

UC Berkeley

UC Berkeley Electronic Theses and Dissertations

Title

Science, Technology, and Know-How: Exploitation of German Science and the Challenges of Technology Transfer in the Postwar World

Permalink

<https://escholarship.org/uc/item/3w65f1hm>

Author

O'Reagan, Douglas Michael

Publication Date

2014

Peer reviewed|Thesis/dissertation

Science, Technology, and Know-How: Exploitation of German Science and the Challenges of
Technology Transfer in the Postwar World

By

Douglas Michael O'Reagan

A dissertation submitted in partial satisfaction of the

requirements for the degree of

Doctor of Philosophy

in

History

in the

Graduate Division

of the

University of California, Berkeley

Committee in charge:

Professor Cathryn Carson, Chair

Professor John Connelly

Professor Daniel Sargent

Professor Deirdre Mulligan

Spring 2014

Abstract

Science, Technology, and Know-How: Exploitation of German Science and the Challenges of Technology Transfer in the Postwar World

by

Douglas Michael O'Reagan

Doctor of Philosophy in History

University of California, Berkeley

Professor Cathryn Carson, Chair

This dissertation is a comparative study of the American, British, and French efforts to exploit German science and technology following the Second World War, and through this, a transnational history of technology transfer, diplomacy, and science-state interaction in the postwar world. In the wake of the importance of science-based technologies in the Second World War, science became closely linked with diplomacy, scientific expertise took on new meanings and importance in government in each of these three nations, and the occupation of Germany created a perceived opportunity to simultaneously shape Germany's future and boost domestic industrial technology. Across the world, the relationships between science and the state changed rapidly in the postwar years, though with important national differences shaped by institutions and values.

The central argument of the dissertation is that different assumptions and beliefs about technology transfer, and in particular conceptions of the importance of 'know-how' or tacit knowledge, fundamentally shaped on-the-ground policy decisions in different ways in each of these nations; and that these decisions, in turn, had important consequences for international diplomacy and domestic science and industrial policy in each of these nations. This dissertation examines the ways in which science and technology fundamentally reshaped, and were fundamentally reshaped by, larger forces and trends in twentieth century history. More specifically, these attempts at scientific intelligence gathering on an unprecedented scale drew upon and shaped the national and international structures for communicating science; they tied together science, technology, and intelligence communities in new ways; and they brought the difficulties of technology transfer to the attention of business and legal communities at a crucial time in the development of multinational corporations and internationalization of business.

Table of Contents

Acknowledgements	ii
CV	iii
Introduction	vi
Chapter 1	1
French Scientific Exploitation and Technology Transfer from Germany in the Diplomatic Context of the Early Cold War	
Chapter 2	20
British Postwar Scientific Exploitation and Tacit Knowledge	
Chapter 3	47
American Postwar Scientific Exploitation and the Myth of German Technological Superiority	
Chapter 4	67
Documentation, the Exploitation of German Science, and the Information Problem of the Twentieth Century	
Chapter 5	83
To Suppress, Exploit, or Support? The Uses of Science in Occupied Germany	
Chapter 6	102
The Curious Life of Know-How - A Business and Legal History	
Conclusion	122
References	127

Acknowledgments

A few words are meager thanks for the generosity that has made this dissertation possible, but they can at least be a start. Thanks go out, first of all, to Cathryn Carson, whose advice and guidance has been deeply insightful, helpfully critical, and supportive at each stage. John Connelly, Daniel Sargent, and Deirdre Mulligan have all been brilliant dissertation committee members, and their comments and critiques have been invaluable for both this work and in planning the research that will emerge from it.

During my tenure at Berkeley, the Office of the History of Science and Technology (OHST), and later the Center for Science, Technology, Medicine, and Society (CSTMS), provided an intellectual home for which I am deeply grateful. Special thanks to Diana Wear in her role there, as well as the staff members who have made it such a resource and community over the years. Within the History Department, Mabel Lee has been a tremendous resource, as have the other department staff members. Thanks to all of the Berkeley faculty I have encountered, who have been invariably helpful and generous with their time, but especially to Massimo Mazzotti, Susanna Barrows, John Lesch, Abena Osseo-Asare, and Margaret Anderson.

As goes funding, so goes the world, and this dissertation has been supported by a number of generous groups. In roughly chronological, thanks to the UC Berkeley History department for graduate funding and summer grants; the UC Berkeley graduate division for a number of grants and fellowships, including a chance to take part in the Student Mentoring and Research Teams (SMART) pilot program (and special thanks to Michael Hahn, who did fantastic research therein); the EU Center, Center for German and European Studies, and Institute for European Studies at UC Berkeley; the Department of Energy for the Edward Teller Fellowship in Science and National Security Studies; the Pennsylvania Area Center for the History of Science for a very productive research grant; and the Miller Center of Public Affairs at the University of Virginia for hosting me in my dissertation completion year via their National Fellows program.

The last of these – for which I would particularly like to thank Brian Balogh, the Miller Center's staff, James Hershberg, and my fellow fellows – also left me indebted to a number of faculty at the University of Virginia, among them (but certainly not limited to) John Brown, John Duffy, and Will Thomas.

Archival work would be impossible without the work of countless archivists and librarians, some of whom I had the pleasure of working with directly, but many more of whom contributed enormously to this work indirectly. Thanks to the staff at the US National Archives in College Park, MD and Washington, DC; the Library of Congress; the U.S. Army Center of Military History at Fort McNair; the Hagley Museum; the Chemical Heritage Foundation; the UK National Archives in Kew; the British Library; the Archives Nationales in Fontainebleau and Paris; and the Service Historique de la Defense. This research would also have been impossible without the efforts of the librarians and library staff at UC Berkeley, Berkeley Public Library, Stanford University, the University of Virginia, and the UVA Law School.

Listing particular individuals for special thanks has the unfortunate side effect of snubbing the infinite others without whom I could not have conceived, started, pursued, or especially finished this project. To that end, I can only offer a sincere thanks to so many who have offered thoughts, insight, criticisms, distraction, or support throughout this process.

DOUGLAS MICHAEL O'REAGAN

EDUCATION

University of California, Berkeley

Ph.D, History

2008 - Present

M.A., History

2007-2008

University of Virginia

B.A., History; B.S., Physics

2003-2007

History Thesis: "The Evolution of Military Satellite Intelligence"

Physics Thesis: "Active Magnetic Field Cancellation for Bose-Einstein

Condensate Experimentation"

DISSERTATION

"Science, Technology, and Know-How: Exploitation of German Science and the Challenges of Technology Transfer in the Postwar World"

Dissertation Committee: Cathryn Carson (Chair, History), John Connelly (History), Daniel Sargent (History), Deirdre Mulligan (Berkeley Law)

PUBLICATIONS

"French Scientific Exploitation and Technology Transfer from Germany in the Diplomatic Context of the Early Cold War," *International History Review* (2014). Online version: (<http://dx.doi.org/10.1080/07075332.2013.879917>)

TEACHING EXPERIENCE

Instructor of Record

- *Science and National Security in the Cold War* Spring 2013

Graduate Student Instructor

- *History of Science in the U.S.* Fall 2012
- *The Origins of Modern Science* Fall 2009
- *Science and Society* Spring 2009
- *United States History to 1865* Fall 2008

Grader, University of California, Berkeley

- *Health and Disease* Spring 2010
- *Modern Physics: From the Atom to Big Science* Spring 2008

Research Mentor

2012-2013

Student Mentoring and Research Teams (SMART) Pilot Program

Mentored an undergraduate on a semi-independent research project

SELECTED AWARDS AND FELLOWSHIPS

Raquel and Arthur Seidel Fellowship in the History of Intellectual Property and Patents (deferred) <i>Chemical Heritage Foundation</i>	2014-2015
Ambrose Monell Foundation Fellowship in Technology and Democracy <i>National Fellows Program, Miller Center for Public Affairs at Univ. of Virginia</i>	2013-2014
PACHS Dissertation Research Fellowship <i>Pennsylvania Area Center for the History of Science</i>	2012 – 2013
Daimler Dissertation Fellowship <i>Institute for European Studies, UC Berkeley</i>	2012 – 2013
Edward Teller Fellowship in Science and National Security Studies <i>United States Department of Energy</i>	2010 – 2011
IES Predissertation Fellowship <i>Center for German and European Studies, Institute for European Studies</i>	Summer 2009
Honorable Mention, Graduate Research Fellowship Program <i>National Science Foundation</i>	Spring 2009
Graduate Division Summer Grant <i>UC Berkeley Graduate Division</i>	Summers 2009-10
Graduate Student Fellowship <i>Department of History, UC Berkeley</i>	2007 – 2010

PRESENTATIONS/SERVICE

History of Science Society (HSS) Annual Meeting, Boston, MA "Diplomacy, Tech Transfer, and British and French Exploitation of German Science and Technology following the Second World War" Panel: Science and Diplomacy in the Cold War	Fall 2013
Invited Guest Lecture – "The Cold War's Impact on American Science" <i>History of Science in the U.S., UC Berkeley</i>	Fall 2012
Invited Guest Lecture – "Science and National Security in the Cold War" <i>The United States from World War II to the Vietnam Era, UC Berkeley</i>	Spring 2013
Invited Guest Lecture – "US Espionage and Intelligence in the Cold War" <i>The United States from World War II to the Vietnam Era, UC Berkeley</i>	Spring 2013
Invited Talk - "The Second World War and Legal History of 'Know-How'" <i>Miller Center for Public Policy, University of Virginia</i>	Spring 2014

Commentator, "Inventing the Military-Industrial Complex"
Miller Center for Public Policy, University of Virginia

Spring 2014

DIGITAL HUMANITIES EXPERIENCE

Creator, 'HistoriCal Outreach' podcast

In this podcast (historicaloutreach.blogspot.com), I interview other UC Berkeley History PhD candidates about their dissertations, with the aim of making cutting-edge historical research accessible and engaging for the broader public.

Creator, 'Science, Spies, and History blog'

This blog (sciencespiesandhistory.blogspot.com) serves as a sounding board for short-form writing, documents, and other items of potential interest to the wider community.

Research Assistant for Professor Cathryn Carson

Summer 2007

Worked on the NSF-funded "Nuclear Berkeley, Nuclear World" project. Researched the history of nuclear reactors on California campuses, including local protests and reactions, and worked on designing a website to present findings for education and outreach

Digital History Researcher, Virginia Center for Digital History

Summers 2004-06

Located, transcribed, coded, and summarized personal papers and diaries for the *Valley of the Shadow* project (<http://valley.vcdh.virginia.edu/>); worked on geo-spatial mapping for the *Emancipation Project* (<http://www2.vcdh.virginia.edu/emancipation/index.html>)

History Department Web Programmer / Computer Support, UC Berkeley

2007-2010

Consulted with professors on web design, media resources for lectures, and troubleshooting; updated and created applications to automate sections of the department website

Computer Support, Society for the History of Children and Youth Conference

Summer 2009

Prepared and provided support for conference presentations at the SHCY's "Children and Youth at Risk and Taking Risks: Historical Inquiries in International Perspective" conference

COMPUTING PROFICIENCIES

C/C++, PHP, MySQL, XML, HTML, Javascript; some Python experience

UNIX and LINUX systems; all Windows variants; all OSX variants

All major productivity software – full MS Office suite, OpenOffice, Google Docs, Adobe products

Some experience with R, Tableau, Mathematica

LANGUAGES

French – Read at a high level, speak and write at an intermediate level

German – Read at a high level, speak and write at an intermediate level

Spanish – Read at a high level, speak and write at an intermediate level

Russian – Read, write, and speak at a basic competence

Introduction: Science, Know-How, and the Allied Postwar Exploitation of Germany

This dissertation is a comparative history of the efforts by the United States, United Kingdom, and France to transfer German science and technology to companies and research facilities in their own countries during the post-World War II occupation.¹ The fundamental question this dissertation initially set out to answer was why each of these nations would pursue 'intellectual reparations' in such similar ways and on such a scale, despite serious differences in their economic, political, and diplomatic positions. Yet as the project progressed, its focus shifted to untangling a debate that seemed to be going on within each of these nations: what does it take to transfer technology at all? Would the new information technology of the day (microfilm) allow tech transfer via duplicating paperwork? In contrast, how much of the technologies sought could only be learned through hands-on experimentation and training? From there, the dissertation unfolded to examine what technological tools, social relationships, and institutions had been employed to communicate scientific and technical information leading in to this period, and what came of this attention being paid to 'know-how' or 'tacit knowledge.'² The efforts to exploit German science and technology were an unprecedented, enormously complex attempt at mass technology transfer, in which the newfound importance of science in national security entangled diplomacy, science policy at home and in Germany, and industrial policy. More than this, they took place at a time of shifting realities and perceptions of how science and technology could be communicated, and the consequences of these exploitation efforts would reverberate in shaping intellectual property law and policy, international business, diplomacy, and industrial-state relations in each of these nations in the postwar world.

