Scientific Intelligence Report No. 22A', 27 June 1944.

¹⁶⁸ CCAC RVJO B.73 & TNA AIR 20/1647, Air Scientific Intelligence Report No.30 'The Location of German Radar and Special Radio Stations in Western Europe', 10 December 1944.

Table I: Characteristics of German Ground Radar.¹⁶⁹

Type	Purpose/ Additional Purpose	Manufacturer	Date Introduced	Number in Service Dec. 1944
<i>Freya LZ</i> (Pole <i>Freya</i>)	Aircraft reporting/ interception control	Gema	1941	400
<i>Freya Lafayette</i> (Limber <i>Freya</i>)	Coastwatcher/ Flak fire control	Gema (1939-40) AEG/Telefunken	1941	500
<i>Freya Koethen</i>	Flak fire control	AEG/Flak School	1942	200
<i>Freya LZ/ Wismar</i>	IFF interrogator	Gema/AEG	1942-3	400
Limber <i>Freya/</i> <i>Wismar I</i>	IFF interrogator	AEG/Telefunken	1942-3	500
<i>IF Freya LZ/Egon</i>	Fighter control	Gema/Telefunken	1942-3	300
<i>IG Freya Voll/Wismar</i> <i>and Drehfreya</i>	Aircraft reporting	Telefunken/AEG/ Lorenz	1944	100
<i>Freya Fahrstuhl</i>	Medium-range height finding	Gema	1943	20
IJ Crossbar	Coastwatcher	Gema	1942-3	5
<i>Calais Lafette</i> (<i>Seetakt</i>)	Coastwatcher	Gema	1939	150
<i>Calais/Zerstörersäule</i> (<i>Seetakt</i>)	Coastwatcher	Gema	1942-3	100
<i>Mammut Gustav</i>	Large Coastwatcher	Gema	1942-3	15
<i>Mammut C</i> (Small Hoardings)	Coastwatcher	Gema	1942-3	20
<i>Mammut F</i> (Hoarding)	Long-range height finding	Gema/MNVK Pelzerhaken	1941-2	9
Wasserman S	Aircraft reporting; long- range interception control	Gema	1942	16
<i>Wassermann M and</i> <i>Wassermann MI</i>	Long-range aircraft reporting	Gema/Siemens	1943	40
<i>Wassermann L</i>	Aircraft reporting	Gema/Zeppelin	1942	10
Wideband <i>Wassermann</i> <i>MI and MIV</i>	Long-range aircraft reporting	AEG/Siemens	1943-4	40
<i>Wassermann M and S/</i> <i>Klein Heidelberg</i>	Long-range aircraft reporting	Gema/LN Versuchs Regiment	1943-4	6
<i>Jagdschloss</i>	Aircraft reporting (with PPI)	AEG/Siemens	Late 1943	30
<i>Elefant</i>	Early warning	?	Experimental	5
FMG 39L/40L	Flak control	Lorenz	1939/40	50
<i>Würzburg Type A</i>	Coastwatcher/ height finding/ blind landing aid	Telefunken	1940	200
<i>Würzburg Type C</i>	Flak fire control	Telefunken	1941	300
<i>Würzburg Type D</i>	Flak fire and searchlight control; GCI	Telefunken	1941/2	2000
Giant <i>Würzburg</i>	Interception control/ Coastwatcher	Telefunken/Zeppelin/ AEG	1941	600
<i>Mainz</i>	Flak fire control	Telefunken	1942	50
<i>Mannheim A & B</i>	Flak fire control	Telefunken	1942/3	500–800
<i>See-Riese</i>	Surface vessel detection	Telefunken	1941/2	20
<i>Riese G</i>	Early warning/ height finding	Gema/Telefunken	1944	50
<i>Mannheim Riese</i>	(Presumed) flak fire control	Telefunken	1941/2	50

¹⁶⁹ All data extracted from CCAC RVJO B.81, CCAC RVJO B.82 & TNA AIR 20/1561, Air Scientific Intelligence Report No.34 ‘Characteristics of German Ground Radar’, April 1945. There was a considerable drive during production of this equipment to combat British electrical jamming and *Window*. This led to a variety of anti-jamming devices and a considerable increase in the width of frequency bands employed. This in turn led to the appearance of a large number of DT sub-types (particularly *Freya*) differing only in the radio frequency circuits and aerial systems.

which truly demonstrated the extent to which ADI (Science) appreciated the diversity and dispersal of DT.¹⁷⁰

In addition to the collective DT SIR series, ADI (Science) produced interim reports and specific SIRs detailing DT intelligence as and when discovered. These merit only brief mention here. In December 1943 they reported intelligence received through 'Army channels' on Italian early-warning radar near Taranto.¹⁷¹ A March 1943 interim report detailed known specifics of a 125ft high by 8ft wide *Freya* derivative called *Wassermann* by the Germans and 'Chimney' by CIU and ADI (Science).¹⁷² Such name provision for DT variants was based entirely on appearance—another collaborative project symbolic of the close liaison between G-Section and ADI (Science) throughout the war. Despite post-war factual discrepancies between Wavell and Jones, the two organisations worked well together, even to the point where Wavell was known as 'Uncle Claude' within ADI (Science). Many joint DT discoveries were put forward by G-Section as *Rhubarb* targets.¹⁷³

Wassermann was 'the finest early warning radar produced by either side during the Second World War.'¹⁷⁴ ADI (Science)'s intelligence of its initial discovery derived from Enigma decrypts, blueprints of construction work from

¹⁷⁰ CCAC RVJO B.81 & TNA AIR 20/1651, Air Scientific Intelligence Report No.34 'Characteristics of German Ground Radar', April 1945.

¹⁷¹ CCAC RVJO B.53, Air Scientific Intelligence 'Interim Report on Italian Radar', 4 December 1943. The intelligence was from Lieutenant Colonel D.S. Studholme of ADA, dated 6 November 1943, and was attached to ADI (Science)'s Interim Report.

¹⁷² CCAC RVJO B.46 & TNA AIR 20/1679, Air Scientific Intelligence Interim Report 'Chimney', 17 March 1943; Hinsley *et al*, *British Intelligence in the Second World War, Volume II*, pp. 250–2.

¹⁷³ TMC MED/DFG 5794, Claude Wavell interviewed by Constance Babington Smith, 24 May 1956. One such DT transmitter, found in Aquihen was named 'The Horse-Bird' by G-Section and ADI (Science). A similar transmitter found east of Cherbourg was then called 'The Bird-Horse'. Neither of these DT derivatives feature in ADI (Science)'s SIRs or in Jones's post-war literature.

¹⁷⁴ Price, *Instruments of Darkness*, p. 69.

HUMINT agency, PRU photography and G-Section interpretation, and AI1(k) interrogation. ADI (Science) first thought *Wassermann* was coast-watching DT, but decrypts confirmed they were GAF apparatus rather than *Kriegsmarine*. ADI (Science) distributed a fascinating photograph (Sortie C/599 1 PRU 10.11.42) showing clearly the long shadow of a *Wassermann*.¹⁷⁵ The only mention of *Wassermann* in *Most Secret War* was Jones's reference to the successful pre-D-Day attack upon a 'Wassermann 3' installation on 16 March 1944 by rocket-firing typhoons of RAF No.198 Squadron.¹⁷⁶

Documentation shows that *Wassermann* presented concern to ADI (Science) during 1944. ADI(K) confirmed that the GAF adapted *Wassermann* to use radiations from British CH stations to plot British aircraft through *Mandrel* screens. ADI (Science) deduced from their extensive DT knowledge that if this was the case, *Wassermann* usage had to be 'small scale'. This baffled them, for since D-Day the main problem for the GAF had been lack of early-warning, and silence from Allied bombers evading GAF Y (used heavily in replacement for loss of early-warning). ADI (Science) believed it inconceivable that the GAF would neglect any available method of early-warning, and guessed that *Wassermann* must have encountered technical difficulties. They concluded that while the picture was unclear, the method represented a significant threat to the Allied bomber offensive—one not to be neglected.¹⁷⁷

¹⁷⁵ CCAC RVJO B.46 & TNA AIR 20/1679, Air Scientific Intelligence Interim Report 'Chimney', 17 March 1943. The Enigma decrypts were protected in the interim report by the words 'one of our agents achieved a fortunate glimpse of German plans'.

¹⁷⁶ Jones, *Most Secret War*, pp. 403–5; see also Price, *Instruments of Darkness*, pp. 200–1.

¹⁷⁷ CCAC RVJO B.71, TNA AIR 8/831 & TNA AIR 20/1690, Air Scientific Intelligence Interim Report 'Heidelberg', 24 November 1944, p. 2. *Heidelberg* was the German name for presentation

DT codenamed 'Jagdschloss' was reported by ADI (Science) in October 1944. As a *Freya* derivative it posed little threat, for ADI (Science) recommended that RCMs that attacked *Freya* would work on *Jagdschloss*. This explains why Jones also only referred to this particular DT once in *Most Secret War*, in reference to effective jamming.¹⁷⁸ Nevertheless, *Jagdschloss* represented GAF attempts to adapt to difficulties in nightfighter control following the loss of its early-warning screen. It also interested ADI (Science) because a POW spoke of *Jagdschloss* being a *Panorama-Gerät* – the German equivalent for British PPI. If true (they were unsure in this regard), then *Jagdschloss* would have been the first example of GAF PPI presentation. ADI (Science) surmised that as *Jagdschloss* was unable to determine height (like *Freya*), then *Wassermann* may well partner *Jagdschloss*, and deduced that *Wassermann* and *Jagdschloss* 'should cover most of Germany' by the end of 1944.¹⁷⁹

Two other DT derivatives deemed worthy of report by ADI (Science) were 'Mannheim' and 'Elefant' – neither of which merited mention in *Most Secret War*. *Mannheim* was investigated by ADI (Science) to the extent that it warranted an SIR. *Mannheim-Gerät* (designated FMG-41T or FuSE-64) was a higher-power *Würzburg* evolution designed for flak control, and fitted as standard with *Stendal* and *Goldammer* anti-jamming devices. Although GAF flak defences were never able to regain anything like their previous technical

equipment for *Wassermann*. Although it operated only on a small scale, *Heidelberg* tracked Allied bombers (despite *Mandrel* screens) by receiving transmissions from bomber radio aids.

¹⁷⁸ Jones, *Most Secret War*, p. 465. Plates 29b and 29c show how *Window* blocked out whole areas of the cathode ray tube presentation.

¹⁷⁹ CCAC RVJO B.69, TNA AIR 8/831 & TNA AIR 20/1689, Air Scientific Intelligence Interim Report 'Jagdschloss', 6 October 1944.

efficiency, *Mannheim* did provide equipped flak-batteries with considerable accuracy.¹⁸⁰ ADI (Science) also expected *Mannheim* to be fitted with a new system of IFF they knew was coming into service, called 'Kuckuck' (Cuckoo). *Mannheim* was mobile, mounted on special trailers with detachable two-wheel bogies, and was a prime example of the direction the war was taking by late 1944. ADI (Science) reported that *Mannheim* was mass-produced at the rate of twenty sets per month, and estimated that, by early-January 1945, some 300 sets were in operational use by the *Flakwaffe*.¹⁸¹

Elefant was the rarest and largest of GAF DT. It was so rare that ADI (Science)'s knowledge of *Elefant* in March 1945 was 'scanty and conflicting', yet they believed they had sufficient data for an interim report potentially of service to RCM producers and users. *Elefant* was also of little threat, yet interesting nonetheless for it was the nearest counterpart to British RDF (working at 30-40Mc/s and providing early-warning at ranges of 300km on large aircraft). ADI (Science) were aware of its use to determine bearing and ranging, and its height-finding capability. They warned that, as *Elefant arrays* were known to operate at Römö and Juist, if Allied forces were to be protected in Heligoland Bight and over Schleswig-Holstein, then 'special countermeasures' were required.¹⁸² Two features of this interim report are

¹⁸⁰ Hinsley *et al*, *British Intelligence in the Second World War, Volume III, Part I*, p. 551.

¹⁸¹ CCAC RVJO B.76 & TNA AIR 20/1648, Air Scientific Intelligence Report No.31 'Mannheim', 25 January 1945. ADI (Science) expected rates of production had been delayed owing to the liberation of France and Holland, for many Mannheim sets were ordered from Radio Technique and Philips. Intelligence for this SIR derived from a factory engineer informant and a technical manual.

¹⁸² CCAC RVJO B.78, TNA AIR 8/831 & TNA AIR 20/1693, Air Scientific Intelligence Interim Report 'Elefant – German CH', 20 March 1945.

notable. The first is its wide distribution.¹⁸³ The other feature is the nature of source – not only the usual low-and-high-grade SIGINT, POW intelligence, and photography, but also captured maps, lecture notes, and other documents. Both of these features emphasise the ease of intelligence work for ADI (Science) during the Allied invasion of occupied Europe.

SIR No.101 of March 1944 began a series of SIRs, with each supplementing the last. Distribution of these SIRs steadily rose from thirty-five initially to fifty by February 1945. The reports covered all known new DT, as well as developments in AI, ASV, DT for U-boats, and German DT policy. Sources extended to American cine-film (of *Lichtenstein-SN2* aerials) and captured manuals and handbooks – one of the latter provided by 30AU at Arromanches fulfilling their original purpose as intelligence commandos.¹⁸⁴ The only intelligence in this series of SIRs that has not already been covered here, was that alluding to development of German centimetric AI. In SIR No.107, ADI (Science) reported that the Germans were copying *H2S*, and had built experimental 9cm equipment with some form of magnetron.¹⁸⁵ SIR No.109 added little to this other than to repeat that the GAF had probably developed centimetric AI and had introduced air-to-air recognition. This intelligence was based on SIGINT provided by DDI4, and ELINT from RAF No.192 (SD)

¹⁸³ Fifty-four copies in all were produced and presented, two-thirds to the usual recipients – Cherwell, TRE, and the intelligence chiefs within Air Ministry and MAP – and the other third to the invasion Command Chiefs, eight of which were US recipients.

¹⁸⁴ CCAC RVJO B.64, Air Scientific Intelligence Report No.107 ‘German Radar Progress’, 29 June 1944, pp. 1–3; Nicholas Rankin, *Ian Fleming’s Commandos: The Story of the Legendary 30 Assault Unit* (Oxford: OUP, 2011), p. 239. Snap-shots of the cine-gun film were included in SIR No.107. For more on 30AU, see Hinsley *et al*, *British Intelligence in the Second World War, Volume III, Part I*, pp. 468–70; www.30au.co.uk, accessed 12 March 2012; ‘The History of 30AU’ television documentary, produced by Vernon Kay in 2011, which accompanied *The Age of Heroes*, produced by Lex Lutzus, Nick O’Hagan, Jamkes Youngs, and James Brown for Giant Films in 2011.

¹⁸⁵ CCAC RVJO B.64, Air Scientific Intelligence Report No.107 ‘German Radar Progress’, 29 June 1944, pp. 4–5.

Squadron, who heard 3290Mc/s (9.1cm) transmissions.¹⁸⁶ It was also noted that the *Kriegsmarine* had borrowed several items of DT from the GAF, presumably as the latter had little use for them after D-Day.¹⁸⁷

Once captured, details of GAF decimetric communications equipment made their way to ADI (Science). These provided the focus for SIR No.28. Summarising the main characteristics of each, this report mostly comprised of statistical and explanatory data, and technical illustrations.¹⁸⁸ This SIR was a fine example of how intelligence on DT had become much less important to the ADI (Science) daily routine, and had been replaced with scientific appreciation of the quarry they had chased for so long. In November 1944 they were able to report the eclipse of the German nightfighters, in light of changes imposed upon them following liberation of Belgium and France. Although *Nürnberg*, *Laus*, *Stendal* and *Goldammer* had been partially successful, British raiding had become so acute that *Würzburg* was no longer of fundamental importance to GAF GCI. *Mandrel* had effectively negated the long-range plotting network based on *Freya*, *Mammut*, *Wassermann*, and *Jagdschloss*. The GAF was looking to produce more powerful valves and magnetrons to help overcome their difficulties. Its nightfighters had resorted to shadowing intruder bomber forces using *Flensburg* and *Naxos* equipment. Once fighters made contact, flares marked positions to assist other fighters in

¹⁸⁶ CCAC RVJO B.77 & TNA AIR 8/831, Air Scientific Intelligence Report No.109 'Recent Developments in German Radar', 22 February 1945, p. 9. At the time, the Halifax pilots of 192 Squadron called their task the 'Electrical Intelligence campaign'; see CCAC RVJO B.531, Harold Kendall-Wigley to Jones, 10 February 1991.

¹⁸⁷ CCAC RVJO B.64, Air Scientific Intelligence Report No.107 'German Radar Progress', 29 June 1944, p. 3.

¹⁸⁸ CCAC RVJO B.68 & TNA AIR 20/1645, Air Scientific Intelligence Report No.28 'Summary of Characteristics of German Decimetre Communications Equipment', 2 September 1944.

locating bomber streams. *Benito* and *Egon* were still used 'to some extent to assist the fighters in navigation'. ADI (Science) concluded SIR No.79 by stating that one duty of intelligence was to discover reasons why enemies succeed, which had been the origin of several past SIRs in the past. In contrast, SIR No.79 had 'the pleasanter duty of recording a picture' showing gaps in the British bomber defence (revealed by past intelligence) had been filled, and that weak points in the enemies' defences had been thoroughly exploited by countermeasures.¹⁸⁹

The GAF sought every opportunity to react to the immense pressure imposed upon them by the Allies. As late as December 1944 they remarkably demonstrated some offensive spirit, for warnings of impending intruder attacks upon Britain by GAF nightfighters screened by *Düppel* were distributed by ADI (Science).¹⁹⁰ When the British moved *Oboe* stations into France, Holland, and Belgium for deeper bombing penetration into Germany, *Oboe* operations were watched carefully by GAF intelligence in order to obtain early-warning of designated targets.¹⁹¹ An 'anti-Oboe organisation' based at Duisburg, had been established in November 1943 – a special GASER detachment (IVth *Abteilung* of LN Regiment 351) – to investigate methods of defence against *Oboe*. From July 1944, they listened to *Oboe* transmissions and predicted with 10–15 minutes warning where the Allies were due to strike. What betrayed the Allies in this regard was W/T, for *Oboe* stations in Britain used landline communications before each operation. By March 1945, ADI

¹⁸⁹ CCAC RVJO B.70, TNA AIR 8/831 & TNA AIR 20/1653, Air Scientific Intelligence Report No.79 'The Present Eclipse of the German Nightfighters', 16 November 1944.

¹⁹⁰ CCAC RVJO B.74, Minute from ADI (Science) dated 15 December 1944.

¹⁹¹ CCAC RVJO B.66 & TNA AIR 20/1652, Air Scientific Intelligence Report No.73 'Raid-Tracking Organisation (Flugwegverfolgung)', 13 July 1944.

(Science) were able to assure that this situation 'had been tightened up', and that Allied introduction of centimetric *Oboe* had 'considerably increased the enemy's difficulties' because 'centimetre technique was still something of a novelty to the Germans'.¹⁹²

Captured documents also showed that the *Oboe* method of bombing, what the Germans called 'Bumerang', was actually mimicked by the GAF in early 1945.¹⁹³ As the Allies advanced through Europe, the GAF resorted to tactical bombing using their *Oboe*-derivative. 'Egon-Zweistand-Bumerang-Verfahren' (*Egon*) used beam transmissions from two *Freya* stations, one of which had to be repositioned for each change in target. This was referred to by ADI (Science) as 'Plotting and Control with two Freyas' and differed from the procedure relayed by Jones and Hinsley *et al*, which used one *Freya* and an R/T transmitter to communicate with FuGe25A.¹⁹⁴ ADI (Science) reported that a full *Egon* control station would have as many as four *Freyas*, and that such a station had been photographed near the *Benito* station at Lantin near

¹⁹² CCAC RVJO B.79, TNA AIR 8/831 & TNA AIR 20/1654, Air Scientific Intelligence Report No.83 'Recent Developments in German Route Tracking and RCM', 26 March 1945, pp. 1–2.

¹⁹³ CCAC RVJO B.80, TNA AIR 8/831 & TNA AIR 20/1650, Air Scientific Intelligence Report No.33 'Benito Control of Fighters and Egon Control', 20 April 1945, p. 16; CCAC RVJO B.64, Air Scientific Intelligence Report No.107 'German Radar Progress', 29 June 1944, p. 6; Hinsley *et al*, *British Intelligence in the Second World War, Volume III, Part I*, p. 563. See also TNA AIR 8/831, Air Scientific Intelligence Report No.25 'German Control of Fighters by the Benito and Egon Methods', 15 June 1944, for an early ADI (Science) appreciation of this method of GAF fighter control. This SIR is not in the CCAC Jones papers.

¹⁹⁴ CCAC RVJO B.80, TNA AIR 8/831 & TNA AIR 20/1650, Air Scientific Intelligence Report No.33 'Benito Control of Fighters and Egon Control', 20 April 1945, p. 16; Hinsley *et al*, *British Intelligence in the Second World War, Volume III, Part I*, p. 557; Jones, *Most Secret War*, p. 397. Hinsley *et al* make fleeting mention of *Egon* used by GAF nightfighters. Neither Jones nor Hinsley *et al* refer to SIR No.33 or to the two *Freya* control method of *Egon*. It is likely that Hinsley *et al* did not have access to SIR No.33 (not in the official files), and perhaps Jones deemed the information irrelevant. But the fact that ADI (Science) reported the two *Freya Egon* cannot be ignored. They even specified that there was 'no technical difficulty in one FuGe25A responding to two interrogating Freyas' provided their pulse rate frequencies differed.

Liege.¹⁹⁵ *Egon* was also used as a bombing procedure by the *Luftwaffe*. First employed in the February 1944 'Baby Blitz' raids on London, it required directed aircraft to be equipped with FuGe25A (GAF IFF). ADI (Science) reported on FuGe25A during the Baby Blitz, based on evidence from DDI4, ADI(K), AI2(g), and reports from TRE (No.EAM74) and RAE (No.T1614).¹⁹⁶ Unable to fully appreciate *Egon* until many contributory sources had been exploited following the liberation of France, Belgium, and Holland, ADI (Science) ended their penultimate SIR by declaring that POW statements and captured documents had 'played by far the greatest part in the increase' of scientific intelligence on the *Benito* and *Egon* methods of aircraft control.¹⁹⁷

In his memoirs, Jones recalled British victory over FuGe25A, through targeting its pulse transmissions with RDF transmitters and receivers, so that intruders could be seen through *Düppel*, which was widely dispersed in every Baby Blitz raid.¹⁹⁸ British flak and fighters could then be directed accordingly. Once again Jones claimed credit for this idea, and told of a Cabinet meeting during which Clement Attlee acknowledged Jones as the man responsible.¹⁹⁹ Yet there is no mention of *Egon* in *Most Secret War*.²⁰⁰ Perhaps this was an oversight on Jones's part due to the *Egon* principle being of little threat once

¹⁹⁵ CCAC RVJO B.64, Air Scientific Intelligence Report No.107 'German Radar Progress', 29 June 1944, p. 2.

¹⁹⁶ CCAC RVJO B.59 & TNA AIR 20/1655, Air Scientific Intelligence Report No.89 'The FuGe 25A Bombing Procedure', 11 March 1944.

¹⁹⁷ CCAC RVJO B.80, TNA AIR 8/831 & TNA AIR 20/1650, Air Scientific Intelligence Report No.33 'Benito Control of Fighters and Egon Control', 20 April 1945, p. 18.

¹⁹⁸ Hinsley *et al*, *British Intelligence in the Second World War, Volume III, Part I*, p. 573.

¹⁹⁹ Jones, *Most Secret War*, pp. 396–8. Although Jones wrote that the follow-up meeting in the Cabinet Room occurred a week after the end of January 1944, War Cabinet records around that time do not confirm Jones's claim. The resulting device – the 'Perfectos' – was not produced in time to affect the Baby Blitz.

²⁰⁰ There is a brief mention of *Egon* by Jones in his 'Navigation and War' (p. 21), published only three years before *Most Secret War*.

discovered. Or perhaps Jones preferred to mask the fact that ADI (Science) had not fully grasped the aircraft control method used in the Baby Blitz.

In *Most Secret War*, Jones provided a diagram he entitled 'The Bombing System used in the 'Baby Blitz', January/March 1944'.²⁰¹ This he had extracted from SIR No.89 detailing FuGe25A, in which the figure is entitled 'FuGe25A Bombing System'.²⁰² Figure 10 of SIR No.33, entitled 'Egon Fighter Control', shows the same diagram but with the target and the split *Freja* beam removed.²⁰³ ADI (Science) reported that *Egon* was 'extensively used' for control of jet-propelled aircraft 'of Battle Unit Hallensleben in attacks on airfields and in support of the army'.²⁰⁴ Also of interest is that ADI (Science) warned that documents captured at Luzon confirmed that the Japanese had produced a device 'very similar in principle to Egon'.²⁰⁵ Only Hinsley *et al* have referred to *Egon*, and even then as a navigational bombing aid which 'by the end of May [1944] the Germans had abandoned'.²⁰⁶ Given that ADI (Science) placed much importance upon *Egon* as a fighter control method in April 1945, it is important that the subject is not overlooked. It has until now and perhaps the reason for this was simply due to *Luftwaffe* offensives mattering so little by April 1945.

²⁰¹ Jones, *Most Secret War*, pp. 398.

²⁰² CCAC RVJO B.59 & TNA AIR 20/1655, Air Scientific Intelligence Report No.89 'The FuGe 25A Bombing Procedure', 11 March 1944.

²⁰³ CCAC RVJO B.80, TNA AIR 8/831 & TNA AIR 20/1650, Air Scientific Intelligence Report No.33 'Benito Control of Fighters and Egon Control', 20 April 1945, Figure 10.

²⁰⁴ CCAC RVJO B.80, TNA AIR 8/831 & TNA AIR 20/1650, Air Scientific Intelligence Report No.33 'Benito Control of Fighters and Egon Control', 20 April 1945, p. 13.

²⁰⁵ CCAC RVJO B.80, TNA AIR 8/831 & TNA AIR 20/1650, Air Scientific Intelligence Report No.33 'Benito Control of Fighters and Egon Control', 20 April 1945, p. 1. This SIR had by far the largest distribution. Sixty-three copies in all were produced, some forty percent of which were distributed to Command Staff.

²⁰⁶ Hinsley *et al*, *British Intelligence in the Second World War, Volume III, Part I*, pp. 575–6.

Naxburg was yet another DT ground receiver designed to search for *H2S* transmissions, and was an ingenious combination of *Würzburg* and *Naxos* invented by Telefunken.²⁰⁷ Although the GAF made *Naxburg* operational from September 1943, no evidence was forthcoming of its existence—essentially because *Naxburg* did not radiate emissions. ADI (Science) finally reported on *Naxburg* in March 1945 after an Enigma decrypt betrayed the device.²⁰⁸ Moreover, *Naxburg* highlighted the GAF's desperation situation. ADI (Science) remarked in March 1945 that 'the last few months' had 'been critical for Germany', because all 'had to be subordinated to the vital needs of immediate defence'.²⁰⁹ This at a time when GAF fuel reserves were drastically dwindling, when it suffered a significant reduction of trained replacement pilots, and it lost the early-warning system (in the west) upon which it had depended for the previous four years.²¹⁰

DT Debrief

In their post-war history, ADI (Science) remarked that for the first three years of the war, 'the most important applications of science to war by the Germans lay in radio-navigation and radar'.²¹¹ The extent of applied DT ensured that the subject remained high on the ADI (Science) agenda until the end of the war. The impression Jones provided in *Most Secret War* regarding the middle years of the war was that victory over the Kamhuber Line was another great

²⁰⁷ Price, *Instruments of Darkness*, p. 176.

²⁰⁸ Hinsley *et al*, *British Intelligence in the Second World War, Volume III, Part I*, p. 560; CCAC RVJO B.79, TNA AIR 8/831 & TNA AIR 20/1654, Air Scientific Intelligence Report No.83 'Recent Developments in German Route Tracking and RCM', 26 March 1945, p. 5.

²⁰⁹ CCAC RVJO B.79, TNA AIR 8/831 & TNA AIR 20/1654, Air Scientific Intelligence Report No.83 'Recent Developments in German Route Tracking and RCM', 26 March 1945, pp. 1–2.

²¹⁰ Hinsley *et al*, *British Intelligence in the Second World War, Volume III, Part I*, p. 317.

²¹¹ CCAC RVJO B.83 & TNA AIR 40/1532, ADI (Science) official history 'Air Scientific Intelligence in War, 1939–45', 1 April 1946, p. 11; AHB, 'Air Ministry Intelligence', p. 294.

success for his scientific intelligence organisation; one that he masterfully led, overcoming all obstacles with few assistants and little outside assistance. The reality was very different.

The morale-lifting Bruneval Raid was pivotal in Jones's war and, somewhat naturally, was positioned precisely at the half-way stage of his *Most Secret War* (Chapter 27 of 53). It mattered little to history whether Jones was the instigator of the raid, but it mattered a great deal to him. The glory of the Bruneval Raid became a 'famous high-point' in Jones's war, as well as Jones's life.²¹² More importantly, from a technological perspective the Bruneval Raid was a TECHINT windfall of unquantifiable proportions. The captured equipment taught TRE so much about German technological capability, and this, coupled with mistakes learnt through the Baedeker Raids and the Channel Dash, led to radio war-winning technological advances.

The official history of the Allied bombing offensive states that, aside from a few brief periods, the radio war did not 'dislocate the air defence of Germany' but it did 'stave off a mastery of the night fighter over the night bomber, which might eventually have become as complete as that of the day fighter over the day bomber'.²¹³ The official history of the *Rise and Fall of the German Air Force* stated that the objective historian must concede that, in a surprising reversal of fortunes since the operational introduction of *Window*, the first six months of 1944 were 'a success for the German night fighter defences'.²¹⁴ This was due to impressive tactical adaptability following collapse of the rigid

²¹² Dom Stacpoole in 'Radar expert's wartime high point', *The Times*, 27 December 1997, 21.

²¹³ Webster and Frankland, *Strategic Air Offensive against Germany, Volume IV*, p. 24.

²¹⁴ TNA AIR 41/10, *The Rise and Fall of the German Air Force*, p. 279.

nightfighter system, steady expansion of the twin-engine nightfighter force, installation of heavier airborne armament, and above all, 'extensive development of the early warning system, in combination with running commentary'.²¹⁵ ADI (Science) provided 'an astonishingly comprehensive picture' of this GAF nightfighter system, and could have done little more than they did to provide timely and quality intelligence on the early-warning system—an intelligence problem that lasted for the duration of the war.²¹⁶

What stands out above all through comparative research of the SIRs, of *Most Secret War*, various war memoirs, and other archive material, is that ADI (Science) were assisted in their quest to understand DT and GAF GCI by many other organisations and individuals whose efforts have been too easily brushed aside, often because of the very ubiquity of Jones's personal version of wartime scientific intelligence. Highly praised by Jones yet rarely mentioned by historians is the contribution throughout the DT investigation by ADI (Science)'s only superior in Air Intelligence, Charles Medhurst. In 1961 Jones paid tribute to Medhurst, recalling that long before Bomber Command realised the magnitude of the GAF GCI threat, Medhurst grasped it, made arrangements for ADI (Science) to assess it, and gave them the 'fullest support right through the heat of the investigation'.²¹⁷

²¹⁵ Webster and Frankland, *Strategic Air Offensive against Germany, Volume IV*, p. 24.

²¹⁶ For 'an astonishingly comprehensive picture', see Hastings, *Bomber Command*, p. 159.

²¹⁷ Jones, 'Emotion, Science, and the Bomber Offensive', 908. Although not expanding too much upon this tribute to Medhurst in his memoirs, Jones did present the impression of a very amiable working relationship between himself and Medhurst: see as examples, Jones, *Most Secret War*, pp. 320, 340 & 497. When Jones applied for the vacant Chair of Natural Philosophy at Aberdeen University, Jones asked Medhurst to be one of his three referees: Jones, *Most Secret War*, p. 515.

Jones also placed great emphasis on how important PR was to scientific intelligence, and indeed believed that ADI (Science) 'owed much to it from 1939 to 1945'.²¹⁸ Yet ADI (Science) owed as much to the PIs as they did to the PRU pilots. G-Section PIs were rigorously trained to spot all kinds of peacetime and wartime transmitters and communication stations, and worked closely with (not for) ADI (Science).²¹⁹ Powys-Lybbe recalled that DT variants 'gradually made their appearance on the interpretation scene' and ADI (Science) 'helped with the information to clear up the mysteries'.²²⁰ Much the same can be said for the Y-Service, irrespective of Jones's preferred memory regarding the technical listening services. Jones later acknowledged the sterling work of the PIs and the radio intercept operators in his 1986 RAF Historical Society Inaugural Lecture – hardly surprising given the audience, and arguably much too little praise given too late.²²¹ TRE technicians were also invaluable to scientific intelligence, and it was no coincidence that two members of ADI (Science) were attached TRE staff. Many other organisations within the large Air Ministry Intelligence network were also of importance to scientific intelligence successes, and perhaps much more than Jones was prepared to admit in his post-war literature.

Of course, this all comes down to a question of sources. Because of the importance of scientific intelligence investigations, the widest range of sources was made available to ADI (Science). For example, after AI4(f) was given responsibility of GAF R/T traffic analysis, AI4 became the sole Air Ministry

²¹⁸ Jones, 'The Scientific Intelligencer', 2.

²¹⁹ TMC MHP468, 'Interpretation of Wireless Apparatus', p. 1.

²²⁰ Powys-Lybbe, *The Eye of Intelligence*, pp. 184–5.

²²¹ Jones, 'The Intelligence War and the Royal Air Force', 14.

recipient of their intelligence reports. Bonsall recalled that there were only two exceptions to this rule. One was the Meteorological Office, the other was ADI (Science) 'which was powerful enough to insist on them'.²²² AI4(f)'s primary focus during 1942 was analysis of GAF nightfighter R/T traffic and, because they exclusively used R/T and not W/T, the tactical content of AI4(f) traffic analysis reports was crucial to the wider picture of GAF GCI collated by ADI (Science).²²³ Jones's organisation was therefore free from the disabilities suffered in other spheres of intelligence, in that 'special' and low-grade SIGINT were not separated, and were supplied with all relevant information through AI4(f), the so-called 'Technical Research Party in Hut 3'. This was in addition to the close collaboration between ADI (Science) and 3G(N), and so there can be no doubt that the 'labours of Hut 3 with ADI (Science) became entirely complementary and made a most effective partnership in the exploitation' of SIGINT.²²⁴ And yet AI4(f) – the GC&CS German Air Section – cannot be found anywhere in *Most Secret War*, while 3G(N) is exclusively defined by Jones as his personal connection with Norman at Bletchley Park. This omission by Jones is the more remarkable given that 3G(N) alone produced 23 CX/MSS reports from their inception in late-1942 through to the end of the war, almost all of which were radar or radio related.²²⁵

²²² Bonsall, 'Bletchley Park and the RAF Y Service', 830–1.

²²³ Hinsley *et al*, *British Intelligence in the Second World War, Volume II*, pp. 257, 269 & 272; Stubbington, *BMP Reports by the German Air Section*, pp. 12–22. By June 1942, AI1(f) were producing daily reports on both day and night GAF fighter R/T traffic analysis. By the middle of 1943, the GC&CS Air Section BMP Reports were providing some 75 per cent of the RAF's intelligence on GAF single-engine fighters. See also TNA HW 43/2, 'History of British SIGINT, 1914–1945: Volume I, British SIGINT, 1914–1942' written by Frank Birch, p. 717

²²⁴ TNA HW 43/2, 'History of British SIGINT, 1914–1945: Volume I, British SIGINT, 1914–1942' written by Frank Birch, pp. 695–6.

²²⁵ TNA HW 43/69, 'Report on the work of 3G(N)', 1 August 1945, pp. 30–1. In Friedman's report about his time in Hut 3 he noted that Norman had 'a very large map' on his wall in which 'charted the location of radar stations': TNA HW 14/85, Report by William F. Friedman, 12 August 1943; Campbell, *Target London*, p. 108.

One of the interminable controversies of Second World War history is that of the Allied Strategic Air Offensive. If it can be assigned as being 'quite basic to the victory in the west', then the fundamental scientific intelligence contribution to the bomber war can be regarded as a great intelligence success even if the Allied bomber offensive was not.²²⁶ The role of ADI (Science), in what was a remarkable collaborative collation of evidence to appreciate German western European defences, significantly contributed to ultimate Allied victory in the west. When the time came to invade France, British and US Commands were provided with monographs detailing the technicalities of enemies' equipment, and measures to overcome the equipment expected to be used against them in combat.²²⁷ Richard Overy noted that the greatest contrast between intelligence efforts of the Allies and Axis lay in the 'degree to which science was utilised for intelligence purposes'.²²⁸ In no other investigation was this contrast more acute than in the Allied intelligence attack upon DT and GAF GCI. Contrary to what ADI (Science) thought at the time, they had no counterpart.

If the Battle of the Beams heralded scientific intelligence, then the DT hunt and appreciation of GAF GCI firmly established it as a permanent component of Whitehall's intelligence machinery. The fundamental principles of scientific

²²⁶ Malcolm Smith, 'The Allied Air Offensive', *Journal of Strategic Studies*, 13: 1 (March 1990), 82. See also Kenneth P. Werrell, 'The Strategic Bombing of Germany in World War II: Cost and Accomplishments', *The Journal of American History*, 73: 3 (December 1986), 702–13; Tami Davis Biddle, *Rhetoric and Reality in Air Warfare: The Evolution of British and American Ideas about Strategic Bombing, 1914–1945* (Woodstock: Princetown University Press, 2002); 'Dresden 1945: Reality, History, and Memory', *The Journal of Military History*, 72: 2 (April 2008), 413–50.

²²⁷ See for example, RAFM AC 944633, 'Air Staff Operational Monograph No.1: Countermeasures to German R.D.F. Defences, May 1944. It is likely that ADI (Science) contributed to the compilation of this monograph as there are some language similarities to ADI (Science)'s SIRs.

²²⁸ Overy, *The Air War*, p. 200.

intelligence had been defined through ADI (Science)'s tireless appreciation of DT, in that scientific precepts and underlying technical details determined technological tactical limitations, and these in turn determined strategic application.²²⁹ ADI (Science) effectively spelt out the importance of their existence, and laid the foundations for this new type of intelligence garnered from new methods and new sources. Throughout the DT chase, which lasted for the duration of the Second World War, Jones as ADI (Science), and his intelligence organisation known as ADI (Science), laid firm collaborative foundations which aided the gathering and collation of intelligence of scientific and technical complexion. Some of these foundations became solidly rooted through friendship and/or confederacy. Others were uprooted due to personal animosities and unwillingness to co-operate and/or co-habit. These are matters of immense fascination that have never previously been addressed objectively, to which this thesis now turns.

²²⁹ Jones, 'Scientific Intelligence', pp. 360–1.

Chapter VII: Scientific Intelligence In and Out of Whitehall

The growth of ADI (Science) was gradual and spanned the full term of the Second World War. Certainly the circumstances of war accelerated the process, but other factors also contributed to the slowness of ADI (Science) expansion. Organisational tensions, personal frictions and animosities, and even disbelief in the need for scientific intelligence, all played their part. This chapter explores each of these factors in depth and addresses questions about the scientific intelligence role and position (both real and imagined) within British intelligence. Jones constantly experienced difficulty recruiting scientific intelligence officers – a fact that persistently rankled both during and after the war. Reasons behind the gradual nature of the advancement of scientific intelligence were however, more logical and pragmatic than Jones led history to believe, and form an important section within this chapter.

Because of Jones's favoured position as one of Cherwell's 'cronies', ADI (Science) possessed significant influence outside of intelligence spheres, in various useful places, not least in the inner Whitehall communities. These connections were vital to scientific intelligence and are also examined here. Previous chapters have shown just how integral other organisations (AI1(k), GC&CS, Y-Service, Medmenham, TRE, RAE) were to wartime scientific intelligence successes. How ADI (Science) connected with these organisations was crucial to their development, and is assessed in this

chapter. Essential to British intelligence networks were paternal/fraternal and 'London Club' connections. These were no less important to scientific intelligence successes, and so are also examined in this chapter.

The Gradual Growth of ADI (Science)

Close examination of the pre-war careers of GC&CS operatives demonstrates that proficient people required for the British war effort were recruited from all walks of life. Of the many thousands who worked at Bletchley, few were so-called 'academics' before the war. Vocational diversity was also experienced at Medmenham, across the Listening Services, and throughout many of the other organisations that collectively formed Britain's war machine. Scientific intelligence was much the same. Few ADI (Science) staff were post-doctoral scientists. Few had no scientific training at all. Some, but not all, had university educations. Many were service personnel, either RAF or Army. Not all were male. Some were much older than others. In order to understand how they operated and interacted, both at individual levels and structurally, appreciation of the personalities involved is essential.

Table II constitutes the most complete breakdown of ADI (Science) personnel to date. Although there is more to tell about Jones's life and career, much has been written about him, and by him. Evidence on Jones's colleagues is sparse in contrast. A few have been nominally discussed, yet little is known about many of Jones's wartime colleagues.¹ Some, but not all, were

¹ R. G. Chambers, J. E. Enderby, A. Keller, A. R. Lang, and J. W. Steeds (eds.), *Sir Charles Frank OBE, FRS: An Eightieth Birthday Tribute* (Bristol: Adam Hilger, 1991); David C. Nutting and James Glanville (eds.), *Attain by Surprise: The Story of 30 Assault Unit Royal Navy/Royal Marine Commando and of Intelligence by Capture* (Privately published, 1997).

Table II: ADI (Science) Personnel.²

Name	Date Recruited	Position in ADI (Science)	Scientific Qualification
Reginald Victor Jones	September 1939	Assistant Director	Ph.D (Physics)
F. Charles Frank	November 1940	Principal Scientific Officer	Ph.D (Physics)
Derrick J. Garrard	November 1940	Scientific Officer	
Mary Francis	Summer 1941	Temporary TRE attachment	Mathematician
'Ginger' Parry	Summer 1941 (transferred 1943)	Temporary TRE attachment	
A. Hugh Smith	October 1941	Principal Scientific Officer	
John Charles Ellison Jennings	November 1942	Scientific Officer	B.Sc.
J. A. Birtwhistle	November 1942	Squadron Leader	B.Sc.
Edward M. Wright	July 1943	Principal Scientific Officer	Ph.D (Mathematics)
Rupert A.V. Gascoigne-Cecil	October 1943	Wing Commander	B.Sc.
David Arthen Jones	Autumn 1943	Scientific Officer	B.Sc.
Eric George Ackermann	Late 1943 - Spring 1944	Scientific Officer	
Howard Percy Robertson	January 1944	Liaison with General Spaatz	Ph.D (Mathematics)
Philip Ivor Dee	August 1944	Liaison with MAP/TRE	Ph.D (Physics)
David Colver Nutting	June 1944	Liaison with AI1(g)	B.Sc.
Maurice Stephenson	June 1944	REME attachment	B.Sc.
Kenneth G. Dobson	June 1944	REME attachment	
Robert Andrew Fell	June 1944	REME attachment	
Ronald Hill	1944	Junior Scientific Officer	
Ronald Lampitt	1944	Special Appointment	
Beavis	1944	Flight Officer	
Margaret Masterman	1944	Flight Officer	
John Vincent Chapman	Early 1945	Special Appointment	
Roy Piggott	Late-war	Liaison with Radio Research Station	

² TNA DEFE 40/1, 'Assistant Directorate of Intelligence (Science)', no date; CCAC RVJO B.126, Testimonial for John Chapman, written and signed by Jones, April 1946; Jones, *Most Secret War*, pp. 484 & 519.

mentioned in Jones's post-war publications, and rarely in any detail. Indeed, regarding personalities, *Most Secret War* provided only cursory glimpses of Frank, Smith and Garrard, who merited various operational scientific intelligence mentions. Other ADI (Science) personnel are practically invisible. This sits awkwardly within the limited historiography of scientific intelligence, particularly as Jones was so lavish in personal detail about many of his wartime superiors. Perhaps he deemed it inappropriate to discuss his staff except regarding their involvement in important operations. Such a stance has skewed perception of scientific intelligence however. This was accentuated by Hinsley *et al* who almost always referred to ADI (Science) in the singular. This thesis represents wartime scientific intelligence as the organisation of people it was, rather than Jones's personal intelligence section.

Jones's first Broadway colleague was Blyth, recommended by Winterbotham's deputy, Gr/Cpt John Perkins. Blyth was responsible for compiling Jones's early SIRs and, being on Winterbotham's staff, often proved a useful contact for Jones. Blyth was not scientific however, and if Jones was to be killed in the Blitz, there was no satisfactory scientific intelligence replacement.³ Frank was therefore recruited not just as a scientific companion for Jones, but to fill the gap in the event of Jones's death.⁴ That same month, Garrard joined Jones and Frank. Joubert believed that Jones was 'still single-handed', which led Jones to recall that Garrard's arrival was 'not without embarrassment' as Frank had just been assigned to scientific

³ Jones, *Most Secret War*, p. 144.

⁴ For more details on Frank's recruitment to scientific intelligence see UOB DM1310/A.12, Pye to Jones, 5 March 1940; CCAC RVJO B.118, Frank to Jones, 8 November 1939; CCAC RVJO B.118, Frank to Jones, 22 February 1940; UOB DM1310/A16, Frank to G. H. Edgington, 28 September 1976; Jones, 'Auld Acquaintance', p. 7; Jones, *Most Secret War*, pp. 77 & 144.

intelligence, and it 'would take some time to get any further newcomer 'cleared' with Security to come and work in Broadway'.⁵ Garrard was therefore requested to initially perform scientific intelligence from Jones's Air Ministry office, alongside Joubert's in the commandeered rooms within the King Charles Street Treasury building. In Jones's and Frank's opinion, Garrard could be 'a bloody nuisance sometimes', which perhaps was one of the reasons for the limited mention of Garrard in *Most Secret War*.⁶

Not long after Frank's and Garrard's appointments, the decision was taken that scientific intelligence was so important to the Air Staff that it should be transferred from MAP back into the Air Ministry fold, and should form the nucleus of a Deputy Directorate consisting of three Scientific Intelligence Officers. Due to 'some miscarriage of paper-work' however, this did not occur.⁷ Instead, ADI (Science) was formed with direct allegiance to ACAS(I), and expanded to a maximum establishment of one Assistant Director (Jones), one senior scientific officer (Frank), and four scientific officers. Garrard accepted one of these scientific officer posts, and Jones was able to consider carefully three suitable scientific men to fill the other three positions.

There was no doubt in Jones's mind that these posts were to be filled by scientific men, rather than scientific women. This was not simply because

⁵ Jones, *Most Secret War*, p. 191.

⁶ When reading the draft of Jones's memoirs, Frank appealed to Jones to 'give a little more credit' to Garrard, but Jones resisted and Frank eventually agreed. Frank recalled that Garrard was 'doing a liaison job' between ADI (Science) and TRE, but he proved 'a bad liaison man because he enjoyed setting up quarrels': UOB DM1310/A.16, Frank to Hooker, 13 August 1981. In contrast to many of their colleagues, Jones and Frank rarely corresponded with Garrard after the war; see CCAC RVJO B.146; RVJO B.207; RVJO K.463.

⁷ CCAC RVJO B.83 & TNA AIR 40/1532, ADI (Science) official history 'Air Scientific Intelligence in War, 1939-45', 1 April 1946, p. 10; AHB, 'Air Ministry Intelligence', p. 293.

there was a lack of women who were scientifically-trained. Jones's conservative traditionalism also played its part. There were female members of staff in ADI (Science) from the middle of 1941 right through to the end of the war. Five in all were deserving of Jones's attention in his memoirs. There were more, but without evidence of their employment it is difficult to appreciate the full extent of female participation in wartime scientific intelligence. Most were clerical, although three were technical. Parry and Francis were recruited as radar-plotters, and Margaret Masterman was later transferred from the Y-Service.⁸ The most mentions by Jones in his memoirs were of Daisy Mowatt, who typed all SIRs and interim reports 'well into 1942'. When she left Broadway for an overseas posting, Parry took over as typist. As ADI (Science) expanded, secretarial arrangements were 'regularized', for Smith 'charmed MI6' into providing secretarial staff, headed by Joan Stenning who had previously worked for the Foreign Office, and at Bletchley.⁹ It seems the distance of time relegated the importance of Stenning's contribution to scientific intelligence. She was Jones's Head Secretary from 1943–1946, acting as his personal secretary, and controlling four other secretaries.¹⁰

⁸ Jones, *Most Secret War*, pp. 196 & 489. Regarding Parry and Francis, Jones rather vaguely explained that these two 'girls' had 'joined' scientific intelligence and did 'most of the plotting of German radar during the time ADI (Science) spent at Stanmore in the summer of 1941. Francis did not stay with ADI (Science) for long. Jones only mentioned Margaret Masterman once in *Most Secret War*, as his WAAF Flight Officer who one day marched into the office and handed him a file and said 'rather pertly, 'I think you should see this, Sir!''.

⁹ Jones, *Most Secret War*, pp. 61, 67, 89, 100, 144, 162, & 330–1. Stenning is mentioned twice in *Most Secret War*. Of the six mentions of Daisy Mowatt in *Most Secret War*, by far the most enlightening was Jones's recollection of her 'with duplicator ink smeared over her elegantly groomed and smiling face' during the haste to finish SIR No.10 on *X-Gerät* in December 1940.

¹⁰ In an employment reference, Jones wrote that Stenning carried out her duties admirably, was well-liked by the girls she supervised, and was 'prepared to stand up when necessary for the interests of her girls'. Stenning was loyal, helpful, and possessed 'a thorough sense of responsibility, discretion, and tact'; CCAC RVJO B.129, reference note entitled 'Miss Joan Stenning', no date; CCAC RVJO B.125, draft letter to DDI4 from ADI (Science), 3 March 1945.

Jones expected scientific recruitment to ADI (Science) to be slow. He believed that good scientific intelligence officers should possess 'rather rare qualities, apart from being scientists'.¹¹ Above all, he insisted upon 'the highest academic qualifications', 'many reliable contacts', and 'a flair for using such contacts to best advantage'.¹² As war progressed, finding personnel with scientific attributes grew more difficult, and so Jones expected recruitment would occur 'when suitable men became available by accident'. He also feared that his 'organisation was so small that one unsuitable man could have seriously jeopardised it'. Wartime scientific intelligence was therefore 'often in the position of a man trying to catch a bus travelling rather too fast for him' because 'to meet all the demands was nearly always beyond the capacity of the small staff'.¹³ This was much the same across the British intelligence spectrum. SIS constantly experienced wartime change as staffs expanded 'all too slowly' due to insatiable military appetite for intelligence.¹⁴

Smith's recruitment in October 1941 took scientific intelligence personnel (excluding secretarial assistance) to five. Although Jones referred to him as

¹¹ CCAC RVJO B.83 & TNA AIR 40/1532, ADI (Science) official history 'Air Scientific Intelligence in War, 1939-45', 1 April 1946, p. 10; AHB, 'Air Ministry Intelligence', p. 293. Jones defined these qualities sevenfold: wide lofty knowledge of the fundamental laws of nature; 'legal' faculty for critical appreciation of evidence; imaginative ability to synthesise intelligence pictures from correlation from few vital facts; powerful memory; command of English; command of foreign languages; ability to handle individuals (to convince sources that their tedious and dangerous work was worthwhile, and to convince operational and research staff that an intelligence picture is sound): CCAC RVJO B.112, ADI (Science) paper entitled 'The Peacetime Establishment of Air Scientific Intelligence', 13 December 1945, pp. 5-6.

¹² CCAC RVJO B.106 & TNA AIR 20/1717, paper written by Jones entitled 'A Scientific Intelligence Service', 7 December 1939, p. 11.

¹³ CCAC RVJO B.83 & TNA AIR 40/1532, ADI (Science) official history 'Air Scientific Intelligence in War, 1939-45', 1 April 1946, p. 10; AHB, 'Air Ministry Intelligence', p. 293. It was further suggested that for this reason ADI (Science) necessarily 'concentrated only on problems of major importance', and at times took risks by neglecting quite important problems for others still more important'. Given the extent of the work undertaken by ADI (Science) throughout the war, combined with the lack of real scientific and technological threats not alerted by ADI (Science), this statement appears to be over-zealous hindsight grumbling.

¹⁴ Philby, *My Silent War*, p. 39.

an engineer by inclination, Smith was not scientifically-trained.¹⁵ Smith joined the RAF upon outbreak of war, but injuries from a motorcycle accident restricted him to staff duty and possible invalidation. Wishing to extend his personal war effort, Smith contacted Jones and offered his services. It is obvious from the persistent references of Smith throughout *Most Secret War* that he made a favourable impression upon Jones. Although health restricted Smith to work only five days-per-week, he proved a first-class draughtsman drawing all the impressive diagrams that pepper the SIRs, and held a permanent wartime position in ADI (Science).¹⁶

Trained physicist, John Charles Ellison Jennings, was the next ADI (Science) recruit, first approached by Jones in June 1942, and eventually joining in November 1942.¹⁷ Jennings and Jones had met before the war, as Jennings had worked for the Philips Company at Eindhoven as British Admiralty liaison. Importantly, Jennings could speak fluent German, French, Spanish, Dutch, and Russian, and proved to be 'a valuable reinforcement' for ADI (Science).¹⁸ Given his extensive linguistic ability Jennings was 'destined to be a full time liaison' at GC&CS.¹⁹ He ended up as ADI (Science) liaison with Russia.²⁰ Sq/Ldr John Birtwhistle also joined ADI (Science) in November 1942, yet little

¹⁵ Smith began his career as a clerk for the Lancashire and Yorkshire Railway before reading English at Leeds University, and later as Reader at University College, London: Jones, *Most Secret War*, p. 212.

¹⁶ TNA DEFE 40/1, 'The Expansion of Scientific Intelligence', 20 November 1942, p. 2; Jones, *Most Secret War*, pp. 212–14. Smith was always eager to return to academia, however, and shortly before official cessation of the war gave Jones a month's notice of employment termination and returned to University College: CCAC RVJO B.125, Smith to Jones, 2 May 1945.

¹⁷ CCAC RVJO B.121, John Jennings to Jones, 8 July 1942. Jennings apologised to Jones for the delay of his application, due it seems to him having to 'wait a very long time' for the form to arrive from Professor Bernal, the original of which 'apparently went astray'.

¹⁸ Jones, *Most Secret War*, p. 326. For post-war correspondence between Jones and Jennings, see CCAC RVJO files A.105; A.151; C.127; D.337; J.192.

¹⁹ TNA DEFE 40/1, 'The Expansion of Scientific Intelligence', 20 November 1942, p. 2.

²⁰ TNA DEFE 40/1, 'Assistant Directorate of Intelligence (Science)', no date.

is known about him. A Fighter Command Intelligence Officer during the Battle of Britain (and mentioned in Despatches), Birtwhistle held a BSc and made an ideal scientific intelligence recruit.²¹ He never officially became a Scientific Officer however, but remained attached to ADI (Science).

By the end of 1942, it was obvious that a scientific staff of six could not cope with the amount of work caused by extensive German application of science, by improved flows of information from collecting organisations, and by increased numbers of scientific intelligence customers. Daily input of raw material amounted to approximately 150 pages per day. Jones therefore wrote a paper for Frank Inglis, the new ACAS(I), suggesting further scientific intelligence expansion, expressing concerns for work overload, and proposing that ADI (Science) be upgraded to a full intelligence Directorate. Although Jones had struggled to fill designated posts, he argued that without a larger staff there was ‘the extreme danger that something vital would be missed’. He emphasised that scientific intelligence was ‘heavily over-saturated’ due to DT and GAF GCI, and that unless relief was forthcoming, ADI (Science) could not accept responsibility for likely surprises sprung upon the British by Germany without timely warning that had been achieved in the past.²²

Jones emphasised that demands upon ADI (Science) had so increased that they were unable to cope in a manner satisfactory to themselves or their

²¹ Jones, *Most Secret War*, pp. 326, 406, 409–10, & 519. Jones did not mention Birtwhistle in any other of his post-war literature. Neither Jones nor Frank corresponded with Birtwhistle after the war. See also J. A. Birtwhistle, ‘The Work Curve and Work Decrement’, *British Journal of Psychology*, 28: 3 (January 1938), 315–20.

²² TNA DEFE 40/1, ‘The Expansion of Scientific Intelligence’, 20 November 1942; CCAC RVJO B.83 & TNA AIR 40/1532, ADI (Science) official history ‘Air Scientific Intelligence in War, 1939–45’, 1 April 1946, pp. 22–3; AHB, ‘Air Ministry Intelligence’, pp. 305–6; Jones, *Most Secret War*, p. 322.

users. Demands had accentuated beyond expectation because of increasing fields of enemy activity to be watched, improvements in British intelligence collecting services, and expansion of the British war machine 'bringing into existence an increasing number of bodies' requiring the supply of scientific intelligence. Jones elucidated the scientific intelligence 'programme of work', including extensive collection, correlation, and dissemination of information in addition to the 'honorary capacity' as scientific advisers to 'C'. Jones proposed two alternatives: to reduce the scientific intelligence scope through fewer subjects or fewer functions; or to increase staff allowance. He proposed himself as Director of Scientific Intelligence in control of a Deputy Director (presumably Frank), three Assistant Directors (equal to his own current standing), and 'perhaps three principal Scientific Officers, six Senior Scientific Officers, and appropriate clerical staff'. This thought Jones would 'immediately be possible to improve the situation'. He named L.S. Harley, who was then relinquishing his post in MAP, and Professor Edward Wright of Aberdeen University as suitable candidates for the higher posts.²³ Jones's paper consisted of an impressive (albeit unsuccessful) appeal for complete enduring control of scientific intelligence. It was not the first, and would not be the last.

The net result of Jones's appeal can be described as a compromise, although Jones viewed it as authorisation of 'some, but not sufficient, increase in staff'

²³ TNA DEFE 40/1, 'The Expansion of Scientific Intelligence', 20 November 1942, p. 7. Jones proposed that the three Assistant Directors would each have separate responsibilities: Offensive, Defensive, and General. The Offensive ADI (Science) would be responsible for enemy defensive policy and new weapons (radar and fighter defences, decoys and jamming). The Defensive ADI (Science) was to be responsible for enemy offensive policy and new weapons (radio-navigational systems, jamming, and Maud – alluding to the secret atomic issues). The General ADI (Science) would be liaison officer to the Middle East, America, and GC&CS, and be responsible for spoof, application of science to intelligence, Combined Operations, *Rhubarb* Appendices, and so on; TNA DEFE 40/1, Note entitled 'Suggested Reorganisation', attached to 'The Expansion of Scientific Intelligence', 20 November 1942.

effective from July 1943. This allowed for provision of one Assistant Director (Jones), three principal, three senior, and three ordinary scientific officers.²⁴ Frank and Smith were instantly promoted to Principal Scientific Officer.²⁵ Jones evidently had Harley or Wright in mind as the other Principal Scientific Officer. Despite all his efforts and complaining however, Jones was never able to fill the Senior Scientific Officer positions. ADI (Science) therefore peaked at three Principal Scientific Officers and four Scientific Officers, with a Junior Scientific Officer, and some liaisons and attachments.

Pre-empting the decision for expansion, and upon discovery that Wright 'was not directly involved in the war', Jones wrote to his erstwhile Oxford colleague, who 'readily agreed' to join ADI (Science).²⁶ Jones later recalled that he had asked a mutual friend whether Wright 'was doing anything and he wasn't'.²⁷ None of these statements are strictly accurate, and somewhat denigrate the importance of Wright's position as Professor of Mathematics. Wright stated that Jones's 'department would have to ask [Aberdeen] University to release' him, that 'it would be advisable to state firmly' that the work was to be 'really important', and that he was regarded by Jones 'as especially fitted for it'. Wright informed Jones of a previous approach by the Foreign Office for him to join GC&CS, which he refused because 'it seemed less useful' than his

²⁴ CCAC RVJO B.83 & TNA AIR 40/1532, ADI (Science) official history 'Air Scientific Intelligence in War, 1939–45', 1 April 1946, p. 23; AHB, 'Air Ministry Intelligence', p. 306.

²⁵ UOB DM1310/A.12, Confirmation of the promotion of Charles Frank from S2b (Tech), August 1943. Frank's revised salary was £850. Presumably Smith's was the same. Their promotion was retrospective to 1 July 1943.

²⁶ Jones confirmed that he had known Wright since 1932 when the latter 'was building an outstanding reputation as a pure mathematician in Oxford': Jones, *Most Secret War*, p. 326. The Oxford connection here is interesting for, in reply to Jones's request for Wright to join ADI (Science), Wright informed Jones that he and his wife had just been blessed with a baby boy and that 'the Prof' (Cherwell) was Godfather: CCAC RVJO B.121, Edward Wright to Jones, 28 October 1942.

²⁷ UOA MS 3620/1/82/1, Oral History interview with R. V. Jones recorded on 17 March 1987, p. 5.

university work. In contrast Wright felt that scientific intelligence was 'more vital (and more interesting!)'. Wright stressed it 'desirable' for Jones to make an official request for him to join ADI (Science) swiftly, otherwise more University's staff would be asked for, and if they went then Wright might 'become really indispensable'.²⁸ Wright officially became Principal Scientific Officer on 1 July 1943.²⁹

Frank recalled that ADI (Science) grew from two persons as it was when he joined in November 1940, to 'a number rather more like a dozen'.³⁰ Excluding secretaries and clerical assistants, wartime scientific intelligence peaked at sixteen personnel, although only nine were classed as scientific officers. Only four were academically trained in science. To reiterate, therefore, it was incorrect to say that ADI (Science) 'acquired a growing staff of scientists'.³¹ Jones, Frank, Smith, Wright, and Garrard (who never rose above Scientific Officer) were joined by an eclectic group of people, some were academically-trained, others not, and, apart from two men fresh from the cloisters, almost all had some form of service experience. While this is not surprising given that four years of war had passed, it is instructive of the make-up of ADI (Science) at its wartime zenith.

²⁸ CCAC RVJO B.121, Edward Wright to Jones, 28 October 1942.

²⁹ CCAC RVJO B.122, Wright to Jones, 21 February 1943; TNA DEFE 40/21, Wright to Jones, 10 March 1943. Wright's appeal to join Jones was put before the University's Senators, and once they had agreed it went before the Court who met on 2 March 1943. The latter body dealt with the salary aspect of wartime transfers. As many universities agreed to supplement the lesser Government salaries of their academics who wished to serve their country, these matters were of great importance to University authorities. In *Most Secret War* Jones marked Wright's recruitment as 1 April 1943, so there was evidently a delay in the official paperwork: Jones, *Most Secret War*, p. 326. Wright was provided a starting salary of £1050 (£200 more than Frank and Smith); CCAC RVJO B.122, S2b (Tech) to Wright, 28 August 1943.

³⁰ UOB DM1310/A.16, Frank to Edgington, 28 September 1976.

³¹ Davies, *MI6 and the Machinery of Spying*, p. 106.

W/Cdr Rupert Gascoigne-Cecil joined ADI (Science) in October 1943.³² An Oxford biochemistry graduate, he rose through the ranks in Bomber Command, accomplishing a DFC and Bar for his two operational tours. Cecil's recruitment enabled ADI (Science) to 'see bomber operations through a pilot's eye', and his presence 'assured Bomber Command that one of their own men' had 'fullest access' to scientific intelligence.³³ Gascoigne-Cecil 'greatly helped' ADI (Science)'s contribution to the Allied bomber offensive, and enabled the offensive 'watch to be maintained at a time when otherwise it would have conflicted with the Defensive work'.³⁴ Having a pilot on the team also allowed ADI (Science) some degree of air mobility. Gascoigne-Cecil was never officially recognised as Scientific Officer, but instead retained his Air Ministry posting as Wing Commander.³⁵

Pinpointing Honorary F/Lt Eric George Ackermann's recruitment accurately has proved extremely difficult.³⁶ It is clear that he worked with Garrard in 1940 on TRE's 'special listening watch' that successfully detected the *Seetakt* 80cm transmissions, and that he worked at TRE for at least the first three years of the war before joining ADI (Science). Ackermann was also a member of Cockburn's Group 5 designing RCMs in 1941, and made over ninety flights (forty accompanying Bomber Command operations) seeking *Würzburg* transmissions in 1941/2. It was for this radio observation work (often under

³² Gascoigne-Cecil (under the abbreviated name of Cecil) merited six mentions in *Most Secret War*, but none in Jones's other post-war literature: Jones, *Most Secret War*, pp. 406–9, 411, 426, 459, & 479. There was brief 1976 correspondence between Jones and Gascoigne-Cecil: see CCAC RVJO J.192.

³³ CCAC RVJO B.347, Jones to Irving, 11 March 1965; Jones, *Most Secret War*, p. 406.

³⁴ CCAC RVJO B.83 & TNA AIR 40/1532, ADI (Science) official history 'Air Scientific Intelligence in War, 1939–45', 1 April 1946, p. 51; AHB, 'Air Ministry Intelligence', p. 51.

³⁵ See TNA DEFE 40/1, 'Assistant Directorate of Intelligence (Science)', no date.

³⁶ Jones, *Most Secret War*, p. 441. The first time Jones referred to Ackermann in *Most Secret War* as one of *his* 'party' was relative to July 1944. Ackermann therefore must have joined ADI (Science) sometime during autumn 1943 to spring 1944.

enemy fire) that Jones credited Ackermann with special mention in his *Most Secret War* 'Dedication'.³⁷ There is no doubt that Ackermann was closely linked with scientific intelligence as an informal TRE liaison to ADI (Science). Early in 1943, Ackermann was sent to the Mediterranean to organise ground and flight investigations to locate German and Italian radar stations prior to Operation *Husky*, and 'landed at Salerno on the first day of the operations'.³⁸ Ackermann's involvement with the British Air Force of Occupation (BAFO) was perhaps his greatest achievement as a scientific intelligence officer.³⁹

Of the youngest of Jones's wartime staff was David Arthen Jones, who joined ADI (Science) sometime during autumn 1943.⁴⁰ As surnames were used in the traditional manner throughout Broadway, the younger Jones was referred to as Arthen by his colleagues.⁴¹ Jones referred to him as a 'young physicist', even though he only obtained his BSc in 1941.⁴² Following graduation, Arthen joined RAF No.60 Group as Technical Officer before spending three years as Scientific Officer with ADI (Science).⁴³ After the war Arthen accompanied

³⁷ Jones, *Most Secret War*, pp. viiii, 136 & 265.

³⁸ CCAC RVJO B.129, incomplete reference, written by Jones, for Flight Lieutenant Eric George Ackermann, no date.

³⁹ Jones, *Reflections on Intelligence*, p. 15. Jones and Ackermann maintained contact intermittently throughout their lives: see CCAC RVJO B.529; RVJO G.333; RVJO G.406; and RVJO G.430.

⁴⁰ CCAC RVJO B.207, Combined reference, written by Jones, for David Arthen Jones and Raymond William Henry Stevenson, no date but circa 1953.

⁴¹ See TNA DEFE 40/21, Smith to Jones, 29 September 1944, in which Smith applied the name Arthen twice in reference to the younger Jones.

⁴² TNA DEFE 40/1, 'Assistant Directorate of Scientific Intelligence (Science)', no date; Jones, *Most Secret War*, p. 413.

⁴³ CCAC RVJO B.207, Combined reference, written by Jones, for David Arthen Jones and Raymond William Henry Stevenson, no date but circa 1953. Arthen also served as Honorary F/Lt attached to 2nd Transport Air Force (TAF) in the field. Jones was keener to relay that Arthen held 'Welsh University 'Blues' for boxing, rugby, and cricket, could have played cricket for England had 'war not intervened, and had he decided to give up physics for full-time cricket': Jones, *Most Secret War*, p. 414.

Jones to Aberdeen University, where he established a reputation within a few years as head of one of the few world centres for crystal growing.⁴⁴

Much less is known of the other wartime scientific intelligence staff. According to documentation, of the sixteen not so far named (excluding liaison staff), are F/O Beavis, P/O Ronald Hill, and Ronald Lampitt. Masterman is at the bottom of the list, but with no official ADI (Science) job-description.⁴⁵ Of the other three, only Lampitt was mentioned by Jones in his memoirs, stating that Smith 'recruited one of his friends' (Lampitt) 'to take over the drawing' of ADI (Science)'s diagrams, because Smith left Broadway to head an ADI (Science) Overseas Party after D-Day.⁴⁶ Lampitt was a 'Special Appointment', although it is unclear from which organisation. Hill was appointed as Junior Scientific Officer, although he is not mentioned in *Most Secret War*.⁴⁷

One other Special Appointment to ADI (Science) that escaped Jones's literary attention was F/Lt John Vincent Chapman. Although not scientifically-trained, Chapman was attached to scientific intelligence in early 1945 and remained

⁴⁴ CCAC RVJO B.206, Neville Mott to R.V. Jones, 28 February, 1946; UOA MS 3620/1/82/1, Oral History interview with R. V. Jones recorded on 17 March 1987, p. 5; Jones, *Most Secret War*, p. 519. Post-war correspondence between Jones and Arthen was entirely academic research-based: CCAC RVJO C.109; RVJO C.125; RVJO D.68; RVJO D.82; RVJO D.83; and G.400.

⁴⁵ TNA DEFE 40/1, 'Assistant Directorate of Scientific Intelligence (Science)', no date. That Masterman is on the list confirms her position as a technical assistant rather than clerical (with his 'my W.A.A.F. Flight Officer' solitary reference to Masterman in his memoirs, Jones had not made her job-description clear): Jones, *Most Secret War*, p. 489. Masterman was also President of Cheltenham Technical College Student's Union; TNA DEFE 40/1, 'Assistant Directorate of Intelligence (Science)', no date.

⁴⁶ Jones, *Most Secret War*, p. 452.

⁴⁷ The only information primary sources divulge on Hill is that he held an MA, was a member of the Campanological Society of South Yorkshire, and that he wrote to Jones in 1980 regarding an incident detailed in *Most Secret War*: TNA DEFE 40/1, 'Assistant Directorate of Intelligence (Science)', no date; CCAC RVJO J.318, Ronald Hill to Jones, February 1980. All that the documents divulge regarding F/O Beavis was that he had been awarded the Africa Star with Clasp, had been trained at the *Technische Hochschule München*, and was good at 'rugger': TNA DEFE 40/1, 'Assistant Directorate of Intelligence (Science)', no date.

until his demobilisation in late 1945. He did not become a designated Scientific Officer, yet Chapman's work did involve 'extraction of important information from a large mass of difficult material obtained by listening to the radiotelephonic instructions to GAF nightfighters'. He organised a staff for the work and personally distilled the essence of intelligence into reports distributed to Bomber Command. Jones believed that 'Chapman's work in this field contributed materially to the maintenance of Bomber Command's offensive'. Upon Jones's request, Chapman wrote a history of the countermeasure war in support of the Bomber Offensive.⁴⁸ Chapman later remarked that if Britain plunged into another war, he should be delighted to put himself at Jones's disposal.⁴⁹ From the tone of this letter it is clear the two men worked well together which makes it difficult to explain why Jones omitted Chapman from his history of scientific intelligence.

Not all attachments to ADI (Science) Overseas Parties were noted by Jones either. He wrote that 'officers from Technical Intelligence' were attached to ADI (Science), yet in *Most Secret War* Jones only mentioned David Colver Nutting.⁵⁰ Importantly, Nutting was also technical intelligence liaison to the Admiralty commandos 30AU, and served as useful liaison between those active scientific intelligence gatherers and ADI (Science).⁵¹ Jones also mentioned three Regiment of Electrical and Mechanical Engineers (REME)

⁴⁸ Jones wrote in Chapman's testimonial that unlike many others, Chapman 'did not slack off after the war, but continued to work conscientiously at full pressure right up to his demobilisation': CCAC RVJO B.126, Testimonial for John Chapman, written and signed by Jones, April 1946.

⁴⁹ CCAC RVJO B.126, John Chapman to Jones, 16 April 1946.

⁵⁰ Jones, *Most Secret War*, p. 484. Jones's recollection of this particular AI1(g) officer is unsurprising given the extent to which Jones and Nutting corresponded about wartime issues during the post-war years: CCAC RVJO B.528; RVJO B.529; RVJO B.534; RVJO B.536-B.538, RVJO B.540; RVJO B.541; RVJO G.273; and RVJO J. 324.

⁵¹ Rankin, *Ian Fleming's Commandos*, pp. 234-6; Nutting, and Glanville (eds.), *Attain by Surprise*.

officers; Captain Maurice Stephenson, Major Kenneth Dobson, and Major Robert Andrew Fell.⁵² In a letter written while on 1944 overseas duty in France, Smith referred to other possible scientific intelligence attachments: Fishwick, Schofield, Palmer, Buckwell, Phinsawl, Davidson, Sanderson, and Evans.⁵³ Only the latter featured in *Most Secret War*. Clifford Evans, a Cambridge botanist, was attached to NID in 1943. Although unclear without confirming evidence, as a radar specialist Evans could well have been attached to ADI (Science) Overseas Parties after D-Day for DT-collection purposes. Jones also referred to an anonymous late-1944 recruit, a classical Oxford scholar who spent most of the war working in Nottingham for the Ministry of Labour.⁵⁴

There were also four very important liaisons to ADI (Science). Philip Ivor Dee, TRE supervisor and co-creator of *H2S* with Bernard Lovell, was attached to scientific intelligence from August 1944. Dee was not a Scientific Officer, but liaison between MAP (as TRE's parent body) and ADI (Science).⁵⁵ Originally Dee was to establish whether there was any truth in the supposition that *H2S* radiation emissions were exploited by the GAF to locate British bombers. A more permanent liaison grew from this connection which resulted in Jones suspecting that Dee had been sent 'as a spy'. Jones was so disappointed by this TRE incursion into his organisation that he felt compelled to tender his

⁵² Jones, *Most Secret War*, p. 484. No post-war correspondence exists between Jones and Dobson, and there is only one letter from Stephenson to Jones regarding a lecture Jones delivered in 1967; CCAC RVJO K.127, Maurice Stephenson to Jones, 1967. In contrast, Fell wrote frequently to Jones after the war on many varied subjects: CCAC RVJO A.168; RVJO D.407; RVJO H.166–H.170; and RVJO H.184–H.188.

⁵³ TNA DEFE 40/21, Smith to Jones, 10 October 1944. Evans and Buckwell are also mentioned by Smith in another letter to Jones, dated 29 September 1944; also TNA DEFE 40/21.

⁵⁴ Jones, *Most Secret War*, pp. 487–8 & 492.

⁵⁵ TNA DEFE 40/1, 'Assistant Directorate of Intelligence (Science)', no date.

resignation.⁵⁶ This was not the first, as it followed frequent resignation threats regarding the V-Weapons (as discussed in the next chapter). Rowe had to explain the situation behind Dee's attachment to ADI (Science). He informed Jones that 'in an ideal and theoretical world' the arrangement would not have been necessary, but because of 'human nature being what it is', Dee's attachment was important. Rowe saw the essence of the problem in Garrard's liaison (or non-liaison for he had become 'a rare visitor' to TRE), and added that Garrard did not possess 'the status to do what a more senior man could do'. Rowe appreciated that original scientific intelligence material was sensitive, and emphasised that 'scientific people' should not be 'kept out of the story'. Dee's attachment was therefore a 'compromise', in that Dee would have full access to scientific intelligence material, and inform TRE if they needed to be involved. Rowe assured Jones that Dee would not pass on what he saw to anyone without authorisation, and that his attachment was not because TRE did not trust Jones, even though TRE 'could not completely trust anyone' in Jones's position.⁵⁷

These documents are important for what they do not say, and it is of little surprise that Jones did not mention this particular resignation threat in *Most Secret War*. Clearly Jones loathed outside influence on his organisation. This

⁵⁶ CCAC RVJO B.123, Jones to Air Vice-Marshal Inglis, ACAS(I), 29 July 1944. Jones informed Inglis he could not make 'stronger protest' against the manner in which the intelligence system (construction of which Jones 'claimed a large part') was 'being ruined'. Jones was concerned that 'every step of acquiescence' Inglis made toward reducing 'demand and invasion of outside bodies' had brought ADI (Science) 'nearer disintegration'. He thought sources would 'be mishandled', collation would 'be wild and incomplete', and presentation of intelligence would 'be political'. Jones warned that an 'ultimate breakdown would 'surely come' unless officers were found 'who would defend the traditions of intelligence to the last', so that the whole intelligence system could 'work out its results in unmolested good faith'.

⁵⁷ CCAC RVJO B.123, Rowe to Jones, 10 August 1944. Why Rowe stated that TRE 'could not completely trust anyone' in Jones's position is not explained. Perhaps it was because Jones had the capacity to criticise TRE work in the political sphere.

is understandable to a degree, but it is evident from this incident that Garrard had become more Jones's man than a TRE liaison. Jones was often accused of withholding important information from other investigative bodies, and this is prime example of there being some truth in such accusations.⁵⁸ TRE quite obviously had reached the extremity of dissatisfaction in their liaison arrangement with ADI (Science). Dee was a more highly-regarded scientist.⁵⁹ From Jones's perspective, such a man thrust into ADI (Science) in such a manner could easily have undermined Jones's authority and his carefully-constructed organisation. Despite initial friction however, Jones and Dee eventually became firm friends.⁶⁰

In July 1944, Jones first met Howard Percy Robertson, Dwight Eisenhower's Scientific Adviser (with the rank of four-star General). As Robertson also sat on the Joint Crossbow Committee investigating the V-Weapon threat to Britain, Jones requested his assistance in 'all flying bomb and rocket matters', and he 'willingly agreed' to 'come right into' ADI (Science). Robertson's role in Jones's narrative of scientific intelligence is sparse and limited to two mentions regarding the V-Weapons and one on their personal 1953 reunion.⁶¹

⁵⁸ CCAC RVJO B.343, 'Verbatim note on interview with Professor R. V. Jones', p. 1. Jones showed Irving a memorandum he had written to Medhurst on 20 November 1942 which confirmed that ADI (Science) were 'sometimes criticised for withholding information', but 'while no instance' had 'been proved', they believed they 'reserved the right to do so' on the grounds that 'to spread half the truth' was 'often to precipitate erroneous action by the Air Staff'.

⁵⁹ Although a trained nuclear physicist not a radio specialist, Dee's work on centimetric radar and his role in creating the Cavity Magnetron had been absolutely essential to the British war effort. Rowe wrote that Dee had 'a profound influence' upon his arrival at TRE, and was the 'moving spirit behind the drive' for 'early application of centimetre radar': Rowe, *One Story of Radar*, pp. 59 & 78–9.

⁶⁰ See Jones, *Most Secret War*, p. 392; Jones, 'Home Sweet Home', 307. For post-war scientific research connections between Jones and Dee, see University of Aberdeen (hereafter UOA) MS 3620/1/82/1, Oral History interview with R. V. Jones recorded on 17 March 1987, p. 4. Their dual research interests inspired regular post-war correspondence but they rarely discussed the war: see CCAC RVJO C.10; RVJO C.127; RVJO C.203; RVJO C.216; RVJO D.70; RVJO F.120; RVJO F.165; RVJO F.168; RVJO H.138; RVJO H.244; RVJO H.875; RVJO J.521; RVJO K.31; and RVJO K.363.

⁶¹ Jones, *Most Secret War*, p. 425. See pp. 446 & 527 for the other two mentions of Robertson.

As Robertson was ‘thoroughly briefed’ on the Manhattan Project, it is probably more likely that Robertson’s liaison was to ensure that any atomic scientific intelligence could be shared.⁶² Robertson’s ADI (Science) role as liaison to General Spaatz, and especially to OSRD, was one of many important links that contributed to the fledgling ‘Special Relationship’, nurtured so carefully and effectively throughout the Second World War intelligence community.⁶³

The only information Jones provided on the attachment to ADI (Science) of Yves Rocard, Sorbonne Professor of Physics, was that he was ‘Chief French Liaison with British Scientific Intelligence’.⁶⁴ It only made complete sense for ADI (Science) to have a French Liaison after Operation *Overlord* however. For this reason, and because he was not on the official list of scientific intelligence personnel, he is excluded from Table II.⁶⁵ Rocard first came to ADI (Science) attention shortly after the Bruneval Raid, when, as a Resistance operative he provided intelligence to SOE detailing a local DT station. Jones deemed the report of ‘very high technical competence’, although his letter of appraisal to that effect caused him to become temporarily embroiled in the awkward friction between SOE and SIS, which led to Jones having to explain his actions to Claude Dansey, one of C’s two deputies.⁶⁶ As SOE could not return Rocard to France, he joined the Free French Navy as DSR, and it was in this capacity that Jones met Rocard for the first time. He was provided with an

⁶² For ‘thoroughly briefed’ see Powers, *Heisenberg’s War*, p. 306.

⁶³ Robertson and Jones corresponded intermittently after the war, mostly on research issues and regarding Jones’s visits to the USA: CCAC RVJO G.308; RVJO G.400; RVJO G.402–G.403; RVJO H.368; RVJO E.153; RVJO L.95.

⁶⁴ Jones, *Most Secret War*, Plate 22b.

⁶⁵ See TNA DEFE 40/1, ‘Assistant Directorate of Intelligence (Science)’, no date.

⁶⁶ Jones, *Most Secret War*, pp. 260–3.

office in Queen Anne's Gate (behind Broadway), which was a prime location from which to assist ADI (Science).⁶⁷

The last of the four important liaisons to join ADI (Science) was Roy Piggott, who served as a useful connection to the Radio Research Station and to Appleton specifically. Jones wrote to Clark that Piggott 'was Appleton's radio amanuensis', and explained that Piggott's attachment to ADI (Science) was as liaison between himself and Appleton 'at the end of the war'.⁶⁸ Why such a liaison should be established so late in the war is not explained by Jones, in either his letter to Clark, nor in *Most Secret War*. Piggott is mentioned in Jones's memoirs however, in connection with post-war activity to renew ionospheric research collaboration between Britain and Germany.⁶⁹

Positioning ADI (Science)'s gradual growth into context is important, and the most effective method is through parallel comparison with Technical Intelligence (MI10). Wartime growth of both organisations was similar. Technical intelligence in September 1939, then designated MI1(d), was a solitary officer with no standing, no authority, and no control over sources. In effect, he was regarded as little more than 'a reader of foreign journals who might not be needed when war stopped their arrival'. It was swiftly realised that technical intelligence was important, and MI10 was formed in October

⁶⁷ Rocard remained in Britain until D-Day and, after the war, received a CBE for his services to the Allied cause. He believed that Jones instigated the honour, and wrote to express that he was 'extremely moved' that Jones 'attached such a high price to the work' he had enacted during the war. A worthy finale to Rocard's liaison with ADI (Science) was that, in his capacity as Overseas Scientific Intelligence Officer, Garrard provided the Sorbonne with a *Würzburg* for research into solar noises, and acted as courier for the brief congratulatory correspondence between Jones and Rocard: CCAC RVJO B.206, Yves Rocard to Jones, 14 December 1947.

⁶⁸ CCAC RVJO B.359, Jones to Clark, 20 September 1968.

⁶⁹ Jones, *Most Secret War*, p. 488. Here Jones referred to Piggott as Appleton's scientific assistant.

1939 for collection from all sources of technical information relating to enemy equipment, and subsequent examination and dissemination. MI10 slowly developed so that by July 1942 it had gained authority and was advising on many matters connected with British policy formation (thickness of enemy tank armour for example). So important became MI10 to the Allied cause that it was hived into three sections (detailed in Appendix I of this thesis). MI10 peaked at twenty-two officers, although staffing was a 'very difficult problem', because officers sufficiently well qualified technically and not too senior to fill rank positions were hard to find, while few prospective officers could satisfy technical efficiency requirements and multi-linguistic capabilities.⁷⁰ The Air Technical Intelligence section, AI2(g), also experienced the same problems, and also serve as a useful comparison to the slow growth of ADI (Science), although not nearly as parallel as that with MI10.

These were problems Jones discovered through trial and error only too well, and was perhaps one of the reasons he combed his scientific friends for staff. Another primary reason cannot be ignored. Jones's determination to surround himself with supporters was important, not just because he possessed an abrasive upstart personality, but also because he was a young man thrown into a relatively cut-throat 'old-boy' network. In fairness to Jones, it probably had as much to do with scientific talent as much as anything else. For example, he persistently attempted to recruit George Pickard, a Clarendon colleague. While Jones worked on the 1937 infra-red aircraft detection project under Lindemann, Pickard was researching for his doctorate. No doubt

⁷⁰ TNA WO 33/2723, 'Military Intelligence Organisation', p. 22.

Pickard would have looked up to Jones as the slightly older and more experienced physicist. When Pickard was awarded his PhD, he was assigned to work with Jones until they were separated 'much against [their] will' when Jones's infra-red project was shut down in favour of RDF.⁷¹

Pickard went to RAE. Prompted by creation of ORS in RAF Commands, Jones went through channels to obtain Pickard as OR liaison to ADI (Science).⁷² Ironically Pickard left RAE in 1942 to join Coastal Command ORS. Had Pickard joined ADI (Science), the somewhat fractious relationship between them and Bomber Command ORS (particularly over *Window*) could have been very different indeed. Jones later wrote that what he thought of Pickard's ability was illustrated by the fact that, for seven years, he 'had repeatedly and strenuously' tried to get Pickard back on his staff. Pickard's later colleagues evidently felt the same way however, because Jones was never able to persuade them to let one of his 'best friends' join ADI (Science) for Pickard 'was always in a key post'.⁷³

Most Secret War makes it difficult for historians to assess with accuracy what Jones truly thought about his staff. Frank, Wright, Smith, Robertson, Dee, and perhaps Gascoigne-Cecil were on par with Jones's intellect and standing, and were treated with respect. All were credited by Jones for their contributions to

⁷¹ CCAC RVJO B.206, testimonial written by Jones for George Pickard, 24 March 1947; Jones, *Most Secret War*, pp. 38 & 41.

⁷² TNA DEFE 40/2, Medhurst to Tizard, 8 October 1941; Pye to Medhurst, 13 October 1941. Pye confirmed that he well understood that Jones requested Pickard because he was a man he knew and worked with at Oxford, but this was not by itself 'strong reason for robbing' RAE of 'a man with valuable experience' whose 'loss would be a serious blow'. Pye emphasised to Medhurst that high grade staff with valuable experience were 'extremely short', and that for the work Jones required 'other men without Pickard's special experience' were 'equally well qualified'.

⁷³ CCAC RVJO B.206, testimonial written by Jones for George Pickard, 24 March 1947.

scientific intelligence (acknowledged to his satisfaction if not theirs). Conversely, and perhaps in the manner which was expected of him, Jones was supercilious to those who were not his equal. Any annoyance they experienced from lack of recognition in *Most Secret War*, paled by comparison with neglect for other scientific intelligence personnel only mentioned in passing (Masterman, Lampitt, Arthen), and especially those Jones forgot entirely (Beavis, Chapman, Hill). The scientific intelligence post-war history noted that there were 'a very large number of unacknowledged colleagues who served the cause'.⁷⁴ Jones made a significant attempt in his memoirs to correct earlier lack of acknowledgment, although his solitary attempt was on his terms based on his preferences.

These preferences do, nonetheless, provide insight to the type of man Jones was. He was typically conservative in all respects. It has been convincingly argued that scientists educated at public school or Oxbridge would enter conservative professions that articulated many of the values and attitudes learned in house or college.⁷⁵ Jones was not public school, but he was Oxford, and although he did not choose scientific intelligence (it chose him), he nonetheless applied his conservatism to that temporary profession. His superiors were always treated with regard and respect.⁷⁶ Those of equal standing to Jones (academically and hierarchically) were ally or rival depending upon personality. His inferiors were regarded as just that, and

⁷⁴ CCAC RVJO B.83 & TNA AIR 40/1532, ADI (Science) official history 'Air Scientific Intelligence in War, 1939–45', 1 April 1946, p. 16; AHB, 'Air Ministry Intelligence', p. 299.

⁷⁵ Philip Chaston, 'Gentlemanly Professionals within the Civil Service: Scientists as Insiders during the Interwar Period', unpublished Ph.D. thesis, University of Kent, October 1997, p. 77.

⁷⁶ Lindemann, Tizard, Appleton, Rowe, Winterbotham, Menzies, Medhurst, Inglis, Portal, Saundby, Dowding, Joubert, Churchill, Sinclair, Cripps, Beaverbrook are just four (of many) from each sphere (scientific, intelligence, Air Ministry, political) that Jones and ADI (Science) combined.

remained so. Jones's memoirs are primary evidence of these personal relationships. Throughout the Jones Papers there are many other examples.⁷⁷

This should be tempered with reference to the flexible atmosphere Jones permitted within wartime scientific intelligence. In his memoirs he frequently recounted jovial incidences remembered so vividly and, when coupled with Mowatt's amusing recollections of ADI (Science) life in Broadway, a mental picture emerges of an enjoyable yet highly efficient workplace.⁷⁸ This speaks volumes for Jones's human resource skills, and indeed, as the last four chapters have recounted, there is no doubt that ADI (Science) were effective and successful in the tasks laid before them. This being said, it is crucial to consider just how small a cog ADI (Science) was within Britain's expansive war machine. *Most Secret War* would have us believe the Allies would have struggled to win the war without Jones's contribution to scientific intelligence. This was far from reality. Examination of the enormity of the structural context in which ADI (Science) resided aids clarity in this regard. Although they tackled many problems outside their normal jurisdiction, their primary concerns were assessing air threats to Britain. The next sub-section therefore

⁷⁷ For examples from each see Jones, *Most Secret War*, p. 487; CCAC RVJO B.125, Jones to S2b (Tech.) (Mr. Godfrey), 5 March 1945 regarding Ackermann.

⁷⁸ Lady Currie's letter to Frank in 1984 provided the most enlightening glimpse into ADI (Science) office life. She had 'many memories of that rather dark room' in which Frank and his two companions (probably Garrard and Smith) 'shared on the 3rd floor' of 54 Broadway. She recalled Frank always seated at his desk, while Smith was operating his model railway system, and Jones was walking up and down 'what little floor space was free, offering advice and comment and usually munching on a biscuit and a bar of chocolate'. Lady Currie informed Frank that the female members of Section II 'constantly asked themselves' how any of the members of ADI (Science) managed to 'do any of the work which was so important'. The other question often asked was whether Frank spent all days and nights in his chair, for no-one could remember seeing him out of it and walking. Lady Currie supposed that these memories mirrored 'the frivolous attitude to the ghastliness of some of those days', which was 'the only way to get through it all': UOB DM1310/A.16, Daisy Currie to Frank, 17 January 1984.

specifically concentrates on ADI (Science)'s position within Air Intelligence, and the Air Ministry.

ADI (Science) as a Structural Component

It is important in intelligence studies to 'get down to the fundamental problem that intelligence is people and personalities more than it is organisation', for 'in the end it has to be people, and you have to rely on people, whether they are in this box or that box, to produce what is ultimately needed in the future'.⁷⁹

This was so very true of ADI (Science). Led by Jones, a very strong personality, ADI (Science) was successful in no small part because of vibrant individual talent. Personality was not the sole reason for their success however. They relied heavily on other organisations within both of the monolithic structures of SIS and Air Ministry. That ADI (Science) was situated in both is important, and was accentuated by Jones in choosing to base his slowly-expanding organisation in 54 Broadway, rather than in Adastral House, Kingsway (home of the Air Ministry Directorate of Research where Jones was also provided with an office). This choice allowed scientific intelligence to benefit from the wealth of intelligence data input and collation output generated by SIS. ADI (Science) also benefited immensely from all of the Air Ministry establishments outside of Whitehall, and indeed outside of London.

Diagram V not only shows how Winterbotham and Jones as AI1(c) and IId respectively were structurally placed in 1940, but also the wider intelligence structure within Broadway, and how small a component the Air Section was at

⁷⁹ Walter Pforzheimer cited in Thomas H. Hammond, 'Intelligence Organizations and the Organization of Intelligence', *International Journal of Intelligence and CounterIntelligence*, 23: 4 (2010), 686.