All three nations undertook such efforts, working cooperatively but competitively. Indeed, each nation's efforts were themselves a tangle of independent or semi-independent efforts, working cooperatively and competitively, with varying objectives, organizational structures, and access to the resources and power of the occupying governments. The many bureaucratic, academic, and private industry entities involved – many of them working at odds, duplicating efforts, or unaware of the broader picture – make for a diverse constellation of archival and other primary sources. Weaving them into coherent narratives is difficult, yet this complexity derives precisely from the variety of contemporary policymakers who saw value in studying German science and technology. Limiting the study to a national context, as has been done to varying extents for each of these three Allied powers, could simplify matters, but at the cost of understanding the transnational phenomena that both shaped and were shaped by these

¹ The Soviet Union, too, took part in related efforts to acquire German expertise, and its efforts are addressed peripherally, but the substantial differences from the other Allies in its overall political-economical system (as well as the accessibility of its archives today) make it a separate question in need of its own additional research, though some excellent work has already addressed this topic.

² It is worth noting up-front that much of this dissertation elides 'science' and 'technology,' despite the significant differences in the communities and institutions that thought of themselves as involved with each. This emerges from the sources, which combine the two, and a historiography that usually does the same, but some of the implications for this combination – for example, the curious focus both on taking technology and aiding science in Germany, operated by the same agencies – will be examined in later chapters.

efforts. This dissertation will not attempt to cover every aspect of this enormously rich historical site, but in drawing on American, British, French, and some German sources, will hopefully contribute to adding layers to our understanding of the postwar scientific exploitation efforts in occupied Germany.

Historical and Historiographic Framing

Entering the Second World War, Germany had a centuries-old reputation for scientific and technological leadership. To be certain, Great Britain, France, and most other nations touted their own national scientific heroes, inventions, and economic strengths, but Germany remained central and powerful in important ways.³ The German model for university education had spread to the United States, but despite the growing economic and scientific importance of the US in the early twentieth century, students hoping to enter the world of academic science in many disciplines would still, if possible, make a pilgrimage to study in a German laboratory.⁴ In mathematics, Ivor Grattan-Guinness has argued that Germany supplanted France as the dominant influence in the mid-nineteenth century, and additional historians have demonstrated "Germany influence in a wide variety of national venues – late nineteenth-century Spain and France, Meiji Japan, and China and the United States in the early twentieth century."⁵ German scientists (by citizenship) earned more Nobel Prizes than any other nation from the Prizes' founding through 1956 (barring one year tied with the United Kingdom in 1904-1905), when the United States took over; counting solely science prizes, Germany led until 1964.⁶

³ On Germany's late-nineteenth and early-twentieth century reputation in science, see eg Gabriele Metzler, "Deutschland in den internationalen Wissenschaftsbeziehungen, 1900-1930," in *Gebrochene Wissenschaftskulturen: Universität und Politik im 20. Jahrhundert*, ed. Michael Grüttner and et al (Göttingen: Vandenhoeck & Ruprecht, 2010); Sylvia Paletschek, "Was heißt "Weltgeltung deutscher Wissenschaft?" Modernisierungsleistungen und -defizite der Universitäten im Kaiserreich," in *Gebrochene Wissenschaftskulturen: Universität und Politik im 20. Jahrhundert*, ed. Michael Grüttner and et al (Göttingen: Vandenhoeck & Ruprecht, 2010).

⁴ Daniel J. Kevles, *The Physicists: The History of a Scientific Community in Modern America, Revised Edition* (New York: Knopf, 1995), 14-45; Anja Werner, *The Transatlantic World of Higher Education: Americans at German Universities, 1776-1914* (New York: Berghahn Books, 2013). See also the essays in Michael Grüttner and others, eds., *Gebrochene Wissenschaftskulturen: Universität und Politik im 20. Jahrhundert* (Göttingen: Vandenhoeck & Ruprecht, 2010).

⁵ The essay by Grattan-Guinness, as well as this quote and the chapters that support it by Elena Aulsejo and Marino Hormigon, Thomas Archibald, Chikara Sasaki, Joseph Dauben, and Della Fenster, respectively, are from Karen Hunger Parshall and Adrian C. Rice, eds., *Mathematics Unbound: The Evolution of an International Mathematical Research Community, 1800-1945* (Providence, RI: American Mathematical Society, 2002), 7-8. Additional discussion of the postwar transition of German preeminence to the United States can be found in Reinhard Siegmund-Schultze, "The Emancipation of Mathematical Research Publishing in the United States from German Dominance (1878–1945)," *Historia Mathematica* 24, (1997); Reinhard Siegmund-Schultze, *Mathematicians Fleeing from Nazi Germany* (Princeton, NJ: Princeton University Press, 2009).

⁶ Full listings of Nobel prize winners can be found at <http://www.nobelprize.org/>; interesting visualization and analysis of prize winners' nationalities over time can be found at Jürgen Schmidhuber, "Evolution of National Nobel Prize Shares in the 20th Century" <http://www.idsia.ch/~juergen/nobelshare.html> (accessed 10 May 2014).

Within Great Britain, "the unusual and intensive admiration shown in Victorian Britain for specifically German learning and German culture" included (though was not limited to) the natural sciences.⁷ John Davis and Ulrike Kirchberger have both demonstrated the significance of the migration of German scientists and academics to Great Britain in the late nineteenth century.⁸ In turn, "this attitude towards German learning was reflected in the flow of Britons outward towards Germany to study;" up to 9,000 British students in German universities between 1849 and 1914, according to Peter Alter.⁹ The founding of the journal *Nature* in 1859 gave the British additional claim to international prominence in science publishing – a field where German companies and institutions held considerable sway, which Reinhard Siegmund-Schultze has argued contributed substantially to German science's prestige in America¹⁰ – but also served to warn Britain of the superiority of German science: "Its British readers obtained from it a clearer picture of the centrality of German science...*Nature* returned incessantly to this theme with the gravity and insistence of Cato warning Rome of the danger of Carthage."¹¹

German scientific reputation and accomplishment extended beyond universities and academic research institutes, and did not derive solely from them. Industrial science and technology also played an important role. Foremost was the chemical industry, which was one of the largest in the world in the first half of the twentieth century, and in which German cartels held a dominant market share entering the First World War.¹² That war has been dubbed "The

⁷ John Davis, "Friedrich Max Müller and the Migration of German Academics to Britain in the Nineteenth Century," in *Migration and Transfer from Germany to Britain, 1660-1914*, ed. Stefan Manz et al. (Munich: KG Saur Verlag, 2007), 94.

⁸ Ibid.; Ulrike Kirchberger, "Deutsche Naturwissenschaftler im britischen Empire: die Erforschung der ausereuropäischen Welt im Spannungsfeld zwischen deutschem und britischem Imperialismus," *Historische Zeitschrift* 271, (2000).

⁹ Peter Alter, *The Reluctant Patron: Science and the State in Britain, 1850-1920* (Oxford: Oxford University Press, 1987), 25; Davis, 96.

¹⁰ Pamela Richards, *Scientific information in wartime : the Allied-German rivalry, 1939-1945* (Westport Conn.: Greenwood Press, 1994); Reinhard Siegmund-Schultze, "'Scientific control' in Mathematical Reviewing and German-U.S.-American relations between the two World Wars," *Historia Mathematica* 21, no. 3 (1994); Siegmund-Schultze, "The Emancipation of Mathematical Research Publishing in the United States from German Dominance (1878–1945)."

¹¹ Rainald von Gizycki, "Centre and periphery in the international scientific community: Germany, France and Great Britain in the 19th century," *Minerva* 11, no. 4 (1973): 477.

¹² On the chemical industry in the late-nineteenth and early twentieth centuries, in addition to the essays in John Lesch, ed. *The German Chemical Industry in the Twentieth Century* (Dordrecht: Kluwer Academic Publishers, 2000). see Werner Abelshauser and others, *Germany Industry and Global Interprise - BASF: The History of a Company* (2004); Volker R. Berghahn, ed. *Quest for Economic Empire: European Strategies of German Big Business in the Twentieth Century* (Providence, RI: Berghahn Books, 1996); Giuliano Pancaldi, "Wartime Chemistry in Italy: Industry, the Military, and the Professors," *Frontline and Factory: Comparative Perspectives on the Chemical Industry at War, 1914–1924*, no. May 1914 (2006); Peter Phillimore and Patricia Bell, "Trust and risk in a German chemical town," *Ethnos* 70, no. 3 (2005); Peter Spitz, *Petrochemicals: The Rise of an Industry* (John Wiley, 1988); Kathryn Steen, "Patents, Patriotism, and "Skilled in the Art" USA v. the Chemical Foundation, Inc., 1923-1926," *Isis* 92, no. 1 (2001); Kathryn Steen, "Technical Expertise and US Mobilization, 1917–18: High Explosives and War Gases," *Frontline and Factory: Comparative Perspectives on the Chemical Industry at War, 1914–1924*, (2006).

chemists' war' for the role chemical technologies played in extending its scope and impact, from poison gases of enormous propaganda and morale implications to the synthetic explosives, fuels, and pharmaceuticals that amplified carnage and stretched out the war's tenure.¹³ In the United States and United Kingdom, the war led to the seizure of German chemical cartels' patents through Trading with the Enemy Acts,¹⁴ combined in the postwar period with extensive government promotion of chemical autarky even as the German chemical trusts expanded again into the interwar international business world. Still, for decades the chemical industry had been almost synonymous with Germany, and in November 1943 British Members of Parliament took time to discuss the American sensation *Germany's Master Plan: The Story of Industrial Offensive* (1943), which argued that "during the past twenty years, this cartel device has been the first line of German assault."¹⁵

These chemical cartels built off of another center point of German reputation for invention and science: the Reichspatentamt, or State Patent Office. After the war, when (as will be discussed more in Chapter 2) British officials inside Germany wanted to recreate a patent office for Germany, they saw obstacles in the French, who were "anxious that the German Patent Office should never be allowed to regain its former prestige as one of the foremost Patent Offices in the world."¹⁶ As mentioned, American lawmakers and the reading public saw German patents as a powerful enough force to be leverage in economic warfare, while British policymakers had

On the chemical industry in the Second World War and postwar period, see Matthew J. Bellamy, *Profiting the Crown: Canada's Polymer Corporation, 1942-1990* (McGill-Queen's Press - MQUP, 2005); Peter Hayes, *Industry and Ideology: IG Farben in the Nazi Era* (Cambridge: Cambridge University Press, 1987); Rainer Karlsch, *Faktor Öl: Die Mineralölwirtschaft in Deutschland 1859-1974* (München: CH Beck, 2003); Arnold Krammer, "Technology Transfer as War Booty: The U.S. Technical Oil Mission to Europe, 1945," *Technology and Culture* 22, no. 1 (1981); Peter J T Morris, "A Personal Historiography of the Chemical Industry since 1956," *Bulletin of the History of Chemistry* 32, no. 1 (2007); Raymond Stokes, *Divide and prosper : the heirs of I.G. Farben under Allied authority, 1945-1951* (Berkeley: University of California Press, 1988); Raymond Stokes, *Opting for Oil: The Political Economy of Technological Change in the West German Chemical Industry, 1945-1961* (New York: Cambridge University Press, 1994).