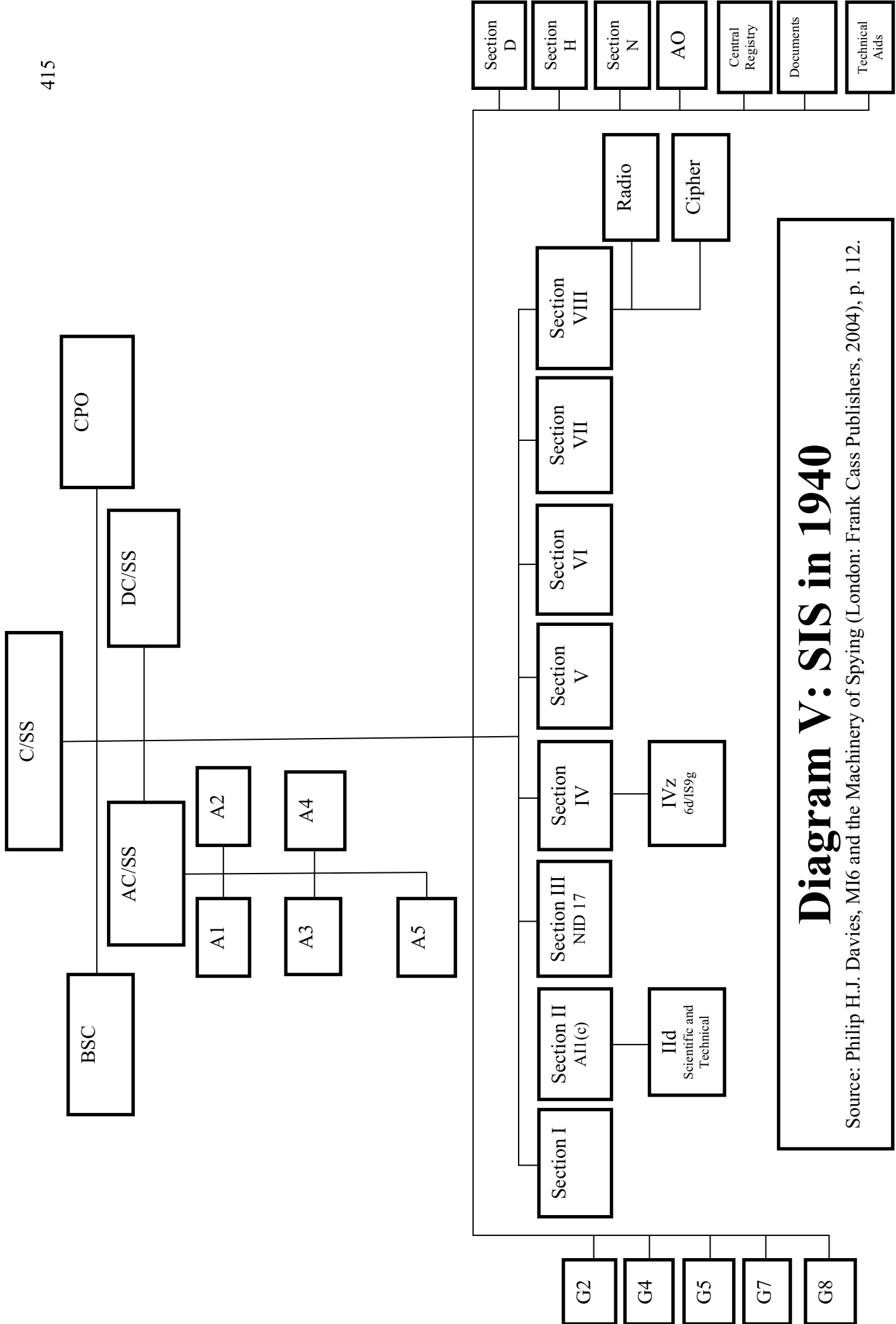


Diagram V: SIS in 1940

Source: Philip H.J. Davies, MI6 and the Machinery of Spying (London: Frank Cass Publishers, 2004), p. 112.

the beginning of the Second World War. AI1(c) was responsible for Air Intelligence Liaison duties; Ild was singularly attached to this liaison position within SIS. It is useful to compare Diagram V with Diagram VI, which shows the extent of Air Intelligence from the SIGINT perspective of December 1940. In the previous month the entire Air Intelligence Directorate was reorganised into four new deputy-directorates. Although this reorganisation maintained geographical sub-divisions, it was a necessary measure designed to manage the rapid expansion of personnel entering Air Intelligence up to 1941 (40 officers at outbreak of war rose to 240 by autumn 1940).⁸⁰ Diagram VI shows how large Air Intelligence had become in such a short space of time, and how important SIGINT had become to the Air Ministry's intelligence organisation. The diagram represents the structural situation of RAF SIGINT some five months after Jones was transferred to MAP DSR following Air Ministry separation. ADI (Science) were included in this structural diagram because Jones received SIGINT through AI1(c) and 3G(N). Jones's inclusion vividly emphasises just how separated Jones was from Air Intelligence as a result of the June 1940 Air Ministry split. Examined from this perspective, it is little wonder that Jones wrote that he would have had a better say if he had a recognised position on the Air Staff, rather than with DSR in MAP.⁸¹

The hierarchy of Diagram VI is also important. Jones was situated above SIGINT collecting organisations, and below Deputy Directors. Although he

⁸⁰ Hinsley *et al*, *British Intelligence in the Second World War, Volume I*, p. 284.

⁸¹ Jones, *Most Secret War*, p. 162.

was in a position to make appropriate demands upon GC&CS and Y-Service Units, he certainly was not positioned to criticise Deputy Directors who outranked him. Jones's 1940 hostility towards Blandy and particularly Lywood as DDSY was inappropriate and led to fractious relations between ADI (Science) and Y throughout the war. Three other points of discussion are notable from Diagram VI. That there was a Scientific Advisor (Y6) within the Y-Service is interesting, although there is no knowledge of who or what their role was. No.80 Wing is positioned attached to Bomber Command in direct response to Jones's discovery of GAF navigational radio beams. Also the Air Section at GC&CS was already large by close of 1940. This component of Air Ministry intelligence was encapsulated by Hut 3, which became without question the most vital aspect of British SIGINT as shown in Diagram VII.

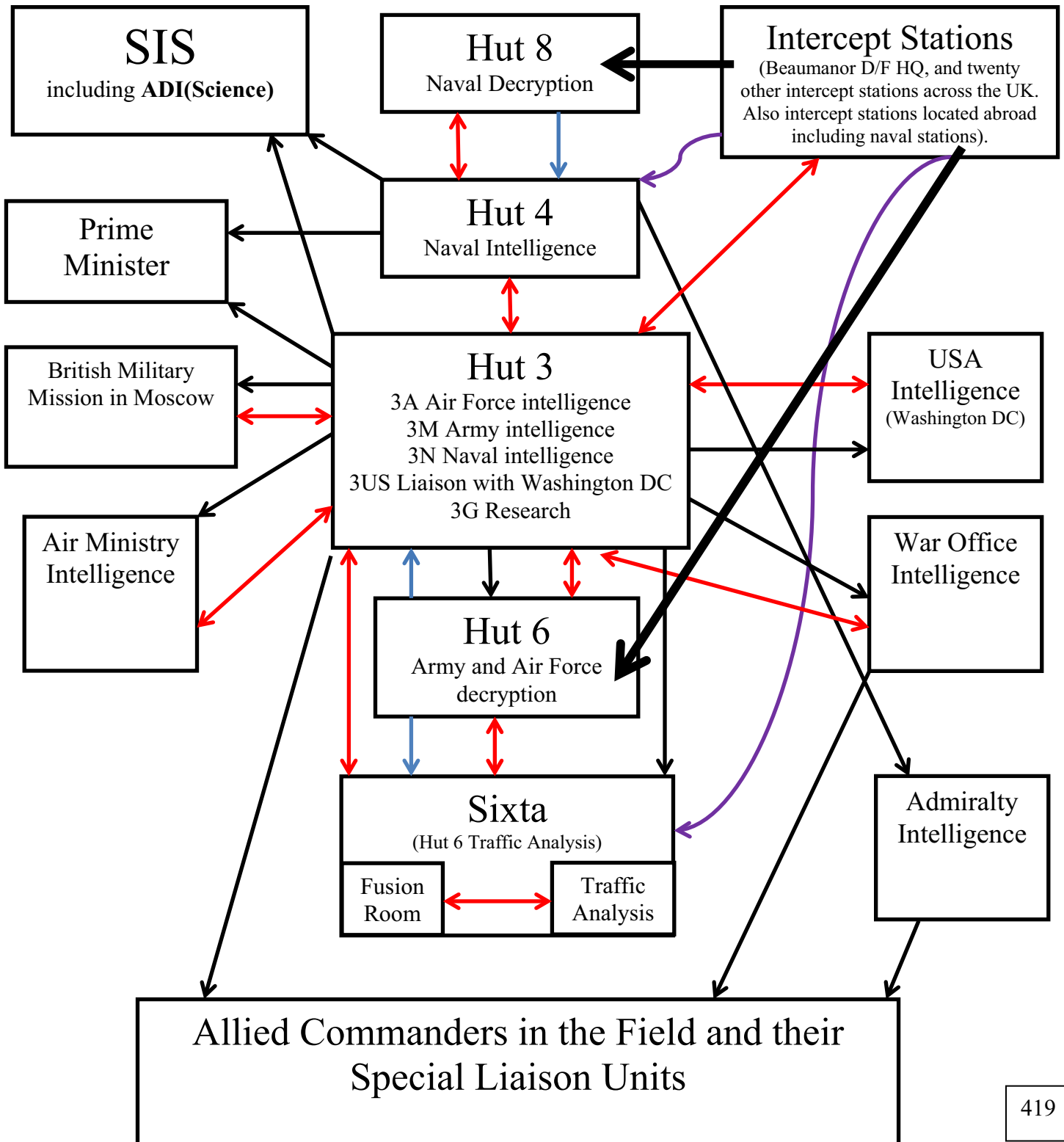
Hut 3 housed the German Army and Air Force Enigma Reporting Section, created by Winterbotham in late 1939, and headed by Commander Malcolm Saunders from January 1940. All officers of Hut 3 were SIS staff, because constitutionally, Hut 3 remained attached to the original Broadway component of GC&CS which then later moved to Bletchley.⁸² Saunders was replaced by W/Cdr (later Gr/Cpt) Eric Jones who remained head of Hut 3 for the duration of the war.⁸³ Hut 6 was the German Army and Air Force Enigma Processing

⁸² See *History of Bletchley Park Huts & Blocks 1939–45*, Bletchley Park Trust Report No.18, September 2009, pp. 3 & 9; Millward, 'Life in and out of Hut 3', p. 26. Edward Thomas, who worked in Hut 3 for a spell, stated that it had been Welchman who was responsible for establishing the Hut 3 Watch and not Winterbotham. Moreover, Thomas corrected one of Winterbotham's 'many mis-statements concerning Bletchley' by explaining that Hut 3 was not initially staffed by German-speaking RAF officers, hence there was a naval commander heading the Watch for a time: see Thomas, 'A Naval Officer in Hut 3', 44.

⁸³ Hut 3 moved to Block D in February 1943 but retained its Hut 3 designation: *History of Bletchley Park Huts & Blocks 1939–45*, Bletchley Park Trust Report No.18, September 2009, p. 3.

Diagram VII: Traffic Flow of Enigma and Fish Ciphers from Interception to Action

Source: James Thirsk, *Bletchley Park: An Inmate's Story* (Galago, 2008), p. 188.



Legend	Liaison between Sections	
Decrypted, paraphrased enemy messages	Raw enemy messages in cipher	
Enemy non-message traffic (logs)	Decrypted enemy messages	

and Decryption Section.⁸⁴ Hut 8 was the German Navy Enigma Processing and Decryption Section.⁸⁵ The Special Liaison Units (SLUs) represented in the diagram were an improvisation of Winterbotham's in early 1941: they proved to be remarkably successful as 'guardians of ULTRA security', in enabling Enigma decrypts to be used by field Commanders without disclosing their existence to the enemy.⁸⁶

The importance of Diagram VII within this thesis is the centrality of Hut 3, not just in Air Intelligence, but in all aspects of Allied intelligence. The three British Service organisations were well catered for by Hut 3, as were the American and Russian allies. The Air Ministry did not directly serve field commanders yet the Admiralty did. The air link was served instead by the Air Section, designated AI4(f). But even then there were difficulties with the AI4(f) intelligence product reaching the RAF Commands. One AI4(f) operative recalled that part of the problem was that AI4 'had no real understanding' of 'detailed intelligence requirements' of 'the natural users' of the BMPs (Tactical SIGINT Reports provided directly to Allied Air Force commanders from June 1942 through to war's end). This awkward working relationship stemmed from DDI4 concerns over security of intelligence in his responsibility. Throughout the war, 'Josh' Cooper, head of AI4(f), noted that he found the 'new occupant

⁸⁴ Established in early 1940 by Gordon Welchman, Hut 6 was taken over by P. S. Milner-Barry in September 1943 when Welchman was promoted to head the new Machine Co-ordination and Development Section. Welchman reached Directorate level in March 1944 when appointed ADI (Machinery), Assistant Director of Machines and Mechanical Devices, a position within GC&CS. Hut 6 also moved to Block D in February 1943, and also retained its Hut designation: *History of Bletchley Park Huts & Blocks 1939–45*, Bletchley Park Trust Report No.18, September 2009, p. 3.

⁸⁵ Established by Alan Turing in early 1940, Hut 8 also moved to Block D in February 1943: *History of Bletchley Park Huts & Blocks 1939–45*, Bletchley Park Trust Report No.18, September 2009, p. 11.

⁸⁶ Jones, 'A Sidelight on Bletchley Park, 1942', 5; Winterbotham, *The Ultra Secret*, pp. 39–40. For 'guardians of ULTRA security' see Robert Cecil, "'C's War', *Intelligence and National Security*, 1: 2 (May 1986), p. 179.

of the DDI4 post' (Gr/Cpt. Fitch) 'much easier to work with'.⁸⁷ Evidently it was not only Jones who found common ground with DDI4 hard to acquire.

Founded by Cooper in 1936, the Air Section was initially housed in Bletchley's Hut 4.⁸⁸ It collectively belonged to, and was manned by, the Air Ministry and GC&CS, the latter dictated working methods and local administration, while DDI4 of the former determined intelligence targets, outputs and outside contacts. It was not an ideal arrangement.⁸⁹ Jones believed it to be 'the result of an organiser's nightmare', for the allocation of duties to huts was indistinct, and did not aid smooth working between sections.⁹⁰ Tactical intelligence had no value if it was not available to operational users in a timely manner and in an immediately relevant and understandable format. That it was far too often not presented in this fashion 'presented massive obstacles caused by bureaucracy, protocols, personalities and failures to communicate'.⁹¹

Although Jones did not meet Cooper, he did refer to the 'outstanding cryptographer' before relaying contacts he made while billeted at Bletchley on the outbreak of war.⁹² Other GC&CS contacts were encouraged, such as Norman, and Blyth's wife Margaret, who worked at Bletchley and proved invaluable as yet another unorthodox scientific intelligence connection. Jones

⁸⁷ Bonsall, 'Bletchley Park and the RAF Y Service', 834.

⁸⁸ By early 1941 it had moved to Hut 10. In mid-1942 it moved to the new brick-constructed Block A, and then in August 1943 moved to Block F: *History of Bletchley Park Huts & Blocks 1939-45*, Bletchley Park Trust Report No.18, September 2009, p. 3.

⁸⁹ See *History of Bletchley Park Huts & Blocks 1939-45*, Bletchley Park Trust Report No.18, September 2009, p. 3.

⁹⁰ Jones, 'A Sidelight on Bletchley Park, 1942', pp. 8-9.

⁹¹ Stubbington, *BMP Reports by the German Air Section*, p. 5.

⁹² Jones, *Most Secret War*, pp. 59-63; Jones, 'A Sidelight on Bletchley Park, 1942', 2. These contacts were historian Geoffrey Barraclough, A. J. Allen, Coutleigh Nasmith 'Jane' Shaw, and especially Edward Travis, Deputy Head of GC&CS (became Head in 1942). Travis in turn introduced Jones to Alan Turing.

wrote that normally ‘all visitors, family or otherwise’ would be barred from his Broadway office, and that indeed he and his staff were not allowed to inform their families where they worked. But ‘Maggie’ Blyth was ‘special’ because she was a cryptographer at Bletchley, knew ADI (Science) secrets, and enjoyed the ‘freedom’ of Broadway.⁹³

There may well have been a lack of co-ordinated organisation within GC&CS, yet this never detracted from the great success of Bletchley Park (the ‘brightest feather in C’s cap’) during the Second World War.⁹⁴ Crucially, Hut 3 – the hub of SIGINT – interacted with scientific intelligence. The inclusion of ADI (Science) in Diagram VII is added in order to signify precisely where it was positioned in the SIGINT traffic flow from interception to action. Jones fostered his GC&CS connections well, and continued to do so throughout the war. As Diagram VII demonstrates, Hut 3 was an impressive collator and provider of intelligence for all concerned. ADI (Science) was a small consumer of the Hut 3 product within a massive intelligence network.

In 1940, the Hut 3 Air Intelligence Section (not to be confused with AI4(f), a separate organisation within GC&CS) established a small party of RAF signals personnel, called SDE. This served as another important contact for ADI (Science).⁹⁵ As the link between Hut 3 and ADI (Science) was so crucial to the success of the latter, Jones would assist Hut 3 whenever possible.

⁹³ Jones, ‘Christmas Eve 1940’, pp. 67–8; Jones, *Reflections on Intelligence*, p. 232; Jones, *Most Secret War*, p. 207.

⁹⁴ For poor GC&CS wartime organisation, see Davies, *MI6 and the Machinery of Spying*, p. 162. Robert Cecil specifically remarked that Section V was the ‘the brightest feather in C’s cap’ after GC&CS; Cecil, ‘C’s War’, 178. See also Robert Cecil, ‘Five of Six at War: Section V of MI6’, *Intelligence and National Security*, 9: 2 (April 1994), 345–53.

⁹⁵ Bonsall, ‘Bletchley Park and the RAF Y Service’, 838.

When in early 1942 a member of Hut 3 fell 'sick through overwork', for example, Frank spent some time helping the staff of Hut 3 maintain the fluidity of their work, which, although vital, did put a great strain on scientific intelligence.⁹⁶ This further developed essential connections between Hut 3 and ADI (Science). Also, in June 1942, when Barraclough was due to leave Bletchley, Saunders chose to inform Jones out of all the Air Ministry authorities.⁹⁷ Jones also lectured to Hut 3 operatives on at least one occasion, to assist cryptographers to discover data pertinent to scientific intelligence.⁹⁸

In addition to ULTRA received from 3G(N), ADI (Science) obtained Enigma decrypts from the Air Ministry disguised as agents' reports.⁹⁹ They did not, however, have exclusivity over such scientific intelligence. Bawdsey, TRE, and RAE received the same intelligence albeit often after ADI (Science) had seen it first. Jones was often accused of retaining information that could have been useful to others, his excuse being that he did not want 'amateurs' to 'go mucking about trying to solve riddles with which he was wrestling'. Yet these so-called 'amateurs' were 'every bit as concerned in solving the same

⁹⁶ TNA DEFE 40/1, 'The Expansion of Scientific Intelligence', 20 November 1942, p. 4.

⁹⁷ CCAC RVJO B.121, Malcolm G. Saunders to Jones, 16 June 1942. Barraclough joined the RAF volunteer reservists. It seems that Saunders was hoping that Jones would employ Barraclough. He informed Jones that Barraclough was 'one of the best intelligence brains and German linguists in the hut', and that such great experience should be utilised, and not wasted by the RAF.

⁹⁸ Jones, *Most Secret War*, p. 122.

⁹⁹ TNA HW 43/2, 'History of British SIGINT, 1914-1945, Volume II', p. 544; Jones, 'A Sidelight on Bletchley Park, 1942', 3; TNA HW 43/69, 'Report on the Work of 3G(N)', p. 10. Jones wrote that part of the disguise for the decrypts 'was to use the standard MI6 preamble to an agent's report, in which the reference always started with 'CX'. The first decrypts which were sent into the Air Ministry in this way had the prefix 'CX/FJ' which in the summer of 1940 was changed to 'CX/JQ' and during 1941 to 'CX/MSS'. Later 'MSS' was replaced by 'ULTRA', while in its turn Ultra was succeeded by other names nearly all of which resulted from the cryptographers' penchant for five-letter groups'. See also Jones, *Command and Complementarity*, pp. 7 & 11 where Jones intriguingly referred to 'agents reports' as original sources to cover any reference to ULTRA.

problems and, more important, in devising the countermeasures'.¹⁰⁰ One wartime scientific investigation establishment from which Jones was not able to withhold information was Admiralty scientific intelligence. Their Jones-equivalent was Professor Edward Gollin, who, according to Zuckerman, had 'been in the post long before Jones was even aware of his existence'.¹⁰¹ Jones only mentioned Gollin in passing, in reference to post-war scientific intelligence arrangements which Jones effectively resigned over.¹⁰²

The November 1940 reorganisation of Air Intelligence commenced a series of reorganisations throughout SIS, which resulted in direct benefit for Service Directorates and implications for the internal mechanisms of SIS. Two processes guided this reorganisation: Service Directorates were preparing for an anticipated influx of information, and were morphing into functional rather than geographical structural organisations. The direct implication this had upon SIS was that newly mobilised recruits infiltrated the inner sanctums of British intelligence.¹⁰³ The creation of ADI (Science) as a structural organisation was part of this process. Further reorganisation of Air Intelligence in April 1941 ensured that ADI (Science) not only expanded, but was brought back into the Air Ministry fold, as Diagram VIII demonstrates.

¹⁰⁰ For 'amateurs', see UOEA SZ/2/GEN, 'Draft letter to Lord Chalfont' written by Solly Zuckerman, no date, p. 1.

¹⁰¹ UOEA SZ/2/GEN, 'Draft letter to Lord Chalfont' written by Solly Zuckerman, no date, pp. 1 & 6. Ewan Montagu defined Gollin as 'a brilliant young scientist', who was 'NID's adviser on all scientific matters': Montagu, *Beyond Top Secret U*, pp. 59–62 & 124–8.

¹⁰² Jones, *Most Secret War*, pp. 492–3 & 509.

¹⁰³ Davies, *MI6 and the Machinery of Spying*, p. 104; Hinsley *et al*, *British Intelligence in the Second World War, Volume I*, p. 284.

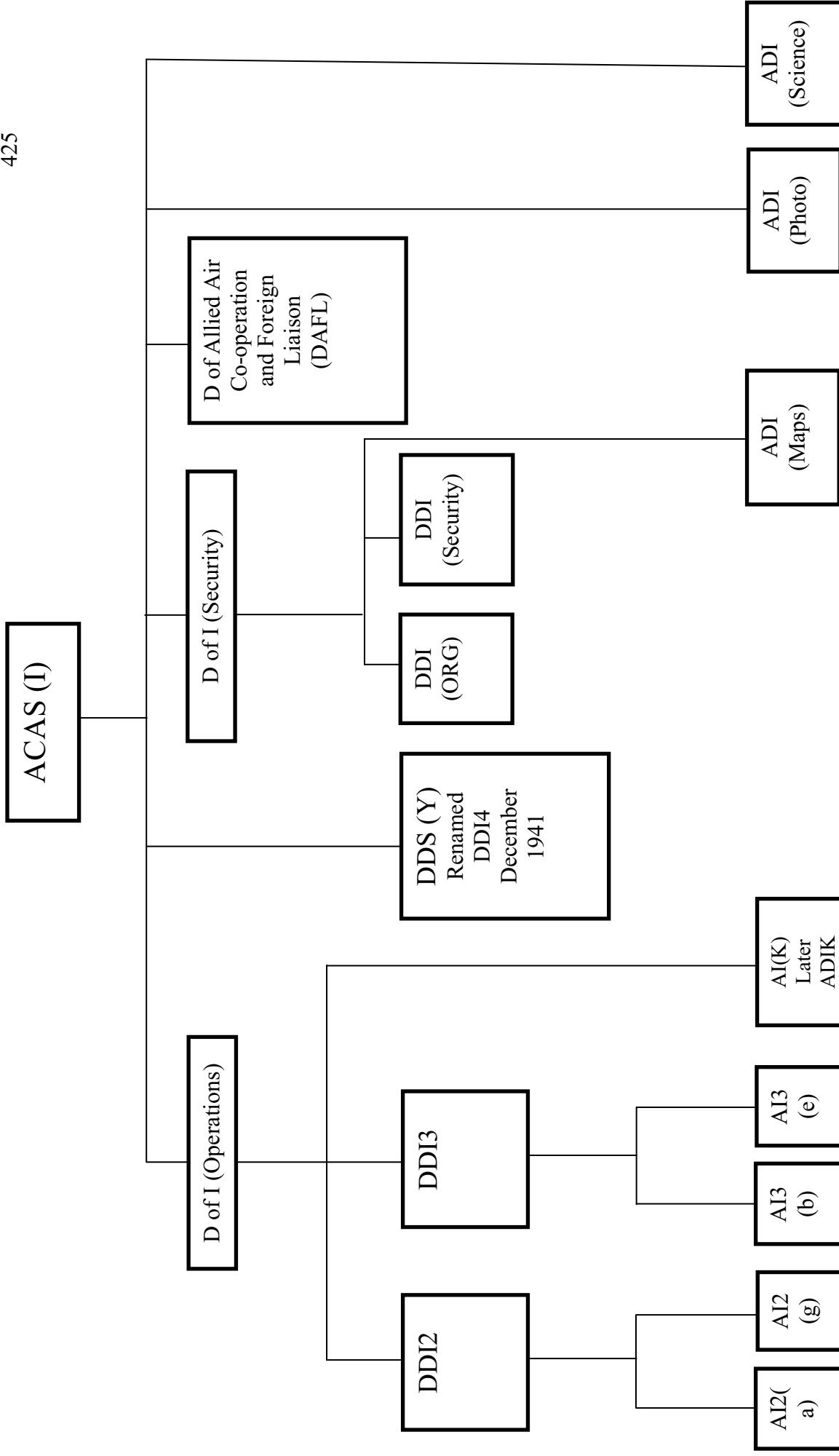


Diagram VIII: Air Ministry Intelligence Organisation, August 1941.
 (Only Units concerned with Special Intelligence are detailed)
 Source: TNA HW 43/1, 'History of British SIGINT, 1914-1945, volume I', p. 202.

Diagram VIII is most important from a scientific intelligence perspective, not just because ADI (Science) is represented under Air Ministry auspices, but also because it is placed alongside two new Assistant Directorates (for maps and photography). The hierarchy of Diagram VIII is again important. Jones recalled that as he had been made directly responsible to Medhurst, he 'was effectively in parallel' with the Directors of Intelligence of Operations (DI(O)) and Security (DI(S)). This, wrote Jones, 'made up for the grudging manner in which the Civil Service had treated' him, and meant he 'became the only civilian in an executive position on the Air Staff'.¹⁰⁴ These two statements not only highlight the over-inflated impression he had of his wartime status, but also demonstrate the extent to which he allowed his rancour to fester over the years for not obtaining the full Directorship he felt he deserved following the beams episode. By informing history as he did that ADI (Science) was 'parallel' in importance and stature to Directors of Operations and Security, he seriously over-stated the case.

Diagram VIII shows that ADI (Science) was far removed from the Directors of Intelligence, and equal in standing to ADI (Photography), ADI (Maps), and the Air Ministry's POW intelligence sub-section AI(K), which although not an Assistant Directorate, had been upgraded from AI1(k). Also of equal standing was AI2(g), the technical intelligence sub-section. Jones of course, as scientific intelligence chief held the equivalent rank to Peter Stewart head of ADI (Photography), and Felkin of AI(k). This alone was a meteoric rise through the ranks, and demonstrates clearly how important scientific

¹⁰⁴ Jones, *Most Secret War*, p. 183.

intelligence had become following the beams successes of late-1940, and DT discoveries of summer 1941. Davies stated that under new (April 1941) arrangements, Jones's 'position in the SIS hierarchy remained unchanged', which contradicts the impression Jones provided.¹⁰⁵ Even Davies's description is only a half-truth. Diagram VIII shows that Jones's Assistant Directorship raised his importance and that of scientific intelligence within the Air Intelligence organisational structure (although less than Jones believed).

There were two other significant reasons for the impressive expansion of Air Intelligence: the ubiquitous nature of Air Intelligence sources compared to other types, and the remarkable increase in Air Intelligence usage. Before the end of 1942, for example, CSDIC were interrogating mostly air and naval POWs, while GAF Enigma and low-grade SIGINT traffic far outweighed that of *Kriegsmarine*, *Wehrmacht*, and *Abwehr*. Moreover, Medmenham and PRU expansion was 'one of the most notable developments in wartime intelligence', as PR sorties rose from 1,198 in 1940 to 2,989 in 1943.¹⁰⁶ Wartime PI Quentin Craig recalled 'great relief' when ADI (Photography) was created, for beforehand, RAF Benson had to decide photographic priorities for all three services.¹⁰⁷ ADI (Photography) served many clients in addition to the services. One rarely-discussed by historians was the Inter-Service Topographical Department which heavily used aerial photographic

¹⁰⁵ Davies, *MI6 and the Machinery of Spying*, p. 106.

¹⁰⁶ Hinsley *et al*, *British Intelligence in the Second World War, Volume II*, p. 38.

¹⁰⁷ TMC DFG 5670, Quentin Craig interviewed by Constance Babington Smith, 17 April 1956.

Interestingly, Craig also recalled that British cameras and lenses at Benson were better than German, and that pilots were given 'escape gadgets', 'survival packs', and relevant currency according to which country they were due to fly over.

intelligence.¹⁰⁸ There was also the August 1941 creation of the Political Warfare Executive (PWE), which was more a user of intelligence rather than a provider, and requiring more intelligence derived from Air Intelligence sources than any other.¹⁰⁹ Great demand for the source therefore, coupled with need for an authority to make tactical and strategic judgment calls, led to a unique organisation of the Second World War. Medmenham expanded to an impressive peak staff of 550 officers and some 3,000 other ranks, half of whom were American.¹¹⁰

The April 1941 reorganisation of Air Ministry Intelligence remained relatively unchanged except for two incidences of restructuring in mid-1943. The first directly affected ADI (Science). Under the April 1941 reorganisation Jones directly reported to ACAS(I), whereas the 1943 alteration meant he became responsible to DI(O), who, in turn, was responsible to ACAS(I) for ADI (Science). This arrangement also affected ADI (Photography). The other alteration was Assistant Directorate upgrade of AI(K) to ADIK, also placed under DI(O). Ambiguity regarding the supposed parallel importance of ADI (Science) with the intelligence Directorates, upon which Jones placed so much emphasis, was removed. It remained this way for almost a year, until further reorganisation in April 1944. This satisfactorily confirms that ADI

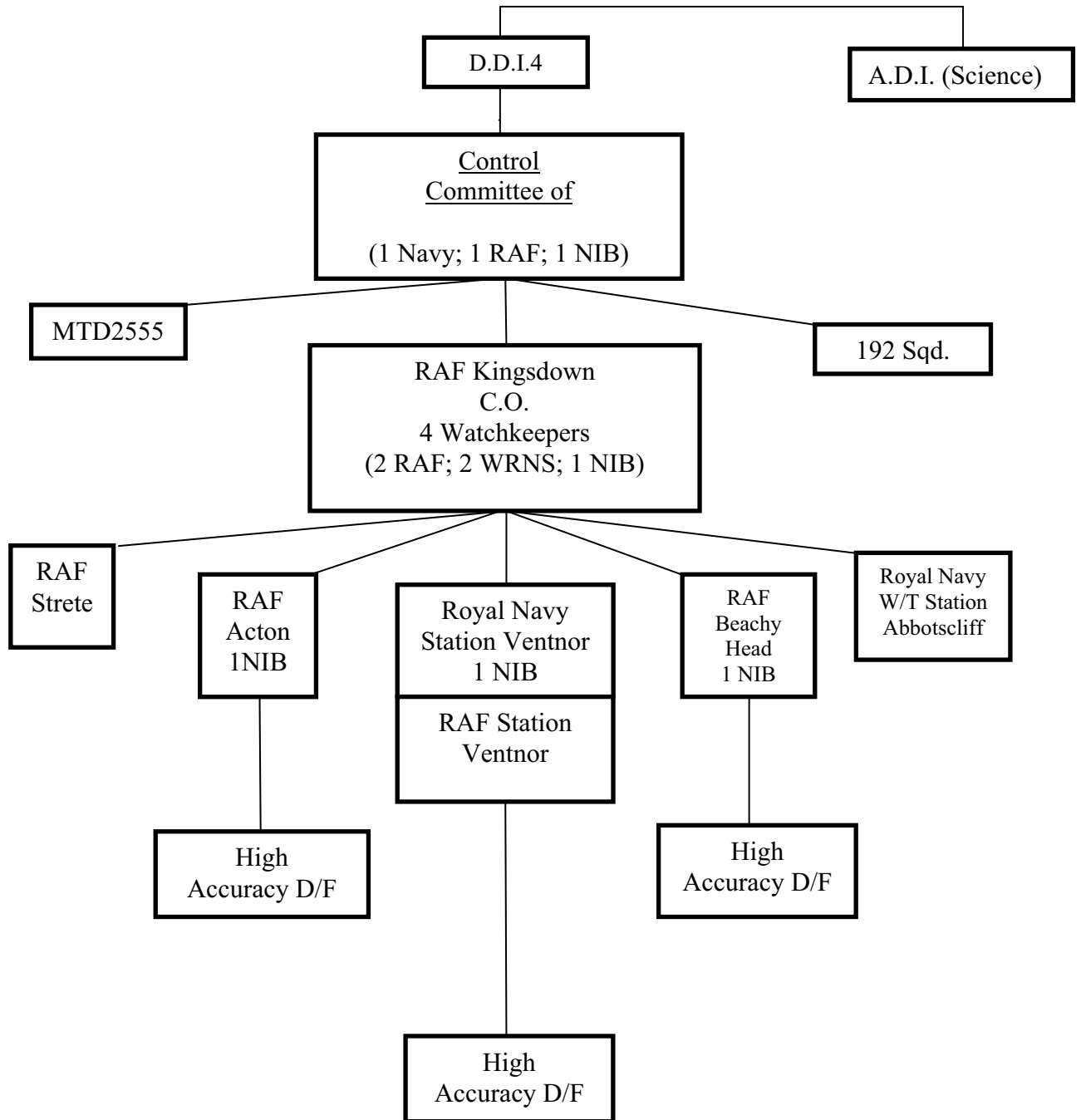
¹⁰⁸ On topographical intelligence, see Bernal's work in Beach intelligence: Cambridge University Library (hereafter CUL) BP ADD/8287/D.6, Combined Operations Handbook 'Beach Intelligence', March 1946; CUL BP ADD/8287/D.11, 'Report on Work Done in Connection with Operation Overlord', June 1944; Brown, *J. D. Bernal*, 240–6. This type of scientific intelligence resulted from decisions made during the Quebec 'Quadrant' Conference of August 1943. See also Kenneth E. Bofrone, 'Intelligence Photography', *Studies in Intelligence*, 5: 2 (Spring 1961), 9; R. A. S. Ratcliffe, 'Some Aspects of Weather Forecasting for the RAF during the Second World War', *Weather*, 7 (July 1984), 219; W. G. V. Balchin, 'United Kingdom Geographers in the Second World War: A Report', *The Geographical Journal*, 153: 2 (July 1987), 159–80.

¹⁰⁹ Hinsley *et al*, *British Intelligence in the Second World War, Volume 1*, pp. 161 & 292, and *Volume II*, pp. 7, 32 & 38.

¹¹⁰ Stanley, *V-Weapons Hunt*, p. 42.

Diagram IX: Provision for the Combined Issue of Noise Signal Intelligence for the Invasion of France, June 1944.

Source: TNA HW 43/1, 'History of British SIGINT, 1914-1945, volume I', p. 243.



Legend:

NIB – Noise Investigation within the RAF Y-Service
 W/T – Wireless Telegraphy
 D/F – Direction Finding

(Science)'s place in the hierarchical structure of Air Ministry Intelligence organisation was parallel with sibling Assistant Directorates—not the Deputy Directorates.¹¹¹ These expansions resulted in an 'unmanageably flat and wide management structure', created by a consumer demand explosion, increased intelligence production caused by war, and diversification of tasks required to undertake such production.¹¹² ADI (Science) was certainly a touchstone of British wartime intelligence diversification, akin to all parallel organisations within the SIS superstructure.

Much the same can be said for scientific intelligence within the Air Ministry superstructure. Diagram IX shows that by June 1944 ADI (Science) was equal in standing with DDI4 following the April 1944 reorganisation. Whereas Jones never had more than twenty-five personnel reporting to him, DDI4 was responsible for an extensive organisation of W/T and D/F stations from Cornwall to Scotland. Diagram X examines DDI4's low-grade SIGINT organisation in closer detail, and shows the breakdown of DDI's responsibility of close to 5,000 personnel across the United Kingdom. It also emphasises the extent to which technology was driving the intelligence-gathering processes during the Second World War, as well as the extent to which Hut 3 was integral to the SIGINT processing procedure.

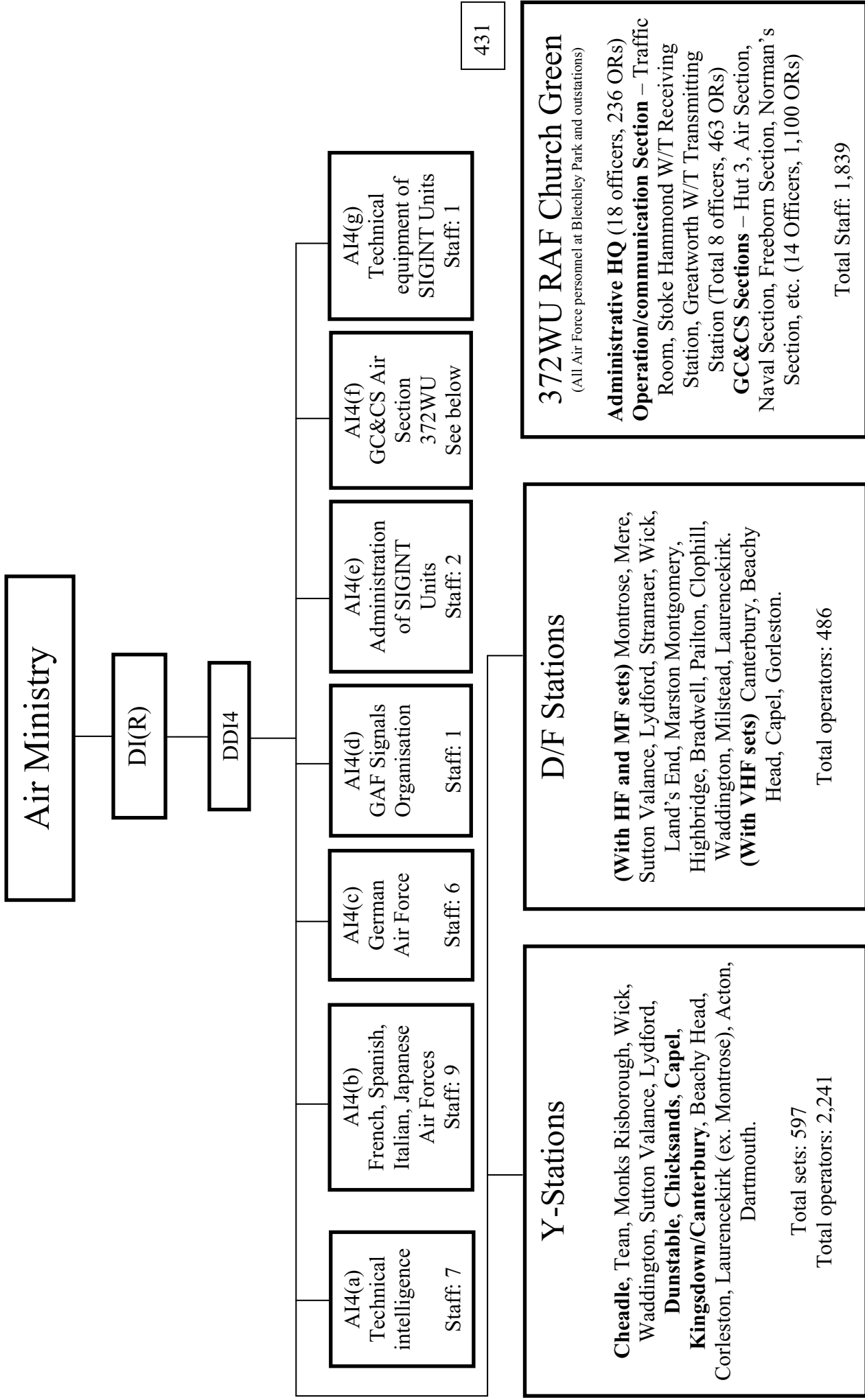
The most important aspect of the April 1944 reorganisation of Air Intelligence was the emphasis placed on research to (and within) the intelligence process

¹¹¹ Hinsley *et al*, *British Intelligence in the Second World War, Volume II*, p. 653.

¹¹² Davies, *MI6 and the Machinery of Spying*, pp. 114, 155 & 160–1; Philip H. J. Davies, 'Organizational Politics and the Development of Britain's Intelligence Producer/Consumer Interface', *Intelligence and National Security*, 10: 4 (1995), 120.

Diagram X: RAF SIGINT Organisation in the United Kingdom – 1944 (Peak)

Source: TNA HW 43/3, 'History of British SIGINT, 1914-1945, volume III', p. 806.



through creation of an Intelligence Directorate for Research (DI(R)). This became responsible for DDI2 organisation (that collated technical intelligence on aircraft, industries, and airfields) and also became responsible for DDI4.¹¹³ This established four Directorates – Security, Operations, Research, and Liaisons – as in Diagram XI, which shows Air Ministry intelligence at its wartime peak in September 1944.¹¹⁴ Other notable additions were the creation of a Deputy ACAS(I), and an Air Intelligence representative on the JIC. Although ADI (Science) was reattached directly to ACAS(I), it remained parallel in standing with the Deputy Directorates, and the two sibling Assistant Directorates, ADI (Photography) and ADIK. DDI4 was transferred from the Operations Directorate to the Research Directorate. This placed all low-grade SIGINT with TECHINT (excluding PR/PI) under the new auspices of ‘Intelligence Research’. AI2(g) never rose to the level of importance enjoyed by ADI (Science). The borderline between the two was always hazy, with scientific intelligence responsible for unexpected developments in GAF technique and equipment, and technical intelligence responsible for normal improvements in aero-engines, air frames, and their components.¹¹⁵

It was no coincidence that Air Intelligence became so extensively connected structurally. Almost all Air Intelligence sections were gatherers of intelligence as well as collators. For example, Hut 3 Air Advisers could not ‘have

¹¹³ Hinsley *et al*, *British Intelligence in the Second World War, Volume II*, p. 653.

¹¹⁴ The Security Directorate requires brief explanation. It was responsible for many aspects of air security, such as handling enemy agents, preventing inadvertent disclosure of information valuable to the enemy, postal censorship, telephonic monitoring, correct transmission of documents. In effect its duty was basic police work, and was efficiently performed: Dean, *The Royal Air Force and Two World Wars*, p. 187. Comparison of the DI(S) organisational structures in Diagrams VIII and XI emphasises the phenomenal expansion that had been necessary due to the consequences of war.

¹¹⁵ TNA HW 43/2, ‘History of British SIGINT, 1914–1945, Volume II’, pp. 544–5. For a complete picture of what every Air Intelligence designation was responsible for during the Second World War, see Appendix I of this thesis.

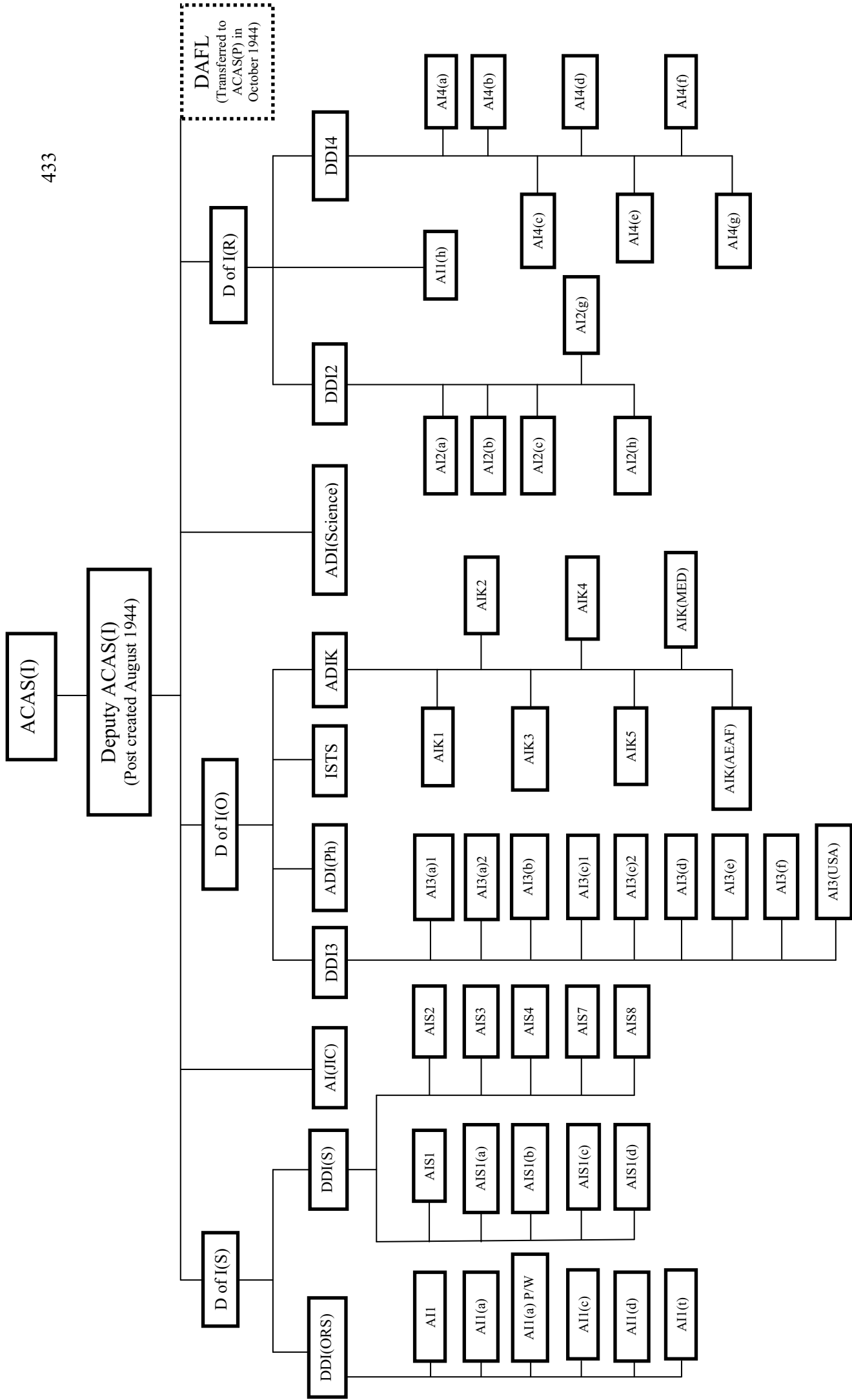


Diagram XI: Air Ministry Intelligence Directorate Organisation, September 1944.