¹³ Guy Hartcup, *The War of Invention: Scientific Developments, 1914-18* (London: Brassey's, 1988); Kevles, Ch. 8-9; David Rhees, "The Chemists' War: The Impact of World War I on the American Chemical Profession," *Bulletin of the History of Chemistry* 13-14, (1992); Steen, "Technical Expertise and US Mobilization, 1917-18: High Explosives and War Gases."

¹⁴ Steen, "Patents, Patriotism, and "Skilled in the Art" USA v. the Chemical Foundation, Inc., 1923-1926."

¹⁵ Hansard, HC, 02 November 1943, Vol. 393, col. 499-501. Joseph Borkin and Charles A. Welsh, *Germany's Master Plan: The Story of Industrial Offensive* (New York: Duell, Sloan and Pearce, 1943). On the importance of Borkin and Welsh in shaping American debates over anti-trust and economic policy towards Germany, as well as other, similar works being produced in the 1940s, see Wyatt Wells, *Antitrust and the Formation of the Postwar World* (New York: Columbia University Press, 2002), 90-113.

¹⁶ "German Patents and the German Patent Office," 11 Nov 1947. The National Archives (TNA): Public Records Office (PRO) FO 1032/93.

long blamed patent institutions for the nation's perceived industrial decline and missed opportunities for industries built on British inventions.¹⁷

In practice, Germany's lead in science and technology – such that it existed in the first place, outside of perceptions – eroded considerably in the first half of the twentieth century. Larger economic trends underlay Germany's relationship with the US, UK, and France in the first half of the twentieth century, and as Volker Berghahn has argued, "neither the pre-1945 relationship between [the US and Germany] nor what happened afterwards can be understood without conceiving of the role of technology in modern industrial societies in much broader terms, than patents and machines."¹⁸ This dissertation argues strongly against his corollary claim that the question for intellectual reparations was "no more than a very special case of limited historical significance," but there is real merit in his general observation that Germany had, over the course of the early twentieth century, been looking more and more towards America for industrial (not merely technological) leadership.¹⁹ Economics literature discussing the postwar years "have generally accorded a leading role to the transfer of American technology and organizational practices within a broad process of 'catch-up and convergence,'" referring to America's substantial lead in per capita productivity in these years (which then dwindled over the postwar decades).²⁰

The impact of the rise of the Third Reich on German science is a complex issue tied to the idea of a German *Sonderweg*, or "special path" of German history that led necessarily to the Nazi state, but in any event, it drove many of Germany's brightest scientific and technical

¹⁷ B. Zorina Khan, "Selling Ideas: An International Perspective on Patenting and Markets for Technological Innovations, 1790–1930," *Business History Review* 87, no. Spring (2013). The issues of British perceived 'industrial decline' and 'missed opportunities' are discussed in detail in Chapter 2, drawing on such work as David Edgerton, *Science, technology, and the British industrial "decline", 1870-1970* (Cambridge; New York, NY, USA: Cambridge University Press, 1996); David Edgerton, "Science and the nation: towards new histories of twentieth-Century Britain," *Historical Research* 78, no. 199 (2005).

¹⁸ Volker R. Berghahn, "Technology, Reparations, and the Export of Industrial Culture. Problems of the German-American Relationship, 1900-1950," in *Technology transfer out of Germany after 1945*, ed. Matthias Judt and Burghard Ciesla (Amsterdam: Harwood Academic Publishers, 1996), 3.

¹⁹ Volker R. Berghahn, *The Americanisation of West German Industry: 1945-73* (Oxford: Berg Publishers, 1986); Berghahn, "Technology, Reparations, and the Export of Industrial Culture. Problems of the German-American Relationship, 1900-1950."; Volker R. Berghahn, "West German Reconstruction and American Industrial Culture, 1945-1960," in *The American Impact on Postwar Germany*, ed. Reiner Pommerin (Providence: 1997); Berghahn, ed. *Quest for Economic Empire: European Strategies of German Big Business in the Twentieth Century*.

²⁰ Steven Tolliday, "Transplanting the American Model? US Automobile Companies and the Transfer of Technology and Management to Britain, France, and Germany, 1928-1962," in *Americanization and Its Limits: Reworking US Technology and Management in Post-War Europe and Japan*, ed. Jonathan Zeitlin and Gary Herrigel (Oxford: Oxford University Press, 2000). Regarding this 'catch up and converge' framing, Tolliday cites eg Nicholas Crafts and Gianni Toniolo, eds., *Economic Growth in Europe since 1945* (Cambridge: Cambridge University Press, 1996); Max-Stephan Schulze, ed. *Western Europe: Economic and Social Change since 1945* (London: Longman, 1999).

innovators abroad, especially to America and Britain, and France in the 1920 and 1930s.²¹ Among them, most famously, were Albert Einstein, Max Born, Hans Bethe, Karl Popper, and hundreds of others, at least 15 of whom would go on to win Nobel Prizes in scientific fields. Historical studies of the impact of this diaspora has emphasized its importance in shifting the center of the intellectual world away from Germany, and more than a few of these émigrés would eventually play very important roles in the Manhattan Project.²² Further, anti-German sentiment engendered in the US, UK, and France – three of the most important producers of scientific papers and personnel by this point – led to systematic exclusion of Germans from international scientific societies, journal publications, and other access points to the world of science.²³ This, too, significantly weakened Germany's relative position in research and development.

Such developments are likely much clearer in hindsight than at the time, and Germany retained much of its image of technological sophistication as the Second World War approached. Future chapters will include additional illustrations of German technology being viewed as particularly advanced. The rise of the Nazi party added a new style of 'modernity' to Germany's image, partly through the party's emphasis on 'cutting-edge' racial science, mass-media propaganda techniques, and the ties between fascism and futurism borrowed from Italy.²⁴ During

²¹ For just a sample of this extensive literature, see Mitchell G. Ash, "Denazifying Scientists and Science," in *Technology Transfer out of Germany after 1945*, ed. Matthias Judt and Burghard Ciesla (Amsterdam: Harwood Academic Publishers, 1996); Gerhard Baader and others, "Pathways to human experimentation, 1933-1945: Germany, Japan, and the United States," in *Politics and Science in Wartime*, ed. Carola Sachse and Mark Walker (Chicago: University of Chicago Press, 2005); Sören Flachowsky, *Von der Notgemeinschaft zum Reichsforschungsrat: Wissenschaftspolitik im Kontext von Autarkie, Aufrüstung und Krieg* (Stuttgart: Steiner, 2008); Hermoine Giffard, "Engines of Desperation: Jet Engines, Production and New Weapons in the Third Reich," *Journal of Contemporary History* 48, (2013); Hayes; Susanne Heim, Carola Sachse, and Mark Walker, *The Kaiser Wilhelm Society under National Socialism* (Cambridge: Cambridge University Press, 2009); Kristie Macrakis, *Surviving the Swastika: Scientific Research in Nazi Germany* (Oxford: Oxford University Press, 1993); Helmut Maier, *Forschung als Waffe: Rüstungsforschung in der Kaiser-Wilhelm-Gesellschaft und das Kaiser-Wilhelm-Institut für Metallforschung 1900-1945/48* (Göttingen: Wallstein, 2007); G Rammer, "Die Nazifizierung und Entnazifizierung der Physik an der Universität Göttingen" (Georg-August-Universität Göttingen, 2004); Carola Sachse, *Die Verbindung nach Auschwitz: Biowissenschaften und Menschenversuche an Kaiser-Wilhelm-Instituten* (Göttingen: Wallstein, 2003); Ralf Schabel, *Die Illusion der Wunderwaffen* (Munich: R. Oldenbourg, 1994); Mark Walker, *Nazi Science: Myth, Truth, and the German Atomic Bomb* (Cambridge, MA: Perseus Publishing, 1995); Mark Walker, "The Nazification and Denazification of Physics," in *Technology transfer out of Germany after 1945*, ed. Matthias Judt and Burghard Ciesla (Amsterdam: Harwood Academic Publishers, 1996).

²² On the emigration of German scientists to the West, and those who stayed, see especially: Macrakis; Monika Renneberg and Mark Walker, *Science, technology, and national socialism* (Cambridge [England]; New York, NY, USA: Cambridge University Press, 1994); Siegmund-Schultze, *Mathematicians Fleeing from Nazi Germany*; Walker, *Nazi Science: Myth, Truth, and the German Atomic Bomb*; Walker, "The Nazification and Denazification of Physics."

²³ Daniel J. Kevles, "'Into Hostile Political Camps': The Reorganization of International Science in World War I," *Isis* 62, no. 1 (1971).

²⁴ On Nazism and modernity, see Zygmunt Bauman, *Modernity and the Holocaust* (Ithaca, NY: Cornell University Press, 1989); Mario Biagioli, "Science, Modernity, and the 'Final Solution'," in *Probing the Limits of Representation: Nazism and the 'Final Solution'*, ed. Saul Friedlander (Cambridge: Harvard

the war itself, Germany developed or deployed several innovative military technologies, including jet engine aircraft (albeit at the very end of the war), advances in small arms, particularly high quality tanks, and most famously, the V-1 and V-2 missiles.²⁵

Given this background and the complete authority the military governments had over the territory they occupied within Germany, it is perhaps unsurprising that reparations efforts would include efforts to 'take' German science and technology. Editorials in American trade journals, newspaper op-eds, and government planning documents show that this idea was appealing – or at least sounded reasonable – to a wide range of business and government leaders in the 1940s. Sidney Kirkpatrick, editor of *Chemical and Metallurgical Engineering*, was a major booster of such efforts, writing in May 1945, "We are not seeing reparations in money, goods, or land. But what we can obtain in the way of new science and technology, processes, patents, and know-how, can be used by the democracies in building a better and safer world."²⁶ An engineer lamented in *Aero Digest* in April 1946 that "We'll Just Never Learn," as "Very few persons realize that the technical information which we have 'liberated' in Germany is one of the biggest 'reparations' we may ever receive."²⁷ Nor was this interest solely American: when offered the opportunity to participate in the British program to hire German scientists for industry, representatives from Canada, Australia, India, and South Africa eagerly accepted (and in fact, South Africa signed on in 1948 after having tried to operate such a program independently).²⁸ As later chapters will discuss, the reactions to German science and technology varied considerably across industry and attained a note of disappointment upon the investigators reaching German facilities, but the initial interest was widespread and intense.

Existing historiography has done an admirable job of addressing many of the particulars of the American investigative efforts, and smaller but still useful bodies of works contribute to understanding the British²⁹ and French³⁰ exploitation efforts as well. Though still in need of

University Press, 1992); Victoria De Grazia, *How Fascism Ruled Women: Italy, 1922-1945* (Berkeley, CA: University of California Press, 1992); Peter Jelavich, "National Socialism, Art and Power in the 1930s," *Past & Present* 164, (1999); Suzanne Marchard, "Nazi Culture: Banality or Barbarism?," *Journal of Modern History* 70, (1998); Scott Spector, "Was the Third Reich Movie-Made? Interdisciplinarity and the Reframing of Ideology," *American Historical Review* 106, no. 2 (2001).

²⁵ On these developments, see Wayne Biddle, *Dark Side of the Moon : Wernher von Braun, the Third Reich, and the Space Race* (New York: W.W. Norton, 2009); William Manchester, *The Arms of Krupp, 1587-1968: The Rise and Fall of the Industrial Dynasty That Armed Germany at War* (Boston: Back Bay Books, 2003); Michael J. Neufeld, *The Rocket and the Reich: Peenemünde and the Coming of the Ballistic Missile Era* (New York: Free Press, 1995); Michael J. Neufeld, *Von Braun : dreamer of space, engineer of war* (New York: A.A. Knopf, 2007); Michael J. Neufeld, "The Nazi aerospace exodus: towards a global, transnational history," *History and Technology* 28, no. 1 (2012).