Source: TNA HW 43/3, 'History of British SIGINT, 1914-1945, volume III', p. 805.

performed their tasks without the elaborate indexes over which ATS, WAAFs, and civilian girls laboured tirelessly', carefully and 'meticulously recording even the minutest details mentioned in the Enigma codes'.¹¹⁶ Indexing, cataloguing, collating, storage, and retrieval are important processes which have significant implications for organisational design.¹¹⁷ In consideration of flow charts of formal organisation and public administration however, it is important to consider that such diagrammatical presentations omit the 'shadowy personal networks' and 'webs of familiarity' so characteristic of intelligence and of the 'Whitehall village', both of which were (and are) 'honeycombed' with committees, working parties, joint groups, and interdepartmental officials.¹¹⁸

Air Ministry Intelligence organisation was effective throughout the Second World War. One consumer stated that it 'had many successes to its credit and it is difficult to point to a serious blunder'.¹¹⁹ Philby described SIS as a 'dysfunctional organisation' due to its effectiveness being undermined by personal disputes among its 'largely mediocre senior officers'.¹²⁰ Davies agreed with this assessment, stating that in the last analysis, 'the SIS quite literally muddled through the Second World War with its own leadership often very nearly its own worst enemy', adding that SIS suffered from a 'weak command and control infrastructure, and prohibitively wide span of control under Menzies, who had no credible mechanism of delegation under him'. Davies explained that although the hand of Menzies was strengthened by

¹¹⁶ Bennett, 'The Duty Officer, Hut 3', p. 35.

¹¹⁷ Hammond, 'Intelligence Organizations and the Organization of Intelligence', 710.

¹¹⁸ Davies, *MI6 and the Machinery of Spying*, p. 329.

¹¹⁹ Dean, *The Royal Air Force and Two World Wars*, p. 187.

¹²⁰ Murphy, 'Keith Jeffery's MI6', 720.

GC&CS success, SIS 'languished and struggled to prevent a complete loss of credibility'.¹²¹ The same cannot be said for Air Intelligence within SIS, or the tiny component within it responsible for scientific intelligence. Jones may have had foibles that resulted in abrasive relations, and he may have allowed his egoistic nature to run wild at times, but these character traits do not outweigh the drive he possessed to ensure a future for ADI (Science). That scientific intelligence did not have the future he expected was not his fault.

Throughout the war, Jones determinedly steered a path for air scientific intelligence which made all concerned watch with interest and take note. One wartime civil servant recalled that once it became known in Whitehall that his own briefs and reports were taken seriously, he and his colleagues 'became people it was worth knowing'.¹²² Much the same can be said for Jones and his colleagues. Their persistent commitment to press scientific intelligence toward a more secure position within the British intelligence structure was commendable and fairly successful. The one-man-band became a small organisation, not solely because of the war, but also because of scientific talent, and the determined efforts of that talent to succeed.

Inter-connectivity of ADI (Science)

Scientific intelligence necessarily engaged with many components of Britain's wartime structural organisation. In addition to all of the other intelligence organisations displayed in the above discussed diagrams, ADI (Science) had relations with Admiralty and War Office intelligence constructs, as well as the

¹²¹ Davies, *MI6 and the Machinery of Spying*, pp. 161–2.

¹²² Professor James Meade interviewed by (now Professor) Alan Booth, 19 February 1981, M3.

more scientific and technical establishments, such as TRE, RAE, Porton Down, REME, and various OR creations. How ADI (Science) connected with each differed according to personality and/or operational need or input. In comparison to fractious relationships with DDI4, Admiralty DSR, and Bomber Command ORS, relations between ADI (Science) and other intelligence and service organisations was relatively straightforward. With certain organisations, collaboration proved 'rewardingly successful'.¹²³

Crucial above all to scientific intelligence interconnectivity, and a significant contribution to its success, was its physical positioning within Broadway. Jones believed the SIS and ADI (Science) relationship to be 'a special one', even though from an orthodox perspective it was an anomaly. The importance of ADI (Science) in Broadway was that 'it was possible to achieve such close contact between collecting and collating agencies that one section could largely perform both functions'. Jones was able to collect data from various heads of section (for example Jempson of Belgian Section during the DT chase), from AI1(e) (later AI4) connected to GC&CS, from AI1(g) for technical intelligence, and so on. At the same time, contact with those sources outside of London, Medmenham and AI1(k) (later AIK), and TRE among others, 'could be performed equally well' from SIS as it could from the Air Ministry.¹²⁴ Many scientific and technological interrogation extractions, documents, and notebooks were sent to ADI (Science) throughout the war.¹²⁵ Placing his

¹²³ Jones, 'A Sidelight on Bletchley Park, 1942', 2.

¹²⁴ CCAC RVJO B.83 & TNA AIR 40/1532, ADI (Science) official history 'Air Scientific Intelligence in War, 1939-45', 1 April 1946, p. 62; AHB, 'Air Ministry Intelligence', p. 345.

¹²⁵ See for example, CCAC RVJO B.180, Flight Lieutenant R. H. Siddam to Frank, 13 February 1945. This report was in regard to an informant's notebook containing scientific data secretly copied in a German laboratory. The informant was a glass-blower who worked for Elektro Akoustic Works

collating section within SIS therefore, 'satisfied the important condition of maximum contact with sources'. An especially crucial factor in this regard was the 'free' atmosphere of SIS, compared with the Civil Service atmosphere within 'normal Departmental offices'. This 'undoubtedly provided better conditions for constructive Intelligence work'. The success of scientific intelligence 'was therefore partly due to the liberality of C' in allowing 'his accommodation and facilities' to be used by ADI (Science), and ACAS(I) for 'allowing one of his sections to spend most of its time outside his offices'.¹²⁶

ADI (Science) reported after the war that they had 'depended entirely upon personal contact and telephonic conversation' with all the collecting agencies, and took them 'completely into their confidence' so that the agencies 'knew exactly' the scientific intelligence objectives and plan of attack.¹²⁷ Such sensible communication would have been more difficult with DDI4 than any other organisation simply because of abrasive personal relations. Reference to personal contact and telephonic conversation is important, for it highlights the complexity of the historians' task (especially for historians of intelligence) when there is little detailed evidence of the decision-making lunches and telephone calls. In this regard, Jones's memoirs are priceless, for he mentions these methods of communication many times throughout.¹²⁸

between April 1942 and February 1944. The data was of a cell 'said to be a vital part of a new aircraft'. Whether this type of data was important or not was for ADI (Science) to decide.

¹²⁶ CCAC RVJO B.83 & TNA AIR 40/1532, ADI (Science) official history 'Air Scientific Intelligence in War, 1939-45', 1 April 1946, p. 62; AHB, 'Air Ministry Intelligence', p. 345.

¹²⁷ CCAC RVJO B.83 & TNA AIR 40/1532, ADI (Science) official history 'Air Scientific Intelligence in War, 1939-45', 1 April 1946, p. 60; AHB, 'Air Ministry Intelligence', p. 343.

¹²⁸ See as examples from the many in Jones, *Most Secret War*, pp. 100, 211, & 259.

ADI (Science) also commented on their arrangement of selecting one 'competent' Scientific Officer to act as a scientific intelligence representative within each collection agency. 'He would then be left to acquaint other sections of the collecting agency' with scientific intelligence requirements, and bring other collating staff into contact with other officers inside the collating agency 'as he' the 'trusted representative' thought fit'.¹²⁹ ADI (Science) personnel contained (or fostered) liaisons within TRE (Garrard, Ackermann, Dee), GC&CS (Norman among others), Medmenham (Wavell), and after D-Day technical intelligence and 30AU (Nutting), and REME (Stephenson, Dobson, Fell), and yet Jones makes no mention in his memoirs that such an arrangement existed with the Y-Service. As Masterman was transferred from Y-Service to ADI (Science), there is every chance that she could have been the technical officer responsible for such liaison.

TRE eventually grew to a peak staff of approximately 3,000 men and women.¹³⁰ MAP did not have the monopoly on scientists, however. Before and during the war, for example, the Admiralty was 'insatiably greedy' for scientists, especially physicists, and, by war's end, employed some 40,000 scientifically and technically trained staff.¹³¹ The more remarkable then that NID did not have an ADI (Science) equivalent. This is even more remarkable given that it had been Buckingham (the naval DSR) who had constricted Jones's efforts in 1939/1940. ADI (Science) later emphasised the school of

¹²⁹ CCAC RVJO B.83 & TNA AIR 40/1532, ADI (Science) official history 'Air Scientific Intelligence in War, 1939-45', 1 April 1946, p. 60; AHB, 'Air Ministry Intelligence', p. 343.

¹³⁰ Rowe, *One Story of Radar*, p. 9.

¹³¹ Hartcup, *The Challenge of War*, p. 25. For 'insatiably greedy' see Hennessy, *Whitehall*, pp. 96-7. Hennessy was specifically referring to the immediate pre-war period, when the Admiralty were requesting 225 physicists and the Central Registry in February 1939 had only 340 on its books. It was investigated 'whether the Admiralty was drawing a long bow'.

opinion (headed by the Admiralty DSR), had proved 'the main obstacle to the growth of Scientific Intelligence throughout the war'.¹³²

Nevertheless, and despite the presence of Gollin (as Jones-equivalent) within Admiralty DSR, scientific matters were a persistent problem for naval intelligence for much of the war. For example, GC&CS found it particularly difficult to summarise and circulate to 'unindoctrinated authorities' outside NID any references in decrypts to scientific matters. For the un-indoctrinated NID collators the data was 'usually obscure', yet for the purposes of secure circulation it needed to be 'paraphrased and camouflaged', which was 'an impossible task for the layman'. Bletchley's Hut 4 had a Technical Intelligence Sub-Section, 'primarily concerned to help the processes of decrypts by providing English equivalents for obscure enemy terminology'.¹³³ This, coupled with NID/DSD9 (responsible for enemy (and neutral) W/T communication systems and interpretation), was the extent of naval scientific intelligence. Neither organisation contained a scientist, although ADI (Science) were in close contact with NID/DSD9 throughout the war.¹³⁴

Jones often remarked that his organisation enacted the Admiralty's scientific intelligence for them. The fact remains however, that for the first four years of the war, neither the Admiralty or the War Office had a scientific intelligence

¹³² CCAC RVJO B.83 & TNA AIR 40/1532, ADI (Science) official history 'Air Scientific Intelligence in War, 1939-45', 1 April 1946, p. 2; AHB, 'Air Ministry Intelligence', p. 285. Matters between Jones and Buckingham came to a satisfactory resolution in March 1940 when the two men 'had a long talk' on scientific intelligence. Buckingham informed Jones of the Admiralty view that they wished to do their own collation, but would be glad of improvements in information collection, a pursuit the Admiralty held to be mainly the concern of SIS. They arrived at a mutually agreeable arrangement, in that all incoming scientific naval information would be seen by Jones, but then dispatched to DSR through DNI without collation: CCAC RVJO B.118, Jones to D.S.R. (David Pye), 6 March 1940.

¹³³ TNA HW 43/2, 'History of British SIGINT, 1914-1945, Volume II', pp. 536-40.

¹³⁴ Hinsley *et al*, *British Intelligence in the Second World War, Volume II*, p. 519.

section, and, as ADI (Science) was directly attached to SIS, all scientific intelligence matters came under ADI (Science) jurisdiction. What made an impact insofar as the Admiralty was concerned was the steady influx of intelligence of scientific and technical nature that was far too important to disseminate; the German *Window* derivative *Aphrodite*, for example, used to deceive Allied coastal or naval aircraft from locating U-boats. ADI (Science) assisted NID in these matters, and doing so emphasised the importance of service-specific applied scientific intelligence.

In March 1943, an officer 'with the necessary scientific and linguistic qualifications (including operational experience of radar) was appointed' to NID/DSD9.¹³⁵ This officer was Evans (the Cambridge botanist) who was, according to Jones, one of ADI (Science)'s 'best friends'.¹³⁶ In June 1943, the Admiralty's chief OR adviser 'loaned' Hut 4 the services of Professor J.H.C. Whitehead and two assistants 'for statistical research on certain U-boat problems'. In the same month Hut 4 also recruited a research physicist with experience in electronics. Finally, in October 1943, a civilian Principal Scientific Officer (equivalent in rank and scientific standing to Frank, Wright, and Smith) was appointed to NID7, the Division's Technical Section. This was Gollin, who became the nucleus of 'a scientific sub-section, known as 7S, with a Special Intelligence commitment on scientific subjects other than those concerned with enemy communications'. By the end of 1943 therefore,

¹³⁵ TNA HW 43/2, 'History of British SIGINT, 1914–1945, Volume II', p. 541.

¹³⁶ Jones, *Most Secret War*, p. 493.

despite the Admiralty initially playing ‘a puckish part’ toward the concept, NID was ‘provided satisfactorily for the exploitation of scientific intelligence’.¹³⁷

Useful (and friendly) liaisons were often facilitated by lectures, designed to present scientific intelligence requirements and/or its importance. For example, in August 1940 Jones lectured at Bletchley to explain how he had mastered *Knickebein*, and how crucial an Enigma decrypt had been to the *Knickebein* discovery.¹³⁸ There is further evidence that Jones lectured again at Bletchley in July 1944.¹³⁹ Similar opportunities stemmed from the *Knickebein* success. In October 1940, Pye asked Jones to lecture at TRE on scientific intelligence matters, in order to develop connections and ensure the same hymn sheet was being referred to by all. Correspondence regarding this request demonstrates the importance of interconnectivity among the various scientific and technological establishments, and provides further insight into Jones’s personal connectivity, which was, more often than not, on his terms.¹⁴⁰ ADI (Science) later presented their work to GC&CS and Bomber Command among other places.¹⁴¹

¹³⁷ TNA HW 43/2, ‘History of British SIGINT, 1914–1945, Volume II’, p. 541; for ‘Puckish part’, see Jones, *Most Secret War*, p. 493; Hinsley *et al*, *British Intelligence in the Second World War, Volume III, Part I*, p. 470.

¹³⁸ Jones, *Most Secret War*, p. 122.

¹³⁹ CCAC RVJO B.123, letter from ‘Station X’ operative (signature illegible) to Jones, 13 July 1944.

¹⁴⁰ CCAC RVJO B.118, Jones to Rowe, 12 October 1940; Rowe to Jones, 19 October 1940; Rowe to Jones, 29 October 1940. Jones sent Rowe his SIRs and interim reports after the Battle of the Beams. Rowe applauded Jones for the ‘extremely well written’ and ‘nicely assessed’ reports, but criticised Jones for the obvious lack of contact with experts who could ‘best help’ Jones ‘in deciding what to do’. Jones did not immediately reply, and Rowe had to press the request. Jones eventually presented his work to TRE personnel sometime in early November. When Rowe again wrote to Jones in 1944, he wondered whether Jones was ‘not due for a visit’ to TRE: CCAC RVJO B.123, Rowe to Jones, 10 August 1944.

¹⁴¹ See CCAC RVJO B.130 for correspondence regarding ADI (Science) lectures to RAF Staff during 1943–45 & Jones, *Most Secret War*, pp. 122 & 298.

There was much more to scientific intelligence interconnectivity that documentation cannot show, such as the connections via telephone, as well as through personal contact.¹⁴² Although covert action and paternal/fraternal connectivity were lesser features in scientific intelligence than other SIS activity, they existed and Jones fostered and manipulated them accordingly. Personal networking was a primary factor in British intelligence during the Second World War, but one that left very little evidence of activity. It has been written that archival research often provides a 'cut of the past's cloth', but intelligence studies are not that straightforward, and so 'testimony of former practitioners is vital' to assist in comprehension of the texture.¹⁴³ There is no question that Jones operated in both overt and covert circles, and he provided a select few snippets of information which help to gain a limited glimpse into how ADI (Science) carried out scientific intelligence networking in Whitehall.

Hugh Trevor-Roper remarked that patronage and accident were the only ways into the secret services.¹⁴⁴ For Jones it was both. Scientific patronage from Lindemann (as he then was) and Tizard, combined with his lack of tenable government employment meant Jones was in the right place at the right time. In effect, Jones fell into secret service due to circumstance and the collegiate scientific circles he was part of. The latter at the time was relatively sparse, and dominated by the Clarendon and Cavendish laboratories. It has often

¹⁴² A prime example is that Jones rarely provided written instructions to Medmenham. Nearly all briefing methods between ADI (Science) and Medmenham were 'either by telephone, or by visits, or by Wavell and the pilots visiting Jones: CCAC RVJO B.341, 'Note on interview with Prof. R.V. Jones', p. 7.

¹⁴³ Huw Dylan and Martin S. Alexander, 'Intelligence and National Security: A Century of British Intelligence', *Intelligence and National Security*, 27: 1 (February 2012), 3.

¹⁴⁴ Lord Dacre of Glanton, 'Sideways into S.I.S.', in Peake and Halpern (eds.), *In the Name of Intelligence*, p. 251.

been mooted that this was political (the former 'blue and right', the latter 'red and left'), but this is doubtful. It was much more who-knew-whom rather than who believed what, and during the war common purpose temporarily removed political differences. Nevertheless, the Clarendon was integral to Jones's character, and he managed ADI (Science) accordingly.

Through Lindemann, Jones had the personal ear of Churchill. Jones made a great deal of his close connection with the wartime Prime Minister, referring to it as 'a constant invigoration'. In reference to the famous June 1940 Downing Street meeting, Jones wrote that 'ever afterward' he would be summoned by Churchill following confirmation from Lindemann that Jones 'perceived a new threat'. This is an exaggeration, however, for Jones was 'sent for' only three times: regarding the beams, *Window*, and the V-Weapons respectively.¹⁴⁵ Nevertheless, it was enough that senior staff of the service ministries believed Jones possessed Prime Ministerial authority.¹⁴⁶ For this reason Jones's old Clarendon tutor was crucial to the success of scientific intelligence.

It was all very characteristic. Butt remembered Lindemann 'spending three quarters of his time on technical and military matters' and highly secret weapon developments, like the first phases of the atom bomb. Harrod would try to no avail to get Lindemann 'seriously interested' in 'post-war things' and 'current economic things'. Instead, Lindemann would discuss matters with James Tuck, his scientific assistant, like the sticky bomb, rockets, and 'the

¹⁴⁵ Reginald V. Jones, 'Churchill as I Knew Him' in R. Crosby Kemper III (ed.), *Winston Churchill: Resolution, Magnanimity, Good Will* (Columbia: University of Missouri Press, 1996), p. 217. Jones firmly believed that he and Churchill 'had always been on such extraordinarily good terms': CCAC RVJO B.343, 'Verbatim note on interview with Professor R. V. Jones', p. 16.

¹⁴⁶ Jones, *Most Secret War*, p. 108.

other things Lindemann was playing with'. Tuck was an important connection here, for he was an old Clarendon colleague and friend of Jones's, and so, as Butt recalled, throughout the war Jones 'used to be in and out with all the intercept information'.¹⁴⁷ Jones recalled that Tuck provided him with 'valuable help', for as Lindemann's assistant 'he came to know a great deal' about British scientific and technological developments.¹⁴⁸

Although not of the Clarendon, Frank and Wright had been Jones's Oxford postgraduate colleagues. But that is the extent to which Jones was able to develop a scientific intelligence fraternity. The attempts Jones employed to recruit Pickard clearly point to the possibility that he wished for ADI (Science) to be an organisation staffed by personnel of his 'type' – male, scientific, Oxonian, conservative. Much as he tried, Clarendon men could not be recruited when he wished due to Treasury restraint; and even when this was lifted, the preferred type was already employed in other essential scientific positions. Jones therefore had to be pragmatic toward ADI (Science) recruitment. He found it necessary to persevere with minimal staff, and recruit suitable personnel as and when they appeared. Of the twenty-two staff listed on Table I, only two (Wright and Arthen) came direct from university, although Frank can also be considered a fraternity recruit. Five scientific intelligence

¹⁴⁷ David Bensusan Butt interviewed by (now Professor) Alan Booth, 20 May 1981, BB4.

¹⁴⁸ Jones, *Most Secret War*, pp. 29–31 & 80–83. Fraternity connections that benefited scientific intelligence extended far beyond scientific circles. Winterbotham was also an Oxonian, and in his memoirs wrote that he had been at Oxford with 'the only bright star in the political galaxy'—Anthony Eden. Winterbotham claimed his job allowed him to be 'not necessarily bound by the same orthodox methods as other government departments'. He spoke of a friend in the Prime Minister's Office who could 'get a reaction' from Lindemann. Winterbotham frequently lunched at the Royal Air Force Club, enjoying the walk to-and-from Whitehall through St. James's Park where 'the flowers were always a tonic'. There he would share ideas with scientific intellects like Barnes Wallis, and with Air Marshals like Tedder: Winterbotham, *Secret and Personal*, pp. 8, 148, 157, & 173. This is a fascinating insight into politics and the services meeting science, technology, and intelligence.

personnel transferred from TRE, two temporarily, three permanently. One came from AI1(g), and three were recruited from unknown organisations. The remaining ten were service personnel before joining ADI (Science) in their respective capacities: six RAF, one USAAF, and three REME. Evidently Jones made the best of a difficult situation.

Supposition is almost all history can present of nepotism, paternalism, covert meetings, and telephonic communication. That it occurred on a daily basis is a given, yet lack of evidence truly does label it the 'missing dimension', if not the missing component of the missing dimension. Davies explained that the presence of both collegial and organic structures within SIS was counter-intuitive, yet compartmentalisation and shadowy networking were essential to the *modus operandi*.¹⁴⁹ How such communicative activity affected scientific intelligence can only be estimated. Much the same can be said for enactment of scientific intelligence overseas, which also left little evidential trace. Scientific intelligence field missions were also significantly important to ADI (Science) development, particularly in their understanding of DT. This was another matter which Jones skirted over in *Most Secret War*. Garrard was sent to Spain to appreciate *Abwehr* infra-red usage across the Straits of Gibraltar and to Egypt in the wake of Montgomery's successful North African campaign. Jennings was sent to Italy and to Rumania to obtain DT for the British before US and Soviet forces procured all the German technology. ADI (Science) overseas Parties were formed and sent to France following D-Day. Ackermann later established a semi-permanent ADI (Science) presence in

¹⁴⁹ Davies, *MI6 and the Machinery of Spying*, p. 8. For 'missing dimension', see Andrew and Dilks, *The Missing Dimension*, p. 1.

France, which endured long after the war. Jones and Frank also visited France before VE-Day.¹⁵⁰

Before the two leading men of ADI (Science) were able to leave London to undertake these field missions however, they had one last great battle to fight. The intelligence attack upon the *Vergeltungswaffen* (the so-called Nazi vengeance or retaliation weapons) would eclipse all of the organisational tensions, the personal frictions and animosities that had gone before. Moreover, it would highlight significant failings by ADI (Science), not apparent contemporaneously (and easy to criticise in hindsight). There were other means of unconventional warfare researched in the Greater Reich than those in the sciences of wave propagation and nuclear physics that should also have been watched carefully by ADI (Science). It is perhaps because they did not watch the research progress of the V-Weapon derivatives that the Battle of the V-Weapons materialised as it did.

¹⁵⁰ For more details on these ADI (Science) field missions, see CCAC RVJO B.28 & TNA AIR 20/1630, Air Scientific Intelligence Report No.14, 'German Applications of Infra-Red', 10 June 1942; CCAC RVJO B.52, Air Scientific Intelligence Report No.19 'Spanner', 27 November 1943; CCAC RVJO B.75, Air Scientific Intelligence Report No.251 'German Infra-Red Development', 25 January 1945, pp. 8 & 10; CCAC RVJO B.34, ADI (Science) minute 'German Equipment for Ship Detection in the Straits of Gibraltar', 15 September 1942; CCAC RVJO B.123–B.124; CCAC RVJO B.126; CCAC RVJO B.206; TNA DEFE 40/21; UOB DM1310/A.13; Jones, *Most Secret War*, pp. 257–8 & 484–491; Price, *Instruments of Darkness*, pp. 94–5; Philby, *My Silent War*, pp. 55–63; Montagu, *Beyond Top Secret U*, pp. 90–1; Kenneth Benton, 'The ISOS Years: Madrid 1941–3', *Journal of Contemporary History*, 30: 3 (July 1995), 381; Desmond Bristow with Bill Bristow, *A Game of Moles: The Deceptions of an MI6 Officer* (London: Warner Books, 1994), p. 76; Trevor-Roper, *The Philby Affair*, pp. 119–20; Hinsley *et al*, *British Intelligence in the Second World War, Volume II*, pp. 720–1; Thomas T. Smith, 'The Bodden Line: A Case Study of Wartime Technology', *Intelligence and National Security*, 6: 2 (1991), 447; Batey, *From Bletchley with Love*, p. 12.

Chapter VIII: ADI (Science) and Unconventional Warfare

ADI (Science) had a much lesser role in the V-Weapons hunt than historical orthodoxy permits. Their contributions to intelligence in this regard were significant, if perhaps belated, arriving as they did from mid-1943. Yet it was not the significance of the scientific intelligence contribution that made an impact upon the decision to allocate responsibility of the V-Weapons hunt to other organisations. It was instead the simple fact that the Allied war machine had become so extensive by mid-1943 that, defensively, there was more than adequate strength-in-depth. In a rare account of events from Duncan Sandys, he commented that Operation *Crossbow* 'was a war within a war' in which 'almost every branch' of the British military system was involved.¹

There were other reasons behind the limited role of scientific intelligence in the V-Weapons campaign. For example, intelligence on the existence of German long-range weaponry was convincing, if initially confusing in detail. This essentially meant that once the threat had been determined, the V-Weapons immediately became an operational defence problem, one outside of the immediate secret intelligence remit. Moreover, the V-Weapons were perceived as unrotated-projectile (UP) artillery and, as such, experts in rocket artillery rather than aviation were deemed authorities in the field. The perceived danger from the V-Weapons forced the British Government to

¹ Duncan Sandys, 'Secrets of the war within the war', *Evening Standard*, 1 December 1964, 15. Sandys named SIS, PRU, the intelligence staff, British and American bomber squadrons, Fighter Command, AA Command, Balloon Command, and the Civil Defence organisation.

attach weighty political concern to countering the threat.² In short, once discovered, the V-Weapons were not considered an exclusive subject for any organisation – British or American, political, intelligence or service.

The primary focus of this chapter examines how ADI (Science) investigated the more unconventional methods of warfare researched by the Axis powers. This chapter argues that, from the Hitler *Waffe* declaration of 1939 through to the atomic holocausts in Hiroshima and Nagasaki, British scientific intelligence was much less involved in unconventional warfare than perceived, yet much less involved than it perhaps ought to have been. The former perception has certainly been erroneously encouraged by Jones through his cultural legacy, particularly his memoirs and television appearances. That ADI (Science) were not as involved in these important scientific warfare issues was through no contemporary error by Jones. Nor was it due to any fault by ADI (Science). Instead, in most instances, the responsibility for close examination of gathered intelligence on such matters was assigned to other bodies. This frustrated Jones and his team throughout the last years of the war. More importantly, Jones's scientific intelligence 'bargaining chip' was

² Upon hearing of the V-Weapons, Churchill initially suggested that the German pilotless aircraft and long-range rockets should be denounced as 'indiscriminate warfare' and that Britain should retaliate with gas: Hinsley *et al*, *British Intelligence in the Second World War, Volume III, Part I*, p. 415; *Volume III, Part II*, p. 579. Jones was present when Churchill made this suggestion on 18 July 1944. This retaliatory comment was blown out of all proportion almost forty years later following a controversial BBC *Newsnight* programme (aired 1 May 1981), see CCAC RVJO B.256, 'Churchill's Anthrax Bombs'; Robert Harris, 'Churchill and the germ bomb', *The Listener*, 4 June 1981, 728; Julian Lewis, 'Churchill and the "Anthrax Bomb": A BBC Myth', *Encounter*, 58: 2 (February 1982), 18–28; Robert Harris and Jeremy Paxman, *A Higher Form of Killing: the Secret Story of Gas and Germ Warfare* (London: Chatto & Windus, 1982); Barton J. Bernstein, 'Churchill's Secret Biological Weapons', *Bulletin of the Atomic Scientists*, 43: 1 (January 1987), 46–50; R. V. Jones and J. M. Lewis, 'Churchill's Anthrax Bombs – A Debate', *Bulletin of Atomic Scientists*, 4: 12 (November 1987), 42–5; Barton J. Bernstein, 'America's Biological Warfare Program in the Second World War', *Journal of Strategic Studies*, 11: 3 (1988), 302. Churchill's suggestion was rejected by the Chiefs of Staff however, who preferred instead to reinvigorate tried and tested conventional defences of Great Britain—guns, fighters, and barrage balloons, all deployed in zones which avoided mutual interference.

much reduced by the end of the war, as a direct consequence of ADI (Science)'s lesser involvement in unconventional warfare research, and developments that mattered so greatly in the post-war world.

Rocket Controversy

The *Vergeltungswaffen* were fourfold: the *Luftwaffe* 'flying bomb' (V1); the *Wehrmacht*'s ballistic missile (V2), and the 'Rheinbote' (surface-to-surface multi-stage free-flight rocket sometimes also referred to as V2); *Hochdruckpumpe* (high-pressure pump) cannon (V3); and the A10 multistage solid artillery rocket (V4). The majority of the research for these projects was carried out at Peenemünde. On 8 July 1943, with the war looking precarious for Germany, Hitler issued a command for the V2 to be prioritised. Five weeks later Peenemünde was heavily bombed. On 20 August 1943 Hitler ordered V2 assembly to be secured in 'caverns or other suitable bunkered positions'. The bombing of Peenemünde was therefore 'a defining moment' for it 'played a pivotal role in the decision to place industry underground'.³ Jones's involvement in the decision-making process that directly resulted in Bomber Command attacks on Peenemünde was important.

Although ADI (Science) were sidelined in the British (if not Allied) intelligence attack, Jones played a minor personal role in de-centralising the V-Weapons

³ Paul Clemence, 'German Underground Factories of the Second World War: An Essential Folly', Unpublished PhD, University of Exeter, 2008, pp. 44–5, 48 & 312. See also the IWM's Kidney Collection, which contains fascinating photographs of the internal and external views of the German underground V-Weapons complex at Nordhausen in the Harz Mountains. For the Dornberger statement, see Dornberger, 'The German V-2', 404. Neufeld also confirmed that the selection of the underground oil storage site near the small city of Nordhausen in Thuringia, was taken on 26 August 1943: see *Michael J. Neufeld, The Rocket and the Reich: Peenemünde and the Coming of the Ballistic Missile Age* (London: The Free Press, 1995), p. 202.

programme.⁴ His version of these events presented through his literature and broadcasts formed a principal part of his legacy that has largely remained unchecked.⁵ This had much to do with the lack of any memoirs from his ‘counterparts’ during the V-Weapons hunt. Only from a photographic intelligence perspective has Jones’s account been taken to task.⁶

Controversy over the rocket and flying bomb were high on the agenda for Jones during the 1963/4 interviews with David Irving.⁷ In the only mention of scientific intelligence in *Britain’s War Machine*, Edgerton wrote that Jones was ‘a key figure in the behind-the-scenes’ analysis during the V-Weapons

⁴ The differentiation between British and Allied intelligence attack is in reference to Robertson being assigned to ADI (Science) as liaison to General Spaatz from January 1944. This direct OSRD liaison acted as tenuous official recognition of ADI (Science) intelligence involvement.

⁵ See especially ‘Dr Jones’s War, part three: ‘The Rocket’s Red Glare’, on *The Time of My Life* programme, transmitted on BBC Radio Four, 1 August 1974; ‘Terror Weapons’ in *The Secret War* series, produced by Brian Johnson in 1976. The full transcript of this television programme is preserved in CCAC RVJO K.477.

⁶ Medmenham’s contribution to Allied victory had for long been championed by wartime PIs Babington Smith and Powys-Lybbe, and both authors dedicated a chapter each of their memoirs to Medmenham’s role in the V-Weapons hunt: Babington Smith, *Evidence in Camera*, pp. 199–232; Powys-Lybbe, *Eye of Intelligence*, pp. 188–212. Babington Smith was also interviewed in the ‘Terror Weapons’ episode of *The Secret War*: CCAC RVJO K.477, transcript for ‘Terror Weapons’, pp. 13–14. The US publication of Babington Smith’s memoirs was entitled *Operation Crossbow*. Metro-Goldwyn-Mayer made a movie of the same name, produced by Carlo Ponti in 1965. Powys-Lybbe commented that she wrote her book primarily to set the record straight after viewing Jones in *The Secret War*, and from reading *Most Secret War*, in both of which he gave the impression that Medmenham PIs were not as efficient as him in interpreting photographs: Powys-Lybbe, *Eye of Intelligence*, p. 13. A PI historian has since reinforced the argument that Jones was not a trained PI, and remarked that although his contributions to this field were sometimes helpful, they were also ‘sometimes misleading’ and ‘even meddlesome’: Stanley, *V-Weapons Hunt*, pp. 9–10. Jones held that it was ‘not true to say’ that he ‘was an untrained observer’, because he ‘had probably been concerned with photographic interpretation for longer than most of the interpreters in Medmenham’: CCAC RVJO B.345, Jones to Irving, 21 August 1964. For many in the wartime intelligence game the stereoscope was ‘an indispensable tool for working intelligence officers of all services’: M. R. D. Foot, ‘What Use are Secret Services?’ in Peake and Halpern (eds.), *In the Name of Intelligence*, p. 280. Foot recalled that he personally carried a stereoscope in his pocket ‘as easily as a pair of spectacles, and used it constantly’.

⁷ See CCAC RVJO B.339–B.353 for fairly extensive correspondence between Jones and Irving between July 1963 and June 1977. Irrespective of Irving’s reputation, these documents are referred to throughout this chapter as invaluable primary source. The last two files contain newspaper cuttings collected by Jones regarding the controversy surrounding Irving’s publications. During the course of the interviews, Irving pestered Jones to show him the V-Weapon SIRs. In one letter Jones wrote to Irving that ‘it would be of course incorrect to pretend that we never derived information by cryptographic means. However, the extent to which we were or were not able to do this is, as in most other cases, a matter of official secrecy, and I am therefore unable to make any detailed comment’: CCAC RVJO B.342, Jones to Irving, 23 May 1964. Despite obvious ULTRA security risks, Jones eventually gave in, and allowed Irving to examine at least two SIRs.

scenario, and that he 'was able to piece together the intelligence to produce a picture which turned out to be remarkably accurate'.⁸ Jones was indeed a key figure, but not for the reasons Edgerton implied or even in the capacity Jones wished for at the time. In a particularly telling statement, Kendall confirmed that although Jones was 'very important in the radar-Wavell context' he was 'not important in the V-Weapons story'.⁹ Jones was only brought into the rocket scare in an official capacity when the likelihood of flying bombs was discovered. By then, for Jones, the damage had been done. It was the degree of intelligence accuracy that proved the contemporary bone of contention, and the primary focus for Jones post-war literary debate regarding the British attack upon the V-Weapons.

Another of Jones primary concerns was to defend ADI (Science) from accusations that, despite the Oslo Report warning of German rocket research, arrival in Broadway of the first secret agent report containing intelligence on the A4 (V2) rocket trials at Peenemünde in December 1942 'caught' his organisation 'napping'.¹⁰ Only a month before this intelligence arrived Jones had written to Inglis stating that it was the duty of intelligence to collect the facts 'and only issue them when a reasonably complete or important picture' was obtained. Jones saw ADI (Science) as 'a watchdog'. It was 'no good

⁸ Edgerton, *Britain's War Machine*, p. 112. See also p. 88 for the only other mention of Jones in reference to his contribution to Churchill's war memoirs.

⁹ TMC DFG5701, Douglas Kendall interviewed by Constance Babington Smith on 15 November 1956. Kendall further recalled that Pryor of MI14(h) was the most important man at the beginning, until Air Vice Marshal Pelly became the Air Ministry leading figure on *Crossbow*. Kendall added that Tizard was in charge early on, and that when Churchill took a personal interest he sent Smuts to Medmenham to 'see what was going on about the V-weapons and assess it'.

¹⁰ Jones, *Most Secret War*, pp. 438–9. Some of Jones's 'caught napping' discussion in *Most Secret War* was written for Churchill's war memoirs, but cut from the final draft: CCAC RVJO B.223, second draft of 'The Pilotless Bombardment', p. 11; CCAC RVJO B.226; draft of 'The Pilotless Bombardment'; see CCAC RVJO B.224 for Jones's technical corrections on Churchill's original version of the chapter.

barking at every damn little noise in the night', but on the other hand, ADI (Science) 'had to bark at the right time' for it was 'no good barking too late'.¹¹

During the panic caused by the rocket scare, even before the flying bomb threat became a reality in Britain, accusations were levelled at ADI (Science) for not providing timely scientific intelligence on the rocket. Paradoxically, the rocket scare created so many committees catering for so many organisations, that the intelligence picture became entirely blurred. This not only opened several lines of inquiry at once, but also attracted experts of varying backgrounds, who drew many different interpretations from the doubtful evidence before them.¹² It also meant that ADI (Science) lost exclusivity over gathered evidence emanating from the very sources they had nurtured for so long. With these issues fresh in mind, and clearly still disgruntled over the loss of scientific intelligence autocracy, ADI (Science) wrote that the investigations which produced the best results were those in which the collecting agencies fed only ADI (Science), who were the central collating section.¹³

The matter of expertise is an interesting one. Jones was introduced to scientific intelligence in September 1939 in order to ascertain the danger from potential secret German scientific and technological weaponry. Jones had 'barked' about the potential danger from German rocketry and flying bombs based on intelligence from the Oslo Report, yet due to its highly doubtful

¹¹ CCAC RVJO B.343, 'Verbatim note on interview with Professor R. V. Jones', p. 2.

¹² For example, in the summer of 1943 Sandys created a *Bodyline* Scientific Co-ordinating Committee of seventeen scientists and engineers 'to advise on the various scientific and technical problems connected with the long-range rocket enquiry'. Among them were Appleton, Cockcroft, Watson-Watt, and Jones: OUNC CHER G.413/7-9; CCAC RVJO B.340, Irving to Jones, 17 October 1943.

¹³ CCAC RVJO B.83 & TNA AIR 40/1532, ADI (Science) official history 'Air Scientific Intelligence in War, 1939-45', 1 April 1946, p. 56; AHB, *Air Ministry Intelligence*, p. 339.

provenance no authoritative body was prepared to listen.¹⁴ Because of the beams and the DT chase, Jones had put aside the Oslo Report (and any thought of flying bomb possibilities) in order to concentrate on the more immediate concerns to Britain's war effort. As a consequence, ADI (Science) became the primary authority on German radar.¹⁵ This common contemporary perception however, negated any possibility of them being perceived as authorities on rocketry when it was deemed that such experts were required. When MI14(h) informed the War Office of German long-range rocket evidence, Army Intelligence, Churchill and the Chiefs of Staff turned to men they considered to be rocket experts.

Jones later believed it would have been better if Military Intelligence had established reliability of early evidence and determined rocket characteristics before calling for countermeasures.¹⁶ He believed that MI14 'caused unending trouble by barking too soon', and proudly declared that 'having the same facts', his organisation 'raised no alarm at all, beyond telling a few senior officers' that they were after the rocket, 'for the thing to do was not to raise an alarm but to seek fresh facts'.¹⁷ This was probably the reason why ADI (Science) were overlooked when the Chiefs of Staff Committee were alerted

¹⁴ See Joubert, *Rocket*, p. 26; Basil Collier, *The Battle of the V-Weapons, 1944-45* (London: Hodder & Stoughton, 1964), p. 141. For correspondence between Jones and Collier regarding the V-Weapons, see CCAC RVJO B.277.

¹⁵ Operation *Bellicose*, the bombing of the Zeppelin factory (known to manufacturing *Würzburg*) at Friedrichshafen on 22 June 1943 was 'the first unconscious blow at the German secret weapons programme'. Jones did not know that at the time he recommended the raid that Zeppelin was involved in anything other than radar, but he later discovered that the raid had 'upset' German rocket production: CCAC RVJO B.346, Jones to Richard Francis (BBC producer of *Panorama*), 3 December 1964; CCAC RVJO B.347, Irving to Jones, 18 March 1965.

¹⁶ Hinsley et al, *British Intelligence in the Second World War, Volume III, Part I*, p. 365.

¹⁷ Jones, 'Scientific Intelligence', pp. 361-2; Hinsley et al, *British Intelligence in the Second World War, Volume III, Part I*, p. 365. The official historians importantly added that the War Office was 'bound to be reluctant to leave responsibility for the intelligence work entirely to the Air Ministry'.

to the possible existence of the rocket.¹⁸ The Chiefs of Staff recommended that Churchill 'should be made aware of reports received', that 'one individual' should be 'charged with the task forthwith', and suggested that Duncan Sandys, the newly-appointed MOS Parliamentary Secretary, 'would be very suitable if he could be made available'.¹⁹ A War Cabinet meeting of 17 May 1943, established measures of co-ordination to allow Sandys related intelligence *carte blanche* to aid his investigations. This excluded co-ordination with ADI (Science), and Sandys's appointment was the catalyst for much political controversy over the rocket.²⁰

In all of his recollections of personal involvement in the V-Weapons hunt, Jones was determined to present himself as the lone crusader, separate from controversy, and outside of what became known in Whitehall circles as the two opposing camps of Cherwell and Sandys. Cherwell disbelieved the evidence and became, as Kendall defined, 'leader of the Hoax Group'; while Sandys was convinced by the evidence, and that the only means to counter

¹⁸ Upon hearing of the rocket from POW intelligence derived from MI10 and CSDIC, Matthew Pryor of MI14 decided to inform the appropriate operational staffs. Lt/General Archibald Nye, Vice-CIGS and second-in-command of the British Army, then sought advice from the Scientific Adviser to the Army Council, Professor Charles Ellis and the MOS Controller of Projectile Development, Dr Alwyn Crow. For specific details of this POW intelligence, not all of which can be found in *Most Secret War*, see TNA CAB 120/748, MI10 and AI(K) Interrogation Reports forming part of report JIC/492/43, 29 March 1943; Hinsley et al, *British Intelligence in the Second World War, Volume III, Part I*, pp. 362–3; Campbell, *Target London*, pp. 56–8 & 89–90; Jones, *Most Secret War*, pp. 332–3. For more on Alwyn Crow see Edgerton, *Warfare State*, p. 131; and Edgerton, *Britain's War Machine*, pp. 42, 264 & 269. For more on Charles Ellis and his role as a 'senior' scientific adviser, see Edgerton, *Warfare State*, p. 164; and Edgerton, *Britain's War Machine*, p. 147.

¹⁹ TNA CAB 121/211, COS (43) 184 (0) 'German Long Range Rocket Development', 11 April 1943; TNA CAB 121/211, Hastings Ismay, Secretary of the Chiefs of Staff Committee to Churchill, 15 April 1943; Churchill, *Closing the Ring*, p. 185; Jones, *Most Secret War*, p. 335; Joubert, *Rocket*, p. 27; Hinsley et al, *British Intelligence in the Second World War, Volume III, Part I*, p. 364; Campbell, *Target London*, p. 61.

²⁰ CCAC DSND 2/4/1, Air Marshall Douglas Evill, Vice-Chief of Air Staff to Bottomley, Assistant Chief of Air Staff (Operations), 4 June 1943. Sandys co-ordination extended to information from agents and POWs directly through the JIC and military intelligence branches, air reconnaissance through DI(O), and air action against appropriate targets through Bottomley. Given that intelligence from agents was included yet ADI (Science) were not seems nonsensical.

the threat was to bomb Peenemünde.²¹ Cherwell preferred instead to allow the Germans more credit, believing that giant rockets would not pay and that 'far better results at much smaller cost' could be made 'by using pilotless aircraft'.²² Cherwell's scoffing inadvertently drew attention to the V1.²³

It was well-known that Cherwell and Sandys disliked each other, and was posited by Jones as further reasoning for Cherwell's stance.²⁴ Sandys later remarked that not being a scientist, he 'refused to be drawn into a scientific argument', and 'took the very simple view' that just because Cherwell did not know how to make a rocket was not grounds to believe that Germany could not do so.²⁵ Jones agreed, and yet Cherwell was determined that Jones

²¹ TMC DFG5701, Douglas Kendall interviewed by Constance Babington Smith on 15 November 1956. Norman Longmate posited that Cherwell's 'hoax' stance was simply because Jones had been overlooked in favour of Sandys: Norman Longmate, *The Doodlebugs: The Dramatic Story of the Flying Bombs of World War II* (London: Arrow Books, 1981), p. 31; Norman Longmate, *Hitler's Rockets: The Story of the V2s* (London: Hutchinson & Co., 1985; Barnsley: Pen & Sword Books, 2009), p. 64.

²² Churchill, *Closing the Ring*, p. 189; R. V. Jones, 'The Peenemünde Mystery', *The Listener*, 26 December 1963, p. 1054; Joubert, *Rocket*, p. 58. Cherwell, who even referred to the supposed rockets as nothing more than 'kite balloons', famously declared that 'at the end of the war', when the 'full story' was known, it would be found 'that the rocket was a mare's nest': see UONC CHER G.417/2 & TNA CAB 121/211, Minutes of the 10th Meeting of the Defence Committee (Operations), 25 October 1943, p. 2; Hinsley *et al*, *British Intelligence in the Second World War, Volume III, Part I*, p. 398; Campbell, *Target London*, p. 148.