²⁶ Sidney Kirkpatrick, "The Clock Strikes Twelve," *Chemical and Metallurgical Engineering*, May 1945, p.93.

²⁷ "We'll Just Never Learn" *Aero Digest*, April 1946, p.23, 169-170.

²⁸ Carl Glatt, "Reparations and the Transfer of Scientific and Industrial Technology from Germany: A Case Study of the Roots of British Industrial Policy and of Aspects of British Occupation Policy in Germany between Post-World War II Reconstruction and the Korean War" (European University Institute, Florence, 1994), 893.

²⁹ David Cassidy, "Controlling German science. I: US and allied forces in Germany, 1945-1947," *Historical studies in the physical and biological sciences* 24, no. 2 (1994); David Cassidy, "Controlling

additional study (which this dissertation will not attempt), the Soviet case has attracted a number of high-quality histories as well.³¹

German science, II: Bizonal occupation and the struggle over West German science policy, 1946-1949," *Historical studies in the physical and biological sciences* 26, no. 2 (1996); Edgerton, *Science, technology, and the British industrial "decline", 1870-1970*; Edgerton, "Science and the nation: towards new histories of twentieth-Century Britain."; Clive Edwards, "Technology Transfer and the British Furniture Making Industry, 1945-1955," *Comparative Technology Transfer and Society* 2, no. 1 (2004); J. Farquharson, "Governed or Exploited? The British Acquisition of German Technology, 1945-48," *Journal of Contemporary History* 32, no. 1 (1997); Glatt; Franklyn A. Johnson, *Defence by Ministry: British Ministry of Defence, 1944-1974* (Holmes & Meier Publishers, 1980); R. V. Jones, *The Wizard War : British Scientific Intelligence, 1939-1945* (New York: Coward, McCann & Geoghegan, 1978); Paul Maddrell, "British-American Scientific Intelligence Collaboration during the Occupation of Germany," *Intelligence and National Security* 15, no. 2 (2000); Patricia Meehan, *A Strange Enemy People: Germans under the British, 1945-50* (London: Peter Owen, 2001); Ian D. Turner, ed. *Reconstruction in Post-war Germany : British Occupation Policy and the Western Zones, 1945-55* (New York: St. Martin's Press, 1989); Matthew Uttley, "Operation 'Surgeon' and Britain's post-war exploitation of Nazi German aeronautics," *Intelligence and National Security* 17, no. 2 (2002); W. K. Wark, "British Intelligence on the German Air Force and Aircraft Industry, 1933-1939," *The Historical Journal* 25, no. 3 (1982); David Cameron Watt, *Britain Looks to Germany: British Opinion and Policy Towards Germany since 1945* (London: Oswald Wolff, 1965).

³⁰ Nicholas Chevassus-au-Louis, *Savants sous l'Occupation: Enquête sur la vie scientifique française entre 1940 et 1944* (Paris: SEUIL, 2004); Corine Defrance, "La mission du CNRS en Allemagne (1945-1950)," in *La revue pour l'histoire du CNRS* (2001); Jean-François Eck, "Les contacts entre groupes de l'industrie chimique français et allemands de 1945 à la fin des années 1960: Entre compétition et coopération," in *Réseaux économiques Et Construction Européenne: Economic Networks And European Integration*, ed. Michel Dumoulin (Bruxelles: P.I.E.-Peter Lang, 2004); Marie-France Ludmann-Obier, "Le contrôle de l'industrie chimique en zone française d'occupation en Allemagne (1945-1949)" (University of Strasbourg III, 1986); Marie-France Ludmann-Obier, "Un aspect de la chasse aux cerveaux : les transferts de techniciens allemands, 1945-1949," *Relations internationales* 46, (1986); Marie-France Ludmann-Obier, *Die Kontrolle der chemischen Industrie in der französischen Besatzungszone 1945-1949* (Mainz: V. Hase & Koehler, 1989); Marie-France Ludmann-Obier, "La mission du CNRS en Allemagne (1945-1950)," *Cahiers pour l'Histoire du CNRS 1939-1989* 3, (1989); Dominique Pestre, "Guerre, renseignement scientifique et reconstruction, France, Allemagne et Grande-Bretagne dans les années 1940," in *De la diffusion des sciences à l'espionnage industriel, XVe-XXe siècle : actes du colloque de Lyon (30-31 mai 1996) de la SFHST*, ed. André Guillerme (Fontenay-aux-Roses (France): ENS Editions, 1999); Jacques Villain, "France and the Peenemuende Legacy," in *History of Rocketry and Astronautics: Proceedings of the Twenty-Sixth History Symposium of the International Academy of Astronautics, Washington, D.C., U.S.A., 1992*, ed. Phillippe Young (San Diego: Univelt, for the American Astronautical Society, 1997); Jacques Villain, "L'apport des scientifiques allemandes aux programmes de recherche relatifs aux fusées et avions à réaction à partir de 1945," in *La France face aux problèmes d'armement 1945-1950*, ed. Maurice Vaisse (Bruxelles: Complexe, 1999).

³¹ See especially Cassidy, "Controlling German science. I: US and allied forces in Germany, 1945-1947."; Norman M. Naimark, *The Russians in Germany : a history of the Soviet Zone of occupation, 1945-1949* (Cambridge, Mass.: Belknap Press of Harvard University Press, 1995); Andre Steiner, "The Return of German "Specialists" from the Soviet Union to the German Democratic Republic: Integration and Impact," in *Technology transfer out of Germany after 1945*, ed. Matthias Judt and Burghard Ciesla (Amsterdam: Harwood Academic Publishers, 1996); Raymond Stokes, "Assessing the Damages:

Most historiography of the American case – and as a result, much of the literature on other nations, which often uses the American studies as models – frames the importance of Allied scientific exploitation through two issues: reparations, and the morality of using 'Nazi' science and recruiting 'Nazi' scientists. The preeminent historian of the scientific and technical investigations and their connection to reparations is John Gimbel, whose *Science, Technology, and Reparations: Exploitation and Plunder in Postwar Germany*, published in 1990, shook the episode from relative obscurity through a forceful and well-researched argument that this form of "intellectual reparations" was on the scale of contemporary Soviet reparations taken in physical plant. Gimbel argued that although American diplomats argued for moral authority in the Cold War by claiming to have refused reparations while the Soviets looted East Germany, in fact these intellectual reparations were of similar value to the US economy: "I admit quite frankly that I am no closer to a precise evaluation [of the value of these 'reparations'] than anyone else. What I have been able to show, however ... is that the amount and the value are by no means insignificant. The \$10 billion figure bandied about by the Russians and their friends and dismissed by State Department functionaries as 'fantastic' is probably not far from the mark."³²

Responses to *Science, Technology, and Reparations* included a conference in 1996 to discuss various additional dimensions of scientific exploitation of Germany, resulting in an edited volume, *Technology Transfer out of Germany after 1945*.³³ The ten essays in this collection address a wide range of topics, from Nazi influences on physics to how 'intellectual reparations' might fit into established concepts of international law, and I will address the specifics of several over the course of the dissertation. Of particular interest is Raymond Stokes' contribution on the chemical industry, in which he suggests that in the chemical industry, "neither Allied hopes nor German fears of the forced technology transfer programs were realized, although one of the programs' unintended effects was to promote integration of each of the postwar German states into the sphere of influence dominated by one of the two superpowers."³⁴ This is an argument with which I am in broad agreement, and as I will argue throughout the dissertation, applies considerably beyond the chemical industry – in fact, it is perhaps less true for chemicals than it is for many other – and runs contrary to much of the other writing on the topic, which tends to adopt Gimbel's methodology and conclusions.

The second line of writing on postwar scientific exploitation focuses on 'Nazi scientists' and their recruitment into American and British science. I use the term 'Nazi' here in scare quotes because, though there were, in fact, scientists taken into the United States, United Kingdom, and France with undeniable Nazi pasts, the label was applied very broadly by contemporary newspapers and some historians since. Nearly all scientists later denied party membership, but

Forced Technology Transfer and the German Chemical Industry," in *Technology transfer out of Germany after 1945*, ed. Matthias Judt and Burghard Ciesla (Amsterdam: Harwood Academic Publishers, 1996).

³² John Gimbel, *Science, Technology, and Reparations: Exploitation and Plunder in Postwar Germany* (Stanford: Stanford University Press, 1990), 169-170.

³³ Matthias Judt and Burghard Ciesla, eds., *Technology Transfer Out of Germany After 1945* (Amsterdam: Harwood Academic Publishers, 1996).

³⁴ Stokes, "Assessing the Damages: Forced Technology Transfer and the German Chemical Industry," 83.

many genuinely did avoid joining the party at real personal risk.³⁵ This literature tends to focus primarily on one aspect of the American case, Operation Paperclip, most famous for bringing German scientist Wernher von Braun to the United States.³⁶ This topic includes more than a few works by journalists and popular historians, some of which are very well written, but tends to engage less (or at least less explicitly) with the other historiography. This dissertation will rarely touch on the moralistic issues of the right and wrong of hiring former Nazis.

Consequences and Importance of Scientific Exploitation

Given this historiography attention already paid to this topic, the most important question to address – as, indeed, in nearly any academic work – is why additional research matters, what justifies the topic. To a minor extent, the popular and academic interest in this episode is itself a justification, assuming there are new archives and sources to use to flesh out some segments less studied. Additional details alone would not be a particularly compelling reason to study this topic in more detail, however.

Further study of the Allied exploitation efforts, studied in a comparative manner rather than on a national basis, matters on two scales. First, it allows better understanding of the events themselves, which played significant and underappreciated roles in shaping the economies, diplomacy, and internal politics of the involved nations. Second, it allows a reframing of larger historical trends, such as the challenges posed by exponential growth in scientific and technical information in the twentieth century, and the technologies used to combat resulting organizational issues; the growing importance of science and technology in international relations and national security considerations; and related to each of these, a growing awareness of the importance of tacit knowledge or 'know-how' for understanding, controlling, and transferring science and technology.

The discussion of 'intellectual reparations,' as this dissertation will attempt to corroborate, tends to ask the wrong questions about why and how these efforts at scientific exploitation matter, because they tend to adopt a fairly simplistic model of technology transfer and scientific communication. To be sure, technology transfer is not a field in which any significant amount of consensus has been reached, and figuring out the contributing and potentially negative factors

³⁵ See Macrakis; Renneberg and Walker; Walker, *Nazi Science: Myth, Truth, and the German Atomic Bomb*; Walker, "The Nazification and Denazification of Physics."

³⁶ Works on Paperclip include Michael Bar-Zohar, *The Hunt for German scientists* (London: Barker, 1967); Tom Bower, *The Paperclip Conspiracy : The Hunt for the Nazi Scientists* (Boston: Little, Brown, 1987); Gimbel; Manfred Herrmann, *Project Paperclip: Deutsche Wissenschaftler in diensten der U.S. Streitkräfte nach 1945* (Nürnberg: 1999); Linda Hunt, *Secret Agenda : The United States Government, Nazi Scientists, and Project Paperclip, 1945 to 1990* (New York: St. Martin's Press, 1991); Franz Kurowski, *Alliierte Jagd auf deutsche Wissenschaftler: Das Unternehmen Paperclip* (München: Kristall bei Langen Müller, 1982); Clarence G. Lasby, *Project Paperclip: German Scientists and the Cold War* (New York: Atheneum, 1971); Lilli Peltzer, *Die Demontage deutscher naturwissenschaftlicher Intelligenz nach dem 2. Weltkrieg* (Berlin: ERS - Verlag, 1995); Albert Presas i Puig, *Reflections on a Peripheral Paperclip Project : A Technological Innovation System in Spain based on the Transfer of German Technology* (Berlin: Max-Planck-Institute for the History of Science, 2008).

has been a driving question in the history of technology.³⁷ This episode is an opportunity to learn about technology transfer, rather than assuming one way or another the value of the technology 'taken' from Germany through 'intellectual reparations.' Given three nations with a desire to learn from Germany's accomplishments, a particular asymmetry of power between the occupiers and occupied, and the differences between the occupying nations, what factors seem to have aided or impeded successful technology transfer and scientific communication? This will be a central theme in this dissertation, and in particular, the role played by the knowledge that people at the time called 'know-how.'

The term 'know-how,' meaning something like "inventions, processes, formulas, designs, skilled manual methods, [and] preferred sequences of industrial operations learned from practical experience,"³⁸ saw a dramatic increase in usage starting in the 1940s.³⁹ (see Chapter 6 for details). This attention paid to intangible knowledge, in turn, had serious implications for policy in Germany the wider postwar business and legal worlds. It was not the basic idea of know-how – or 'tacit knowledge' as it is sometimes called, especially in academic circles where the term was coined by scientist and philosopher Michael Polanyi – that was new. The accumulated skills and insights gained by personal experience were the basis for apprenticeships and guild systems, one

³⁷ Michael Eckert, "Strategic Internationalism and the Transfer of Technical Knowledge: The United States, Germany, and Aerodynamics after World War I," *Technology and Culture* 46, no. 1 (2005); Karen Johnson Freeze, "Innovation and Technology Transfer during the Cold War: The Case of the Open-End Spinning Machine from Communist Czechoslovakia," *Technology and Culture* 48, no. 2 (2007); Pal Germuska, "Conflicts of Eastern and Western Technology Transfer Licenses, Espionage, and R&D in the Hungarian Defense Industry during the 1970s and 1980s," *Comparative Technology Transfer and Society* 7, no. 1 (2009); Jonathan D. Hagood, "Why Does Technology Transfer Fail? Two Technology Transfer Projects from Peronist Argentina," *Comparative Technology Transfer and Society* 4, no. 1 (2006); J. R. Harris, *Industrial espionage and technology transfer: Britain and France in the eighteenth century* (Aldershot, Hants, England; Brookfield, VT: Ashgate Pub., 1998); Mikael Nilsson, "The Power of Technology: U.S. Hegemony and the Transfer of Guided Missiles to NATO during the Cold War, 1953–1962," *Comparative Technology Transfer and Society* 6, no. 2 (2008); Scott W. Palmer, *Dictatorship of the air: aviation culture and the fate of modern Russia*, Cambridge centennial of flight (Cambridge; New York: Cambridge University Press, 2006); Liv Ramskjaer, "Users and Producers of Plastics in Post-World War II Norway: Building a New Industry Through Transfer of Technology," *Comparative Technology Transfer and Society* 3, no. 1 (2005); Mike H. Ryan, "The Role of National Culture in the Space-Based Technology Transfer Process," *Comparative Technology Transfer and Society* 2, no. 1 (2004); Bruce Edsall Seely, "Historical Patterns in the Scholarship of Technology Transfer," *Comparative Technology Transfer and Society* 1, no. 1 (2003); Bruce Edsall Seely, Donald E. Klingner, and Gary Klein, "'Push' and 'Pull' Factors in Technology Transfer Moving American-Style Highway Engineering to Europe, 1945–1965," *Comparative Technology Transfer and Society* 2, no. 3 (2004); Baichun Zhang, Jiuchun Zhang, and Fang Yao, "Technology Transfer from the Soviet Union to the People's Republic of China: 1949–1966," *Comparative Technology Transfer and Society* 4, no. 2 (2006).

³⁸ John B. Nash, "The Concept of 'Property' in Know-how as a Growing Area of Industrial Property: Its Sale and Licensing," *Patent, Trademark, Copyright Journal of Research and Education* 6, (1962): 289.

³⁹ See Chapter 6 for full details, but most usage data derives from Google's N-gram tool (<https://books.google.com/ngrams>), as well as other databases such as the law review collections of HeinOnline (<http://home.heinonline.org/>).

of the primary methods of intergenerational technology transfer for hundreds of years.⁴⁰ As businessmen and policymakers started to pay increased attention to this tacit knowledge component of technology, however, worries about capturing know-how fundamentally shaped the American, British, and French exploitation efforts; and longer-term, the legal and business structures for tech transfer in the postwar world. There are certainly many other factors that likely contributed to the dramatic increase in the importance of know-how in this period, including increasingly complex technology shared by newly-important multinational corporations, but investigators' experiences in Germany served as a catalyst for this change, drawing widespread attention to it at this critical period.

Structure and Overview

This dissertation is structured (if informally) into two parts, each consisting of three chapters. The first section examines the experiences of France, the United Kingdom, and the United States, in turn, in their attempts to exploit German science and technology. They are not treated in isolation, but the density of acronyms, people, and organizations involved in each case makes this initial national division a useful simplifying structure. The second part, in contrast, addresses broader, thematic issues from a comparative standpoint. As such the dissertation tends to move from a narrow to an increasingly wider lens.

The **first chapter** addresses the French occupation of Germany, and the mutual shaping of diplomatic relations between France and its allies and the domestic project of revitalization of French science and technology. The relative diplomatic isolation of France from the US and UK, born of mutual distrust and the role that communists played in postwar French society and politics, put less pressure on the French to conform to the Anglo-American models of exploitation than might have been the case had relations been warmer and efforts to coordinate more holistic. That relative isolation, combined with important policymakers' fundamentally different understanding of technology transfer, led to French exploitation efforts that diverged from the other allies' in important ways. French policymakers' conception of science and technology as deeply, fundamentally socially embedded led to very different strategies for exploiting German advances than those taken by America and Britain, which only generated more friction among the allies even as they debated policies for Germany's future. Meanwhile, this same French belief in the inutility of extracting German scientific personnel or facilities led to strategies of exploitation in place and building collaborative Franco-German research centers, a policy that likely had significant impact in easing antagonism between these nations and integrating their scientific and economic systems in the early formative era of a European economic community.

The **second chapter** addresses the efforts by the United Kingdom as it sought to balance two increasingly urgent priorities emerging from the war: a need to maintain or improve relations with the United States, on whose strength and alliance Britain's postwar security would be built; and the need to develop export industries to pay down national debt and repair balance-of-trade

⁴⁰ Pamela O. Long, "Invention, Authorship, "Intellectual Property," and the Origin of Patents: Notes toward a Conceptual History," *Technology and Culture* 32, no. 4 (1991); Pamela O. Long, *Openness, Secrecy, Authorship: Technical Arts and the Culture of Knowledge from Antiquity to the Renaissance* (Baltimore: Johns Hopkins University Press, 2001).

issues, to be jump-started through efficient integration of German technology into British (and colonial) industry. The efforts by the United Kingdom following the Second World War to exploit German science and technology for the benefit of British industry were a key site of a shifting understanding of state-sponsored technology transfer. Amidst Parliamentary and bureaucratic debates about the relationship between scientific knowledge and gaining economically useful technology, British industrial investigators scoured Germany for patents, blueprints, trade secrets, and in some cases, skilled personnel. Though this was initially conceived in part as a diplomatic tool to draw together American and British intelligence, the difficulties in transferring technology via written – and therefore easily reproducible – means forced a shift towards a more self-interested exploitation style emphasizing 'know-how,' or 'tacit knowledge.' These scientific exploitation efforts, in turn, were part of and influenced a broader process in which ideas of 'know-how' were permeating British intellectual property law and policy debates over the state's role in promoting export industry and scientific excellence.

The sharp contrast between expectations and reality of German technology superiority, and the importance of investigations of German technology for America's image at home and abroad, lies at the heart of the **third chapter**. Since the 1990s, historiography about American reparations policy towards Germany following the Second World War has emphasized the 'intellectual reparations' taken in terms of patents, industrial investigations, and the hiring of German scientific and technical personnel in Western countries. Both the popular and academic histories about this topic focus on the 'value' of these reparations, yet this emphasis involves both evidentiary and theoretical problems. While American companies expressed great enthusiasm for investigations of German science and technology, they also frequently wrote about their disappointment with what they found in Germany; and in any case, the fundamental differences between intellectual and material property must be taken seriously in accounting for gains and losses. The greatest discovery of American industrial investigators in Germany was not a cache of new technologies or scientific secrets, but rather a new perception of American technology and industry as leading the world. Whatever the 'value' of these reparations in monetary terms, this reorientation of America's perceived place in the world is likely far more important in the diplomatic context of the quickly developing Cold War.

With at least the basics of each nation's efforts understood, **Chapter Four** examines the international phenomenon of the vast increase in scientific and technical information being communicated in the twentieth century, and argues that the exploitation efforts in Germany both reflected and significantly worsened these problems. As a result, it was a significant impetus towards some of the solutions, which became fundamental to the fields of library and information science. In many ways, the efforts and relative failures to deal with the glut of information produced by investigations in Germany were the metastasis of a much larger issue in scientific communication, and in communication in general, that had been developing for decades. An exponentially growing world of international science had led to a number of technological innovations in the nineteenth and early twentieth centuries, such as expanded use of microfilm and the collation and distribution of scientific bibliographies. The Second World War fractured the lines of communication that ran through this world wide web of scientific periodicals and personal connections just as science and technology became more of a priority for national security than ever before, leading states to invest significant resources into moving intelligence agencies into investigating and prioritizing targets of science and technology, while similar investments expanded the scientific world still further. The war's end, combined with

dozens of agencies from a number of countries pouring over Germany's scientific 'secrets,' led to a massive overload in the ability of earlier information technologies such as microfilm distribution to make this information available in an efficient manner. The result was a major investment of the postwar state into science and technology as intelligence targets and investments in scientific communication, but also another spur for the often-observed expansion of classified science and dependence on defense funding for science.

The **fifth chapter** explores the new roles that science and technology played in state strategies for diplomacy and control in the wake of the Second World War. Recent historiography has emphasized the ways in which the United States government, acting in concert with 'neutral' charitable agencies such as the Rockefeller and Ford Foundations, used science as a source of soft power and coalition-building throughout Cold War Europe.⁴¹ This chapter expands on this work to argue that the United Kingdom and France, too, were attempting to use science and technology as tools of soft power in reshaping Germany, each other, and themselves in the early postwar period. Though the details of its use and perceived utility varied by country, the integration of science into diplomacy and increased perception of science and technology shaping the societies around them – and thus, being important considerations in nation-building and control – was an international phenomenon.

The **final chapter** takes the widest lens, tracing the phenomenon of 'know-how' that so confounded the allied exploitation efforts into the realm of legal and business history. The 1950s and early 1960s saw an explosion of 'know-how agreements' and 'know-how licenses' between international businesses that sought to transfer technology, usually in combination with patent licenses but increasingly replacing them. In the United States, the importance of know-how for business thrived even as (and perhaps partly because of) a trend of antitrust zeal that severely undermined the utility of patents and other intellectual property. The chapter traces the legal position of know-how in the US and Europe across the twentieth century, and argues that while its rise was most likely due to a combination of a great many factors, the experiences of investigators and administrators in postwar Germany played an important role in shaping the debate and resultant policy.

⁴¹ John Krige, *American Hegemony and the Postwar Reconstruction of Science in Europe* (Cambridge, Mass.: The MIT Press, 2006).

Chapter 1: French Scientific Exploitation and Technology Transfer from Germany in the Diplomatic Context of the Early Cold War

Abstract: While most discussions of the international efforts at postwar exploitation of German science and technology by the Allied occupation powers assume similar methods and aims across the nations involved, the French case diverges in important ways because of important policymakers' fundamentally different understanding of technology transfer. The Americans and British hoped to enlist the French in exploitation programs similar to their own, and to an extent succeeded, but persistent distrust of French motives largely prevented coordination beyond the surface level. French policymakers' alternate conception of science and technology as socially embedded led to very different strategies for exploiting German advances, and despite postwar antagonism, led to Franco-German research collaboration that would prove valuable building relationships between these nations.