²³ Reynolds, *In Command of History*, pp. 398 & 452. In revisions to Sandys draft of the "Hitler's Secret Weapon" chapter in Churchill's war memoirs, Cherwell assured enduring acknowledgement of his prescience regarding the pilotless aircraft, as well as strong vindication of his unfortunate hoax stance: CCAC CHUR 4/314/30–58. See also Roy Irons, *Hitler's Terror Weapons: The Price of Vengeance* (London: HarperCollins Publishers, 2002), p. 73.

²⁴ CCAC RVJO K.477, Transcript for 'Terror Weapons', p. 7. Much has been made over Cherwell's awkward personality and his judgement during the Second World War. Bernal once remarked that Cherwell's treatment of scientific data was distorted by his preconceptions and aims: RS PB.91.64, Bernal to the Editor of *The Times*, 27 April 1961. At this time Snow's *Science and Government* prompted Jones to write his article entitled 'Lord Cherwell's Judgement', published in *The Oxford Magazine* and *RUSI* respectively. Before publication Jones shared the draft of this article with Blackett hoping that he would review the evidence he had given to Snow: see RS PB.91.64, Jones to Blackett, 5 December 1962. Blackett chose not to do so. Even A. J. P. Taylor got involved, stating that although he only knew Lindemann 'slightly', he believed that he had 'never met anyone more dislikeable': A. J. P. Taylor, 'Lindemann and Tizard: More Luck than Judgment?', *The Observer Weekend Review*, 9 April 1961, 20. But although Cherwell 'was admittedly disliked by a good many people, there were also a good many people who liked him very much': RS PB.91.64, MacDougall to Blackett, 2 June 1961. See also 'Lord Cherwell and Sir Charles Snow', *The Oxford Magazine*, 1:20 (18 May 1961), 355–6.

²⁵ CCAC RVJO K.477, Transcript for 'Terror Weapons', p. 7.

should be included in the debate, despite the difference of opinion.²⁶ This was crucial to the British response to the Nazi V-Weapon campaign. In the famous late-night conference held in Whitehall's underground War Rooms on 29 June 1943, Jones sided with Sandys against his old friend because he believed in the rocket and agreed that bombing Peenemünde was the only sure means to halt German rocket development.²⁷

Adamant that he had not defected from Cherwell in order to lodge himself firmly in the Sandys camp, Jones later admitted that originally he personally 'knew nothing about rockets', that he 'had not picked up anything of the backwash of the German pre-war activities', and that it was 'only late in 1944' that he 'came to know of them'.²⁸ Usually he could make up for his ignorance by talking to British experts in particular fields (TRE for radar, NIB for signals, and so on), but he 'never heard anything' from British 'rocketeers'. In contrast, Sandys had a history of rocketry experience.²⁹ In March 1951, when

²⁶ Jones later recalled receiving a telephone call from Cherwell to discuss a point of contention over the rocket. Jones defined this as a 'very friendly gesture', particularly as Cherwell warned Jones that the other organisations involved in the investigation were 'just waiting' for Jones 'to make one mistake': CCAC RVJO B.342, Jones to Irving, 23 May 1964. Jones frequently acknowledged this unselfish contributory factor, notably in rebuttal to Snow's polemic which argued that Cherwell was some form of scientific dictator: see Jones, 'Lord Cherwell's Judgment', 326–7; Jones, *Most Secret War*, p. 341; Snow, *Science and Government*, pp. 67–8.

²⁷ This meeting 'impressed itself strongly' in Jones's memory. In the previous week's meeting on the possible effects of *Window*, Churchill asked Jones if Sandys had contacted Jones regarding the rocket threat (Cherwell had been pressing for such pooling of resources). Jones informed Churchill that Sandys had not, to which Churchill replied 'very well, I will call a Staff Conference next week – hold yourself in readiness!': CCAC RVJO B.340, Jones to Irving, 23 August 1963; CCAC RVJO B.344, Jones to Irving, 3 August 1964.

²⁸ CCAC RVJO B.347, Jones to Irving, 11 March 1965; CCAC RVJO B.346, Jones to Michaelis, 3 December 1964. For 'Sandys and his camp', see Birkenhead, *The Prof in Two Worlds*, p. 259; Campbell, *Target London*, p. 59. Within the Sandys camp was William Cook, MOS Assistant Controller of Projectile Development, Harold J. Phelps, explosives expert and MEW scientific adviser, and Colonel Kenneth Post, Sandys Oxford friend and second-in-command during his spell of operations in Norway.

²⁹ He had played a key role in the 'typically cronyist' rocket programme that had been a pet late-1930s project of Churchill's and Lindemann's. Sandys saw active service in Norway commanding an AA regiment and from October 1940 commanded an experimental regiment testing the feasibility of using rockets and photo-electric fuses against attacking dive bombers. This developed into him commanding

Churchill's literary syndicate were compiling his war memoirs, Jones attempted to convince Churchill that the 'scientific picture' of the rocket 'was so complex' that 'Sandys' advisers were out of their depth'.³⁰ Throughout his own postwar literature, Jones insisted that ADI (Science) 'did not know enough and certainly no-one else knew enough' about rocketry.³¹ At the late-June War Room meeting however, Sandys was the authority on rockets, while Jones was the authority on how to interpret intelligence of a scientific and technological nature. For this reason, Jones insisted upon the importance of having scientific intelligence assessed by intelligence experts rather than by experts on the particular machines—an argument he professed for many years after the war.³²

In November 1939, Jones had written that pilotless aircraft were technically feasible, and that Britain could have made such weapons had sufficient time been devoted to research on the matter. He also referred to them being intended as long-range projectiles that could have had serious demoralising

the first regiment of 'Z-batteries', equipped with rocket-projectors that homed onto targets using gun-laying RDF: Edgerton, *Britain's War Machine*, p. 109–10. That Sandys possessed political power was a welcome addition to his supposed expert knowledge in rocketry, for it meant he could insist upon countermeasures: Collier, *The Battle of the V-Weapons*, p. 30. See also David Kendall and Kenneth Post, 'The British 3-Inch Anti-Aircraft Rocket. Part One: Dive-Bombers', *Notes and Records of the Royal Society of London*, 50: 2 (July 1996), 229–39; David Kendall and Kenneth Post, 'The British 3-Inch Anti-Aircraft Rocket. Part Two: High-Flying Bombers', *Notes and Records of the Royal Society of London*, 51: 1 (January 1997), 133–40. See also N. Piers Ludlow, 'Sandys, (Edwin) Duncan', *Oxford DNB*. To date there is still no biography of Duncan Sandys.

³⁰ CCAC RVJO B.222, notes by Jones for Churchill entitled 'Detailed comments on Vol.V – Book I – Chapter XI 'Hitler's Secret Weapon', 3 March 1951; Reynolds, *In Command of History*, p. 398. Jones believed that he had been asked by Churchill when writing his memoirs to 'arbitrate between Sandys and Cherwell': CCAC RVJO B.341, 'Note on interview with Prof. R.V. Jones', p. 16.

³¹ Jones, 'Scientific Intelligence', 361; Jones, *Most Secret War*, p. 334; Hinsley *et al*, *British Intelligence in the Second World War, Volume III, Part I*, p. 365.

³² Edgerton, *Britain's War Machine*, p. 112. For the applied speculation that hindered correct interpretation of the German rocket, see Hinsley *et al*, *British Intelligence in the Second World War, Volume III, Part I*, pp. 371–3.

effects similar to the Paris gun of 1918.³³ During the course of the war however, this threat was forgotten. For all his lone crusader rhetoric, Jones was partly to blame for not recognising the V-Weapon threat. The impression Jones provided in his memoirs (which persisted throughout his war-related literature) is that he was right and the rest were wrong. Only close examination of the SIRs can determine the degree of truth in his claim.

ADI (Science) completed their first interim report on 'German Long Range Rockets' only three days before Jones appeared at the 29 June late-night meeting. This report was 'Interim' for a reason and had a notably restricted circulation. It explained that gathered evidence had been derived 'mainly from three types of source: secret agents, prisoners-of-war, and photography', although 'collateral evidence from other types of source' was also considered. 'Rocket starting of aircraft' was then discussed along with mention that rocket-propelled bombs had been used against British ships in the Crete operations of May 1941. ADI (Science) confirmed that reports about German rocket development began with 'the remarkable Oslo Report of November 1939'. This source, 'who has since proved correct in almost everything he described', spoke of wireless controlled rocket gliders being tried against ships, and gyro-stabilised rocket shells of 80cm diameter being developed for use against the Maginot Line.³⁴

³³ CCAC RVJO B.2 & TNA AIR 20/8535, Air Scientific Intelligence Report No.1 'The Hitler "Waffe"', 11 November 1939, p. 5; Hinsley *et al*, *British Intelligence in the Second World War, Volume III, Part I*, p. 359.

³⁴ CCAC RVJO B.86 & TNA AIR 20/1681, Interim Report 'German Long Range Rockets', 26 June 1943, p. 1, and frontispiece summary. The restricted circulation comprised exclusively of Cherwell, War Office DMI, CAS, ACAS(I), and Sandys (for the War Cabinet).

The Oslo Report's accuracy regarding the V2 was indeed remarkable, especially for 1939. The span of time between research and military use truly emphasises the technical (and political) difficulties the Germans faced with V2 development and production. It does not, however, account for why ADI (Science) did not maintain alertness caused by the early Oslo Report warning, and why they did not persist in alerting others. They attempted to explain this in a later report and, by doing so, went some way to admonishing those responsible for such wide dispersal of the rocket problem. British experts were engaged in developing weapons for British use, and German experts for German use. Requirements and stimuli were different in each case, and knowledge of bad experiments could discourage either side. Four situations, therefore, could have arisen with any one technological development:

1. Neither side made it work; this presented no intelligence problem.
2. Both sides succeeded; this was the normal intelligence problem.
3. British experts succeeded; the Germans failed.
4. British experts failed, or did not try; the Germans succeeded.³⁵

The latter was the case regarding flying bombs and rocketry. For Jones the rocket was the most interesting intelligence problem, but one in which prejudice was difficult to overcome due to the common (arrogant) belief that, if the British could not accomplish such development, then its foreign existence was either impossible or foolish.³⁶

³⁵ CCAC RVJO B.97 & TNA AIR 20/1688, Interim Report 'A4', 26 August 1944, pp. 40–1; CCAC RVJO B.341, 'Note on interview with Prof. R.V. Jones', p. 11; Jones, *Most Secret War*, p. 457.

³⁶ Edwin R. Walker, 'Intelligence in Recent Public Literature: The V-Weapons', *Studies in Intelligence*, 11: 1 (Winter 1967), 94. This article was in review of David Irving's second publication

Following the Oslo Report, little more was heard of Peenemünde or of rockets for the next three years, which was not surprising given that agent cover in the region 'was very thin'.³⁷ Such lack of cover meant that only if the rockets became operational would intelligence be forthcoming. Rocket research at Peenemünde may well have been reported to Welsh through SIS Stockholm contacts in 1941. Jones later remarked that, at the time, Welsh 'had no motive for not circulating the report' to him. It was possible therefore, that Welsh 'did not consider the Peenemünde report serious enough to merit any circulation at all', as had been the case regarding Tronstad's heavy water signal that same year.³⁸ A PRU pilot had randomly taken photographs of Peenemünde in May 1942, but nothing untoward was interpreted.³⁹

The first noteworthy source that referred to rocket trails near Swinemünde (30 miles south east of Peenemünde), arrived in Broadway, delivered via teleprinter from the SIS Stockholm office, on 18 December 1942.⁴⁰ ADI (Science) remarked after the war that it was fortunate that by the end of 1942 they had solved most of the intelligence problems concerning GAF night-defences, before the first report reached them concerning the German long range rocket. This 'fantastic story' came from a 'new agent', a Danish

entitled *The Mare's Nest: The German Secret Weapons Campaign and British Counter Measures* (London: William Kimber, 1964) for which Irving had initially approached Jones for interviews.

³⁷ CCAC RVJO B.86 & TNA AIR 20/1681, Interim Report 'German Long Range Rockets', 26 June 1943, p. 2. This particular intelligence scarcity was confirmed by the official historians: Hinsley *et al*, *British Intelligence in the Second World War, Volume III, Part I*, p. 360.

³⁸ CCAC RVJO B.441, Kramish to Jones, 10 February 1985; Jones to Kramish, 19 February 1985; Jones, *Most Secret War*, pp. 205–6.

³⁹ Babington Smith, *Evidence in Camera*, pp. 200–1; Collier, *Battle of the V-Weapons*, p. 141; Longmate, *The Doodlebugs*, p. 29.

⁴⁰ CCAC RVJO B.86 & TNA AIR 20/1681, Interim Report 'German Long Range Rockets', 26 June 1943, p. 2; Campbell, *Target London*, pp. 51–2. The original teleprinted message is preserved at CCAC RVJO B.123, upon which Jones later annotated 'This signal important – start of rocket flap.'

chemical engineer, who stated that he had overheard two scientists from the Berlin Technical High School discussing 'some trials with a new missile which they had witnessed'.⁴¹ Jones later wrote that this agent's report 'resensitized' ADI (Science) to possibilities that 'had no more than stayed in the background' of their thoughts during the intervening years, and that the 'Danish engineer's warning was timely' as only three prototype V2 rockets had been fired from Peenemünde.⁴² With prompting, the Danish engineer was twice more forthcoming with data on trajectory, range, and blast effect of the rocket. The reliability of this source was established through provision of further data on aircraft factories, and the gathered intelligence led directly to PR sorties over Peenemünde.⁴³

Gordon Hughes, who had flown the August 1941 sortie which first confirmed the *Freya* 'cow-bins', and had missed out on the Bruneval low-oblique sortie, was asked specifically by Jones to cover Peenemünde 'without making it a 'job'.⁴⁴ This is important as, following Sandys's appointment to the *Bodyline* Committee (established to investigate the rocket), Jones 'began to sense signs of a move to corner all the information', and that 'particular instructions were issued that all photographs of Peenemünde were to go only to

⁴¹ CCAC RVJO B.113, 'Scientific Intelligence in the S.I.S., 1939-45', circa 1945, p. 1; CCAC RVJO K.477, Transcript for 'Terror Weapons', p. 6; Jones, 'The Peenemünde Mystery', 1053-6.

⁴² Jones, *Most Secret War*, p. 332; Joubert, *Rocket*, pp. 27 & 47-8. Joubert also wrote of 'uncorrelated records' in the files of Danish intelligence from fishermen in the vicinity of Bornholm Island who had witnessed 'strange aeroplanes' coming 'from the direction of Peenemünde'.

⁴³ Hinsley et al, *British Intelligence in the Second World War, Volume III, Part I*, p. 360; Keegan, *Intelligence in War*, p. 335. John Keegan remarked that because this Danish engineer 'then disappears from the record', it reinforces 'the suspicion, held by numbers of historians of Nazi Germany that the Nazi state contained more well-placed sympathisers with the Allied cause than the danger of discovery by the Gestapo would suggest'.

⁴⁴ TMC DFG 5697, Constance Babington Smith's 1956 interview with Gordon Hughes. Babington Smith confirmed that Hughes's log book showed a record of Peenemünde sorties on 27 June, 8 August, and 22 August 1943, after the decision had been made to bomb the rocket research establishment.

Sandys'.⁴⁵ 3G(N) later admitted that the political rivalry surrounding the rocket was 'not without influence' on their 'approach to source'.⁴⁶ Jones therefore manipulated his contacts to ensure that he was supplied with the information he required. Another crucial move in this regard was to alert 3G(N) that he had a new quarry, and for SIGINT to place a 'special watch' on what he knew to be the most expert of GASER (namely the 14th and 15th).⁴⁷ The intelligence attack on both 'produced gems'.⁴⁸ Benefit of past scientific intelligence experience paid significant dividends in this regard.

Unravelling the German secret weapon programme was an entirely different puzzle for ADI (Science) to solve. With the DT hunt they had to determine apparatus, purpose, location, inter-connection, and counter-measures. With rocket derivatives it was much simpler. As SIR No.V demonstrates (and which thereby confirms Jones's post-war claims), ADI (Science)'s experience in the DT hunt was crucial to intelligence developments regarding the pilotless aircraft.⁴⁹ They appreciated that if the Germans were developing pilotless projectiles then they would want to monitor them using radar, and supposed that they would employ the best available radar organisation. Through 'combined reasons of sentiment and prudence', GASER signals had been a

⁴⁵ CCAC RVJO B.342, Jones to Irving, 10 July 1964; CCAC RVJO B.344, Jones to Irving, 3 August 1964; Jones, *Most Secret War*, pp. 336–7; Campbell, *Target London*, pp. 67–8. *Bodyline* included 'expert' panels – one for scientists (the Scientific Co-ordinating Committee) and a fuel panel. The scientist Edward Bullard and Ian Fleming were the *Bodyline* representatives for the Admiralty.

⁴⁶ TNA HW 43/69, 'Report on the work of 3G(N)', 1 August 1945, p. 20.

⁴⁷ Jones, 'The Peenemünde Mystery', 1054; Jones, *Most Secret War*, p. 336; Hinsley *et al*, *British Intelligence in the Second World War, Volume III, Part I*, p. 402. The 'special watch' Jones referred to was defined by 3G(N) as a 'keyword' technique; TNA HW 43/69, 'Report on the work of 3G(N)', 1 August 1945, p. 16. See also Calvocoressi, *Top Secret Ultra*, pp. 72–4 for a more detailed explanation of the Hut 3 'Watch'.

⁴⁸ CCAC RVJO B.343, 'Verbatim note on interview with Professor R. V. Jones', p. 14.

⁴⁹ CCAC RVJO B.89 & TNA AIR 20/1667, Air Scientific Intelligence Report No.V, 'German Pilotless Aircraft', 23 December 1943. This document is also preserved complete in TNA AIR 40/3009. From the annotation on the frontispiece it appears that this copy was sent to Frank Norman of Bletchley Park's Hut 3 following initial distribution.

source that had served British Intelligence so well in the past. To sentiment and prudence can be added remarkable intuition and fortune, although the Bletchley card index system deserves its due credit. For in April 1943, 14th Company sent a *Würzburg* to the Flak Experimental Station at Peenemünde, reported aircraft projected from Peenemünde, and from early October reported projected aircraft from Zempin.

Secret agent intelligence was doubtful, for it could have been planted by the Germans. Recorded conversations of German generals captured in North Africa were another matter entirely, and proved to be the convincing pointer – what Jones later defined as ‘the crucial point in the story’.⁵⁰ Intelligence derived from General von Thoma (the ‘intelligent pessimist and most technically informed’ of the ‘galaxy of German generals’) and General Crüwell, was believed by ADI (Science) to be ‘in good faith’ for it agreed with their own knowledge where it existed. For this reason the whole ‘character of the intelligence picture changed’, for it then ‘became reasonable to accept German long range rocket development as an established fact’.⁵¹ British intelligence had been forced to enter a German fantasy world where romance replaced economy. This, stated one intelligence author, was perhaps ‘not the least valuable lesson to be found’ from Jones’s experiences.⁵²

⁵⁰ CCAC RVJO K.477, Transcript for ‘Terror Weapons’, p. 6.

⁵¹ CCAC RVJO B.86 & TNA AIR 20/1681, Interim Report ‘German Long Range Rockets’, 26 June 1943, p. 3. For more details and transcripts of the von Thoma and Crüwell bugged conversations see Neitzel, *Tapping Hitler’s Generals*. It is worth noting however, that their bugged conversation of 22 March 1943 in which von Thoma spoke of stratospheric rockets is not included by Neitzel. See also Hinsley *et al*, *British Intelligence in the Second World War, Volume III, Part I*, pp. 362–3; Jones, *Most Secret War*, pp. 332–3.

⁵² Walker, ‘Intelligence in Recent Public Literature’, 96.

From January through to May 1943, PRU repeatedly photographed Peenemünde, and the photographs were the subject of various reports by CIU.⁵³ These revealed ‘an extremely widespread and vigorous establishment’, known ‘from independent evidence to play an important part in German research’. Intelligence was supplemented by other snippets of information from various agents, notably two Luxembourgers, conscripted into the *Wehrmacht* based at Peenemünde, and present at trials of ‘cigar-shaped missiles’ fired by catapults from ‘cubical contrivances’.⁵⁴ Moreover, Jones believed (and later informed the War Cabinet) that ‘the theory of the rocket was considerably stronger’ than ‘evidence on which they had based their conclusions about the use of beams by the Germans’.⁵⁵

With all this data ADI (Science) began to see the blurring of conflicting intelligence. Nevertheless, the combination of evidence convinced them that Peenemünde was an Army research establishment. Besides, the rocket photographed could not have been the Cherwell ‘hoax’, for ‘nobody would be so rash as to exhibit a dummy rocket’ to be photographed ‘because if the hoax were successful it might result in disaster to Peenemünde’. ADI (Science) therefore concluded that there appeared to be ‘no counter short of direct bombing attack against the various ramifications of the rocket producing

⁵³ CCAC RVJO B.86 & TNA AIR 20/1681, Interim Report ‘German Long Range Rockets’, 26 June 1943, pp. 4 & 8; Hinsley *et al*, *British Intelligence in the Second World War, Volume III, Part I*, p. 363.

⁵⁴ TNA CAB 121/211, COS (43) 342(0) ‘German Long Range Rocket’, p. 3; Jones, ‘The Peenemünde Mystery’, 1054; Hinsley *et al*, *British Intelligence in the Second World War, Volume III, Part I*, p. 391. This intelligence was the first received on the V1, although at the time both Sandys and ADI (Science) misinterpreted the evidence.

⁵⁵ CCAC DSND 2/4/1 & TNA CAB 121/211, Minutes of War Cabinet Meeting DO (43) 5th Meeting entitled ‘German Long Range Rocket Development’, 29 June 1943, pp. 4–5. Jones stated to the War Cabinet on 29 June that he ‘could not accept the theory of the hoax’, and that ‘photographs showed conclusively that the rocket was in existence’. Cherwell replied that the photograph only ‘revealed a rocket which was clearly single stage’ with a range of forty miles.

and projecting organisation'.⁵⁶ Armed with this loaded report, Jones attended the late-June conference determined to 'demolish' Cherwell's scepticism.⁵⁷

This he did, and the decision to bomb Peenemünde was made. In Churchill's mind Jones had been right about the beams and, only a week before, had been accurate in his operational expectations of *Window*. Jones's involvement in the decision-making process regarding the bombing of Peenemünde should not be underestimated. Delays in attack were proposed; not just to wait for darker nights, but to ensure that Bomber Command 'could really devastate' the research establishment.⁵⁸ A plan of the factory at Peenemünde expected from 'an agent on the continent', caused further delay.⁵⁹ The Peenemünde raid of 17/18 August 1943 was a 'masterpiece of tactics', for there was good use of *Window*, excellent target-marking as well as the use of a Master Bomber who issued instructions from a near vicinity.⁶⁰ Outstanding PR

⁵⁶ CCAC RVJO B.86 & TNA AIR 20/1681, Interim Report 'German Long Range Rockets', 26 June 1943, pp. 5 & 9.

⁵⁷ See CCAC RVJO K.477, Transcript for 'Terror Weapons', p. 9 for Jones's use of the word 'demolish'. An alternate perspective is interesting. Robert Cecil recalled that it was C who 'fought a battle for the mind of Churchill' with Cherwell 'who was sceptical', and that 'C's evidence clinched the matter in June 1943'. No doubt in 'C's evidence' Cecil was referring to Jones as the only SIS representative at the 29 June meeting: Cecil, 'C's War', 181.

⁵⁸ CCAC DSND 2/4/1 & TNA CAB 121/211, Minutes of War Cabinet Meeting DO (43) 5th Meeting 'German Long Range Rocket Development', 29 June 1943, p. 7; Jones, *Most Secret War*, p. 345; Campbell, *Target London*, pp. 87–9. Brief delay for real devastation was Churchill's recommendation, after Portal's suggestion that an immediate raid by Mosquitoes 'might' have caused 'the Germans to move everything of value' before Bomber Command 'could launch a real assault'.

⁵⁹ CCAC DSND 2/4/1, Sandys to Bottomley, 11 June 1943. Attached to this letter was a list of recommended PRU flights in connection with the rocket threat – Peenemünde (about once a fortnight); the island of Griefswalder Oie; Leustatder Hohe; the island of Rugen; the island of Bornholm; Holtzkirchen near Munich; and enemy occupied territory within 130 miles of London (concentrating specifically on railway lines and sidings).

⁶⁰ Dean, *The RAF and Two World Wars*, p. 278; 'Terror Weapons', *The Secret War*, BBC Enterprises. Jones believed that the use of *Window* significantly reduced Bomber Command losses that night, perhaps up to three or four-fold. For a detailed account of the raid, see Martin Middlebrook, *The Peenemünde Raid: The Night of 17–18 August 1943* (London: Allen Lane, 1982).

evidence enabled the raid to be a precision rather than an area attack.⁶¹ Forty aircraft were lost and thirty-two were damaged. These losses could have been significantly worse irrespective of good Allied tactics, for GAF *Wilde Sau* target predictions that night proved inaccurate. After the raid, Enigma decrypts showed that GAF nightfighters circumventing *Window* first thought the target to be Berlin and therefore arrived at Peenemünde too late.⁶² The raid was a success, for it delayed commencement of the V2 offensive by some two months, and affected research of the V1 flying bomb.⁶³

Flying Bomb Derivatives

On 7 September 1943, two encrypted telegrams sent through the 'Brown' strain of Enigma traffic spoke of unfamiliar technology—one referred to 'Flak target apparatus Flakzielgerät 76', the other simply of 'FZG-76'. These telegrams reached ADI (Science) through 3G(N).⁶⁴ Jones later recalled that these decrypts comprised the 'first really good piece of solid evidence' about FZG76.⁶⁵ It took only one week for scientific intelligence to make significant deductions and produce a report based on the findings. Perhaps owing to the friction caused by too many personalities and committees investigating the rocket, ADI (Science) felt the need to use their ULTRA privilege to bark first and loudest on the new technological intelligence. Their 'Special Note' entitled

⁶¹ Hinsley *et al*, *British Intelligence in the Second World War, Volume III, Part I*, p. 382. The bombing was so severe that the Air Staff asked the USAAF to defer its planned follow-up attack on Peenemünde until there had been a detailed assessment of the damage and Sandys had produced his next report.

⁶² Hinsley *et al*, *British Intelligence in the Second World War, Volume III, Part I*, pp. 310–11.

⁶³ CCAC CHUR 4/314 B, Comments by Sir Guy Garrod on Churchill's war memoirs, 'Vol. V, Bk I, Chap XI Hitler's Secret Weapon', 19 December 1951; Dean, *The RAF and Two World Wars*, p. 278. See also M. Zvegintzov, 'The Peenemünde Mystery', *The Listener*, 9 January 1964, 66. This letter was written in response to Jones's article of the same name.

⁶⁴ CCAC RVJO B.87 & TNA AIR 20/1721, Special Note 'The Flakzielgerät 76', 14 September 1943, p. 1; Hinsley *et al*, *British Intelligence in the Second World War, Volume III, Part I*, p. 393.

⁶⁵ CCAC RVJO B.343, 'Verbatim note on interview with Professor R. V. Jones', p. 3; Campbell, *Target London*, p. 135

'The Flakzielgerät 76' was designed for a select intelligence-only circulation.⁶⁶

Such exclusivity on important intelligence matters, and irrespective of ULTRA secrecy regulations, often caused significant command problems.⁶⁷

Furthermore, the low circulation in this instance confirmed the need for ADI (Science) to be seen to be barking first on fresh German technological developments. Hasty deductions based on limited intelligence do not always provide accurate assessments however.

Once again the Oslo Report had given remarkable forewarning which had been largely ignored. Nevertheless, the differentiation between long-range projectile rockets and radio-controlled pilotless aircraft was an ADI (Science) coup. Moreover, the existence of pilotless aircraft exonerated Cherwell's scepticism, and effectively 'let him off the hook' for any blunders he had made over the rocket. The penultimate paragraph in the Special Note related to secret agent intelligence on both types of offensive long-range rocket-driven weaponry, and in *Most Secret War* Jones stated that he specifically designed the paragraph to warn others of Cherwell-instigated continued opposition. Probably due to the restricted readership of the Special Note, the warning made little if any difference, for Cherwell continued to refuse to acknowledge feasibility of a rocket of any description. Because Cherwell was so vehement,

⁶⁶ CCAC RVJO B.87 & TNA AIR 20/1721, Special Note 'The Flakzielgerät 76', 14 September 1943. Designated 'Personal' copies each sent to C and the Service Intelligence Directors – Inglis as ACAS(I), Commodore Rushbrooke for the Admiralty, and Major-General Davidson for the War Office. This Air Scientific Intelligence Special Note is reproduced in full in Hinsley *et al*, *British Intelligence in the Second World War, Volume III, Part I*, 589–92. See also Campbell, *Target London*, p. 135.

⁶⁷ For example, Kenneth Strong, chief of SHAEF intelligence and Eisenhower's personal intelligence adviser, recalled that he 'knew nothing' about the V-Weapons 'because of a stupid rule which confined the knowledge of the weapons to a small and restricted circle'. This led Strong 'on more than one occasion into giving inadequate advice' to his colleagues: Strong, *Intelligence at the Top*, p. 130.

and because he was so revered, his views inspired additional committees of scientists (more experts) to further investigate rocket possibilities.⁶⁸

Five days before ADI (Science) distributed their Special Note, the Fritz-X (FX) radio-controlled glider bomb was used in action for the first time against the Italian fleet sailing to Malta to surrender to the British. Designed by Max Kramer, armour-piercing FX was in theory an ordinary bomb with an ordinary bombsight, but remotely-guided by joy-sticks in the bombers. Each bomber of *Gruppe III* (nine in total) of *KG100* carried a single FX, and four caused direct hits upon their targets. The Italian flagship *Roma* was struck three times, broke in two, and sank, while her sister ship, the *Italia* suffered one direct hit and was damaged. That very day the Allies had enacted Operation *Avalanche*, the amphibious landing at Salerno, and during the ensuing week III/*KG100* used FX operationally scoring hits on HMS *Warspite*, HMS *Uganda*, USS *Savannah*, and a number of freighters. Such impressive losses prompted the Allies to hastily construct two small airfields so that Spitfires could counter the guided-missile threat. During 9–19 September 1943, the FX sank some 68,000 tons of shipping and damaged a further 90,000, yet did not achieve a single success thereafter for the remainder of the war.⁶⁹ Enigma

⁶⁸ Jones, *Most Secret War*, pp. 356–7; CCAC RVJO B.87, Special Note ‘The Flakzielgerät 76’, 14 September 1943, p. 3; Campbell, *Target London*, pp. 136–7. The fresh experts on the newly-formed Scientific Co-ordinating Committee (accompanying Alwyn Crow) were Professor of Mathematics G. I. Taylor, Sir Frank Smith, chief engineer of armament design at Fort Halstead, and Professor Sir Ralph Fowler, scientific adviser to the Admiralty.

⁶⁹ Alfred Price, ‘The First Generation’ in John W. R. Taylor (ed), *Aircraft Annual 1966* (London: Ian Allan, 1966), pp. 84–6; Richard P. Hallion, ‘Bombs That Were Smart Before Their Time’, *World War II*, September 2007, 52–7. Price referred to the FX as the ‘X-1’ which could well have been the weapon development code. Hallion referred to the FX as ‘Fritz X’. See also AHB, ‘Air Ministry Intelligence in War’, p. 382. Alfred Price remarked that the guided-missile age was born, and that ‘never was so much achieved by so few’.

provided the technical specifics when it reported the sinking of *Roma* by III/KG100 using PC1400FX high-altitude free fall armour-piercing bombs.⁷⁰

These guided-rocket bombs were only ever mentioned once by ADI (Science) throughout their reports, and only after the missiles were used operationally.⁷¹

Yet the threat from 'gliding bombs' had been high on the November 1939 list of weapons that Jones warned 'should be anticipated', and for which he recommended 'precautionary action'.⁷² Clearly 'gliding bombs' had been forgotten along with pilotless aircraft: that both were airpower weaponry, made at Peenemünde, and alluded to in the Oslo Report (the FX was probably the FZ21) meant that German development of these guided-missiles fell loosely into the remit of ADI (Science). In *Most Secret War* Jones provided fleeting mention of the use of guided-bombs by KG100, but gave no reason why ADI (Science) had not alerted naval intelligence to the threat.⁷³

Even more remarkable is the lack of discussion from Jones regarding the Hs293. Designed by Professor Herbert Wagner, and defined as 'true pilotless aircraft', the Hs293 lacked the armour-piercing capability of FX, but was much

⁷⁰ Hinsley *et al*, *British Intelligence in the Second World War, Volume III, Part I*, p. 337.

⁷¹ CCAC RVJO B.88, untitled report regarding the likelihood of rockets at Peenemünde, 25 September 1943, p. 8.

⁷² CCAC RVJO B.2 & TNA AIR 20/8535, Air Scientific Intelligence Report No.1 'The Hitler "Waffe"', 11 November 1939, p. 5.

⁷³ This was in reference to how he first heard of the missiles from two separate sources: a Danish naval officer posted at Bornholm, Lt/Cdr Hasager Christiansen, who photographed and sketched a missile, and sent it through the channels of Danish Naval Intelligence services; and the French agent, Jeannie Rousseau, codename 'Ammiarix' of the Alliance Resistance network, codenamed 'Noah's Ark' (as the agents were coded as birds and animals). Jeannie Rousseau (later Vicomtesse de Clarens) wrote the 'Foreword' to *Most Secret War*, and was also a co-dedicattee: Jones, *Most Secret War*, pp. xi, xiii-xiv, & 351-2; Marie-Madelaine, *Noah's Ark* (London: Unwin & Allen, 1973); Campbell, *Target London*, pp. 120-3. For other French Resistance activity in connection with science and technology (including the V-Weapons), see Jacques Bergier, *Secret Weapons, Secret Agents* (London: Panther, 1958).

more flexible in flight and therefore easier to guide.⁷⁴ Sinking one cruiser, six destroyers, and ten large merchant ships (totalling 90,000 tons) and damaging some 250,000 tons between first use on 25 August 1943 and last recorded use in March 1945, the Hs293 was only marginally more successful than FX. This had much to do with continual reductions to operational ability of the *Luftwaffe*.⁷⁵ ADI (Science) were oblivious to almost all of the research and development of these weapons and to many other German rocket aircraft and guided-missile derivatives: the Kramer X-4, RM4, and Hs298 air-to-air missiles, the ‘Schmetterling’ and BV143 anti-shipping missiles, the ‘Enzian’, ‘Rheintochter’, ‘Taifun’, and ‘Wasserfall’ surface-to-air missiles, and the rocket and jet-powered aircraft variants DFS194, He176, Me163, the *Komet* (Me163B), and *Natter* (Ba349) are just some examples.⁷⁶ The *Rheintochter* spawned the *Rheinbote* (V2 derivative), of which some 200 were used against Antwerp in 1944.

DFS194 is a fine example of a German secret weapon that ADI (Science) heard about but were never to appreciate, being a tailless aircraft of the type referred to by intelligence emanating from Peenemünde.⁷⁷ Jones later wrote that the Germans, stung by the July 1943 attacks on Hamburg, had continued to develop successful surface-to-air guided-missiles (SAM), and that these missiles were first to have replaced gun defences, and might ultimately have

⁷⁴ Hallion, ‘Bombs That Were Smart’, 56.

⁷⁵ Price, ‘The First Generation’, 86–8. Although these weapons had no effect on the course of the war, they ‘missed greatness by a very small margin’.

⁷⁶ For specifics on these German secret weapons, see Hogg, *German Secret Weapons of the Second World War*; Richard P. Hallion, ‘Rocket Dreams’, *World War II*, October/November 2008, 54–61.

⁷⁷ CCAC RVJO B.88, untitled report regarding the likelihood of rockets at Peenemünde, 25 September 1943, p. 3. The DFS194 was a combined 1939 Alexander Lippisch and Willy Messerschmitt design that improved Lippisch’s 1931 Delta 1 tailless all-wing aircraft: Hallion, ‘Rocket Dreams’, 56–7.

supplanted nightfighters.⁷⁸ Easy to state in hindsight, but development of these German 'secret weapons' entirely eluded ADI (Science) at the time. Many of the German research establishments also received little if any attention from British scientific intelligence.⁷⁹

Their contemporaneous ignorance probably had much to do with blurred rocket-related intelligence from agents, the very limited reference to such weapons via Enigma, and the overwhelming amount of 'experts' involved in the rocket intelligence collation process.⁸⁰ As the many variant secret weapons increased, the task grew ever more complex. Within this complexity hides a crucial point regarding wartime British Air Intelligence. The differentiation between scientific intelligence and technical intelligence was ambiguous. AI1(g) was, for the first two years of the war, responsible for examining crashed enemy aircraft. From June 1942 however, when AI1(g) spawned the research section AI2(g), technical intelligence 'assumed responsibility for scrutinising and assessing intelligence from all sources' on possible new GAF developments, 'with a view to providing advance warning' of 'the emergence of new types or sub-types of aircraft, new aero-engines and new armament, radar and other equipment'.⁸¹ Intelligence on the German jet aircraft programme, for example, fell into the AI2(g) remit and, working in close

⁷⁸ CCAC RVJO J.1, 'The Radio War', p. 25.

⁷⁹ Bleicherode and Kochel (used extensively after the first bombing of Peenemünde), and the Göring Aerial Weapon Establishments at Braunschweig and Ruit, are just four examples.

⁸⁰ See Keegan, *Intelligence in War*, pp. 311 & 317 for much the same conclusion. Keegan importantly added that HUMINT, irrespective of its frequently conflicting data, 'played a significantly greater part in the identification of the V-Weapons than it did in any other sector of the British intelligence war against Germany'.

⁸¹ Hinsley *et al*, *British Intelligence in the Second World War, Volume III, Part I*, p. 330.

connection with PRU and Medmenham, proved to be their finest success.⁸² Indeed it was AI2(g) understanding of photographic evidence of tailless aircraft at Peenemünde (known at CIU as P30) and discussed at the 29 June Defence Committee meeting, that led to further investigation into the possible existence of pilotless aircraft.⁸³ Interestingly, Jones credited this lead to Lindemann rather than to technical intelligence.⁸⁴

With certain technical exceptions, such as sub-types of aircraft and aero-engines, the AI2(g) remit could easily have applied to ADI (Science).⁸⁵ Jones recalled that after December 1943, ADI (Science) 'did not have much to do with the detailed analysis of the construction of the flying bomb', because AI2(g) had come 'into the picture', leaving ADI (Science) to concentrate 'on the overall performance rather than the detailed design'.⁸⁶ Nevertheless, collecting agencies were not to appreciate the difference, and were often confused over which organisation to send scientific and/or technical intelligence. To confuse matters even further, a new Air Intelligence Section,

⁸² TNA AIR 40/2166, AI2(g) Report on the Me163, 20 April 1944. See also AHB, 'Air Ministry Intelligence in War', p. 369; Hinsley *et al*, *British Intelligence in the Second World War, Volume III, Part I*, pp. 350–1 & 579–84. For a comparative history of Second World War jet aircraft, see Sterling Michael Pavelec, *The Jet Race and the Second World War* (Praeger Security International, 2007).

⁸³ TNA CAB 121/211; Hinsley *et al*, *British Intelligence in the Second World War, Volume III, Part I*, pp. 334–5, 369 & 391. The official historians rightly stated that photographic evidence of the activities at Peenemünde 'proved to be a critical point in the investigation'. P30 was later realised as the Me163.

⁸⁴ Jones, *Most Secret War*, p. 346.

⁸⁵ Each organisation could coincidentally have assumed that the other was covering any particular field within their respective remit. A typical example of this emanated from an ADI (Science) Minute detailing intelligence on 'composite aircraft', which caused concern for Jack Easton, head of AI2(g). He believed the Minute revealed overlap and duplication of effort between ADI (Science) and AI2(g). Easton realised this just before he was about to send a report on composite aircraft, only to receive one from ADI (Science) with notably similar content. Easton confirmed that in the past 'there had been no difficulty in drawing a line between the technical responsibilities' of AI2(g) and 'the scientific responsibilities' of ADI (Science), and proposed a meeting in order to draw a 'hard and fast line of responsibilities'. Easton wished to clarify however, that 'pickaback' aircraft with explosive warheads came 'under the category of normal aerodynamics and armament', and that these were within the AI2(g) remit: CCAC RVJO B.123, Jack Easton to Jones, 19 May 1944. The Minute was dated 17 May.

⁸⁶ CCAC RVJO B.345, Jones to Irving, 26 October 1964.

designated AI1(h), was created as a combined War Office and Air Ministry organisation instructed to exclusively interpret V-Weapon intelligence. This was headed by Bletchley's W/Cdr Godfrey Mapplebeck, who merited no mention by Jones in *Most Secret War*.

That AI2(g) were 'taken entirely by surprise' by FX and Hs293 guided-missiles could perhaps have been avoided had there been adequate demarcation, and, more importantly, liaison between scientific intelligence and technical intelligence.⁸⁷ Had there been close relations between the two organisations there would not have been any initial AI2(g) concern and no need to request clarity. That the Admiralty were entirely surprised operationally by GAF guided-missiles was unforgivable. This again raises the more fundamental issue of naval scientific intelligence, for it 'became absolutely obvious' from the 'advent' of the Hs293, and irrespective of Gollin's presence in the Admiralty, that intelligence of a scientific nature was found wanting in NID. The outcome was that in October 1943 NID established NID7S, its own Scientific Intelligence Section. This however, does not excuse ADI (Science) from not being alert to GAF guided-missiles. Had they discussed earlier data with AI2(g), and had the latter shared intelligence with the former, then between them countermeasures could have been determined, with ships and lives potentially saved. More importantly, the two organisations could arguably have predicted the natural evolution from glider bombs and guided-missiles to

⁸⁷ The nearest ADI (Science) came in warning of radio-controlled missiles before the intelligence debacle over FX and Hs293, was SIR No.11 of May 1941 which detailed collation of varied sources of intelligence on German research into steered bombs: CCAC RVJO B.21, Air Scientific Intelligence Report No.11 'The Photoelectric Steered Bomb in Germany', 13 May 1941.

pilotless aircraft and flying bombs, for the former were the 'first of a series of unorthodox German weapons'.⁸⁸

One guided-missile that ADI (Science) were alerted to, and warned about in April 1944, was the 'BV246', which had the operational name of 'Hagelkorn'. This was probably the 'pickaback' composite aircraft that Easton spoke of. GASER radio traffic spoke of a 'BV 246 aerial bomb'. ADI (Science) surmised that this 'suggested some kind of glider bomb made by Blohm and Voss along the lines of the Hs293'. They determined that BV246 had wooden or plastic frames, flew at 60mph ground-speed, and possessed a range of 25miles which supposed their use against towns and ships. ADI (Science) claimed that it was 'too early to say' whether it was radio-controlled or had independent propulsion, but that its behaviour would become evident upon further observations. They recommended the usual countermeasure of watching Peenemünde and Baltic aerodromes through photographic searches.⁸⁹ 3G(N) were also monitoring trials of FZG76 at these particular sites during April 1944, and these were beginning to reap dividends due to 'mass firings' which implied 'either an increased degree of urgency in the trials', or that they had 'reached the stage where sustained rate of fire' was being tested due to the missile itself proving satisfactory.⁹⁰

⁸⁸ For 'taken entirely by surprise', 'became absolutely obvious', 'advent', and the creation of NID7S see Hinsley *et al*, *British Intelligence in the Second World War, Volume III, Part I*, pp. 332 & 340 respectively. For 'first of a series of unorthodox German weapons', see AHB, 'Air Ministry Intelligence in War', p. 378, although the report adds that 'strictly speaking, the first "secret weapon" was the magnetic mine'.

⁸⁹ CCAC RVJO B.90, Interim Report 'BV246', 26 April 1944.

⁹⁰ TNA DEFE 40/12, ADI (Science) memorandum, 1 May 1944; Campbell, *Target London*, p. 227.

A second Interim Report on BV246 followed swiftly, as fresh evidence comprising of 'statements' revealing gaps in British knowledge of this missile had been obtained. Although the intelligence source was not specified, the word 'statements' alludes to POW interrogation. From the data provided, ADI (Science) reported that BV246 were gyro-controlled glider-bombs for distant area targets, made from laminated steel, lacking independent propulsion (although radio-control was under development), and that He111s could carry three bombs, while Ju-88s could carry two.⁹¹ In a very brief mention of this 'possible' V-Weapon in *Most Secret War*, Jones confirmed that the BV246 was 'an early example of a 'stand-off' missile'.⁹² A 1st US Army report on the November 1944 V1 bombardment of Liege, spelt out for the first time by an Allied power that the V1 (and its derivatives) was 'definitely suitable for use as a tactical weapon'.⁹³ That ADI (Science) collated intelligence on the BV246 air-to-surface missile and not specifically on others is also interesting, particularly in light of the creation of NID7S. The blurred demarcation between air and naval scientific and technical intelligence evidently persisted, especially regarding air-to-surface guided-missiles. No source has confirmed the operational use of BV246 to date, but it is possible that contemporary reports of damage by V1s might have been caused by BV246 bombs instead.

Continued doubt over the rocket threat in September 1943, led the Defence Committee to request from C a report on the reliability of the intelligence

⁹¹ CCAC RVJO B.91, Second Interim report 'BV 246', 6 May 1944.

⁹² Jones, *Most Secret War*, p. 463. The French Exocet missile used so effectively in the Falklands War was a later evolution of the principle behind the BV246.