I. Introduction

Emerging from the Second World War, the Provisional Government of France (which would turn into the Fourth Republic in 1946) faced challenges ranging from rebuilding its economy to regaining international influence and overcoming the shame of Vichy collaboration. Policymakers in France and elsewhere saw science and technology as important resources in rebuilding in the postwar world, yet like the rest of the country, France's laboratories, universities and factories had suffered serious damage and loss of personnel during the war.¹ Germany had not been uniformly destructive to French science, instead hoping to use scientific ties and shared library resources as a symbol of alliance between Nazi Germany and the Vichy regime, but the anti-Jewish laws, wartime bombing and looting and the loss of talented personnel on the front lines left the scientific infrastructure in a poor state.

In the context of these challenges, and at the additional prompting of the United Kingdom and the United States, missions sprang up in the French bureaucracy to exploit German science and technology as a way to leap back to the forefront of science; to achieve, in the words of one French scientist, 'the preeminence to which we pretend'.² To this extent, the French efforts fit neatly into the international story of the unprecedented attempt at mass technology transfer enacted by the victorious power during and following the Second World War, aimed at utilizing German science and technology in their own militaries and civilian economies. Such efforts, enacted in varied forms by the United States, United Kingdom, France and the Soviet Union,

¹ For nuclear science as an investment made by the French state with the conscious aim of using technology to build a new national identity, see Gabrielle Hecht, *The radiance of France: nuclear power and national identity after World War II* (Cambridge, Mass.: The MIT Press, 1998). For the struggles of French science under Nazi occupation, see Chevassus-au-Louis.

² Economie Nationale, "Le Problème de la recherche technique et scientifique allemande," 10 March 1946. A[rchives] N[atationales de] F[rance,] F[ontainebleau], C[entre] N[atationale de] R[echerche] S[cientifique] records, R[ecord] G[roup] 19780283, carton 35.

combined collection of artifacts – blueprints, prototypes, patents, etc. – with interviews, interrogations and job offers for German scientific and technical personnel.

The postwar efforts by the United States and Soviet Union to make use of German science and technology have received considerable academic and journalistic attention in recent decades, and they were no great secret from newspapers at the time.³ The titles and subtitles of some of these works illustrate the moralistic tone many of these studies exhibit: 'the hunt for Nazi scientists'; 'exploitation and plunder'; 'secret agenda'. In the standard portrayal in these works, competition between investigators from the formed Allied nations led to a cut-throat frenzy of looting this 'intellectual war booty' and 'intellectual reparations'. Estimates of the value of these 'intellectual reparations' vary enormously. Contemporary Soviet accusations aimed at the Truman administration proposed that the US had taken over \$10 billion, a figure historian John Gimbel considered largely plausible in his study of the American effort.⁴ More qualitative attempts to highlight these programs' impacts point to the boost given to the incipient American space program by Werner von Braun's team of rocket scientists, then extrapolate outwards to great technological benefits.⁵

Though roughly analogous programs to exploit German science and technology did exist in each of the nations occupying Germany (and indeed technical investigators from many more nations visited occupied Germany in the postwar decade), the large majority of this historiography centers on the American efforts, especially the FIAT (Field Intelligence Agency, Technical). The Soviet Union has received the most attention of the remaining three Powers, with its dramatic seizure of thousands of German scientists and technicians in 'Operation Osoaviakhim' in October 1946 making headlines at the time and remaining part of most histories of East Germany.⁶ Both the United States and Soviet Union saw scientists and technical personnel as war assets worth denying to other nations even at significant cost, and planned to

³ Gimbel.; Berghahn, "Technology, Reparations, and the Export of Industrial Culture. Problems of the German-American Relationship, 1900-1950."; Cassidy, "Controlling German science. I: US and allied forces in Germany, 1945-1947."; John Gimbel, "The American Exploitation of German Technical Know-How after World War II," *Political Science Quarterly* 105, no. 2 (1990).; Herrmann.; Hunt.; Bower.; Lasby.; Judt and Ciesla, eds.; Neufeld, "The Nazi aerospace exodus: towards a global, transnational history."

For an example of contemporary news coverage, see for example Franklin M. Davis, Jr., "The Army's Technical Detectives," *Military Review* 28, (1948).; John MacCormac, "Russians Seize Nazi Assets, Austrians and U.S. Protest," *New York Times*, 7/7/46 1946.

⁴ Gimbel, *Science, Technology, and Reparations: Exploitation and Plunder in Postwar Germany*. See especially p. 169-170: "I admit quite frankly that I am no closer to a precise evaluation [of the value of these 'reparations'] than anyone else. What I have been able to show, however ... is that the amount and the value are by no means insignificant. The \$10 billion figure bandied about by the Russians and their friends and dismissed by State Department functionaries as 'fantastic' is probably not far from the mark."

⁵ An interesting exception to these rosy estimates is Stokes, "Assessing the Damages: Forced Technology Transfer and the German Chemical Industry." Stokes' conclusions are 'tentative,' but still very well argued. In this, he is in partial disagreement with Kramer.

⁶ On the USSR efforts, see especially Cassidy, "Controlling German science. I: US and allied forces in Germany, 1945-1947."; Naimark; Steiner; Stokes, "Assessing the Damages: Forced Technology Transfer and the German Chemical Industry."

harness some of Germany's vaunted scientific and technological prowess to strengthen their own economies and militaries.

Extrapolating from the American and Soviet cases to the British and French is deeply problematic, however, and the latter even more so than for the former. While the United Kingdom and the United States worked closely together on these exploitation efforts – another aspect of the 'Special Relationship' in intelligence cooperation they maintained throughout much of the Cold War – France remained largely on the outside. Eventually American and British officials decided that there was more to be gained than lost by (partially) giving in to French pressure to cooperate in these exploitation efforts, which was to be handled by newly-created organizations operating under the names FIAT (US), FIAT (BR) and FIAT (France). These FIAT branches authorized and provided logistics for teams of investigators to visit other occupation zones, and the French efforts appeared to France's allies similar in purpose and function to their own.

The outward similarities in the bureaucratic organization of these efforts to utilize German science and technology in fact disguised essential differences between the US approach and that of the French Fourth Republic. The French military did adopt many of the tactics utilized by the American and British wartime efforts to understand and acquire German innovations in aeronautics and electronics. When it came to the much broader postwar efforts to exploit German science and technology for the benefit of civil industry, however, chief French policymakers' fundamentally different understanding of the possibilities and limitations of technology transfer, combined with the often-recognized diplomatic prioritization of suppressing German resurgence in any form, led to very different policy in practice than that pursued by the other Western Allies. If the US efforts relied upon an arguably overly optimistic view that science and technology could be lifted whole-cloth from Germany and dropped into American industrial and military labs without complication, France operated from an almost opposite set of assumptions, in which there was no point in even attempting systematic recruiting of German personnel or seizure of German labs or factories, because minds and even labs taken from their contexts were thereby rendered 'practically sterile'.⁷

Working from this set of assumptions, FIAT (France) and its organizers continued to facilitate American and British investigations, but French efforts mostly shifted to emphasize 'controlling' German science by rebuilding German labs in the French Occupation Zone as collaborative Franco-German institutions, where the training of German and French scientists could be shaped and monitored. This, in turn, would help alleviate stark needs for scientifically-trained personnel by creating French scientists with the skills of Germans, but with the ties to France to be useful, trustworthy, and (unlike German imports) politically acceptable. This was not an absolute doctrine – there are certainly important cases of the recruitment of German scientific and technical personnel by the French government. Nor was it France's first choice of policies – the ongoing diplomatic tension between France and its Anglo-American allies deeply shaped France's postwar science and technology policy by limiting what policymakers perceived as possible. In this way, this episode is a key site and example of the mutual formation of international relations and science and technology policy in an era of rapidly, overtly politicized

⁷ Economie Nationale, "Le Problème de la recherche technique et scientifique allemande," 10 March 1946. ANFF, CNRS records, RG 19780283, carton 35.

science. This French policy of scientific exploitation *in place* might well have both failed to achieve its immediate aims of control and been a great advantage to building Franco-German economic cooperation in the longer view.

II. Anglo-American Projections of French Intentions

American and British distrust of France in intelligence matters (and much else) persisted from de Gaulle's wartime leadership through his provisional postwar government and into the Fourth Republic. During the war, the G-2 (Intelligence) division of the Supreme Headquarters, Allied Expeditionary Force (SHAEF) operated a Combined Intelligence Objectives Subcommittee (CIOS) tasked with choosing targets for scientific and technical intelligence missions. As the liberation of France began in June 1944, SHAEF moved to France and set up a liaison office to coordinate with the newly created Provisional Government of the French Republic. Still, France was still not considered a true 'Power' in the same sense as the United States, United Kingdom and Soviet Union. As just one obvious example of this dynamic, we might consider the Yalta and Potsdam conferences of 1945 consisting of discussions amongst the Big Three – not Big Four – regarding plans for postwar Europe.⁸

As CIOS learned of potential targets for technical exploitation, it added the most promising and important leads to its secret 'Black List,' while less pressing or security-related targets went on the 'Grey' or 'White' lists. As SHAEF forces pushed into and beyond France, they were accompanied by so-called 'T-Forces,' units operating under the authority of Section T subdivision of G-2, tasked with securing the facilities on these black and grey lists as they fell within Allied control. According to a later CIOS report, 'during the pre-invasion days and the Battle of France, various French agencies and individual officers rendered great assistance to Allied agencies in the collection of German technical and economic intelligence in France.'⁹ During the quick advances of 1945, the expulsion of Germany from France and formation of the French Provisional Government, however, a large number of Black List targets slipped by the T-Force troops. Now under the sovereign authority of this Provisional Government, investigative teams needed the cooperation of French authorities in order to reach and legally investigate them.¹⁰ G-2 was placed in a bind between a desire to maintain secrecy from the French and the need for French cooperation.

On 24 January 1945, the G-2 officer in the SHAEF Mission to France sent an official request back to headquarters in which it was 'tentatively proposed' to send names of targets to the

⁸ Regarding France's relative place in postwar diplomatic discussions, see for example Alec Cairncross, *The Price of War : British Policy on German Reparations, 1941-1949* (New York, NY: Blackwell, 1986); Cassidy, "Controlling German science. I: US and allied forces in Germany, 1945-1947."; John Gimbel, *The Origins of the Marshall Plan* (Stanford: Stanford University Press, 1976); William Hitchcock, *France restored : Cold War diplomacy and the quest for leadership in Europe, 1944-1954* (Chapel Hill: University of North Carolina Press, 1998).

⁹ F.A.A. Blake, Col., General Staff (GS), G-2 to Office of the A C of S, G-2, S[hared] H[eadquarters,] A[llyed] E[xpeditionary] F[orce], 25 June 1945. RG 260, Vol. 17, Box 2, folder 8. N[ational] A[rchives] at] C[ollege] P[ark, College Park, MD].

¹⁰ F.A.A. Blake, Col., GS, G-2 to Lt. Col. Stagnaro, le Chef de la 2eme Section, d'É[tat-]m[ajor] G[eneral de la] D[éfense] N[ationale], "German Technical Intelligence in France," 31 Jan. 1945. RG 260, Vol. 17, Box 2, folder 8. NACP.

French government, extending to a copy of the Black List.¹¹ Approval came through, of a kind. Brigadier General J.J. Davis of the Adjutant General Corps in the US Army sent authorization with a strict warning: while the CIOS Geographic Black List could be shared, the CIOS 'technical item' Black List 'will in no circumstances be issued and care should be taken to ensure that the French do not become aware of its existence'.¹² SHAEF (France) sent an invitation to General Alphonse Juin, Chief of the General Staff for National Defense in the French army, who was eager for the opportunity – so long as it was on French terms. Juin freely admitted that such investigations had 'value not open to question' and were 'greatly to be desired,' but insisted that special instruction be given to avoid the impression that the US and UK were investigating French industry. 'Such an investigation into the workings of French concerns might run the risk of causing a certain uneasiness among the French industrialists whose plants were investigated, as well as among the public generally. Those who were insufficiently informed as to the real purposes of the inquiries might quite honestly interpret them as being a technical investigation of French industry.'¹³ Whether these remarks were a veiled warning against overstepping their bounds or a sincere effort to avoid misunderstandings, Juin was sold on the idea of cooperation for the exploitation of German industry, and in the same letter introduced the newly created 'Comité de coordination scientifique'. This group would be an analogue of the joint US-UK Field Information Agency, Technical (FIAT), and indeed soon became known as FIAT (France), even using this nickname on its own stationary. Juin finished his response by suggesting that this collaboration extend beyond the border of France and into Germany itself, in a truly cooperative and integrated intelligence effort.

This was a step further than the Anglo-American alliance was willing to go, at least without significant hedging and drawn out discussion. SHAEF suggested sharing the Black List with France in January 1945, yet only received permission for the partial list in March, then the first response to Juin's suggestion of closer collaboration came in May, when the Combined Chief of Staff in Washington pushed the matter off still further, saying they 'consider[ed] it inexpedient to take action in Washington relating to details of internal administration' and would refer the matter back to SHAEF (who had referred the matter to the Chiefs in the first place months earlier).¹⁴ In mid-June, US Adjutant General Davis agreed in principle to a reciprocal arrangement in which express authority would be required from an occupation zone's administrations before investigators could be sent or files copied, then again insisted to SHAEF (France) that the CIOS technical item black list must remain strictly secret from the French.¹⁵ French Army General Block-Dassault, President of the Comité de coordination scientifique, was among several French officials who registered complaints about this continued formal exclusion from the Anglo-American technical intelligence missions. He insisted that they be represented on

¹¹ A.S. Knight, Col., GSC, Chief 'T' Sub-Division, G-2, to G-2, SHAEF Mission (France), "German Technical Intelligence in France," 24 Jan. 1945. RG 260, Vol. 17, Box 2, folder 8. NACP.

¹² J.J. Davis, Brig[adier] Gen[eral], A[djutant] G[eneral], to Head, SHAEF Mission (France), "French Participation in the Collection of Technical Information in Germany," 15 June 1945. RG 260, Vol. 17, Box 2, folder 8. NACP.

¹³ A. Juin, Gen., Chief, EMGDN to General Commanding, SHAEF Mission (France), "General Technical Intelligence in France," 28 Feb. 1945. RG 260, Vol. 12, Box 2, folder 8. NACP.

¹⁴ Combined Chiefs of Staff, Washington, D.C. to Chief of the French Military Mission. RG 260, Vol. 12, Box 2, folder 8. NACP.

¹⁵ J.J. Davis, Brig. Gen., AG, to Head, SHAEF Mission (France), "French Participation in the Collection of Technical Information in Germany," 15 June 1945. RG 260, Vol. 17, Box 2, folder 8. NACP.

the CIOS committee, criticized the 'attitude' of SHAEF and generally lobbied to 'participate fully with the British and US Forces in the collection of technical and economic intelligence.'¹⁶ Delays continued. In June 1945, the US and UK intelligence units insisted that no agreement could be completed prior to the upcoming dissolution of SHAEF – fully eight months after the first suggestion by G-2 of cooperation with the French on matters of technical intelligence – and that even then, the matter was 'still under consideration by higher authority' than G-2 itself.¹⁷

Late August finally saw some progress in integrating the French, if only in deciding what limits to place on cooperation. FIAT (BR) – now a separate, national entity with the dissolution of SHAEF – decided that 'no release of information from the FIAT Secret records ... be made to the French. Information from the non-Secret records,' however, 'may be given.'¹⁸ Visits to the French zone could be arranged through the French Liaison officer to FIAT (BR). US authorities clearly agreed with this assessment of how much (or little) to trust the French, as a November 1945 memo from the Deputy Military Governor for Germany to the Joint Chiefs of Staff requested that the long-standing ban on sharing secret files with the French be extended to Soviet requests.¹⁹ In the early occupation phase, it seems, the French were even less trusted (or at least less important to placate) than the Soviets.

The ongoing debates over official policy on how far to trust France to join the scientific exploitation efforts did not prevent unofficial cooperation throughout much of this period. Hundreds of investigative teams from dozens of organizations and missions streamed into occupied Germany: military intelligence branches, government-sponsored industrial investigators and recruiters, the Strategic Bombing Survey, a Technical Oil Mission, the ALSOS survey of German atomic weapons research and many others from the US and UK; similar mixes of military-sponsored groups and investigators organized by the Board of Trade for the UK; and the Centre nationale de recherche scientifique (National Center for Scientific Research, CNRS) mission to investigate German science and technology, military agencies and the secret services tasked with extracting desired personnel and various agencies with ties to the occupation authority for the French. Reciprocal arrangements allowed teams to receive passes to investigate targets within each zone, and the national FIAT services organized these through liaison offices. In his initial letter, General Juin commented that 'such a collaboration ... has already been put into effect on several occasions,' and throughout 1945 and 1946 both sides emphasized the importance of 'informal contact on technical points,' a 'desire to see personal contacts maintained,' 'the present cordial and effective relationship ... strengthened'.²⁰

¹⁶ "Report on French Participation in the Collection of Technical Intelligence in Germany," 24 June 1945. RG 260, Vol. 17, Box 2, folder 8. NACP.

¹⁷ P.M. Wilson, Major, G.S., Enemy Personnel Exploitation Section, G-2, FIAT to Intelligence Section, Exploitation Division, U[nited] S[tates] S[trategic and] T[actical] A[ir] F[orces], "Exploitation of German Personalities in French Zone," 8 June 1945. RG 260, Vol. 17, Box 2, folder 8. NACP.

¹⁸ H. Read, Lt. Col. to RJ Maunsell, Brig. Gen., Chief FIAT (Britain), "Exchange of Information with the French," 20 August 1945. RG 260, Vol. 17, Box 1, folder 30. NACP.

¹⁹ Deputy Military Governor (US) for Germany to Joint Chiefs of Staff, 21 Nov. 1945. RG 260, Vol. 13, Box 3, folder 11. NACP.

²⁰ A.S. Knight, Col., GSC, Chief 'T' Sub-Division, G-2, to G-2, SHAEF Mission (France), "German Technical Intelligence in France," 24 Jan. 1945. RG 260, Vol. 17, Box 2, folder 8. NACP; A. Juin, Gen., Chief, EMGDN to General Commanding, SHAEF Mission (France), "General Technical

The lack of a formalized and lasting coordination structure allowed room for clandestine action, though, and the French military and secret service was no more afraid to make aggressive bids for technical personnel than were the other nations investigating Germany. In May 1945, the same month as the creation of the Comité de coordination scientifique (aka FIAT (France)), de Gaulle – prompted by an optimistic note from General Juin – issued a top secret order authorizing the 'transfer' of German scientists and technicians 'of great value' to France for interrogation and to 'engage them to stay at our disposition'.²¹ The details of how to determine this 'great value' were not discussed, nor were the limits of how to 'engage them to stay'.

The American and British agencies involved in exploiting German science and technology certainly felt aggrieved by anecdotes of French teams sneaking in and 'stealing' away promising personnel with more lucrative contracts or freedoms than they had been offered by the US or UK. In June 1945, Brigadier General Eugene Harrison, Assistant Chief of Staff of G-2, sent a file to his superiors detailing French 'violations' to date.²² A German radio engineer reported that the Secretary of the French Committee for Industrial Production had told him in December 1944 'that he was not to reveal to the Americans or British any details of Germany radio and radar technique, manufacturing methods, or research'. Dr Wilde, the director of the German firm Askania, claimed a similar warning from the French Navy, in fact that he had been threatened with being added to the Allied List of War Criminals if he were to share his knowledge with the Americans or British. Several other CIOS-sponsored teams reported similar instruction from French officials, from the Sécurité militaire as well as the Navy, Industrial Production and the Arsenal. At this point, Harrison added that 'difficulties in the French area have been very few and have been largely limited to the field of electronics,' but nonetheless this information was significant enough to merit a note hand-written on this report by its recipients: 'A special file on French activities of this nature should be kept.'

Whether for this report or not, incidents accumulated in American and British records of French 'misdeeds,' perceived or real. When the French detained the chairman of the board of Messerschmitt, a prominent German aircraft company, along with cartons of the company's records, it was felt 'that if this incident had not been witnessed by an Allied officer, the existence of this material would not have been made known to the Allies'.²³ Separate reports from February, May and July 1946 tell of several incidents of scientists hired by French agents despite their being in the custody of British or American FIAT, and in one case, V-weapons researcher Herman Ehrenspeck was jailed for threatening to go to the French zone without permission

Intelligence in France," 28 Feb. 1945. RG 260, Vol. 12, Box 2, folder 8. NACP; "Report on French Participation in the Collection of Technical Intelligence in Germany," 24 June 1945. RG 260, Vol. 17, Box 2, folder 8. NACP.

²¹ In the original French: "Il y aura lieu de faire transférer en France les scientifiques ou techniciens allemands de grande valeur pour les faire interroger à loisir sur leurs travaux et éventuellement les engager à rester à notre disposition." SHAT/EMGDN, 5 P 118. Reference originally found in Ludmann-Obier, "Un aspect de la chasse aux cerveaux : les transferts de techniciens allemands, 1945-1949."

²² Eugene L. Harrison, Brig. Gen., G.S.C., G-2 to 'T' Sub-Division, G-2, SHAEF Mission (France), "Activities of Sécurité militaire," 2 June 1945. RG 260, Vol. 17, Box 2, folder 8. NACP.

²³ "Report on French Participation in the Collection of Technical Intelligence in Germany," 24 June 1945. RG 260, Vol. 17, Box 2, folder 8. NACP.

rather than surrender his papers to FIAT for inspection.²⁴ The American State-War-Navy Coordinating Committee (SWNCC) – tasked by the Joint Chiefs of Staff with developing 'long-range Government policies and procedures' regarding the exploitation of German scientists – drafted a report in March 1946 warning that if efforts weren't quickly escalated, the Russians were 'already proceeding with an aggressive policy of long-range exploitation' and the French were 'offering lucrative contracts to selected specialists'.²⁵ Similarly, US Army's Air Intelligence Division issued a report in April 1946 listing ten 'typical' cases of exploitation by the 'French and Russian agents' with which the American zone was 'literally crawling'.²⁶ A State Department official reported in June 1946 that they had 'caught the French red-handed again stealing scientists out of our zone'.²⁷

To the extent that existing historiography touches on French actions aimed at exploiting German science and technology, it frequently reflects this Anglo-American perception of the French as playing a shadier version of the same game as the US and UK. Gimbel's *Science, Technology, and Reparations*, the preeminent work on the American FIAT program, mentions the French almost exclusively in this context.²⁸ Reports from Europe 'describe intense and secretive French recruitment efforts,' including a French liaison officer 'caught ... in the dead of the night' loading wind-tunnel experts for the French zone.²⁹ Before extrapolating from these reports, however, we must take into account the rhetorical uses made of these anecdotal 'French and Russian agents' apparently on a frenetic, secret search for German science and technology.

There is little reason to doubt that there were attempts by the French military and security services to recruit specific German scientists, at least in particular scientific-technical fields and to a limited extent – this will be the focus of the next section – but these anecdotes and preexisting distrust of the French Provisional Government were combined to form a perception of the French as playing a more underhanded but fundamentally similar sort of game as the American and British. These stories, in turn, were used to promote the construction of detention camps for German scientists and technicians (known as 'Dustbin' and 'Ashcan') and increased funding and attention given to existing exploitation efforts. US and UK reports argued, basically, that they had better amplify their own efforts, because after all everyone else was already doing

²⁴ "Report on French Participation in the Collection of Technical Intelligence in Germany," 24 June 1945. RG 260, Vol. 17, Box 2, folder 8. NACP; FIAT (US) to Enemy Personnel Exploitation Section, FIAT (Britain), 8 Feb. 1946. RG 260, Vol. 17, Box 1, folder 30. NACP; A.E. O'Flaherty, Jr., Col., Infantry, Chief, Operations Branch, FIAT (US) to Office of the Assistant Chief of Staff, G-2, Operations Branch, Technical Intelligence Unit, US F[orces] E[uropean] T[heater], "Evacuation of German Scientists to French Zone," 28 May 1946. RG 260, Vol. 17, Box 1, folder 30. NACP.