⁹³ TNA AIR 40/2656, First United States Army Report 'Analysis of V-1 Activity Preceding and During the Bombardment of Liege', 30 November 1944.

available.⁹⁴ C naturally delegated the task to ADI (Science), who saw it as the ideal opportunity to quash the hoax theory once and for all. After spelling out the amassed intelligence to date, they theorised on the 'Hoax Hypothesis' and the 'Possibility of Mistaken Interpretation'. The primary foci of this report was twofold: to emphasise the likelihood of the existence of German rocketry, and to differentiate between the long-range rocket and the pilotless aircraft. This may well have been the case, for once the Cabinet became aware of intelligence on pilotless aircraft, ADI (Science) were officially assigned intelligence collation responsibility. Rather than picking at the rocket problem from the outside, they were at last able to focus on a hunt—a hunt that Sandys and other 'experts' were not party to. This untitled report contains the first ADI (Science) mention of Hs293, which by then had already been used operationally. This, they stated, was the 'latest' item to appear that had 'been anticipated in some detail' by the Oslo Report, and 'said to have been developed at Peenemünde'.⁹⁵ The question must be asked as to why ADI (Science) did not bark loudly and timely enough on this matter.⁹⁶

⁹⁴ CCAC RVJO B.88, untitled report regarding the likelihood of rockets at Peenemünde, 25 September 1943, pp. 8–9; Hinsley *et al*, *British Intelligence in the Second World War, Volume III, Part I*, p. 389; Campbell, *Target London*, p. 138. The Chiefs of Staff version of this report can be accessed at TNA CAB 121/211. Churchill's copy is preserved in TNA PREM 3/110, the concluding three paragraphs of which featured in Churchill, *Closing the Ring*, p. 192. Jones sent the extract to Churchill after reading Sandys draft of the 'Hitler's "Secret Weapon"' chapter. This comprises the very passage that Reynolds noted Jones was 'particularly anxious to insert' so as to give 'credit to his own unit' and to himself: see CCAC RVJO B.222 and Reynolds, *In Command of History*, pp. 398 & 452. See also CCAC CHUR 4/314 B, Churchill to Sandys, 25 April 1951 in which Churchill stated that it was 'necessary to meet Professor Jones's request for the publication of this particular passage or parts of it'. None of this assumes wartime circulation of the report.

⁹⁵ CCAC RVJO B.88, untitled report regarding the likelihood of rockets at Peenemünde, 25 September 1943, p. 3. Hs293 was also mentioned in CCAC RVJO B.89, Air Scientific Intelligence Report No.V 'German Pilotless Aircraft' 23 December 1943, p. 12; and CCAC RVJO B.90, Interim Report 'BV 246' 26 April 1944.

⁹⁶ The first scientific intelligence note of such devices was provided by Jones in his August 1940 Monthly Summary in which he referred to torpedoes fired from He111s. Intelligence at that time was still relatively sparse, and Jones wrote that there 'was little to suggest' that there was 'anything abnormal about the torpedoes' yet the results appeared 'to be of great interest to the German Air Staff': CCAC RVJO B.13, Air Scientific Intelligence Monthly Summary No.5 for August 1940, p. 3.

By the time ULTRA informed naval intelligence of FX and Hs293 in May 1943 it was far too late to research potential countermeasures; nor were NID able to correlate the decrypt with earlier intelligence that they knew nothing of.⁹⁷ ADI (Science) misinterpreted early intelligence based on scientific and technological pre-suppositions; which is precisely what Jones and many others openly criticised Cherwell for over the V2. In September 1943, ADI (Science) were determined not to make the same mistake. They reported that there was nothing in the rocket story which detracted from the suggestion that Germany were developing pilotless aircraft to launch against the 'big cities' of Britain. Moreover, 'much of the critical evidence', including the August 1943 Lisbon Report, pointed 'to both weapons' – the *Wehrmacht* developing one, the GAF developing the other, with 'keen rivalry'. Importantly, ADI (Science) warned (for the first time and in plenty of time) that long-range guns were 'similarly not excluded'.⁹⁸

Pilotless Aircraft

On 13 September 1943, Sandys reported to the War Cabinet that evidence suggested the threat of a pilotless aircraft bombardment upon Britain, and recommended the same countermeasure enacted over the rocket scare – 'the destruction by bombing of the sources of manufacture and of the sites or airfields from which they [were] launched'. The following month Churchill

⁹⁷ Hinsley *et al*, *British Intelligence in the Second World War, Volume III, Part I*. p. 338.

⁹⁸ CCAC RVJO B.88, untitled report regarding the likelihood of rockets at Peenemünde, 25 September 1943, pp. 4 & 8. The Lisbon Report, cited by ADI (Science) as 'Evidence from the German High Command', specifically referred to 'PHI 17' pilotless aircraft and a 'big rocket "A4" 16m. long, 4.5m. diameter, with explosive equivalent to a British 4 ton bomb'. See also CCAC RVJO B.441, Jones to Kramish, 19 February 1985 for Jones's confirmation that the Lisbon Report did get through to him, but did not figure in the decision to bomb Peenemünde (even though the intelligence from this source commenced in April 1943) because it was from an 'unchecked source'.

wrote to Roosevelt regarding the scientific division over the practicability of the rocket, adding that he was ‘personally as yet unconvinced’ that rockets could not be made. It was the evenly-balanced and confusing evidence combined with conflicting views, both among scientists and members of the Defence Committee, that led Churchill to appoint Stafford Cripps ‘with his special knowledge and judicial mind’ to replace Sandys in reviewing the intelligence aspect of German long-range weapons.⁹⁹

Cripps unfortunately further confused the situation on 16 November by reporting both small and large long-range rockets, and that the so-called ski sites which had repeatedly cropped up in PR/PI might be rocket-launchers.¹⁰⁰ By then *Bodyline* had become ‘Crossbow’, and had been given its own Directorate within the Air Ministry (headed by Bottomley); thereafter, at an ‘enormous cost in aircraft’, bombing activity to quash the threat from long-range bombardment became immense.¹⁰¹ High-level changes also prompted JIC involvement, which was ‘at first allowed to comment of non-scientific aspects’ of the findings of the various Committees. From November 1943

⁹⁹ TNA CAB 121/211, War Cabinet Memorandum entitled ‘Bodyline’, 4 November 1943; Churchill, *Closing the Ring*, pp. 191–4. Cripps appointed his own scientific advisers, namely Thomas Merton, and the railway engineer, Sir William Stanier. Scientists and statisticians in the RE8 Oxford Extra-Mural Unit also later analysed the effects on public attitudes and local conditions from the flying bombs: see UEA SZ/OEMU/59/13 and SZ/OEMU/59/45.

¹⁰⁰ TNA CAB 121/211, ‘Extract from Second Report by the Minister of Aircraft Production’, 16 November 1943, p. 3. Cripps declared that ‘the order of probability from the purely experimental point of view’ was larger-sized Hs293 glider-bombs; pilotless aircraft; long-range rockets, smaller than A4; and rocket A4. As Campbell rightly stated: ‘the rocket was being reinvented to fit the evidence’: Campbell, *Target London*, p. 168. See also James McGovern, *Crossbow and Overcast* (London: Hutchinson, 1965), pp. 37–8.

¹⁰¹ See TNA CAB 121/211, for the Crossbow division of responsibilities and the first Chiefs of Staff Crossbow Committee report, COS (43) 760 (0), 17 December 1943; Joubert, *Rocket*, p. 104; Hinsley *et al*, *British Intelligence in the Second World War, Volume III, Part I*, p. 415; Campbell, *Target London*, p. 166. Kendall recalled that *Bodyline* changed to *Crossbow* in December 1943, and was a ‘simple security precaution’: TMC MDM622, Douglas Kendall unpublished memoirs, p. 114. Babington Smith recalled that the codename change denoted that the V1 ‘was the danger to be countered first’: Babington Smith, *Evidence in Camera*, p. 224.

therefore, intelligence work on the V-Weapons was divided between the JIC and the Air Ministry, and supervised by an *ad hoc* inter-departmental committee, represented by the JIC, the Air Ministry, the Ministry of Home Security, and the Home Defence Executive.¹⁰²

Jones saw this as the ideal opportunity to stake an official claim for scientific intelligence. Once again he was overlooked. Jack Easton, newly promoted from AI2(g) to DI(R), expected the job, but was also disappointed, for Air Commodore Claude Pelly was invited to chair the *Crossbow* intelligence attack. Jones wrote to Victor Cavendish-Bentinck, the JIC Chairman, clarifying his position hoping that common sense would prevail. He explained that it 'had been his duty since the beginning of the war to anticipate new applications of science to warfare by the enemy, and to forestall new weapons and methods'. He claimed that pilotless aircraft and long-range rockets were 'two such weapons' he had 'watched over the whole period', and that unless he had 'failed in that duty' he saw 'little case for a Committee covering much the same work'. He complained over the indicative 'lack of confidence' in his methods that may well have caused him to consider resignation (again). If no-one else thought him indispensable, he at least believed it to be so. Jones therefore informed Cavendish-Bentinck (and Inglis) that his section would 'continue its work regardless of any parallel committees which may arise', and

¹⁰² Hinsley *et al*, *British Intelligence in the Second World War, Volume III, Part I*, p. 411; Craddock, *Know Your Enemy*, p. 22; Campbell, *Target London*, p. 166. See TNA CAB 121/211, for JIC Crossbow Committee reports, JIC (43) 507 (0), 10 December 1943, JIC (43) 508 (0), 11 December 1943, JIC (43) 516 (0), 18 December 1943. Sandys by then 'feared' that 'the accumulated experience of the scientific experts might be wasted' and that it 'was for the Joint Intelligence Sub-committee to make what arrangements they considered best': TNA CAB 121/211, COS (43) 298 (0), 7 December 1943.

would 'be mindful only of the safety of the country'. In this duty, he trusted that ADI (Science) should 'not be hindered'.¹⁰³

Official exclusion persuaded Jones that time was over-ripe for ADI (Science) to produce an SIR on the subject. This report, entitled 'German Pilotless Aircraft', and circulated two days before Christmas 1943, was the fifth in the series of secure SIRs. Other than the usual Cherwell copy, all others were exclusive to the Air Ministry. It began with a general appreciation of the flying bomb, the organisation behind the trials (led by Colonel Wachtel), the so-called ski sites, and importantly the probability that the pilotless aircraft programme showed 'many signs of haste' leading to the occurrence of delays. ADI (Science) supposed that the long-range rocket had failed to mature and that decisions had been made by the Nazis to 'rush ahead with the aircraft'. They spelt out the vast quantity of intelligence, from the Oslo Report to sources both inside and out of Peenemünde, that had materialised since first mention in Britain of pilotless aircraft in late June—evidence that convincingly showed the flying bomb to be 'a more imminent threat'. They then explained, perhaps in sympathy to Cherwell, and certainly in an attempt to hijack the rocket problem, that the 'hoax hypothesis' had 'linked the rocket and aircraft

¹⁰³ TNA DEFE 40/12, Jones to Victor Cavendish-Bentinck (copy to Inglis), 15 November 1943; Jones, *Most Secret War*, p. 366; Campbell, *Target London*, pp. 169 & 182. Campbell noted that it 'was clear that the feud between career airmen, self-regarding scientists, waspish civil servants and ambitious politicians was hobbling the intelligence effort', and that 'quite a few people thought that Jones was the problem'. Campbell cited a letter from Bottomley to Inglis commenting that ADI (Science) needed watching lest they 'not be pulling their full weight', and believed that the clash of personalities would be 'quickly forgotten' if senior officers made 'generous use of Dr Jones's very high ability in his own particular line'.

so inextricably' that it was 'impossible to describe the Intelligence history of the one without constant reference to the other'.¹⁰⁴

With the exception of thinking that FZG76 was a rocket, SIR NO.V was loaded with excellent accurate and timely intelligence. Referring back as it did to the evolution of pilotless aircraft, it also highlighted that British intelligence had been taken by surprise over the rocket debacle. Much of the blame for this should be laid on the doorstep of ADI (Science). Paragraph 16.2 declared their own failing—or at the very least Air Intelligence failings in not specifically differentiating between scientific intelligence and technical intelligence. ADI (Science) believed it was 'a reasonable assumption' that Hs293 experience suggested the possibility of 'cheap pilotless aircraft for the bombardment of towns'. Although there was 'no sudden jump from the Hs293 to the 200km weapon', the 'range was improved in steps through 70 and 150'. In their own defence, they added that the 'earliest reliable fact in this development was the appearance of the first catapult at Peenemünde in the latter half of 1942'.¹⁰⁵

Whether this was a reasonable excuse is significantly open to question. AI2(g), for example, reported extensively on the rocket-powered Me-163 long before it passed from trials to operations. Their report concluded that when Me-163 eventually did become operational it would 'undoubtedly be startling', yet its 'very unconventionality' prohibited 'any reliable assessment of its

¹⁰⁴ CCAC RVJO B.89, Air Scientific Intelligence Report No.V 'German Pilotless Aircraft', 23 December 1943.

¹⁰⁵ CCAC RVJO B.89, TNA AIR 20/1667 & AIR 40/3009, Air Scientific Intelligence Report No.V 'German Pilotless Aircraft', 23 December 1943, p. 23.

fighting potentialities'.¹⁰⁶ This leads to questions as to why ADI (Science) did not watch German rocket development with the same vigour. To blame the lack of incoming intelligence regarding such developments is inadequate. Jones believed wholeheartedly in the Oslo Report, and his post-war projected belief in that particular source has led many historians to laud it as one of the greatest intelligence windfalls of all time. ADI (Science) evidently forgot about the rocket projectile data in the Oslo Report.

ADI (Science) noted that the pilotless aircraft was a problem of defence, and such intelligence problems are usually easier to solve than their offensive counterparts. With the pilotless aircraft, technical problems could only be solved by the admirable work of many secret sources.¹⁰⁷ But there was much more to this intelligence problem than technical specifics and source availability. That ADI (Science) had so closely examined DT and the GAF night defence organisation from mid-1941 led them to almost entirely neglect Germany's offensive development possibilities.¹⁰⁸ It is ironic that Jones retrospectively remarked that after SIR No.V there 'was almost nothing to do' on the pilotless aircraft 'except perhaps on the engine'. All ADI (Science) could do, was report pilotless aircraft activity mentioned by intelligence sources, as it was Pelly's task 'to do anything further'.¹⁰⁹ ADI (Science) were simply expected to provide the JIC *Crossbow* Committee with 'raw

¹⁰⁶ TNA AIR 40/2166, AI2(g) Report on the Me163, dated 20 April 1944; reprinted in full in Hinsley *et al*, *British Intelligence in the Second World War, Volume III, Part I*, pp. 579–84.

¹⁰⁷ CCAC RVJO B.89, TNA AIR 20/1667 & AIR 40/3009, Air Scientific Intelligence Report No.V 'German Pilotless Aircraft', 23 December 1943, p. 25.

¹⁰⁸ Jones confirmed that most of his personal effort was on the GAF night defences, while Frank 'continued to do much' of ADI (Science)'s 'more general reading'. It was Frank's reading of the von Thoma interrogation transcripts that eventually led to them taking the 'rockets seriously': Jones, 'The Peenemünde Mystery', 1054.

¹⁰⁹ CCAC RVJO B.343, 'Verbatim note on interview with Professor R. V. Jones', p. 4.

information' so that it could be assessed into intelligence appreciations by Pelly—a man who had 'no previous experience of Intelligence'.¹¹⁰ To make matters worse for Jones, Pelly sought ULTRA clearance. In a Christmas Eve letter to Inglis, Jones further objected to 'intelligence by committee', and complained that his section regarded 'itself as holding a post of honour in the front line' of Britain's defences, and would 'only surrender' that position upon evidence that another organisation could do better. Three days later, Jones asked Inglis for 'his permission to resign'.¹¹¹ Inglis refused.

During January-March 1944 Inglis circulated seven reports to the Chiefs of Staff detailing all known intelligence on V-Weapon sites in France.¹¹² The bulk of this intelligence derived from ADI (Science), although not all. By this time, for example, Jempson would have been circulating his reports on sightings from the Belgian 'Luc' network, and especially from the Service Clarence network regarding both rockets and jet aircraft.¹¹³ Wizernes (an underground rocket depot) had already been selected as a bombing target by the Chiefs of Staff but, as it was still under construction, Inglis advised that they 'wait until it

¹¹⁰ Jones, *Most Secret War*, p. 365; Campbell, *Target London*, p. 170.

¹¹¹ TNA DEFE 40/12, Pelly to Inglis, 23 December 1943; Jones to Inglis, 24 December 1943; Jones to Inglis, 27 December 1943; Campbell, *Target London*, p. 203. An enlightening letter from Brigadier Ian Jacob to Churchill advances knowledge on the perception of Jones at this time. Jacob understood that 'part of the difficulty' was Jones's personality. Jacob viewed Jones as 'a very clever and capable man', but one who liked 'working on his own'. Jones had 'all along disliked the Crossbow Committee', and his 'mode of procedure' had been to 'disagree with all they do and to brief Lord Cherwell privately in the opposite sense'. Jacob saw these difficulties being overcome, however, for it was his understanding that Jones was to be 'handling the intelligence side' of Crossbow 'in the Air Ministry': TNA CAB 120/749 8775, Brigadier Ian Jacob to Churchill, 2 January 1944; Campbell, *Target London*, pp. 203–4. Campbell wrote that this meant that 'Jones had kept the keys to the Ultra castle'.

¹¹² Specifically located at Watten, Mimoyecques, Wizernes, Lottingham, Siracourt near Calais, and Martinvast and Sottevast in the Cherbourg peninsula: TNA CAB 121/212, various reports from Inglis to Chiefs of Staff – COS (44) 59(0) dated 22 January 1944; COS (44) 94(0) dated 28 January 1944; COS (44) 130(0) dated 5 February 1944; COS (44) 173(0) dated 19 February 1944; COS (44) 219 (0) dated 4 March 1944; COS (44) 266(0) dated 18 March; and COS (44) 308(0) dated 31 March 1944; Hinsley *et al*, *British Intelligence in the Second World War, Volume III, Part I*, pp. 593–6.

¹¹³ Jeffery, *MI6*, pp. 521–2.

was more damageable'.¹¹⁴ The site that attracted the greatest attention, however, was Mimoyecques. This had been bombed during the previous November and ground agents had revealed thereafter that tunnels were connected to shafts for launching large rockets.¹¹⁵ Further Allied bombing was carried out in July 1944 by RAF 617 Squadron using the penetrating 'Tallboy' 12,000lb bombs. Mimoyecques also received bombing attention in the ill-fated Operation *Aphrodite* missions, which used obsolete bombers loaded with high explosives and directed to targets by remote control, after the two-men crew had parachuted out.¹¹⁶ Although it was not known by the Allies at the time, the site being bombed comprised the missile projector known as the V3.¹¹⁷

Once again another German weapon had been researched and developed without any detailed appreciation by British scientific intelligence; not at least until Allied forces captured the V3 site at Mimoyecques.¹¹⁸ Activity in and around the site had been monitored by PRU and Medmenham during the ski site hunt. False haystacks had also been discovered through stereoscopes.¹¹⁹ Railway tracks that disappeared into hillside tunnels had been photographed, and shafts appeared to be sunk from the hilltop to meet the tunnels.¹²⁰ None of this intelligence, however, indicated the sinister underground explosively-

¹¹⁴ TNA CAB 121/212, Inglis to Chiefs of Staff, COS (44) 130(0) dated 5 February 1944; Hinsley *et al*, *British Intelligence in the Second World War, Volume III, Part I*, pp. 385, 436 & 595.

¹¹⁵ TNA CAB 121/212, Inglis to Chiefs of Staff COS (44) 308(0) dated 31 March 1944; Hinsley *et al*, *British Intelligence in the Second World War, Volume III, Part I*, p. 595.

¹¹⁶ Campbell, *Target London*, p. 324. Joseph Kennedy, brother of the future President of the USA, was killed in one of these missions on 12 August 1944 when his US Navy aircraft exploded prematurely.

¹¹⁷ For the technical specifics of the *Hochdruckpumpe* (also known as *Fleißiges Leischen* and *Tausendfüßler*), see Hogg, *German Secret Weapons of the Second World War*, p. 45–7; Brian Ford, *German Secret Weapons*, p. 136–42; Max Gadney, 'V-3: The Vengeance Weapon', *World War II*, June/July 2008, 68–9.

¹¹⁸ Jones, *Most Secret War*, p. 462.

¹¹⁹ Hogg, *German Secret Weapons of the Second World War*, p. 48.

¹²⁰ TNA CAB 121/212, Inglis to Chiefs of Staff – COS (44) 59(0) dated 22 January 1944; Hinsley *et al*, *British Intelligence in the Second World War, Volume III, Part I*, p. 593.

charged firing chambers directly targeting London. Jones wrote that some sources had reported that the Mimoyecques site was comprised of a long-range gun; yet in defence of his team, Jones held that "ski sites were also sometimes described in the same way" and so such evidence 'was inconclusive'.¹²¹ In defence of ADI (Science), they were not the only intelligence organisation to misinterpret the good PR/PI of Mimoyecques.¹²² Jones raised the issue of ADI (Science)'s 'limited effort' being concentrated 'on the most urgent problems'.¹²³ Minimal staffing of his organisation suited Jones as and when it was appropriate, and whenever there were murmurs of scientific intelligence failure, it was his trump card. There was more than a murmur of intelligence failure over the V3.

Long after Mimoyecques had been overrun in August 1944, ADI (Science) produced two reports on the V3 *Hochdruckpumpe* (HDP). The first, dated April 1945, declared that the 'failure of intelligence about the Mimoyecques weapon' had 'hitherto been rather mysterious'. ADI (Science) referred to the fact that agents and PR/PI had detected the site, but had not proved the case of a long-range gun. In a rare demonstration of introspection, this report was produced by ADI (Science) to discover why so few clues to the exact nature of HDP had materialised. Usually, they stated, when 'a serious weapon' approached the operational stage, 'so many people have to know about it that the penetration of its security' became 'impossible'. ADI (Science) referred

¹²¹ Jones, *Most Secret War*, p. 463.

¹²² Hinsley *et al*, *British Intelligence in the Second World War, Volume III, Part I*, pp. 405, 436 & 594. At the end of January 1944, Sandys even proposed an SOE special operation to capture a German technician as a means of acquiring information about the large sites. This was approved on 8 February. An SOE operative was briefed and began his search on 19 March. The mission was a failure.

¹²³ Jones, *Most Secret War*, p. 463.

specifically to the 'flying bomb and A4 rocket' as 'sufficient examples', and yet the HDP 'parallel in time' failed 'to give comparable penetration'.¹²⁴

ADI (Science) applied captured documents previously belonging to Professor Osenberg (seized with documents near Gottingen) as the answer to this conundrum. These documents spoke of HDP trials at Misdroy, near Swinemünde, and alluded to it being 'a most unsatisfactory weapon, a 'complete failure', and a deplorable 'waste of work'. ADI (Science) concluded their report by announcing that because HDP did not approach experimental success, it could 'never have been a threat to London'. They added that had it reached the operational stage then 'opportunities for penetration would have been greater', and the 'normal techniques' of intelligence would have 'provided some clue'. Somewhat flippantly, ADI (Science) summarised that although there 'was little warning, there was little danger'.¹²⁵

Osenberg's captured documents led to photographic cover of Misdroy to see if any trial equipment existed at that location. And indeed, trials were continued by German technicians and forced labour in attempts to refine the V3. It has even been rumoured that two short-barrel versions of the HDP were made operational to support the German Ardennes offensive of 1944, although as no post-war reports referred to any kind of mysterious shells these rumours are difficult to believe.¹²⁶ ADI (Science) confirmed that at the

¹²⁴ CCAC RVJO B.105 & TNA AIR 20/1695, Interim Report 'Mimoyecques: HDP', 26 April 1945; Jones, *Most Secret War*, p. 463. Such introspection on scientific intelligence failures, as shown in this report, would have been welcome in *Most Secret War*.

¹²⁵ CCAC RVJO B.105 & TNA AIR 20/1695, Interim Report 'Mimoyecques: HDP', 26 April 1945; Jones, *Most Secret War*, p. 463.

¹²⁶ Hogg, *German Secret Weapons of the Second World War*, p. 49.

time, however, there was 'a little evidence that some form of shorter-range HDP was operated for a short time and on a small scale against Continental targets about the time of the Ardennes offensive'.¹²⁷ Two shorter-range HDPs were found at the Hillersleben Proving Ground (near Berlin) upon its capture in winter 1944.¹²⁸ This was yet another German secret weapon research and development establishment that ADI (Science) knew nothing about.

Perhaps to further excuse the intelligence failure over HDP, ADI (Science) distributed a letter from Osenberg to Martin Bormann informing him of the 'misapplication of German scientific talent in general', and 'complete waste of effort' on another reprisal weapon. This document confirms that HDP was technically the second reprisal weapon behind A4, but that despite the efforts of a minimum of 5000 workers the gun was a failure due to ineffective construction of the barrels which caused the projectiles to topple.¹²⁹ This persuaded ADI (Science) to reiterate in their accompanying Minute that 'Mimoyecques at no time constituted a serious threat to London'. The reality was however, that an earlier operational HDP could have been very dangerous indeed. After investigation of the captured HDP at Misdroy, the Sanders Report of February 1945 estimated the planned rate of fire of the

¹²⁷ CCAC RVJO B.105, ADI (Science) Minute 'A Sidelight on Mimoyecques', 11 May 1945.

¹²⁸ Gadney, 'V-3: The Vengeance Weapon', 68; Hogg, *German Secret Weapons of the Second World War*, p. 50.

¹²⁹ CCAC RVJO B.105, 'Translation of Letter from Professor Osenberg to Hitler's Deputy', 8 May 1944, circulated by ADI (Science) on 11 May 1945. This intelligence later featured in an SIR following Tizard's request for the state of knowledge on German organisation of science: CCAC RVJO B.108 & TNA AIR 8/831, Air Scientific Intelligence Report No.32 'The War Organization of German Science', 29 March 1945, pp. 1–3. Intelligence derived from the Japanese Attaché in Berlin, also inspired an SIR on Axis exchange of science and technology: CCAC RVJO B.107 & TNA AIR 8/831, Air Scientific Intelligence Report No.131 'Air Technical Liaison between Germany and Japan', 16 October 1944.

long-range gun at ten rounds per minute (600 per hour).¹³⁰ Fortunately for the Allies, by the time HDP materialised in pre-operational form, it was, like the other V-Weapons, far too late to make a significant difference.

The first flying bomb landed in the early hours of the morning of 13 June 1944, destroying a railway bridge in Bethnal Green killing six people.¹³¹ This was one of ten launched that night, only four of which reached Britain. This prompted Cherwell that day to utter his now famous words in reference to the insignificance of the German effort: 'The Mountain hath groaned and given forth a mouse!' to which Jones replied that in his opinion the limited damage caused had 'been an organisational hiccup' on the part of Wachtel's regiment. Jones also recalled with amusement how he had been accurate in predicting the arrival of the flying bomb.¹³² Inglis in contrast was far from amused. In early July he wrote to Bottomley concerned that the other service ministries had been somewhat critical over the Air Intelligence handling of *Crossbow*. Although Inglis believed that the failure to predict the arrival of the flying bomb was 'perhaps inevitable', he stated that it was 'a fact that the organisation within Intelligence to meet this menace' had 'been inadequate'.¹³³

A key event in the V-Weapons campaign momentarily altered everything for ADI (Science). On the morning of 18 June 1944 a pilotless aircraft skimmed the rooftops of Queen Anne's Mansions, and exploded on the nearby Guard's

¹³⁰ 'Investigation of the 'Heavy Crossbow' Installations in Northern France', 21 February 1945. See also the United States Strategic Bombing Survey reproduced at 'V-Weapons (Crossbow) Campaign' at www.allworldwars.com, accessed 10 March 2012.

¹³¹ CCAC RVJO k.477, transcript for 'Terror Weapons', p. 1.

¹³² Jones, *Most Secret War*, p. 417–8.

¹³³ TNA AIR 20/2632, Inglis to Bottomley, 3 July 1944; Campbell, *Target London*, pp. 288–9.

Chapel. Although one SIS agent recalled the plaster ceiling collapsing, Broadway was spared and ADI (Science) had a narrow escape.¹³⁴ Jones believed, however, that this explosion so close to Whitehall prompted significant changes. As a direct consequence, Churchill called the *Crossbow* Committee together to make new Air Staff arrangements. Burdens on Air Ministry operational staff (due to overwhelming intelligence co-ordination and countermeasures) led ACAS(I) to instruct ADI (Science) to be officially involved in analysing V-Weapons intelligence.¹³⁵ Mapplebeck acted as Jones's 'deputy in CROSSBOW matters', and at the same time continued to head the recently-created AI2(h), which had spawned from AI1(h).¹³⁶ It was hoped that this re-organisation would improve co-ordination between AI3(e) and 3G(N), with ADI (Science) expected to 'bring this about'.¹³⁷

After the war, 3G(N) admitted that, due to the formation of AI1(h) and later AI2(h), their service 'deteriorated'. They stated that both the AI3 and AI(h) sections failed to acknowledge 3G(N)'s 'right or obligation to make interpretations', and 'belonged on the whole to the opposite political camp' from ADI (Science), the latter to whom 3G(N) were 'bound' by 'old allegiance' and 'loyal co-operation'.¹³⁸ This is a rare insight into friction at the heart of Hut 3, and it is evident that Jones was in the thick of it. When AI3(e) reported a

¹³⁴ Cecil, 'C's War', 181; Cecil stated erroneously that it was a rocket. See also Jones, *Most Secret War*, p. 425.

¹³⁵ TNA AIR 40/2452 & TNA DEFE 40/12, Minutes of Air Ministry meeting, 6 July 1944; Hinsley *et al*, *British Intelligence in the Second World War, Volume III, Part I*, p. 444.

¹³⁶ TNA AIR 40/2452 & TNA DEFE 40/12, Minutes of Air Ministry meeting, 6 July 1944, p. 6; Campbell, *Target London*, p. 291.

¹³⁷ TNA AIR 40/2452 & TNA DEFE 40/12, Minutes of Air Ministry meeting, 6 July 1944, pp. 2 & 4. It was this re-organisation that brought Robertson into ADI (Science), to 'contribute his knowledge and experience and at the same time General Spaatz would feel that he had a representative who would know intimately the scope and extent' of the intelligence material'.

¹³⁸ TNA HW 43/69, 'Report on the work of 3G(N)', 1 August 1945, pp. 13 & 24; Campbell, *Target London*, p. 402.

week later on the 'German Flying Bomb Organisation' it starkly demonstrated how dispersed the intelligence attack had become as a result.¹³⁹ Jones recalled that, although it 'was very late in the day', he had at last 'a chance' to co-ordinate British intelligence efforts.¹⁴⁰ Now at last he could participate in the politics of *Crossbow*, and instil some continuity with ADI (Science) at the centre. The only downside for Jones was that Sandys was specifically requested by Churchill to chair the reorganised *Crossbow* Committee.¹⁴¹

Nine of the ADI (Science) reports on German unconventional projectile development were produced specifically for, or on behalf of, the *Crossbow* Committee. This was during the limited time that Jones led the intelligence attack on German rockets and pilotless aircraft—a responsibility he later defined as 'carrying the can for co-ordinating the Intelligence'.¹⁴² The first of these reports, circulated on 16 July 1944, was predominantly regarding the long-range rocket, although Jones introduced the report by declaring that the 'Flying Bomb' had 'temporarily eclipsed its Army rival'. This was not new intelligence, for V1s had been raining down on London for over a month. ADI (Science) were nonetheless able to announce the development of the 'technically impressive missile' the Germans called 'A4'; performance of which

¹³⁹ TNA AIR 40/2882, AI3(e) report 'German Flying Bomb Organisation', 13 July 1944; Campbell, *Target London*, p. 301.

¹⁴⁰ Jones, *Most Secret War*, p. 425. Jones stated that because of the V1 attack on St James's Park Guard's Chapel, Churchill 'formed' the *Crossbow* Committee. His memory failed him in the regard, for documentation clearly confirms that the JIC and COS *Crossbow* Committees were formed on 23 November 1943 as described above. Or perhaps for Jones the *Crossbow* Committee did not exist until he and his team were officially involved.

¹⁴¹ Churchill instructed a War Cabinet *Crossbow* Committee as part of this reorganisation. It was to meet daily, and he intended to chair it himself but, on 20 June, he relinquished the chairmanship to Sandys: Hinsley *et al*, *British Intelligence in the Second World War, Volume III, Part I*, p. 440. Nevertheless, the initial decision prompted urgency. GC&CS, for example, issued a directive on 17 June stating that anything of importance regarding *Crossbow* 'should be passed to Hut 3 for teleprinting to Broadway for Dr Jones, and to the Air Ministry for Crossbow Watch': TNA HW 14/106; Campbell, *Target London*, p. 262.

¹⁴² CCAC RVJO B.343, 'Verbatim note on interview with Professor R. V. Jones', p. 5.

was 'good enough at least for a desultory bombardment of London'. ADI (Science) confirmed that the elusive rocket was six feet in diameter, and forty feet long with two stabilising tail fins. Importantly they wrongly concluded that the rocket's main fuel was 'based upon hydrogen peroxide' burnt in a multiple jet unit akin to those used in Hs293 glider bombs.¹⁴³

From July 1944, as the Allied Expeditionary Force invaded deeper into German occupied France, evidence of V-Weapon activity accumulated. This created the opportunity for better understanding of the scientific and technological issues involved. Jones wrote in his memoirs that the time had come for Cherwell to cease denial of the rocket's existence lest he 'look very silly'. But the amassing of equipment and data also encouraged the 'experts' to further complicate the situation by opening up 'all kinds of false trails'. It was for these reasons that Inglis instructed ADI (Science) to produce a report on the state of knowledge on the German long-range rocket.¹⁴⁴ Because his organisation was not yet ready to bark, Jones was unhappy about the timing of such an order. He later complained that he wrote the report 'under the strongest possible protest' and, when asked why he did so anyway, claimed that it was because the pilotless aircraft bombardment had caused 'panic' in people who did not have 'enough guts to keep their heads'. Moreover, the

¹⁴³ CCAC RVJO B.92, TNA AIR 20/1711 & TNA CAB 121/213, War Cabinet "Crossbow" Committee Report (CBC (44) 24) on the 'Long Range Rocket', 16 July 1944 written by ADI (Science), p. 1; Jones, *Most Secret War*, pp. 370–2. Jones wrote in his memoirs that this was the 'biggest mistake' of his estimates, but one that was 'of no consequence'.

¹⁴⁴ TNA CAB 121/213, *Crossbow* Committee Minutes of 6th meeting, 14 July 1944; Jones, *Most Secret War*, pp. 433–4; Hinsley *et al*, *British Intelligence in the Second World War, Volume III, Part I*, pp. 446–7; Campbell, *Target London*, p. 305.

War Office was 'beginning to grumble' that Air Intelligence was 'overlooking the rocket' and so Inglis 'got extremely worried'.¹⁴⁵

ADI (Science) produced only five further 'Weekly Summaries' (plus three additional reports) on behalf of the *Crossbow* Committee.¹⁴⁶ In July they reported that a Polish agent had arrived in England with specimens of long-range rocket equipment recovered from tests in Blizna. He also provided drawings and descriptions compiled by Polish Intelligence. ADI (Science) reported that Blizna experimental station had been closed owing to the Russian advance, and so they expected no further evidence from Polish sources.¹⁴⁷ Only two weeks earlier, and for the purposes of 'effectiveness' of 'countermeasures', Churchill had sent a personal request to Stalin that he 'give appropriate instructions for the preservation' of rocket 'apparatus and installations at Debrice'.¹⁴⁸ ADI (Science) also provided the Committee with three crucial items of intelligence: the weight of the rocket was lighter than hitherto considered by 'experts'; German production was potentially in excess of '1000 rockets' (based on transportation data provided by the Polish agent); and that 'V2 "the Army's new Torpedo"' would begin to be used 'within two or three months' time'.¹⁴⁹ The following day ADI (Science) reported cloudy

¹⁴⁵ CCAC RVJO B.343, 'Verbatim note on interview with Professor R. V. Jones', p. 4.

¹⁴⁶ These reports had a very select circulation: Cripps, Portal, Bottomley, Inglis, Cherwell and C.

¹⁴⁷ CCAC RVJO B.93, 'Crossbow Intelligence, First Weekly Summary', 30 July 1944. This Polish intelligence is probably that in TNA DEFE 40/18, 'Collection of Rumours and Miscellaneous Information on Rockets'. ADI (Science) applied the title to the report of the 'First' Crossbow Weekly Summary, implying that all before was erroneous.

¹⁴⁸ CCAC CHAR 20/168/44, Churchill to Marshal Stalin, 13 July 1944.

¹⁴⁹ CCAC RVJO B.93, 'Crossbow Intelligence, First Weekly Summary', 30 July 1944. The weight of the rocket had been a primary component of Cherwell's stance that the rocket was a hoax.

evidence, based on radar tracks commencing in Belgium, that ‘flying bombs’ were connected with III/KG3 and thus were being launched from He111s.¹⁵⁰

ADI (Science) were not, however, the first Air Intelligence organisation to warn of III/KG3’s involvement in pilotless aircraft operations. In July 1944, AI3(b), which had closely monitored III/KG3 since before they had been renamed I/NJG7, had analysed ULTRA intelligence (Pearl/Zip/Klavier No.17) and deduced that III/KG3 was connected with the V1 (and possibly the V2) in one of three functions: raid tracking, radio-control, or transport of vital spares. AI3(b) invited DDI4 to comment and help simplify these suggestions.¹⁵¹ ADI (Science) were not on the distribution list for this intelligence. Nor were they party to AI3(b)’s late-July report that inferred intelligence of flying bombs being launched from He111s.¹⁵² Only when a fully detailed report was released by DI(O) in August were ADI (Science) included in distribution, along with forty-five other organisations and individuals.¹⁵³ Even though ADI (Science) were leading the *Crossbow* intelligence attack, they were not party to all Air Intelligence. Little wonder then that they reported the intelligence as ‘cloudy’.

¹⁵⁰ CCAC RVJO B.93, ‘Flying Bombs launched from aircraft’, 1 August 1944.

¹⁵¹ TNA AIR 40/2656, AI3(b) Report ‘Notes on III/K.G.3’, 25 July 1944.

¹⁵² TNA AIR 40/2656, AI3(b) Report ‘Flying Bombs from Dutch-Belgium area’, 31 July 1944.

¹⁵³ This report suggested eight airfields from which ‘flying bomb-carrying He111s’ could operate, and confirmed widespread incidents in Kent, Essex, Norfolk, and London where pilotless aircraft had struck with no warning and with great accuracy. AI3(b) claimed that ten percent of the ‘flying bomb effort’ was ‘launched by He111s’, and led to the supposition that this method of attack was the natural evolution to the ski sites being over-run by Anglo-American advances across Northern France: TNA AIR 40/2656, DI(O) Report ‘Flying Bombs from Dutch-Belgium area’, 5 August 1944. For more on air-launched flying bombs, see Peter J. C. Smith, *Flying Bombs over the Pennines: The story of the V-1 attack aimed at Manchester December 24th 1944* (Manchester: Neil Richardson, 1988); Ron Freethy, *Lancashire 1939-1945: The Secret War*, (Newbury: Countryside Books, 2005), pp. 20–1. Both accounts narrate the history of Operation *Martha*, the Christmas Eve attack on towns in Lancashire by scores of V1s fired from He-111s over Hull. See also Collier, *Battle of the V-Weapons*, p. 101; Hinsley *et al*, *British Intelligence in the Second World War, Volume III, Part II*, pp. 545–6; Campbell, *Target London*, p. 414.

The second 'Weekly summary' produced by ADI (Science) for the *Crossbow* Committee followed up the 'cloudy' intelligence of 'pickaback missiles', by relaying that ULTRA alluded to shipment of 'FZG' to Norway. As the only FZG scientific intelligence were aware of was the FZG76 (Flying Bomb), they deduced that 'a few may be launched against North Britain'.¹⁵⁴ The Third Weekly *Crossbow* Summary was entirely regarding inorganic fuels.¹⁵⁵ This intelligence derived from GC&CS breaking a little used *Wehrmacht* Enigma key ('Corncrake'), decrypts from which proved to be signals between Peenemünde and Blizna.¹⁵⁶ The contents of Corncrake 'created an intelligence sensation in Hut 3', and was described as the 'army equivalent of Brown III' (used by GASER).¹⁵⁷ ADI (Science) remarked that this intelligence revealed the Germans to be 'far ahead' of the British 'in the development of simple organic fuels'. Lack of scientific experience in these matters crucially meant that scientific intelligence proceeded 'briefless to find one surprise after another', although receipt of intelligence on German research and development did of course suggest mimicry.¹⁵⁸ By this time RAE had reconstructed the components recovered from a wayward rocket that landed in Sweden. ADI (Science)'s fourth *Crossbow* Weekly Summary therefore confirmed the rocket's weight as approximately 13–14 tons, and the warhead

¹⁵⁴ TNA AIR 40/2656, DDI4 to Vintras, 12 December 1944 discussing SHAEF 'V' Section to AII(h) Air Ministry, 2 December 1944, Annex No.1 'Subjects for Further Investigation'.

¹⁵⁵ CCAC RVJO B.96 & TNA AIR 20/1711, 'Crossbow Third Weekly summary', 13 August 1944.

¹⁵⁶ Hinsley *et al*, *British Intelligence in the Second World War, Volume III, Part I*, p. 443.

¹⁵⁷ TNA HW 43/71, 'The History of Hut 6: Volume II'; Campbell, *Target London*, pp. 231 & 417. Later attempts to break another Enigma strain related to the V2, known as 'Ibis', proved much more difficult than Corncrake. Ibis was broken in January 1945, but not in time to be significantly useful.

¹⁵⁸ CCAC RVJO B.96 & TNA AIR 20/1711, 'Crossbow Third Weekly summary', 13 August 1944.

comprising 1200–1500lbs of explosive. The reconstruction also suggested the use of four different fuels rather than five as previously thought.¹⁵⁹

One intelligence coup that ADI (Science) deserve credit for was the deception of V-1 firing distances and drop locations. This again involved Cholmondeley of MI5's B1A, who had approached ADI (Science) because Germany was requesting V1 explosion information from their supposed London agents. In order to diminish the actual damage caused to London, it was Jones so he claimed in his memoirs, who suggested that the agents should deceive their masters. Jones thought that if the agents provided accurate locations of V1 explosions (such data would be corroborated by German PR), yet submitted the incorrect timings of the V1 explosions, then German authorities would be deceived into thinking that their ranging was either too long or short. Despite a War Cabinet ruling that 'Providence' should not be interfered with, the plan went ahead.¹⁶⁰ These actions perhaps later deceived V-1 authors over pilotless aircraft accuracy.¹⁶¹ Nonetheless, it was another example of ingenuity in the thrust-and-parry of scientific and technical warfare carried out by British intelligence. Perhaps Jones was not wrong to claim the idea,

¹⁵⁹ CCAC RVJO B.96 & TNA AIR 20/1711, 'Crossbow fourth Weekly summary', 20 August 1944. Also preserved in the Jones Papers is a report on the 'Nature of T-Stoff'. It is undated, anonymous, and does not contain familiar ADI (Science) report characteristics; although this does not rule out the possibility that it might have been a scientific intelligence production. This report referred specifically to the 'first Most Secret indication' of the existence of T-Stoff, and confirmed the subsequent discovery that T-Stoff was 'the driving component fuel of the Hs293 rocket unit': CCAC RVJO B.102, 'Most Secret Evidence Concerning the Nature of T-Stoff', no date. In all likelihood Jones did write this T-Stoff report, for in *Most Secret War* he was full of self-congratulation for 'spotting a clue that nobody else had seen': Jones, *Most Secret War*, p. 371. This 'clue' was the specific connection of T-Stoff being used by both Hs293 and V1.

¹⁶⁰ CCAC RVJO B.341, 'Note on interview with Prof. R.V. Jones', p. 15; Jones, *Most Secret War*, pp. 420–2; Montagu, *Beyond Top Secret U*, p. 159. Montagu called the War Cabinet veto (in Churchill's absence) a decision 'based on the cowardly principle that no one was entitled to decide that A should die rather than B'.

¹⁶¹ Stanley, *V-Weapons Hunt*, p. 242.

although many more people and organisations were involved in the V-Weapon deception than Jones relayed.¹⁶²

During the summer of 1944, ULTRA had been very quiet on the rocket. Connected snippets of intelligence however, had led Jones to believe that 1000 rockets had been manufactured. Decrypts referred to works numbers of apparatus delivered to Peenemünde from Blizna in Poland.¹⁶³ Jones applied the same methodology that had been successful with *Würzburg* in 1942, and calculated rocket stockpile probabilities based on the serial numbers within the decrypts.¹⁶⁴ According to *Most Secret War*, he then re-scrutinised aerial photography of Blizna that he had requested in May when that particular location had first appeared in Polish source intelligence, and found a rocket that had been overlooked by Medmenham. For Jones this ‘immediately transformed the Intelligence situation’.¹⁶⁵ He openly mocked the PIs then and long after for their supposed failure to spot the Blizna rocket that led him to produce a ‘Most Embarrassing report entitled ‘The Lemon Squeezer’.¹⁶⁶

¹⁶² Montagu, *Beyond Top Secret U*, pp. 38 & 157–61; Masterman, *The Double Cross System*, pp. 173–8 & 182–8; Hinsley and Simkins, *British Intelligence in the Second World War, Volume IV*, pp. 235–74, 344–5; Howard, *British Intelligence in the Second World War, Volume V: Strategic Deception*, pp. 167–83, 190, & 235–41; Keegan, *Intelligence in War*, pp. 332–4; Campbell, *Target London*, p. 396. See also Eddie Chapman, *The Real Eddie Chapman Story* (London: Tandem, 1966); Ben Macintyre, *Agent Zigzag, The True Wartime Story of Eddie Chapman: Lover, Betrayer, Hero, Spy* (London: Bloomsbury, 2007); Nicholas Booth, *ZigZag: The Incredible Wartime Exploits of Double Agent Eddie Chapman* (New York: Arcade Publishing, 2007).

¹⁶³ CCAC RVJO B.97 TNA AIR 20/1688, Interim Report ‘A 4’, 26 August 1944, pp. 27–8; CCAC RVJO B.341, ‘Note on interview with Prof. R.V. Jones’, p. 7; Jones, *Most Secret War*, p. 435; Hinsley *et al*, *British Intelligence in the Second World War, Volume III, Part II*, p. 551.

¹⁶⁴ CCAC RVJO B.341, ‘Note on interview with Prof. R.V. Jones’, p. 8.

¹⁶⁵ Jones, *Most Secret War*, pp. 430–1 & 436.

¹⁶⁶ CCAC RVJO B.95, ‘Air Scientific Intelligence Tentative Report on the Nature of Lemon Squeezers’, 10 August 1944; CCAC RVJO B.341, ‘Note on interview with Prof. R.V. Jones’, p. 5; Jones, *Most Secret War*, p. 452. There was at least one other ‘Most Embarrassing Report’ produced by ADI (Science), this following festive season mockery of Margaret Masterman: CCAC RVJO B.125, draft letter to DD14 from ADI (Science), 3 March 1945.

It was with this fresh intelligence that Jones arrived prepared for the *Crossbow* Committee meeting of 18 July 1944, during which he stated that 'there might well be a thousand rockets already in existence'.¹⁶⁷ This led Churchill to declare that British intelligence 'had been caught napping'. Jones replied that if this was so, then it was Churchill's fault for issuing a directive before D-Day that offense should take priority, and that in the field of scientific intelligence this 'meant concentrating on knocking out the German radar'.¹⁶⁸ Official historians convincingly demonstrated that ADI (Science) had been at fault for 'not sufficiently' stressing 'the significance' of 'valuable' POW evidence that the rockets were fired from concrete platforms, and that Jones's claims to the *Crossbow* Committee that 'he had identified a concrete platform' on the Blizna photographs the previous day, 'produced consternation'. A week later, despite Cherwell's protestations, the responsibility for distributing *Crossbow* intelligence was removed from ADI (Science), on the grounds that they 'had shown a disinclination to circulate and discuss intelligence'.¹⁶⁹ He was replaced by Easton, perceived to have done well over the Swedish

¹⁶⁷ TNA CAB 121/213, Minutes of Crossbow Committee Meeting, 18 July 1944; Churchill, *Triumph and Tragedy*, p. 56; Jones, *Most Secret War*, pp. 437–9; Hinsley *et al*, *British Intelligence in the Second World War, Volume III, Part I*, pp. 448–9; Campbell, *Target London*, p. 317.

¹⁶⁸ Jones, *Most Secret War*, pp. 438–9. Jones did however add that his 'own memory could have exaggerated the drama of the encounter'. The words 'caught napping' actually derived from Cherwell in a note he wrote to Churchill expressing his thoughts on the suspected rocket threat, and his keenness for Jones to head the intelligence attack. He wrote: 'Jones, who you may remember is in charge of air intelligence, has been following these developments closely and I do not think there is any great risk of our being caught napping': UONC CHER G.410/7–8, Cherwell to Churchill, 11 June 1943; Campbell, *Target London*, p. 80.

¹⁶⁹ Hinsley *et al*, *British Intelligence in the Second World War, Volume III, Part I*, pp. 449–50 & 455. Even though the responsibility of heading *Crossbow* had been removed from Jones, and despite recalling that he had 'retired from the fray', he remained a member of the inter-departmental committee: CCAC RVJO B.341, 'Note on interview with Prof. R.V. Jones', p. 16. The Fifth Weekly *Crossbow* Report presented by ADI (Science) comprised of their A4 interim report; Jones adding only that there had 'been little fresh information' that week, which had allowed the 'opportunity' to complete the masterpiece: CCAC RVJO B.99 & TNA AIR 20/1711, 'Crossbow Fifth Weekly Report', 27 August 1944. The Sixth Weekly Report, distributed two weeks later, summarised intelligence from Dutch agents of two rocket projectiles being fired from The Hague on 8 September. One of these was the first rocket to land in Britain, specifically in Chiswick, the other landed in Epping shortly after. Additional evidence confirmed that firing points altered daily: CCAC RVJO B.99 & TNA AIR 20/1711, 'Crossbow Sixth Weekly Report', 12 September 1944.

rocket.¹⁷⁰ Jones complained to Portal, but the decision stood.¹⁷¹ Jones managed to keep the job he had long coveted for only twenty days!

Evidently this, coupled with Churchill's stricture that scientific intelligence 'had slept', hurt Jones, for his delayed and considered reply was in the form of the largest (and least effective) scientific intelligence interim report produced throughout the war.¹⁷² To fully confirm that ADI (Science) had not been caught napping, Jones attached as Appendices to the 'A4' Interim Report, the previous connected reports from June and September 1943.¹⁷³ It seems however, that Churchill did not see this report at the time and so its primary intent was futile.¹⁷⁴ Nevertheless, it constituted impressive intelligence assessment in which there were no polite or sentimental restrictions. In Appendix D, for example, which detailed the intelligence regarding the weight of the rocket, the opening line stated that 'the earlier approach to the weight problem was wrong', and full of 'misconceptions', for which there 'was no Intelligence basis', that 'biased many subsequent estimates'.¹⁷⁵

¹⁷⁰ Jones, *Most Secret War*, p. 443; Campbell, *Target London*, pp. 341–2. Campbell stated, perhaps in exaggeration, that Jones 'was sacked' but 'still had his small staff'.

¹⁷¹ TNA AIR 40/2452 & TNA DEFE 40/12, Jones to Portal, 26 July 1944; Jones, *Most Secret War*, pp. 442–3; Hinsley *et al*, *British Intelligence in the Second World War, Volume III, Part I*, p. 455; Collier, *Battle of the V-Weapons*, p. 105; Campbell, *Target London*, pp. 341–2. Jones wrote in his letter to Portal that if it was substantiated that he was 'not working in the best way', then he would 'readily resign'. In his memoirs he recalled that Easton becoming responsible for *Crossbow* 'drove any further thought of resignation' from his mind, because of 'the mess' that would be created if he ceased to watch the rocket himself.

¹⁷² CCAC CHUR 4/398 D/220, Jones to Dennis Kelly, no date but circa 1950.

¹⁷³ ADI (Science) stated it a 'minor purpose' that 'readers may judge for themselves whether or not' they had 'neglected' their 'traditional duty': CCAC RVJO B.98 & TNA AIR 20/1688, Appendices and Photographs to Interim Report 'A 4', 26 August 1944; Appendix A 'Interim Report German Long Range Rockets' (CCAC RVJO B.86) and Appendix B, untitled report regarding the likelihood of rockets at Peenemünde (CCAC RVJO B.88).

¹⁷⁴ CCAC CHUR 4/398 D/220, Jones to Dennis Kelly, no date but circa 1950.

¹⁷⁵ CCAC RVJO B.98 & TNA AIR 20/1688, Appendices and Photographs to Interim Report 'A 4', 26 August 1944, Appendix D 'Intelligence regarding Weights'.

ADI (Science) held that confusion had been caused by the obfuscation of facts deriving from two separate weapons being developed in one place. This restricted 'geographical discrimination' which would have assisted in sifting out specific rocket reports. ADI (Science) charted intelligence received on Peenemünde, Heidelager, and Blizna from varied sources (mostly secret agency and photography) and technical intelligence, documents and hardware from Sweden and Normandy.¹⁷⁶ The intelligence regarding Heidelager derived from a fresh strain of SIGINT (a German police key known at GC&CS as 'Quince'), following the continued watch by 3G(N) on flying bomb trials.¹⁷⁷ ADI (Science) then described the rocket fuel intelligence picture, providing further details in Appendix C.¹⁷⁸ ADI (Science) claimed that the RAE reconstruction of the Swedish A4 ended 'a phase in the Rocket story', which 'began in Autumn 1939 when suspicions were first aroused', through to the second phase in 1943 with the focus on Peenemünde, and the final phase from Autumn 1943 to D-Day. They therefore closed the intelligence account of the rocket, the reputation of which they had steered 'between the Scylla of monstrosity and the Charybdis of negation'.¹⁷⁹

It is wholly evident within the elaborate presentation of this rocket report that ADI (Science) respected the brilliant technical accomplishment of the rocket, irrespective of its immediate futility. Moreover, ADI (Science) could not rest without declaring their disgust over the way in which the British intelligence attack on the Nazi rocket had been handled, and in particular the way in which

¹⁷⁶ CCAC RVJO B.97 & TNA AIR 20/1688, Interim Report 'A 4', 26 August 1944, pp. 3–7 & 9.

¹⁷⁷ Campbell, *Target London*, p. 219. The original decrypt is at TNA HW 5/709, dated 23 March 1944.

¹⁷⁸ CCAC RVJO B.98 & TNA AIR 20/1688, Appendices and Photographs to Interim Report 'A 4', 26 August 1944, Appendix C 'Intelligence regarding Fuels'.

¹⁷⁹ CCAC RVJO B.97 & TNA AIR 20/1688, Interim Report 'A 4', 26 August 1944, pp. 10–11.

they themselves had been brushed aside to accommodate the 'experts'. In the epilogue to the A4 report, they wrote that it was perhaps natural that when Britain was faced with a magnified threat (as the rocket had become) that 'some anxiety' would be 'felt as to the normal channels to cope with the new situation'. They admitted that not all knowledge about the rocket had been unravelled, notably radio-control, field organisation, and scales of effort and production. They deplored the fact that intelligence organisations had 'raised the Rocket alarm' before there had been 'enough evidence to gauge the magnitude of the threat'. They argued that perhaps this justified 'the calling in of independent experts to assess the evidence', although such a course rarely mended this type of situation. They stated that expert advice could 'be dangerous in Intelligence problems' simply because the stimuli were different between British weaponry experts and those of an enemy. Importantly they added that this did not negate the 'positive contribution' that experts could bring to intelligence from a tactical advice perspective.¹⁸⁰

Words of wisdom, based on four years of hard practical air intelligence experience, concluded this immense scientific intelligence report. Interpreters of insufficient facts should neither be frightened by (personal or collective) ingenious imaginations, nor lulled into false security by prejudice, but instead should seek fresh facts: 'This is the first duty of Intelligence, whose responsibilities must be respected' if 'the truth' is to be reached 'by the shortest way'. This very cleverly-worded statement encapsulated all the disappointment, dejection, and dismay Jones and his team had experienced

¹⁸⁰ CCAC RVJO B.97 & TNA AIR 20/1688, Interim Report 'A 4', 26 August 1944, pp. 40–1; Jones, *Most Secret War*, pp. 457–8.

for over a year. The word ‘respected’ was not applied lightly, for ADI (Science) had been clearly disrespected in the intelligence attack on the rocket from its first convincing appearance. They had however, been given opportunity to make the rocket problem their own, but had been much too busy thinking offensively rather than defensively—a rare paradox in intelligence.

As Chairman of the *Crossbow* Committee, Sandys was on the distribution list.¹⁸¹ Upon reading the report, Sandys strongly objected to the epilogue, considering it unjustified and unfair to the many experts he had employed. Sandys complained to Portal, who instructed Inglis to recall the report. Jones believed that this was a certain way for a report to be ‘read from cover to cover’, and was ‘content to leave it to historians to decide’ whether or not the report’s withdrawal was ‘justified’.¹⁸² Vitriol towards the ‘experts’ was far from opaque in this report, despite the inevitability of many experts being drawn in due to the novelty of the V-Weapons, the paucity of intelligence, and the difficulty of assessing the reliability of what intelligence was available.¹⁸³ Nonetheless, the vitriol did not mar what was a masterpiece of intelligence, and withdrawal of the A4 interim report was indeed unjustified.

¹⁸¹ Forty copies of the ‘A4’ interim report were distributed. Uniquely, Copy No.1 was for the Prime Minister (instead of the usual channel through Cherwell). The other thirty-nine were circulated across the Commands and appropriate Ministries.

¹⁸² CCAC RVJO B.341, ‘Note on interview with Prof. R.V. Jones’, p. 7; CCAC RVJO B.344, Jones to Irving, 3 August 1964; CCAC RVJO B.345, Jones to Irving, 21 August 1964; Jones, *Most Secret War*, p. 458; Campbell, *Target London*, pp. 362–4. Jones recalled to Irving that he was certain that this report had been withdrawn ‘on the representations of Mr. Sandys’, who had argued that the report was ‘tendentious and provocative’.

¹⁸³ Hinsley *et al*, *British Intelligence in the Second World War, Volume III, Part I*, p. 365.

Sandys held a press conference on 7 September 1944 to declare that the pilotless aircraft had been defeated and that the Battle of London was over.¹⁸⁴ With immense irony the first V2 fired in anger landed near Chiswick, London the very next day.¹⁸⁵ DI(S) reported thereafter that the rocket had left no radar trace, but that the sound-ranging organisation had plotted its course and determined its arrival from Rotterdam.¹⁸⁶ Nevertheless, Sandys certainly viewed the 'enthraling episode' of the flying bomb as over, and in thanking Pile for the 'grand support' he had given throughout, Sandys imagined that AA Command were 'not likely to have many more birds to fire at of any kind for the rest of the war'.¹⁸⁷ Other than a brief note regarding the continued ADI (Science) responsibility to 'watch for the imminent flying bombs', Jones gave the impression in *Most Secret War* that the rocket's arrival heralded the end of the V-Weapon hunt.¹⁸⁸ From an intelligence perspective it was, and yet ADI (Science) struggled to let go of the scientific element of the problem.

Determination that focus should concentrate on the scientific aspects (beyond control issues) of the rocket, led ADI (Science) to produce technical reports

¹⁸⁴ This conference was inspired by Brenden Bracken, the Minister of Information: See TNA AIR 20/6016, 'Notes of a Press Conference on the Flying Bomb', September 1944; Duncan Sandys, 'The whole story of how the Flying Bomb was beaten', *Daily Express*, 8 September 1944; Jones, *Most Secret War*, p. 458; Campbell, *Target London*, p. 376–7. Jones remarked that Sandys 'was big enough' to invite him to the post-conference cocktail party held at Sandys flat, although Jones did not confirm whether or not he accepted the invitation.

¹⁸⁵ On their way into work the next day Jones and Frank went to examine the crater: CCAC RVJO B.343, 'Verbatim note on interview with Professor R. V. Jones', p. 17–18; Jones, *Most Secret War*, p. 459. See CCAC RVJO B.177 for three excellent photographs of the large crater caused by the first V2 near Chiswick.

¹⁸⁶ TNA AIR 20/4236, memorandum from DI(S), 9 September 1944.

¹⁸⁷ CCAC DSND 2/13, Sandys to Pile, 9 September 1944. Joubert remarked that 'conventional weapons had defeated something new which could have been most formidable if it had been brought to perfection in time': Joubert, *Rocket*, p. 120.

¹⁸⁸ Jones, *Most Secret War*, p. 475. After the war, ADI (Science) reported that apart from the control mechanics, the rocket 'was no longer a problem in Scientific Intelligence when it came into operation on 8th September 1944': CCAC RVJO B.83 & TNA AIR 40/1532, ADI (Science) official history 'Air Scientific Intelligence in War, 1939–45', 1 April 1946, p. 51; AHB, 'Air Ministry Intelligence', p. 334.

that were not hugely significant.¹⁸⁹ Scientific intelligence analysis of rocket activity became more operational than predictive as the threat waned.¹⁹⁰ 'Traffic Vera' (the same name as Jones's wife is coincidental) provided 'a useful supplement' to other sources on rocket activity. For 3G(N), 'Vera' was 'the strangest and least intelligible part of A4 intelligence'. It was an amalgamation of three cyphers – 'R', 'Playfair' a bigram code and 'one or two substitution codes' – and accompanied the firing of rockets, and summarised it at the end of each day.¹⁹¹ ADI (Science) cross-correlated 'Vera' flimsies with Fighter Command radar plots of incoming missiles, and confirmed the reliability of the new SIGINT. They reported that 'Vera' agreed with the radar plots within +/- 2.5 minutes, and was 'almost completely reliable evidence of the fact and time of rocket launchings', and 'of the target area aimed at'.¹⁹²

Because these rocket-firing organisations reported in advance the times at which they intended to launch their rockets, 'Vera' gave an ideal opportunity for pre-strike countermeasures. The problem was that 'Vera' was graded ULTRA, so could not be circulated low enough in Fighter Command to be tactically useful, and PR could not be enacted in time as the regulated ULTRA

¹⁸⁹ CCAC RVJO B.100, Air Intelligence Scientific Note No.1, 'Elementary Theory on Long-Range Rockets', 25 September 1944; CCAC RVJO B.101, Interim Report 'An Analysis of Rocket Activity and Rocket Reporting in the First Week of November 1944', 18 December 1944; CCAC RVJO B.104, TNA AIR 8/831 & TNA AIR 20/1692, Interim Report 'An Examination of the Fall of Shot Pattern of the A4 Rocket', 1 March 1945. ADI (Science) also reported on the lop-sided dispersion of rockets fired at London: CCAC RVJO B.103, ADI (Science) Minute, 1 January 1945.

¹⁹⁰ ADI (Science) were by then 'primarily interested' in radar intelligence relative to *Crossbow*: TNA AIR 40/2656, Vintras (new DI(R)) to DDI4, 9 December 1944.

¹⁹¹ TNA HW 43/69, 'Report on the work of 3G(N)', 1 August 1945, p. 29.

¹⁹² In the 'best periods of reception' the new traffic gave information on approximately ninety percent of rockets fired by *Gruppe Nord* and seventy percent fired by *Gruppe Süd*: CCAC RVJO B.101, Interim Report 'An Analysis of Rocket Activity and Rocket Reporting in the First Week of November 1944', 18 December 1944, p. 6.

guise. Norman therefore managed to get 'Vera' downgraded.¹⁹³ ADI (Science) produced an aerial map of The Hague superimposed with firing point locations from radar with *Batterie* identities from 'Vera'.¹⁹⁴ In this matter, ADI (Science) played a useful role as middlemen between Hut 3 and Fighter Command, correlating SIGINT and radar for operational purposes. How effective this intelligence was is not known, yet evidence referring to discussions of potential bombing of The Hague area shows that the rocket was continuing to be menacing to the British irrespective of 'Vera' intelligence.¹⁹⁵ This probably had much to do with the fact that the Germans had adapted a 'revolutionary concept' of mobile launching platforms, known as the *Meillerwagen*, which made V2 launching positions particularly difficult to locate and destroy.¹⁹⁶

ADI (Science) confirmed that V2s fired at Antwerp and near the end of their track could be plotted by British radar, which allowed an insight into the firing *Batterie* responsible.¹⁹⁷ RAF 11 Group Filter Room, fitted with a specially-designed device called 'Oswald', was crucial in this radar plotting, the codename for which was 'Big Ben'.¹⁹⁸ No further scientific intelligence on the V-Weapons was recorded by ADI (Science) after the last rockets were fired at London and Antwerp on 27/8 March 1945. The threat to Britain was over.

¹⁹³ TNA AIR 40/2639, Easton to Portal and Bottomley, 27 November 1944; TNA HW 14/177, Norman to Easton, 2 December 1944; Campbell, *Target London*, p. 403–4.

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¹⁹⁵ TNA CAB 121/215, 'Countermeasures against Long Range Rocket Attack on United Kingdom', 16 January 1945; Campbell, *Target London*, p. 412.

¹⁹⁶ Keegan, *Intelligence in War*, p. 309.

¹⁹⁷ CCAC RVJO B.104, TNA AIR 8/831 & TNA AIR 20/1692, Interim Report 'An Examination of the Fall of Shot Pattern of the A4 Rocket', 1 March 1945.

¹⁹⁸ Eileen Younghusband, *One Woman's War* (Cardiff: Candy Jar Books, 2011), pp. 184–96.

Younghusband was sent to Malines (twelve miles from Antwerp) in December 1944 to plot V2s from mobile radar units, and calculate the launch position using slide rules and elementary geometry.

Conclusion

Four days before VE-Day, Jones presented his ideas on the future of scientific intelligence in a document entitled 'An Improved Scientific Intelligence Service'. He explained that as scientific intelligence had 'problems peculiar to itself', and since it was likely to be an important part of intelligence as a whole, it was therefore perhaps justified in designing a scientific intelligence section subject to its own requirements. Jones tackled sources first. As wartime sources, such as prisoners, captured equipment and documents would vanish, and other sources, such as technical listening and PR would fade, then all that would be left was GC&CS and SIS (both under C), and foreign publications. Jones acknowledged that the distinction between scientific intelligence and technical intelligence was 'hard to draw'. He was concerned about potential causes for dispute between an energetic technical section anxious to keep abreast of new developments and a scientific section reluctant to part with subjects that still contained much scientific interest. Rather than consider amalgamation of the two intelligence organisations, Jones proposed instead (perhaps unsurprisingly) that the best way to alleviate such dispute was to give scientific intelligence the main responsibility.¹

Jones stated that scientific intelligence personnel must be 'high-grade scientists', drawn from both academic and military research backgrounds, who retained continual contact with these backgrounds, and possessed first-hand knowledge of the intelligence machine and of intelligence methods.

¹ CCAC RVJO B.109, 'An Improved Scientific Intelligence Service', 2 May 1945.

Realising there might not be enough men of the required calibre for each service to have its own full 'Scientific Intelligence Section' in peacetime, each service should nonetheless be confident that its interests would be adequately watched. He confirmed that one of the fundamental difficulties of intelligence work was that input was by source, and output was by subject, and proposed that there had to be a changeover inside the intelligence machine. It had to 'act as far as possible as a single perfect human mind, observing, remembering, criticising and correlating different types of information, and then giving expression to the result'. No card index could do this, and the larger the organisation, the less it would resemble a single mind. An intelligence organisation therefore had to consist of 'as small a number as possible of individuals with abilities as great as possible', for intelligence was 'better done by a staff than by a committee'. Jones concluded by declaring that an intelligence organisation was 'a plant of slow growth', that a peacetime scientific intelligence organisation would take some time to build up to full strength, and that it 'may be worth spending five years in this process'.²

These recommendations went unheeded. Six months later, Portal thanked Jones personally for the 'first-class work' he had done as ADI (Science), and commented that, on many occasions, Jones had 'made outstanding contributions to operational problems of the greatest importance', and that the Air Ministry, and, indeed, the British nation, had 'been fortunate' to have a man of Jones's 'great ability and originality in this key position'.³ Evidently

² CCAC RVJO B.109, 'An Improved Scientific Intelligence Service', 2 May 1945.

³ CCAC RVJO B.125, Portal to Jones, 21 December 1945. In reply, Jones thanked Portal for his 'kind remarks', and added that Portal's interest in ADI (Science) had been constantly inspiring and would be missed deeply, particularly as the work was known to a restricted circle which had diminished 'with

Jones thought long and hard about his future over the Festive Season of 1945, for thereafter he informed Portal that owing to 'recent events' he felt that he had 'overstayed' his time on the Air Staff and in intelligence. Jones believed that his methods, 'while generally producing results in war', would 'hardly fit the proposed Scientific Intelligence organisation in peace'. Nor did he believe that his wartime results made up for his 'lack of academic eminence'. It was 'with great regret' therefore that Jones intended to apply for the vacant Chair of Natural Philosophy at Aberdeen University. He even doubted his chances in such an application because his work had 'been completely hidden during the ten years' that he had devoted himself to the defence of Britain, and his 'knowledge of scientific fact' had 'at the same time largely evaporated'.⁴

The Air Staff appealed to the Chief of Air Staff Secretariat for appropriate action to be taken in order to keep Jones as ADI (Science). They proposed to upgrade him to the rank of Director, but there was concern within Scientific Civil Service circles that such a promotion was 'likely to cause difficulty'. Nevertheless, it was 'a matter of the highest importance' that Jones remained as head of ADI (Science), and 'be given suitable status and emoluments' for his 'new and extended duties as Director'. They recommended that it might be possible 'to find some other title which would ease the difficulty'.⁵ No promotion materialised for Jones, and in March 1946, Elmshirst (newly-promoted ACAS(I)) declared that he was 'much disturbed' by the long delay.

sad rapidity'. What was undiminished, Jones informed Portal, was his own confidence in scientific intelligence 'as a worthwhile end'.

⁴ CCAC RVJO B.125, Jones to Portal, 27 December 1945.

⁵ CCAC RVJO B.126, Maurice Dean to D.U.S., 14 September 1945. Dean specifically cited that CAS and VCAS agreed that it was a matter of great importance.

The departments concerned were 'in the air', with their work naturally suffering, while Jones was 'very naturally unsettled' and was 'known to be looking for an outside appointment'. Elmshirst expressed that it was 'most desirable' to keep Jones, but that the long delay was making Jones feel that the Air Ministry was 'little interested in either him or his department'.⁶ Bottomley applied further leverage by adding that 'Jones would be exceedingly difficult – if not impossible – to replace', and that 'it would be a serious loss to the Service' if the Air Ministry 'were to fail to retain him'.⁷

Jones was eventually promoted to the post of DI(R), effective from 9 April 1946.⁸ The long delay for clarity regarding Jones's and indeed ADI (Science)'s position was, it seems, due to the difficulty in obtaining Treasury agreement regarding Jones's status.⁹ There is some irony in the fact that there was Treasury reluctance to recruit Jones (or any other scientist) before the war, and that it was Treasury indecision that led Jones to resign a year after it had ended. Jones did not mention his promotion to the post of DI(R) in *Most Secret War*, preferring instead to express his discontent with the future direction of scientific intelligence. Shortly after receiving his letter of appointment, Jones received notification that he had been invited for interview at Aberdeen University. This took place on 30 April 1946 and resulted in him being offered the chair—an offer assisted by a pre-emptive intervention by Churchill who happened to be receiving an Honorary Degree from Aberdeen

⁶ CCAC RVJO B.126, T. W. Elmshirst to Bottomley, 22 March 1946.

⁷ CCAC RVJO B.126, Bottomley to P.U.S., 22 March 1946.

⁸ CCAC RVJO B.126, A. J. Nichols of the Air Ministry to Jones, 18 April 1946. His new position carried a salary increase to £1600 (£1800 with London Allowance). A condition of higher appointments in the Scientific Civil Service was that he was expected to provide a term of six months for a notice of termination to his employment.

⁹ CCAC RVJO B.126, R. E. Vintras as Acting ACAS(I) to S.2., 23 April 1946.

University a few days before Jones's interview.¹⁰ Two weeks later it was arranged for Frank to be interviewed at Burlington House on 28 May with a view to him becoming the new head of ADI (Science) in Jones's stead.¹¹

On 31 May, Jones offered Portal his resignation. Plans for British intelligence handling of atomic issues were at the forefront of Jones's mind when he put pen to paper.¹² There was however, much more at stake than atomic intelligence alone. For Jones, the very principles of scientific intelligence that he had established were being sacrificed on the atomic altar. He later wrote that science had 'two functions in intelligence': 'to aid generally in collecting information'; and 'to study the applications of science to warfare by the enemy'.¹³ Jones believed that, even in peace, this encapsulated much more than atomic energy. His ten page resignation letter, therefore, was a matter of 'extreme searchings of conscience' concerning 'the fate of Scientific Intelligence'—an organisation that he had 'built up personally', and upon which he could not 'avoid stating a personal viewpoint'.¹⁴

His prime concern was that 'despite the lessons of the Beams, the German Night Defences, the Rocket and the Flying Bomb', the post-war organisation established by the JIC had 'completely wrecked the working system' he had built. In December 1939 he had proposed inter-service intelligence

¹⁰ UONC CHER D.124/15, Cherwell to Churchill, 3 May 1946; Jones, *Most Secret War*, pp. 515–6. Cherwell had asked Churchill 'to put in a word' for Jones. This he evidently did, as Cherwell confirmed to Churchill that Jones had been elected at Aberdeen 'largely thanks to your intervention'.

¹¹ CCAC RVJO B.126, S.2.Q. to D. of I.R., 15 May 1946.

¹² Goodman, *Spying on the Nuclear Bear*, p. 205.

¹³ The latter function was what Jones defined as 'Scientific Intelligence proper': CCAC RVJO B.115, paper on 'Scientific Intelligence' written by R. V. Jones, 17 November 1952, p. 1; Goodman, *Spying on the Nuclear Bear*, p. 86.

¹⁴ CCAC RVJO E.143, Jones to Portal (copy to Elmshirst), 31 May 1946.

collaboration, but the JIC 'turned it down', and so he had had 'to proceed alone'. As he could not be 'in two places at the same time', he had established his base in Broadway, which had turned out to be 'a great advantage' as it had given him 'direct contact with secret sources'. Jones claimed that between 1939 and 1943 the JIC 'took no interest in Scientific Intelligence', and he was therefore able to proceed 'unmolested'. Glossing over the failures of JIC committees regarding the rocket and the flying bomb (during which, he held, only professors commanded respect), Jones proceeded to criticise the JIC decision that ADI (Science) was to be separated from SIS, and for each service (and SIS) to have their own independent scientific intelligence section. For Jones, this was a 'poor sequel' to his team's war contribution. He regretted leaving intelligence 'more than anything else' he had 'ever done', because he had been prepared to spend his life in scientific intelligence, had he 'been allowed to do so' in his 'own way'.¹⁵

Frank was successful in his interview for promotion and it was agreed that he would take over from Jones once the latter's resignation notice had been served. It was also agreed between MI6 and the Air Ministry that, as part of the inevitable widespread post-war contraction of military personnel and establishment, ADI (Science) would vacate Broadway for much less salubrious premises in Bryanston Square.¹⁶ Even though he had resigned, Jones was livid about the prospect of such a move for the organisation he had

¹⁵ CCAC RVJO E.143, Jones to Portal (copy to Elmshirst), 31 May 1946.

¹⁶ The town houses in Bryanston Square were deemed unsuitable by Jones to accommodate his progressive expanding intelligence organisation. ADI (Science) was to be housed in premises that had been constructed at the end of the reign of George III and had served numerous generations as residences for field marshals, solicitors, and 'men of letters': Algernon Cecil, *A House in Bryanston Square* (London: Eyre & Spottiswoode, 1944), pp. 13–14. Perhaps Jones's complaints were less about the accommodation, and more about the decentralisation of ADI (Science).

created and nurtured over the previous six turbulent years. On behalf of the staff he was to leave behind, Jones expressed his anger in a letter to ACAS(I). He complained of the 'considerable pressure' imposed by SIS upon ADI (Science) due to the enforced date (30 September) of their move to 5 Bryanston Square. He felt it 'poor reward' for his and his staff's wartime effort that they should be 'exiled into inconvenient, ill-furnished, uncomfortable and depressing premises with few facilities' and be faced with the problem of recruiting secretaries and clerical staff anew. Jones believed that a move to Bryanston Square 'would set ADI (Science)'s work back by six months'. More importantly he expressed deep fears that ADI (Science)'s work could be 'permanently damaged' due to the scientific intelligence foothold in SIS being lost, with the added potential that SIS may take the opportunity of keeping ADI (Science) 'right out'. Jones once again relayed his 'constantly reviving amazement that the Air Ministry should have committed itself to a policy so detrimental to its own interests', and desired it to be put on record, along with his note of resignation, 'against the day when a failure' in the 'future intelligence may prompt an enquiry'.¹⁷

By mid-November 1946 Frank was operating as head of ADI (Science) on a once-a-week basis, essentially because he had also accepted an academic posting shortly after Jones received his chair at Aberdeen.¹⁸ He had been invited to join Professor Nevill Mott and his research team at Bristol University, and saw this as his best opportunity for speedy rehabilitation in

¹⁷ CCAC RVJO B.126, Jones to ACAS(I), undated but certainly summer 1945.

¹⁸ Whilst head of ADI (Science), Frank kept Jones informed of how his erstwhile colleagues fared as the newly-established ADI (Science): CCAC RVJO B.126, Frank to Jones, 18 November 1946. Frank reported that Horton, Garrard and Mrs Cornell 'tick [ed] over, very hard worked'; Ackermann was 'active as ever', and Hartley was a colossal improvement on the previous man'.

pure science. Frank kept the wartime ADI (Science) flame alive a little longer after Jones's departure, but only just.¹⁹

Jones once asked Frank what he thought they might do if there was another war. Frank replied that their responsibilities would probably be akin to that of Lindemann and Tizard 'while the young chaps have all the fun'. Jones frequently wrote of the fun he had during the war, and that emanates vividly from his memoirs. He recalled that their scientific intelligence responsibilities 'elated rather than depressed them' during the war, and that if at any time their performance still commanded respect, then it is the 'best possible argument for not resenting, but instead encouraging, the inclusion of youth into the highest councils'.²⁰ Jones, Frank, and some of the younger scientific intelligence officers were examples of the many young academics who were 'sucked into intelligence' by the Second World War, and 'who found there a strange, new world, dominated (as it often seemed to them) by retired naval

¹⁹ Shortly after Jones officially resigned, and in light of his impending departure from scientific intelligence, Frank wrote to Jones to formally state his own position. He reminded Jones that he had not envisaged a Civil Service career for himself, had only entered Government service because of the war, and had never intended to continue with ADI (Science) indefinitely. Peacetime circumstances did not give Frank grounds to alter his intentions in that respect, and he informed Jones that he had only stayed on another year after the war because of Elmhirst's request for him to do so, to assist in the transition of ADI (Science) from war to peace, and that this he continued to do to the best of his ability. By May 1946, Frank reached the realisation that such transition would be facilitated by his own departure. Like Jones, Frank wished to resume his academic research work, and believed that the longer he postponed, the more difficult it would become. He had hoped that a different structure of scientific intelligence would have developed along the lines Jones proposed directly after the war (which both men discussed very closely together at the time) and that Jones would remain in charge of ADI (Science). Frank had also hoped that he might be able to collaborate with ADI (Science) as an outside consultant. He therefore submitted his resignation with regret that it had in fact developed so differently to what he (and Jones) had perceived: UOB DM1837/C.231, Frank to Jones, 31 May 1946.

²⁰ R. V. Jones, 'Epilogue' to 'A Discussion on the Effects of the Two World Wars on the Organisation and Development of Science in the United Kingdom', *Proceedings of the Royal Society of London, Series A, Mathematical and Physical Sciences*, 342: 1631 (April 1975), 550. See also Norman Moss, 'The Theoretical Joker', *The Sunday Times Magazine*, 18 February 1973, 48.

officers, Indian policemen and others', between whom there was little mutual sympathy'.²¹ All had to make the best of the given circumstances.

Scientific intelligence would continue without them both; at least for a time, for the 'father of scientific intelligence' would return to his old role in 1952. Jones always took his duties seriously and saw his parental responsibility with clarity.²² He had defined himself 'as the first watchdog of national defence'.²³ Yet, as he found out to his great chagrin, when he returned to scientific intelligence upon Churchill's request in September 1952, the watchdog was muzzled by entirely new sets of rules that had established the Americans as the new lead partner in the armed truce of the Cold War.²⁴

Nevertheless, the fundamentals of scientific intelligence that Jones and Frank had nurtured during the war, fermented amongst post-war international suspicions, and evolved to establish STI as the primary pursuit of Cold War intelligence.²⁵ Moreover, the very science and technology, and the very means of intelligence-gathering dramatically enhanced the collection of

²¹ Cecil, 'C's War', 170.

²² Even after he had resigned, Jones was keen to learn of ADI (Science) developments. See CCAC RVJO B.207, Garrard to Jones, 21 May 1949, a reply to Jones's request for information on some of the wartime scientists that he had lost contact with. Garrard annotated the typed letter referring to Claude Wavell being with him at the time, returning wartime documentation as Wavell was 'about to demob'. This letter confirms that Garrard was still with ADI (Science) in Bryanston Square in May 1949

²³ Jones, 'Scientific Intelligence', 354.

²⁴ For Jones's return to scientific intelligence and the problems he envisaged and encountered, see CCAC RVJO B.115, paper on 'Scientific Intelligence' written by R. V. Jones, 17 November 1952; Goodman, *Spying on the Nuclear Bear*, pp. 134–5. Pincher even referred to there being 'an anti-Jones faction' in charge at the Ministry of Defence at that time: Pincher, *Too Secret Too Long*, p. 242.

²⁵ Maddrell defined the principal intelligence relative to the revolution of nuclear weaponry and other military technologies in the years 1947–55 as 'scientific-intelligence gathering'. Using documentation of the JIC, Maddrell confirmed that in 1947 STI was the 'top priority' for SIS in Germany: Maddrell, 'British-American scientific intelligence collaboration during the occupation of Germany', 74.

intelligence of a scientific nature.²⁶ Intelligence about foreign scientific research and national application of science and technology were recognised as ‘central to the mission and operation of the CIA and its predecessor agencies from the very beginning’.²⁷ Indeed, intelligence became so scientific that often interrogation of captured Cold War spies necessarily had to be undertaken by a scientist – Sir Michael Perrin’s 1950 interrogation of Klaus Fuchs is the most well-known example.²⁸ These realisations surprisingly took time to augment however. The Second World War had ‘clearly demonstrated that science had joined economics’ as ‘a practical factor to be reckoned with in the international arena’, yet it took the National Security Council until 1949 to issue its ‘first directive concerning the collection of basic scientific information abroad’.²⁹ In the meantime, scientists continued to be in a quandary regarding the contradictions inherent within the fundamental principles behind scientific secrecy.³⁰

Without Jones and Frank, and because Cold War was so very different from world war, British air scientific intelligence would never be the same again. In almost every respect, and within the trammels of wartime Whitehall

²⁶ For an example text on war-related science and technology, see Donald H. Avery, *The Science of War: Canadian Scientists and Allied Military Technology during the Second World War* (Toronto: University of Toronto Press, 1998).

²⁷ Doel & Needell, ‘Science, Scientists, and the CIA’, 59–60. This can be extended to the US Navy and US Army which also established their own scientific intelligence gathering functions; as did the Manhattan Project which created its own Foreign Intelligence Branch. See also ‘The Original Wizards of Langley: A Symposium Commemorating 60 Years of S&T Intelligence Analysis’ (Centre for the Study of Intelligence, October 2008), available at www.cia.org, accessed 1 March 2010. Jones is cited in this document as the perceived ‘father of scientific intelligence’.

²⁸ Goodman and Holloway, ‘The Interrogation of Klaus Fuchs’, p. 123.

²⁹ Wilton Lexlow, ‘The Science Attache Programme’, *Studies in Intelligence*, 10: 2 (Spring 1966), 21.

³⁰ See as examples Nevill Mott and Bertrand Russell, ‘Should a Scientist be Free to Tell’, *Picture Post*, 11 (15 June 1946), 18; A. V. Hill, ‘Scientists & Morals’, *The Sunday Times*, 5 December 1954; A. V. Hill, *The Ethical Dilemma of Science and Other Writings* (London: The Scientific Book Guild, 1962); R. W. Reid, *Tongues of Conscience: War & the Scientists Dilemma* (London: Constable, 1970).

bureaucracy, the two men had made it their own organisation. The Second World War made it unique, in that immediacy of the required scientific intelligence ensured the need for ADI (Science) as an autonomous construct with Air Intelligence, attached to SIS, and within the Air Ministry. Peace dictated a complete alteration to this requirement, essentially owing to contraction of bureaucracy directly after the war, but also because the atomic bomb radically transformed the very nature of scientific intelligence. The secret of such power became very secret indeed and directly led to the US Government implementing a clause (Section 10) within their Atomic Energy Act of August 1946 to halt any possibility of exchange of nuclear information between themselves and other nations.³¹

The Attlee administration favoured Blackett and Tizard as its key scientific advisers on defence issues.³² For all the pretence that politics does not interfere with science and *vice versa*, it is difficult not to assume that, as Jones was not of their political persuasion (being on the surface Lindemann's man), political reasons were possibly behind Jones and his team falling out of favour. Nevertheless, Frank believed that Jones had been right to complain against 'Blackett's interventions' with regard to the post-war intelligence structure, even though such complaints were unproductive.³³ Within the

³¹ Jones, *Reflections on Intelligence*, pp. 16–17; Goodman, *Spying on the Nuclear Bear*, pp. 15–18; Maddrell, 'British-American scientific intelligence collaboration during the occupation of Germany', 76; Richard Maguire, 'Scientific Dissent amid the United Kingdom Government's Nuclear Weapons Programme', *History Workshop Journal*, 63: (Spring 2007), 113–35. Jones stated that the McMahon Act 'all but severed exchanges with Britain in atomic matters'.

³² See Blackett's post-war literature on atomic issues: P. M. S. Blackett, *Military and Political Consequences of Atomic Energy* (London: Turnstile Press, 1948); *Atomic Weapons and East-West Relations* (London: CUP, 1956); *Studies of War: Nuclear and Conventional* (New York: Hill and Wang, 1962).

³³ UOB DM1310/A.16, Frank to Hooker, 13 August 1981. Such complaints did not stop Jones seeking Blackett's advice in 1947: see RS PB.3/1/33/22, Jones to Blackett, 19 May 1947; Jones to Blackett, 8

Directorate of Requirements, scientific intelligence became a full section in its own right as R7, representing the needs of the Directorate of Scientific Intelligence (DSI) at the developing Ministry of Defence, the Service Directorates of Intelligence, and the JIC's Joint Scientific and Technical Intelligence Committees.³⁴

Jones found his 1952 re-acquaintance with scientific intelligence much to his distaste, for atomic issues ensured that being Director of Scientific Intelligence was very different in peace than it had been in war. He lasted eighteen months. Following Jones's final resignation from scientific intelligence, the DSI ceased to exist as a separate unit for it was absorbed into the Joint Intelligence Bureau.³⁵ In 1962, Jones again returned to civil service upon the request of Zuckerman who had risen through the scientific civil service to become the Chief Scientific Adviser to Lord Mountbatten, the then Minister of Defence. The task Zuckerman set for Jones was for him to head a committee to determine the scientific and technological aspects of Britain's defence in any prospective war over the next two future decades.³⁶ Jones was later quoted saying that 'he had last engaged in intelligence activity when he

June 1947; Blackett to Jones, 20 June 1947. Jones also sent written congratulations to Blackett on his Order for Merit: RS PB.3/1/33/22, Jones to Blackett, 19 May 1947.

³⁴ Davies, 'Organizational Politics and the Development of Britain's Intelligence Producer/Consumer Interface', 125. Goodman showed how R7 swiftly evolved into R9, the Technical Co-ordinating Section: Goodman, *Spying on the Nuclear Bear*, p. 13.

³⁵ See Chapman Pincher, 'Scientific Intelligence and Defence', *Nature*, 4456 (26 March 1955), 529; Goodman, *Spying on the Nuclear Bear*, p. 208; Huw Dylan, 'The Joint Intelligence Bureau' (article and unpublished PhD thesis).

³⁶ See R. V. Jones, 'The Falklands: An Unplanned Contingency in Air Defense', *Journal of Electronic Defense*, June 1983, 60–8. There are some documents that are still classified in the Jones archive that probably relate to intelligence issues during the Falklands/Malvinas War of 1982.

contacted Baroness, then Prime Minister, during the Falklands war to convince her to use operations research officers in the conflict'.³⁷

Although the visionary Tizard Committee can mostly be credited for the birth of scientific intelligence, there can be little doubt that Jones was solely responsible for the creation of ADI (Science). Without his tenacity (often despite bureaucratic adversity and objections based on conservatism), scientific intelligence as a British national pursuit would have stalled in 1939. This is not to suggest that it would not have been reinvigorated at some stage during the war. It probably would have been, but in a very different way. Even though Jones portrayed the slow evolution of ADI (Science) as significantly hindered by departmental restraint, it was never as restrained as he implied, no worse than restrictions upon all other wartime operations, and the hindrance at any rate often proved beneficial to scientific intelligence as Jones admitted on frequent occasions.

The significance of Jones's choice of Frank as his second-in-command cannot be overestimated. They formed a perfect partnership. Jones relied heavily on Frank during the war, while the latter remained totally loyal to Jones at all times. Frank also made some crucial discoveries of his own that significantly contributed to scientific intelligence successes. In 1976, Jones informed Frank that he had recorded some material for television, and had made the BBC aware that Frank was responsible for 'noting the Auderville shadows and the Bruneval dot'. Also, that Yorkshire Television were also

³⁷ Briscoe, 'CIA honours British genius of spy world', 11.

‘talking of doing one programme, or more, as a TV version corresponding more to ‘Dr. Jones’ War’, and that he had given Frank’s name ‘as the one who was most closely associated’ with himself.³⁸ Less than two years later, Jones wrote of the Auderville incident that ‘Charles spotted the vital clue’, and that the Bruneval raid ‘was undertaken as a result of Charles Frank’s alertness’.³⁹

In rare personal and comparative assessments of their time together as ADI (Science), Frank recalled that he himself was as good as Jones ‘at solving puzzles and at spotting the significant observations’, while ‘Jones was responsible for, and best at, the long-sighted strategic planning of the Intelligence attack’. Frank believed that Jones’s important responsibility to ADI (Science) and their successes was more ‘long run’, rather than any ‘immediate quick-wittedness, which of course was also necessary’. Frank further stated that Jones’s memory (an important attribute in intelligence) was better than his – Frank’s ‘used to be very good’ but Jones’s ‘was superb’.⁴⁰

Whether Jones was really as good as he made out in his memoirs has been a primary theme of examination during the research within this thesis. When *Most Secret War* was in draft stage, Jones asked Frank about fairness of credits. Frank recollected ‘a couple of occasions where a “we” rather than an “I” would have pleased’ him ‘a little more’, but he ‘made no note of these’.⁴¹ As

³⁸ UOB DM1310/J.100, Jones to Frank, 1 October 1976. Jones warned however, that ‘since others, such as Cockburn and Sandys’ were also talking to the BBC, he was unsure of the likely overall result.

³⁹ Jones, *Most Secret War*, pp. 190, 225–6. Jones also credited ‘Tony Hill’s superb skill in photographing the Bruneval *Wurzburg*’.

⁴⁰ UOB DM1310/J.100, Frank to Jones, 15 November 1976; UOB DM1310/A.16, Frank to Hooker, 13 August 1981.

⁴¹ UOB DM1310/J.100, Frank to Jones, 15 November 1976. A similar note was made by Reynolds regarding Churchill’s war memoirs: Reynolds, *In Command of History*, p. 505.

a contemporary wrote to Frank after reading *Most Secret War*, Jones produced 'a fascinating story somewhat marred by his egotism'.⁴² As this thesis has shown, there were many wartime incidences where Jones owed much to other organisations and other individuals, some of which were acknowledged by Jones, others that were not. Often Jones had his reasons for such lack of accreditation. Perhaps in others he simply forgot. It is important however, that history does not forget that scientific intelligence during the Second World War was much more than Jones permitted in his memoirs, and involved other organisations and many more people (internally and externally of Broadway) than he chose to recall.

The Battle of the Beams, for example, is the one major event for which Jones alone is entitled to full credit for unravelling the mystery, but not for the actual 'bending' of the beams. This should not be assigned to Jones as many writers have done after reading *Most Secret War*, but rather to Cockburn of TRE who devised the countermeasures which jammed the beams and misdirected them to open country. As Zuckerman highlighted, nowhere in *Most Secret War* 'does Jones make this plain'.⁴³ For his part, and directly after the war, Cockburn was particularly praising of Jones and ADI (science) and, while making fully aware of just how vital his organisation (TRE) was to Jones's, remarked that ADI (Science) 'made a major contribution to the war effort as a

⁴² UOB DM1310/A.16, Stanley Hooker to Frank, 9 August 1981.

⁴³ UOEA SZ/2/GEN, 'Draft letter to Lord Chalfont' written by Solly Zuckerman, no date, p. 2. Instances of Jones being assigned the credit for bending the beams are widespread. See as typical examples, 'The Boffin who managed to bend the beam', *The Times*, 13 March 1978; Stephen Budiansky, 'A Young Physicist who Blunted the Blitz', *World War II*, July/August 2007, 21.

whole and particularly to its timely deployment'.⁴⁴ After reading *Most Secret War* however, Cockburn believed that Jones seemed still unaware or unwilling to recognise the pervasive impact of organised science at every level of the war effort. Blackett, Zuckerman, Bernal, and Cockcroft, were among many other scientists with great calibre who 'were not inactive' during the Second World War. Cockburn referred to Jones's wild claims for various ideas that were 'common currency' in British research establishments among men such as those at TRE – Dippy, Dee, Lovell, Sam and Joan Curran, and Jackson among the many lesser-known scientists and technicians. Crucially, Cockburn stated that all these men 'put the war years behind them and got on with other things' yet Jones 'remained encapsulated' by the war.⁴⁵ Like many of his contemporaries, Jones knew that the things he did then were the most important things he would ever do.⁴⁶ That Jones's war effort was important is not in doubt, but it is debatable whether they were any more important than say, Cockburn's countermeasures, Lovell's AI contributions, or Bernal's contributions to topographical intelligence in the run-up to D-Day. The difference was that most of Jones's scientific contemporaries put the war behind them and 'moved on'. Few wrote memoirs of their war exploits, and when they did, their wartime efforts formed fascinating chapters in their wider scientific careers, rather than being the sole focus of their respective books.

This may well explain why Jones made every effort to enjoy his unusual position while it lasted. And yet, despite the evident pleasure and pride of his

⁴⁴ Cockburn added that the collaboration between ADI (Science) and TRE 'was close and the technical resources and experience of the Establishment were always available' to Jones's team: CCAC ROCO 1/1 & CCAC RVJO B.158, Robert Cockburn, 'The Radio War', p. 8.

⁴⁵ UOEA SZ/2/GEN, 'Draft letter to Lord Chalfont' written by Solly Zuckerman, no date, pp. 9–10.

⁴⁶ Bullard, 'Processes of Scientific Intelligence', 191.

wartime accomplishments, there endured an underlying pang of regret that may well have been akin to many of his contemporaries who had found themselves wrenched from their civilian potentialities and thrust into their respective nation's war machine. For Jones, the move from scientific research to scientific intelligence was as opportune as it was destructive.

That scientific intelligence during the Second World War has ever since been the sole domain of Reginald Victor Jones was a given, even before the publication of *Most Secret War*, due to his frequent media presence on the subject. Had Frank written memoirs detailing his secret war, history would perhaps have been provided with a more balanced appreciation of scientific intelligence. Jones did favour Frank in *Most Secret War*, but rarely repeated such favour in his other post-war productions. Moreover, it is notable in this regard that Frank's papers are surprisingly sparse in terms of any reference to scientific intelligence, and indeed are significantly lacking in wartime memories of any description, providing further confirmation that, for Frank, the war was much less absorbing in the post-war period than it was for Jones. The same can be said for the archival collections of some of the other scientists mentioned throughout this thesis.

David Reynolds has shown that the influence of memoirs and 'history books' of the war published directly after the war has been neglected by historians. This, for Reynolds, has been a mistake, for memoirs and what he called 'instant histories' have often established the conceptual framework for public and popular memory, but also and perhaps more importantly, they set the

narrative framework.⁴⁷ Churchill, for example, eloquently spelt out the template for Dunkirk, the Battle of Britain, the Blitz, the Battle of the Atlantic, the turning of the tide, and so on. He also set the template for the Wizard War, which Jones was so evidently keen to foster thereafter. Jones re-branded *Most Secret War* for his American readers to *The Wizard War*, thereby not only taking the opportunity to cash in on the 1970s American Churchill-mania, but also to position his memoirs as a companion to Churchill's.

Most Secret War came along at the right time—for Jones, if not for history. A prime reason for him writing his memoirs was to tell his own story before someone else (such as Irving) did it before him. Asa Briggs recently remarked that *Most Secret War* is still 'very readable', the 'liveliest personal account of all', and 'by far the most interesting book on the subject'.⁴⁸ This is the point: for far too long Jones's account has been accepted as the definitive history of wartime scientific intelligence. It will always remain an authority because it is a first-hand account, and a most valuable one at that, but Jones's literature should not remain the authority, essentially because of its biased tendencies and inaccuracies as highlighted throughout this thesis. During the war, Jones was always conscious of his deficiencies in certain fields of science and technology—he was after all a young man with large responsibilities placed upon him during a time of national crisis. These deficiencies were forgotten however, by the time he set to writing his recollections.

⁴⁷ Reynolds, 'How the cold war froze the history of World War Two', 6; Reynolds, *In Command of History*, p. xxiv.

⁴⁸ Asa Briggs in Paul Lay, 'A Very Open Intelligence', *History Today*, 61: 1 (January 2011), 11; Briggs, *Secret Days*, p. 14. Briggs had often spoken to Jones about Bletchley Park and its personalities during his visits to Aberdeen University. The more they talked, remarked Briggs, the more he 'was left in no doubt' that Jones knew more about Bletchley Park than Briggs. He also believed that Jones knew more than Hinsley about all aspects of intelligence.

Christie Campbell, who has produced the closest examination to date of Jones during the V-Weapons campaign, concluded that Jones was 'not as indispensable as he thought', that he often 'thought he was running the war', and was regarded by his contemporaries as a loner rather than a team-player outside of his immediate ADI (Science) sphere.⁴⁹ These are accurate suppositions, but only for the latter part of the war. As the war progressed there was a slow transformation of his self-opinion, and his belief that he had indeed become indispensable to scientific intelligence. Jones's persistent resignation threats are testament to this. He himself provided much evidence in this regard through his memoirs, and comparison of his accounts with papers left behind by many of his contemporaries show that Jones certainly understated this particular inflated element of his persona. Essentially, ADI (Science) became indispensable to the Allied war effort, but Jones was never irreplaceable. Sometimes Jones's obstreperous behaviour worked to the benefit of scientific intelligence, but on many occasions it was to the detriment of smooth working relations, throughout the service, political, intelligence, and scientific circles that he frequented between 1943 and 1946.

His pre-war scientific specialism was infra-red; he came out of the war particularly interested in crystal growing (for electronics) and precision instruments. Jones's post-war scientific research interests had been stimulated by his war experiences. For example, because Britain was ill-equipped to deal with the German beams in 1940 and Jones had to

⁴⁹ Campbell, *Target London*, pp. 357 & 364.

investigate the matter, it inspired his later penchant for precise measurement.⁵⁰ The war therefore, not only altered his outlook on life, but also diverted his academic career. Jones was never entirely happy with this situation, and even believed in hindsight that military intelligence work was 'on a lower plane than pure scientific discovery'.⁵¹ Nonetheless, he recalled that during the war there were occasions 'when one was hardly less important' to British survival 'than the other'. This was especially so during the V-Weapons campaign, in which he saw himself as 'a scientist at work outside his specialist field'.⁵² That he was a scientist in government employ, especially at the heart of wartime British intelligence is, and will always remain, the fundamental importance behind Jones.

In 1963, Jones pondered ADI (Science)'s particular contribution to the war effort as scientists. He stated that it was 'not altogether in the application of scientific method', for this was little different from any person in a new field of experience applying 'the twin aids of observation and reason'. Jones's team of scientific intelligencers combined scientific method with their 'grounding in the

⁵⁰ R. V. Jones, 'Introduction' to 'A Discussion on the Effects of the Two World Wars on the Organisation and Development of Science in the United Kingdom', *Proceedings of the Royal Society of London: Series A, Mathematical and Physical Sciences* 342: 1631 (April 1975), 442.

⁵¹ Jones never pretended that scientific intelligence was 'as fundamentally satisfying a pursuit as either pure science or applied science'. All intelligence was parasitic for Jones, whereas science was original. One could 'only find out about a weapon if someone has done the more fundamental job of bringing it into existence'. Nor did he pretend that a spell in intelligence could 'ever enhance a scientist's reputation in his own field'. If anything, the reverse was likely to happen. He believed that it should always be realised that any scientist working in intelligence was making a deliberate sacrifice of their personal interests partly because they should believe that the western way of life was worth defending: UOB DM1310/J.122, Draft of Jones's paper on Scientific Intelligence, p.12; CCAC RVJO B.115, paper on 'Scientific Intelligence' written by R. V. Jones, 17 November 1952, p. 2; Jones, *Most Secret War*, p. 529. Frank believed that the war had given scientists more self-confidence, with a feeling that they had done something useful, and helping them to 'drop the idea that to do anything useful' was *infra dig*. He held that when the war was over 'it left a feeling that some time had been lost over a temporary affair', and that individual scientists 'had to work hard and enthusiastically to catch up on scientific questions of more permanent significance': UOB DM1310/J.100, Frank to Jones, 28 September 1973.

⁵² Jones, 'The Peenemünde Mystery', 1053.

fundamental laws of nature', and referred to these 'when in technical difficulty'. They also applied their ability to put 'numerical figures to arguments', fished 'for orders of magnitude', and maintained 'a readiness to try to imagine' themselves 'humanely in the enemy's position'. This claimed Jones 'was the key' to what they 'did' in ADI (Science).⁵³

One of Jones's obituarists wrote that his 'grasp of physics enabled him to develop new systems and battle tactics that influenced the course of the Second World War, while his whimsical, sophisticated but highly intelligent 'double think' baffled the German High Command.⁵⁴ This had tended to be the common perception: Jones, the 'brilliant, hubristic, exasperating, impossible', and 'in the end indispensable' scientist who saved Britain from disaster.⁵⁵ American author William Breuer remarked that, in his opinion, if ever one man contributed to winning the war with Nazi Germany, he would have to name Jones.⁵⁶ Even Hinsley *et al* almost always defined ADI (Science) in the singular throughout their official history. There was so much more to ADI (Science) than one man however, just as there was much more to scientific intelligence than a solitary team of Jones's followers.

The British learnt from bitter experience that military strength depended on economic, geographic, scientific, technical, and psychological factors of the

⁵³ Jones, 'The Peenemünde Mystery', 1056. Jones cited Frank's technical determination of the possible range of the V-2 rockets as prime example of all these attributes.

⁵⁴ Bleaney, 'Reginald Victor Jones', 644.

⁵⁵ Campbell, *Target London*, p. xvi.

⁵⁶ AAMA 4D2/2/2/2, William Breuer to Major G. G. Norton, 6 October 1986. When Breuer was 'finally able to locate' Jones teaching at 'a college in Aberdeen', he asked him to read his manuscript 'dealing with the British radar-radio scientist's ongoing war-within-a-war with the German scientists'. See also Breuer, *Secret Weapons of World War II*.

enemy status.⁵⁷ ADI (Science) satisfied one of these necessities, just as other individuals and organisations satisfied the other requirements. Importantly, what ADI (Science) ‘did’ during the war, as Jones remarked in 1963 (but less so thereafter), ‘could not’ have been done ‘without the powerful help of colleagues brought up in other disciplines such as the humanities and the Services’.⁵⁸ There was nothing remotely similar to the symbiosis between ADI (Science) and 3G(N) across the spectrum of British intelligence in the Second World War. There were often frictions among similar organisational relationships in the other services. The naval equivalent for example was seen as imperialist by the OIC who thought they could research intelligence problems better themselves.⁵⁹ This was far from the case between ADI (Science) and 3G(N), which stated after the war that any future 3G(N) ‘must have access to and power to report to the future ADI (Science), although they added that it also ‘must have an adequately trained scientific staff’.⁶⁰

Many scientific intelligence deductions emanated from the tireless and skilful interrogation processes of Felkin’s ADI(K), and their captured documents section.⁶¹ The Y-Service, TRE, and the many other organisations discussed throughout this thesis, all contributed in their own special way to scientific intelligence, and much more so than Jones recalled. PR/PI was absolutely invaluable to ADI (Science) for the duration of the war. PR had always been

⁵⁷ Strong, *Intelligence at the Top*, p. 223.

⁵⁸ Jones, ‘The Peenemünde Mystery’, 1055. Jones added that apart from its value in war, the whole of Britain ‘profited from the mutual contact between the disciplines’. The memory of this convinced him that ‘the difference between the two cultures is one of emphasis rather than kind’.

⁵⁹ Hamilton, ‘The Character and Organisation of the Admiralty Operational Intelligence Centre during the Second World War’, 316.

⁶⁰ TNA HW 43/69, ‘Report on the work of 3G(N)’, 1 August 1945, p. 15.

⁶¹ It is a confirmed fact that ‘nearly all major intelligence scoops’ obtained by ADI(K) during the war ‘were from direct interrogation’ rather than from the M Rooms: TNA AIR 40/1177, ‘Intelligence from Interrogation’, p. 11.

technological but during the Second World War, and even more so after, it became incredibly scientific.⁶² PR/PI also inspired other aspects of scientific intelligence during the Second World War, such as topographic, geographic, hydrographic, oceanic, and meteorological intelligences.

Jones was often misleading in his recollections when referring to the contacts so essential to the successes of ADI (Science). For example, he recalled to Irving that Norman of 3G(N) and Stewart of Medmenham were ‘other members of his team’. By the time he wrote *Most Secret War*, 3G(N) had been removed from his recollections altogether. Jones also recalled that ADI (science) and ADI (photography) ‘always saw completely eye to eye’. The evidence confirms however, that the relationship between ADI (Science) and ADI (photography) was not always complementary. With typical inflated ego, Jones further recalled that he ‘could order any source’, and ‘direct any Intelligence collecting agency’, either as himself or as C’s scientific adviser, and had ‘pretty well complete powers’ in this regard.⁶³ As this thesis has shown, this was mostly far from the truth. Nevertheless, Jones firmly believed (and rightly so) that these crucial contacts ‘turned out to be more important than professional scientific competence’; an attribute ADI (Science) found difficult to recruit because of the desperate need for scientists and technicians in all aspects of the war.⁶⁴

⁶² See for example Roy Hall, ‘Photographic Spying from Aircraft and Satellites’, *The New Scientist*, 19 May 1960, 1253–5; John W. Cain, ‘Technical Factors in Aerospace Photography’, *Studies in Intelligence*, 6: 4 (Autumn 1962), 1–8; Dino A. Brugioni, ‘The Art and Science of Photoreconnaissance’, *Scientific American*, March 1996, 78–85.

⁶³ CCAC RVJO B.341, ‘Note on interview with Prof. R.V. Jones’, pp. 3 & 7.

⁶⁴ CCAC RVJO B.342, Jones to Irving, 10 July 1964. Jones believed that Stewart’s true ‘devotion to duty’ to ADI (Science) was perhaps the reason why ‘he became the subject of obloquy’ thereafter.

In Lindemann, Tizard, Pye, Winterbotham, and Medhurst, Jones had role models in science and intelligence.⁶⁵ If Jones is forever to be defined as the ‘father of scientific intelligence’, then these men should be remembered as the grandfathers—Tizard especially, for it was his brilliant vision that conceived the essential need for scientific intelligence before 1939. More importantly, Jones learnt from these men the importance of science and intelligence fused together for the benefit of his country. It was this that made him and his wartime position unique. That he was yet another scientist in the service of the British government (then a very restricted vocation) was icing on the cake. Although paid by the Air Ministry throughout the war, being positioned in Broadway (through preference) not only allowed him and ADI (Science) to be central to the whole air intelligence structure, but also enabled them at the same time to achieve ‘an inter-service position’, covering many key scientific and technological developments in land, sea and especially air warfare.⁶⁶

Reynolds concluded his seminal examination of Churchill’s war memoirs by citing subsequent historians who had adopted Churchillian ‘phases and phrases’, and declared (after J.H. Plumb) that ‘Churchill the historian lies at the very heart of all historiography of the Second World War, and will always remain there’.⁶⁷ Much the same can be said for Jones’s ‘history’ of the birth of scientific intelligence during the Second World War. Although he never intended it to be a definitive history, *Most Secret War* has been used as such ever since its publication. As this thesis has shown, there was so much more

⁶⁵ In contrast, Jones recalled, ‘Inglis was disinterested in scientific intelligence’: CCAC RVJO B.341, ‘Note on interview with Prof. R.V. Jones’, p. 5.

⁶⁶ CCAC RVJO B.346, Jones to A. R. Michaelis, 3 December 1964.

⁶⁷ Reynolds, *In Command of History*, p. 526; A. J. P. Taylor, *Churchill: Four Faces and the Man* (London: 1969), p. 149.

to scientific intelligence than Jones relayed, and it was much more expansive than just one small section in the heart of British intelligence. This thesis serves as solid foundation for future research into what became crucial to intelligence services all over the world. As world war moved rapidly into cold war, the means of unconventional warfare researched during 1939–45 radically transformed scientific intelligence, dramatically heightened its importance, and ensured its permanent position at the heart of most national defences for the remainder of the twentieth century and into the twenty-first.

Appendix One: Intelligence Branches of the Second World War.¹

AI – Air Intelligence, Air Ministry

Head of Air Intelligence was the Chief of Air Staff responsible for intelligence, designated **ACAS(I)**. The post of **Deputy ACAS(I)** was formed in August 1944 to assist the extensive duties of **ACAS(I)**.

Directorates

DI(O): Directorate responsible for Air Intelligence operations.

DI(R): position created in April 1944 to take responsibility of the subjects which **DDI2** were previously responsible – aircraft industries, airfields, and technical intelligence. **DDI4** was also incorporated into these responsibilities. Creation of this position marked the final acceptance by the services of the term ‘Research’ previously regarded with misgiving.

DI(S): Directorate responsible for Security.

DAFL: Directorate of Allied Air Co-operation and Foreign Liaison. Transferred to **ACAS(P)** in October 1944.

Deputy Directorates

DDI(ORS): Deputy Director responsible for administration, Air Attachés, establishments, liaison, translation, training, and paperwork.

DDI(S): Deputy Director responsible for security measures covering the entire Air Ministry intelligence organisation.

DDI2: Deputy Director responsible for technical information on matters relating to administration, industry and airfields in foreign countries.

¹ Data extracted and collated from the following archive files: TNA AIR 40/2659; TNA WO 33/2723; TNA HW 43/1; TNA HW 43/2; TNA HW 43/3; TNA WO 32/10776; TNA ADM 223/84; AHB, ‘Air Ministry Intelligence’; and from the following secondary sources: all four volumes of Hinsley *et al*, *British Intelligence in the Second World War*, Thomas, Ransom, Knight, *British Intelligence in the Second World War*; Twigge, Hampshire, Macklin, *British Intelligence*; Thomas Hennessy & Claire Thomas, *Spooks: The Unofficial History of MI5, From M to Miss X, 1909–39* (Stroud: Amberley Publishing, 2010).

DDI3: Deputy Director for operational and organisational intelligence on all foreign air forces – orders of battle, reserves, training, target information, air operations and all other matters falling generally within the air field staff.

DDI4: Deputy Director responsible for RAF Y and low-grade signals intelligence; previously defined as **DDS(Y)** and renamed to **DDI4** in December 1941; incorporated into **DI(R)** in April 1944.

AI(JIS): Air Intelligence representative of the Joint intelligence Committee.

Assistant Directorates

ADI(K): prisoners of war and captured documents.

ADI (Maps): responsible for obtaining and appropriately disseminating intelligence from captured maps.

ADI (MCH): position within GC&CS created in March 1944 responsible for deciphering machinery and mechanical devices.

ADI (Photography): responsible for obtaining, collating and appropriately disseminating intelligence interpreted from aerial photographs derived from photographic reconnaissance.

ADI (Science): responsible for collation of intelligence concerned with potential threats from enemy scientific development. By September 1944 this responsibility had been further refined to include enemy scientific research.

ISTS: Inter-Services Topographical Section.

Assistant Directorate Sub-Sections

AI1: British air attachés and missions, distribution of papers, printing and issue of intelligence handbooks.

AI1(a): administration and establishments for **ACAS(I)**.

AI1(a) P/W: liaison with the Ministry of Economic Warfare.

AI1(c): Air Intelligence Liaison duties.

AI1(d): RAF and WAAF intelligence personnel, intelligence establishments, foreign language courses.

AI1(e): intelligence from air signals (later **AI4**).

AI1(h): intelligence on V-Weapons (created Spring 1944).

AI1(t): translation section.

AIS1: security advice, co-ordination, organisation and liaison representation at security.

AIS1(a): security questions relating to individuals, individual security records, loss of documents.

AIS1(b): security questions in connection with (a) aviation other than RAF; (b) official air mails; (c) classification of documents.

AIS1(c): co-ordination of home and overseas security, allocation of privacy equipment, corrected transmission of categorised documents.

AIS1(d): policy regarding prevention of sabotage, security measures at protected places and prohibited areas, carriage of cameras in and photography from aircraft, leakage of information, closing of roads, security questions concerning POW passes, permits and identity documents, policy, restrictions on and employment of aliens, policy, liaison with **AI5** and **AI6**.

AIS2: security education, policy and preparation of material.

AIS3: policy regarding release of technical information, state of security records, Security RT1 Committee.

AIS4: operational security and Inter-Services Security Board liaison duties.

AIS7: liaison duties.

AIS8: postal and telegram censorship and port liaison, unit censorship policy, censorship stamps.

AI2(a): enemy aircraft industries and production.

AI2(b): enemy airfields.

AI2(c): liaison for clandestine organisations; gave advice to SIS and SOE on the air aspect of clandestine projects, and co-ordination with RAF procedure.

AI2(g): continuous technical and scientific development of enemy armaments, chemical warfare, navigational equipment, oxygen apparatus, salvage, life-saving gear, signals and electrical equipment, radio navigational aids, aircraft and gliders, heating and de-icing, parachute troop equipment, production of CD131. Unlike **ADI (Science)** who were concerned with scientific and technological research, **AI2(g)** dealt with scientific and technological developments already in service.

AI2(h): intelligence on V-Weapons (created July 1944).

AI3(a)1: distribution of information, liaison with Foreign Office Service departments and RAF Commands, preparation of Daily Summaries.

AI3(a)2: editing of AMWIS political and strategic intelligence, preparation of appreciation and collation of information supplied by specialist sections, preparation of daily summaries of General Intelligence, general assistance to AI(JIS), liaison with other Government departments and the BBC.

AI3(b): order of battle of the air forces of Germany and her satellites (except Finland), liaison with RAF and USAAF Command Intelligence Sections, Admiralty, and War Office, estimates of future scales of attack and forecasts of German intelligence.

AI3(c)1: production of target material for use of RAF and USAAF, and liaison with MEW.

AI3(c)2: bomb damage assessment and enemy aircraft losses and for the preparation of operational target intelligence for the Allied air forces, including operational planners, target maps, illustrations and information dossiers for the briefing of aircrews. Approximately 560,000 items per week were produced at the height of the Allied Strategic Air Offensive. Target material for tactical and clandestine air operations was also produced by this section.

AI3(d): order of battle of the Japanese Air Forces (JAF), estimates of future scales of attack and forecasts of Japanese intentions, all other intelligence and research of the JAF, recording of past campaigns and operations.

AI3(e): created in August 1941 to relieve **AI3(b)** of certain non-operational subjects concerning the organisation of the GAF where study was primarily based on Enigma, such as GAF manpower, supply, maintenance, training, transport, and POW intelligence on these matters; also responsible for research and recording of past campaigns.

AI3(f): organisation and operations of the Air Forces of Russia, Finland, Sweden, Spain, Portugal, Switzerland, China, Turkey, Iraq, Iran, Afghanistan, and Egypt.

AI3(USA): order of battle and organisation of the Air Forces of the USA and Latin America, liaison with USAAF in the United Kingdom, American Embassy, and the RAF Delegation in Washington DC.

AI4: Air Signals Intelligence.

AI4(a): enemy radar and navigational aids.

AI4(b): Traffic Section reports derived from the French, Spanish, Italian, and Japanese air forces.

AI4(c): enemy call-signs.

AI4(d): enemy Signals Organisation.

AI4(e): organisation and personnel, administration, and general duties of the signals intelligence units, home and overseas.

AI4(f): breaking GAF aircraft codes and secret call-sign systems. **AI4(f)** was the designation for the Air Section at GC&CS.

AI4(g): responsible for the dissemination and maintenance of the technical equipment and communications of the signals intelligence units.

AIK1: air components of **CSDIC(UK)**, detailed interrogation of POWs and preparation of reports, appreciation of captured documents.

AIK2: local interrogation officers, interrogation of POWs in England upon Capture, POW Security lectures.

AIK3: records, propaganda from POW sources.

AIK4: Interrogation of refugees other than Norwegian.

AIK5: Air Liaison with Royal Norwegian forces, Interrogation of Norwegian refugees.

AIK(MED): Air Sections of the CSDIC's workings in the Mediterranean.

AIK(AEAF): Air POW interrogation unit working with AEAF.

MI – Military Intelligence, War Office

As Military Intelligence was the first bureaucratic organisation of British intelligence, it would serve well to provide here a brief summary of the history of Military Intelligence organisation. In 1904 the War Office made the decision to integrate the Intelligence Division created during the Boer War (in which it proved its value) into the Directorate of Military Operations (DMO). The resulting body consisted of six sections:

MO1: Strategic Section, responsible for plans of operations outside the United Kingdom, strategic distribution of the Army, defence schemes abroad,

information relating to British possessions overseas; also Egypt, Afghanistan, Bhutan, Nepal, Tibet, Persia, Muscat, Socotra, Siam, and Central Asia.

MO2: Information concerning the following countries and their colonies; Germany, Holland, Austria, Switzerland, Balkan States, Ottoman Empire, Arabia, Greece, Crete, Spain, Portugal, Italy, Abyssinia, United States, Mexico, Central and South America, Cuba, Haiti, San Domingo, Liberia, and Tangier.

MO3: Information concerning the following countries and their colonies; France, Belgium, Russia, Norway, Sweden, Denmark, Morocco, China, Japan, and Korea.

MO4: Geographical Section, responsible for collection and distribution of topographical information, and preparation of maps.

MO5: Special duties, comprising policy regarding submarine cables and W/T, press correspondents and control of the press in war, censorship, ciphers, policy regarding martial law, aliens and civil population in war, international law, draft books affecting the General Staff, municipal law affecting defence schemes, traffic in arms, compensation claims, interior economy and co-ordination of work in the Directorate, and the General Staff Library.

MO6: collection of medical information relating to foreign armies and colonial forces.

In addition to this organisation, in 1914 the War Office established an **Intelligence Corps** which initially consisted of journalists, teachers, and police officers. As war proceeded the Intelligence Corps gained a mounted section, a motorized section and a security section. Three members of the Intelligence Corps were also attached to each squadron of the RFC for the purposes of aerial photography and reconnaissance. In 1916, as Military Intelligence became prolific (and thereby unmanageable) it was once again separated from operations. It was this reorganisation which established the MI prefixes; some of which remain to this day. Of note within these designations is the role of the original **MI6**, as well as the position of SIS within Military Intelligence:

MI1: Secretariat Section responsible for administration and secret Intelligence.

MI1(a): responsible for clerical duties.

MI1(b): responsible for enemy ciphers.

MI1(c): the precursor of the Secret Intelligence Service (SIS).

MI1(d): responsible for producing Intelligence summaries.

MI2 and **MI3** were responsible for Europe, the Middle East, and the Americas.

MI4: responsible for the production and storage of maps.

MI5: counter-espionage and Special Intelligence.

MI5(a): responsible for aliens on war service.

MI5(d): responsible for overseas Special intelligence.

MI5(e): responsible for control of ports and frontiers.

MI5(f): Preventative Branch.

MI5(g): Detective Branch.

MI5(h): Administrative Branch (Office and Records).

MI6: responsible for trade policy, international law, and arms traffic.

MI7: responsible for press control and propaganda.

MI8: responsible for cable censorship.

MI9: responsible for postal censorship.

MI10: created in 1917, responsible for foreign military attachés and missions.

MIR: created in 1918, responsible for Russia, Caucasus, Asia, and Far East.

Such was the extent of British Military Intelligence organisation in 1918. In 1919, much of the communications intelligence activity was centralised with the creation of **GC&CS**. By the Second World War many **MI** Section designations had altered or disappeared altogether. In the Second World War they were to multiply exponentially. There were two significant re-organisations of Military Intelligence during the Second World War; one in May 1940 (when SIS became **MI6**), the other in December 1941. Some Sections, however, were established or re-designated outside of these dates; such developments are noted here accordingly:

CSDIC: Combined Services Detailed Interrogations Centre

DMI: Director of Military Intelligence.

D (Signals): Director of Signals Intelligence.

DDMI (PW): established in December 1941 to take charge of **MI9** and the new **MI19**.

DDMI (F): Military Intelligence representative at SIS HQ appointed in March 1942.

DDMI (Y): created in spring 1943, responsible to **DMI** and **D (Signals)** for the organisation of the Y Service. **DD(Y)** acted as War Office representative on the Y Committee, as the channel between **DMI** and **GC&CS**, and as the formulator of general policy regarding the provision, administration and allocation of Army Y Units.

GC&CS: Government Code and Cypher School (Bletchley Park).

IS9: Intelligence School for training Intelligence officers the principles of escape and evasion so they in turn may train others.

ITC: Intelligence Training Centre, situated at Matlock in Derbyshire.

JIC: Joint Intelligence Committee, responsible for co-ordination of all strategic Military Intelligence.

MI(co-ord): responsible for co-ordinating all operational Military Intelligence

MI(R): established in the interwar period, its charter embraced general research, employment (and training) of 'irregular' or Special Forces, technical research and the production of appliances responsible for Military Intelligence Research, and the collection of information by 'special means outside of the province of other agencies'. **MI(R)** was abolished in October 1940, its duties transferred to **DMO**.

MI3: responsible for all Europe (except Germany and German order of battle in occupied territories), and took over Russia, Scandinavia and Eastern Europe from **MI2** in the summer of 1941.

MI5: Home Security Service and counter-espionage.

MI7: liaison between the War Office and Medmenham.

MI8: implemented interception policy, disseminated information from Y and had operational control of fixed Y Stations in the UK.

MI8(c): cover designation for the Radio Security Service (RSS) whose brief was to 'intercept, locate and close down illicit wireless stations operated either

by enemy agents in Great Britain or by other persons not being licensed to do so under the defence regulations of 1939'.

MI9: responsible for escape and de-briefing of British POWs; and for the administration and interrogation of enemy POWs before **MI19** was established.

MI10: overall responsibility for Technical Intelligence.

MI10(a): responsible for armoured fighting vehicles.

MI10(b): responsible for engineering equipment.

MI10(c): responsible for transportation (railways and canals), oil and military science.

MI11: responsible for Field Intelligence, and for protecting troops against enemy agents hidden among the civilian population.

MI12: responsible for postal censorship and liaison with **MI5**.

MI14: responsible for Germany and German order of battle in occupied territories.

MI14(h): the War Office component of the joint **NID/MI** section that was established on 22 August 1943 to supply coastal defence Intelligence for the whole of Europe (except the Channel which had by then become the responsibility of COSSAC). **MI14h** worked with **NID23** and in close co-operation with **MI15**, in collection, assessment, and plotting agreed intelligence on coast defences, and to produce reports in which were included AA defences as compiled by **MI15**.

MI15: responsible from early 1942 for processing PR requests.

MI15 (AA): created in July 1941 to be responsible for the collation and distribution of all intelligence on German anti-aircraft defences. This work had previously been carried out by a sub-section of **MI14** which had dealt directly with the Air Ministry and which from the summer of 1942 had had US officers attached to it. **MI15 (AA)** continued to work as an inter-service and inter-Allied organisation.

MI16: overall responsibility for Scientific Intelligence.

MI17: established in April 1943 to act as the secretariat directly under **DMI** which presented to the CIGS the views of Military Intelligence on matters requiring Cabinet consideration. It incorporated **MI (JIC)** and **MI (Co-ord)**, the

two sections which had previously been responsible for co-ordinating the work of the Intelligence and Operations Directorates. Like **NID17** it had a sub-section which distributed summaries of Sigint in the War Office.

MI19; established in December 1941 to take over the responsibility for enemy POWs from **MI9**.

PWIS: POW Interrogation Centre where preliminary POW investigation after capture was undertaken.

Sigs4: responsible for all signals personnel and equipment, for the administration of fixed Y Stations, and for the requirements of Y communications.

Sigs6: responsible to **DDS(Y)** on matters of technical security.

NID – Naval Intelligence Department, Admiralty

DNI: Director of Naval Intelligence

NID1: Northern Section (i.e. Germany and northern Europe)

NID3: Mediterranean Section

NID4: Far Eastern Section

NID7: Technical Section

NID7S: Scientific Intelligence Section created in October 1943, and headed by Professor Edward Gollin.

NID/DSD9: enemy (and neutral) W/T communication systems and the interpretation of such traffic.

NID12: established in July 1942 through amalgamation of **NID17M** and

NID16: Russian Section, formed in July 1941 out of **NID4**, the Far Eastern Section

NID17: personal bureau/inner office of DNI.

NID17P: this sub-section was formed in July 1941 to study and summarise the contents of non-operational Intelligence (and thus non-naval Intelligence, operational Intelligence remaining the responsibility of the **OIC**) that was reaching the Admiralty from Sigint and SIS. Its responsibilities were to review, study, and circulate in secure summary form, all 'Special Intelligence' received from all sources. By October 1942, **NID12** was summarising some 400 items

per day of German Enigma, diplomatic and Secret Service and various Italian decrypts. **NID12** was also responsible for the production, control and execution of all naval deception measures by intelligence methods.

NID20: formed in December 1941 to study Vichy France, Spain and Portugal and their overseas possessions, subjects originally covered by **NID3**, the Mediterranean Section. In the spring of 1942 it took over from **NID3** responsibility for east Africa and Rhodesia. In its early days its chief work was the provision of defence and topographical Intelligence, including Intelligence about the French Fleet, for the planning of Operation Torch, and of the landings in Madagascar (*Operation Ironclad*).

NID23; the naval component of the joint **NID/MI** section that was established on 22 August 1943 to supply coastal defence Intelligence for the whole of Europe (except the Channel which had by then become the responsibility of COSSAC). **NID23** worked with **MI14h** and in close co-operation with **MI15**, and for this reason was established in the War Office.

Appendix Two: The Publications, Broadcasts, and Lectures of Reginald Victor Jones CH, CB, MA, DPhil (Oxon), FRS¹

Books

Most Secret War: British Scientific Intelligence, 1939–1945 (London: Hamish Hamilton, 1978); (London: Coronet Edition, 1979); (London: Wordsworth Editions Limited, 1998); (London: Penguin Books, 2009); published in the United States of America as: *The Wizard War: British Scientific Intelligence, 1939–1945* (New York: Coward, McCann & Geoghegan, Inc., 1978); published in France as: *La Guerre Ultra Secrète* (Paris: Plon, 1980).

Instruments and Experiences: Papers on Measurement and Instrument Design (Chichester: John Wiley & Sons Ltd., 1988).

Reflections on Intelligence (London: Heinemann, 1989); (London: Mandarin Paperbacks, 1990).

(With Akademiia nauk SSSR) *Pamiati D.K. Maksvella*, (AN SSSR, 1980). A Siberian publication located in the Special Library and Archive of the University of Aberdeen.

Future Conflict and New Technology, The Washington Papers, IX: 88, (London: Sage Publications, 1981).

Some Thoughts on Star Wars, Centre for Policy Studies, Policy Study No. 71. See UEA SZ.Gen.J for correspondence between Solly Zuckerman and Jones regarding this publication. This publication can be found online at:

¹ R.V. Jones's honorary titles were extended thus – HonDSc (Strathclyde, Kent, Westminster College, Aberdeen), DUniv (York, Open, Surrey), HonLLD (Bristol).

www.cps.org.uk/files/reports/original/111028092209-New Light on StarWars1985.pdf, accessed 4 May 2012.

Articles and Reviews

The following is a list (by subject) of publications written by Jones detailing his experiences and recollections, which featured in many various edited books, magazines and journals. Republication and/or archive locations are included where appropriate. This list improves upon the incomplete list of Jones's publications which can be found in the Jones papers at CCAC RVJO J.100. Many of the original scripts written by Jones and transcripts given to Jones can be found in Sections J and K of the Jones papers.

On Optical Levers

'A simple method of attaching a photoelectric cell relay to a mill galvanometer', *Journal of Scientific Instruments*, 11 (1934), 302–3.

'Photoelectric relays for galvanometers', *Nature*, 133 (9 June 1934), 872; Jones's name was misspelt as 'V. R. Jones' in this publication.

'Some points in the Design of Optical Levers and Amplifiers', *Proceedings of the Physical Society, B*, LXIV (1951), 469–82.

(With C. W. McCombie) 'Brownian Fluctuations in Galvanometers and Galvanometer Amplifiers', *Philosophical Transactions of the Royal Society of London, Series A*, 244: 881 (January 1952), 205–30.

(With J. C. S. Richards) 'Recording Optical Lever', *Journal of Scientific Instruments*, 36 (February 1959), 90–4. This article was republished in *Instruments and Experiences*.

'Some Developments and Applications of the Optical Lever', (Duddell Medal Lecture at University of Reading on 22 September 1960), *Journal of Scientific*

Instruments, 38 (February 1961), 37–45. This article was republished in *Instruments and Experiences*.

'The Optical Micrometer', *Optical Engineering*, 15, 3 (1976), 247–50. This article was republished in *Instruments and Experiences*.

On Capacitance Micrometers

(With J.C.S. Richards), 'The Design and Some Applications of Sensitive Capacitance Micrometers', *Journal of Physics E: Scientific Instruments*, 6 (1973), 589–600. This article was republished in *Instruments and Experiences*.

'The Measurement and Control of Small Displacements', *The Bulletin of the Institute of Physics*, (1967), 325–36. This article was republished in *Instruments and Experiences*.

Springs

'Parallel and Rectilinear Spring Movements', *Journal of Scientific Instruments*, 28 (February 1951), 38–41. This article was republished in *Instruments and Experiences*.

'An Optical Slit Mechanism', *Journal of Scientific Instruments*, 29 (November 1952), 345–50). This article was republished in *Instruments and Experiences*.

'Angle Spring Hinges', *Journal of Scientific Instruments*, 32 (September 1955), 336–8. There is correspondence regarding 'Angle Spring Hinges' in *Journal of Scientific Instruments*, 33 (June 1956), 245. The article 'Angle Hinge Springs' was republished in *Instruments and Experiences*.

(With I. R. Young) 'Some Parasitic Deflexions in Parallel Spring Movements', *Journal of Scientific Instruments*, 33, (1956), 11–15. This article was republished in *Instruments and Experiences*.

'A Large Optical Slit Mechanism Employing Spring Movements', *Journal of Scientific Instruments*, 33 (May 1956), 169–73. This article was republished in *Instruments and Experiences*.

'A Parallel-Spring Cross-Movement for an Optical Bench', *Journal of Scientific Instruments, Laboratory and Workshop Notes*, 33, (July 1956), 279.

'Anti-Distortion Mountings for Instruments and Apparatus', *Journal of Scientific Instruments*, 38 (October 1961), 408–9. This article was republished in *Instruments and Experiences*.

'Some uses of Elasticity in Instrument Design', *Journal of Scientific Instruments*, 39 (May 1962), 193–203. This article was republished in *Instruments and Experiences*, and derived from a lecture given by Jones on 18 January 1962 to the Annual Exhibition of the Institute of Physics and the Physical Society.

'Mechanical Design in Instruments', *Discovery*, March 1965.

On Optics

(With J.C.S. Richards) 'The Polarization of Light by Narrow Slits', *Proceedings of the Royal Society*, A.225 (1954), 122–35.

'The Velocity of Light in a Transverse Magnetic Field', *Proceedings of the Royal Society*, A.260 (1961), 47–60. This article was republished in *Instruments and Experiences*.

Radiation Pressure

'Radiation Pressure in a Refracting Medium', *Nature*, 167 (17 March 1951), 439.

'The Pressure of Radiation', *Royal Institute of Great Britain, Weekly Evening Meeting*, Friday 6 March 1953. This article was republished in *Instruments and Experiences*, and in *Nature*, 171 (20 June 1953), 1089.

'The Pressure of Radiation in a Refracting Medium', *Proceedings of the Royal Society*, A.221 (1954), 480–98. This article was republished in *Instruments and Experiences*.

(With B. Leslie), 'The Measurement of Optical Radiation Pressure in Dispersive Media', *Proceedings of the Royal Society of London. Series A, Mathematical and Physical Sciences*, 360: 1702 (4 April 1978), 347–63. This article was republished in *Instruments and Experiences*.

'Radiation Pressure of Light in a Dispersive Medium', *Proceedings of the Royal Society of London*, A.360 (1978), 365–71. This article was republished in *Instruments and Experiences*.

'Radiation Pressure and 'Aether Drag'', *Nature*, 277 (1979), 370. This article was republished in *Instruments and Experiences*.

'Aether Drag'

'Aberration of Light in a Moving Medium', *Journal of Physics, A: General Physics*, 4 (1971): Letters to the Editor L1–L19.

'Fresnel Aether Drag' in a Transversely Moving Medium', *Proceedings of the Royal Society of London: Series A, Mathematical and Physical Sciences*, 328: 1574 (13 June 1972), 337–52. This article was republished in *Instruments and Experiences*.

'Aether Drag' in a Transversely Moving Medium', *Proceedings of the Royal Society of London: Series A, Mathematical and Physical Sciences*, 345, 1642 (30 September 1975), 351–64. This article was republished in *Instruments and Experiences*.

'Rotary 'aether drag'', *Proceedings of the Royal Society of London: Series A, Mathematical and Physical Sciences*, 349: 1659 (29 June 1976), 423–30. This article was republished in *Instruments and Experiences*.

Microbarographs

'Sub-Acoustic Waves from Large Explosions', *Nature*, 193 (20 January 1962), 229–32. This article was republished in *Instruments and Experiences*.

(With S. T. Forbes) 'Sub-Acoustic Waves from Recent Nuclear Explosions', *Nature*, 196 (22 December 1962), 1170–1. This article was republished in *Instruments and Experiences*.

(With S. T. Forbes) 'A Microbarograph', *Journal of Scientific Instruments*, 39 (5 August 1962), 420–7. This article was republished in *Instruments and Experiences*.

'Microbarograph Record of Waves from the Chinese Thermonuclear Explosion on 17 June 1967', *Nature*, 215 (5 August 1967), 672. This article was republished in *Instruments and Experiences*.

Miscellaneous Science

'The Production of Metallic Films', *Journal of Scientific Instruments*, XIII, 9 (September 1936), 282–8.

(With William Paul) 'Blue Sun and Moon', *Nature*, 168 (29 September 1951), 554–6.

(With William Paul) 'Separation of small spheres according to size', *Research*, 3 (1950).

(With William Paul) 'Production and Separation of Small Glass Spheres', *British Journal of Applied Physics*, 3 (October 1952), 311–4.

'A Galvanometer Lamp and a Clamp with Four Degrees of Freedom', *Journal of Scientific Instruments*, 29 (October 1952), 338.

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Edward Leaf, *Above all unseen: The Royal Air Force's photographic reconnaissance units 1939–1945* (Sparkford: Patrick Stephens, 1987).

Addresses

'Inaugural Lecture as Professor of Natural Philosophy at the University of Aberdeen', delivered by Jones in 1946.

'Professor Jones on Philosophers and Kings', a lecture delivered by Jones in 1963 to the Rand Corporation.

'Valedictory Address to New Graduate in Science', Aberdeen University, 6 July 1966.

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Radio Broadcasts

'Emotion, Science, and the Bomber Offensive', on the BBC Radio 4 *Third Programme*, aired 12 November 1961 at 6.35–6.55p.m.

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Television Broadcasts

Jones briefly featured in a *Panorama* programme on the V-Weapons, aired on 23 November 1964. For correspondence regarding this programme, see CCAC RVJO B.346.

Jones featured in a *Horizon* BBC Television Programme in September 1967. This included interviews with Lord Chandos, Edward Bullard, and David Irving on the subject of Professor Lindemann. There was also a Lindemann programme aired on the BBC sometime in the summer of 1968 but this could well be the same programme simply repeated.

'The Battle of the Beams', episode one of *The Secret War*, transmitted on BBC1, 5 January 1977. The Historical Adviser for this television series was Alfred Price. The transcript for this production can be accessed at CCAC RVJO K.475.

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'Terror Weapons', episode three of *The Secret War*, transmitted on BBC1, 19 January 1977. The transcript for this production can be accessed at CCAC RVJO K.477.

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AVHL – A. V. Hill Papers

CHAR – Chartwell Papers (Winston Churchill Papers pre-27 July 1945)

CHUR – Churchill Papers (post-27 July 1945)

DSND – Duncan Sandys Papers

GOEV – Charles Goodeve Papers

920/HIL – The unpublished memoirs of Archibald Vivian Hill

ROCO – Robert Cockburn Papers

RVJO – R. V. Jones Papers, specifically: Sections A – biographical; B – wartime/war-related documentation; E – war/post-war defence and intelligence related documents; G – conference papers/correspondence; J – publication-related documents; K – lectures, speeches, broadcasts.

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HTT – Henry Tizard Papers

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Constance Babington Smith Papers

The unpublished memoirs of W/Cdr Douglas Kendall

The National Archives (TNA)

ADM – Admiralty Papers

AIR – Air Ministry Papers

AVIA – Aviation Papers

CAB – Cabinet Papers

DEFE – Ministry of Defence Papers

HW – Government Communications Headquarters (GCHQ) Papers

KV – Secret Service (MI5) Papers

PREM – Prime Minister Papers

T – Treasury Papers

WO – War Office Papers

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