²⁵ Gimbel, *Science, Technology, and Reparations: Exploitation and Plunder in Postwar Germany*, 41-42.

²⁶ *Ibid.*, 46-47.

²⁷ *Ibid.*, 47.

²⁸ It should be noted that Gimbel is completely open about this, as his aim was to examine the American case from American and German files, with the French, British, and Russian cases explicitly left for future historians. His discussion of the French in this context, then, is by no means a criticism of his work, but rather a reflection of the perception of the agencies whose records he studied. See Gimbel, *Science, Technology, and Reparations: Exploitation and Plunder in Postwar Germany*, xi.

²⁹ *Ibid.*, 40.. These reports are cited therein as USFET, G-2, to Chief of Staff, USFET, subj: evacuation of German scientists by France, 13 Feb. 1946, RG 332, ETO, USFET, G-2 Section, Operations Branch, box 25, Correspondence, 1945, WNRC; Clay to General Pierre Koenig, 13 Feb. 1946, *ibid.*

it, and they wouldn't want to miss out in this zero-sum game of scientific and technical war booty. This conception of French motives and methods of scientific intelligence both augmented and reflected diplomatic tension among the Western Allies, yet disguised much deeper differences in attitudes towards the possibility of technology transfer; and these tensions, in turn, would shape the execution of the French efforts at exploiting German science and technology.

III. French Policy and Perceptions of Technological Embeddedness

Certain policymakers and powerful institutions within France – especially the military – most certainly did see great potential gains from exploiting German science and technology through investigations and hiring personnel, and they operated a systematic effort to target those of particular value from 1945 through at least about 1950. The results of this were significant, particularly in the emerging field of military aerospace technology (and even more specifically V-2-based ballistic missiles). Some hundreds of German scientists were brought to France in these years. However, in the context of the broad ambitions of the American and British FIAT programs' aim for sweeping industrial technological gains and meaningfully large-scale denial of technical personnel to the Soviets, and eventual Soviet policy of forcing thousands of Germans to move into Soviet territory and ongoing technology transfer efforts from their occupation zone, even these analogous French military efforts were modest in ambition and scale.³⁰ They also represent a split with the broader French efforts at scientific and technical intelligence, in which such attempts to take scientists and technicians from their contexts was considered necessarily futile.

Within the French military, and by extension the military occupation authority initially in control of the French zone in Germany, enthusiasm for German technology was every bit as apparent as in the American or British cases. On 16 May 1945, the Chief of Staff of the Defense nationale send a top secret message to General de Gaulle, reporting that 'the results obtained, especially in the domain of secret weapons, has very much impressed those who have examined them,' adding that certain personalities had already been brought consensually to Paris for interrogation, which de Gaulle quickly agreed was a fine way to proceed.³¹ By November 1946, the Minister of Armaments reported that it had imported about 800 technical personnel.³² Though the report with this specific number has few other declassified details, much of this must be associated with the efforts of the Armament's sub-branch GOPA (Groupe opérationnel des projectiles autopropulsés) to study and recreate the German V-2 rockets. This group, led by Professor Henri Moreau, advanced from collecting parts of V-2s used on and around Paris to investigating the plants – some of them on French soil, others in the French zone of occupation – in which they were built and tested, and finally to the direct recruitment of German personnel who had worked on the V-2 rockets.³³ For Moreau and 'certain military authorities,' Jacques Villain writes in a history of the V-2 's legacy in France, 'it was clear that, before undertaking to

³⁰ Regarding American aims at civilian industry, see, for example the aims of FIAT (US) as portrayed by General Clay, head of the US occupation authority in Germany: "with respect to trade processes and advanced scientific thought, we are taking the thought of German scientists and fashioning it for our own purposes ... squarely in the commercial field." Cited in *ibid.*, viii.

³¹ Ludmann-Obier, "Un aspect de la chasse aux cerveaux : les transferts de techniciens allemands, 1945-1949," 196-197.

³² *Ibid.*, 198.

³³ Villain, "France and the Peenemuende Legacy," 124.

produce the missile, France should first assimilate the German know-how ... [It] was also clear that it was necessary to obtain the services of the German specialists who had designed this equipment.³⁴ Villain does not provide a final number for the personnel recruited for this expansive and decades-spanning effort to harness the information gleaned from the V-2 and its designers to boost French military aeronautics, but at least 123 technicians were hired from the Peenemunde alumni alone. The V-2 rocket had a major psychological impact, despite its relatively modest impact as a functional weapon during the war, and France was as eager as any of the victorious powers to expand upon its apparent potential.

Outside of these limited fields and cases, however, a very different attitude prevailed. Like in the US and UK, many different French agencies had some role in the exploitation of German science and technology. In fact, the bureaucratic lines could become very difficult to untangle even at the time. A FIAT (France) report on 4 July 1946 complains that no fewer than three separate agencies possessed, in theory, a monopoly on commerce between France and occupied Germany, which somewhat frustrated several others with mandates to import goods and hire personnel from these areas.³⁵ Among the prominent agencies with at least a potential mandate to exploit German science and technology for civilian industrial purposes, the most active were the Centre nationale de recherche scientifique (CNRS) mission to Germany; the branches of the Production industrielle, Économie nationale and Education nationale tasked with the occupation zone; and the Comité de coordination scientifique (aka FIAT (France)). These were not fully independent entities, nor were their relationships stable over the course of their lifetimes (roughly the mid-1940s to early 1950s). The CNRS mission was at one point in 1945 attached to FIAT (France), but the director of the Education nationale thought that it should be under his purview, leading to an administrative battle that remained a seed of resentment even after a nominal compromise involving a shared deputy position.³⁶ Several additional restructurings took place in 1946 alone, and finally FIAT (France) was replaced in April 1947 with a new entitle, Service de documentation extérieure et de contre-espionnage (SDECE), a general intelligence agency with a scientific and technical aspect.

Key policymakers in charge of these missions held a fundamentally different view of the possibilities and limitations of technology transfer than did their American (or even French military) counterparts, and this led to the employment of significantly different strategies for utilizing and controlling German science and technology. An early expression of this comes in a report authored by the Service for German Affairs of the Économie nationale titled 'The Problem of German Scientific and Technological Research,' dated 10 March 1946.³⁷ The destruction and interdiction of scientific research in Germany, it argued, is neither truly desirable nor realistic.

³⁴ Ibid., 127.

³⁵ The SIE had a monopoly on importations to France; the Commercial Mission had a monopoly on commercial contracts between France and Germany; OFICOMEX (the Office for External Commerce) had a monopoly on commercial operations in the French occupation zone; and possibly more had similarly overlapping "sole" authority. Caigniard, Lt. Col., Section d'information scientifique (FIAT (France)), Chef de la Sous-Section CNRS, "Note pour le Centre National de la Recherche Scientifique," 4 July 1946. ANFF, CNRS records, RG 19780283, carton 35.

³⁶ For a fuller history of the organizational ties of the CNRS mission to Germany, see Ludmann-Obier, "La mission du CNRS en Allemagne (1945-1950)." and Defrance.

³⁷ Economie Nationale, "Le Problème de la recherche technique et scientifique allemande," 10 March 1946. ANFF, CNRS records, RG 19780283, carton 35.

Instead, German science must be controlled and turned to the benefit of the entire world, or failing that, at least for the benefit of France. Transfers of material or personnel, however, cannot accomplish this goal. The 'milieu' around a scientist, including personal contacts, is so essential that 'a top scientist or technician displaced in another country ... is practically rendered sterile.'³⁸ Transferring such a person, 'by cutting all his connections, seriously diminishes German science ... [and] he does not regain his dynamism until after he has established new connections with the French scientific community ... It is therefore preferable to let him reside in Germany and to control his activity in a manner of use to the French state.'³⁹ 'In general, the transfer of German laboratories and centers of research would cause a considerable diminution and render laboratories of little value and difficult to integrate into the French economy.'⁴⁰ This is not simply an argument that transfers would be difficult, or hiring Germans politically embarrassing (though these arguments were brought up as well). This is a conception of science and technology as profoundly embedded in the societies around them, demanding a completely different policy for maximally making use of these resources for the benefit of France.

The Économie nationale was only one of the agencies involved in this interconnected web of those exploiting Germany. During the following meeting of FIAT (France) – which included representatives from CNRS, the Défense nationale, several of the military investigation agencies and the Centre national d'études des télécommunications (National Center for Telecommunication Studies, CNET) – this report was a topic of conversation recorded in detail in the meeting's minutes. For Engineer General P.T.T. Janes, head of CNET, 'the principles enunciated are excellent, in particular the national problem is perfectly posed.'⁴¹ Engineer General de Saint Paul, head of FIAT (France), echoed its words almost verbatim: he [felt] that the transfer of research establishments to France considerably diminishes what they can give us. Researchers work in teams [underlined in the original] and it is pointless to hope that some technicians taken from their establishments could continue their work in good condition.'⁴² The military representatives present made no mention of the report – indeed, Captain Demeocq of the Navy focused his report around worries over the somewhat dubious prospect of the Germany breaking up military research into parts performed across the four occupation zones so as to

³⁸ In French, "un savant ou un technicien déplace dans un autre pays ... est pratiquement rendu stérile." *Ibid.*

³⁹ "L'intérêt du transfert est pratiquement nul lorsqu'il existe en France un organisme analogue à celui qui existe en Allemagne ... Un transfert, en coupant tous ces liens, dévaloriserait fortement le centre allemand. Il ... ne reprendrait de dynamisme qu'après avoir rétabli de nouveaux liens avec les milieux scientifiques français ... Il est alors préférable de laisser subsister le centre allemand et de contrôler son activité de manière à retirer de l'état d'avancement de la recherche scientifique et technique en Allemagne." *Ibid.*

⁴⁰ "En règle générale, le transfert des laboratoires et centres de recherches allemands amènera une diminution considérable du rendement de ces laboratoires qui seront d'une intégration difficile et peu rentable dans l'économie française." *Ibid.*

⁴¹ "Les principes énoncés sont excellents : en particulier le problème national est parfaitement pose." "Procès-Verbal de la 3eme Séance du Comité de coordination scientifique de Défense Nationale, Réunion Spéciale, a la Grande Chancellerie de la Légion d'Honneur," 25 March 1946. ANFF, CNRS records, RG 19780283, carton 35.

⁴² Il "estime que le transport des établissements de recherche en France diminuera considérablement leur rendement. Les chercheurs travaillent en équipes et il est vain d'espérer que quelques techniciens prélevés sur un établissement pourront continuer leur travaux dans de bonnes conditions." *Ibid.*

continue it without the individual occupying nations being aware, and suggested closer inspections in case – but clearly this argument of technological embeddedness either made a serious impression on most involved or reflected a shared, preexisting belief.

The result of France's subsequent half-hearted cooperation with American and British FIAT agencies was confusion and suspicion. American and British investigators were allowed into the French zone, but their orders for copies of documents were considered slow, which caused considerable concern for the other Western powers. In the view of FIAT (Britain), 'the difficulty at the moment is not so much that the French are unwilling to let us or the Americans, or for that matter anyone else, have a look at [French zone technical information], but that they have not made any attempt to co-ordinate it in such a way that their own industrialists or the other interested powers can use it. So far as we and the Americans are concerned, the French collection seems to be the only substantial block of data that is likely to escape us.'⁴³ American and British representatives debated through the late 1940s 'whether they [the French] have valuable information which they wish to keep to themselves, or whether they think we can be lured yet further with what may prove to be mediocre bait.'⁴⁴ The idea that French policymakers could simply not believe in the cost-effectiveness of splicing German technology into France's economy rarely seems to have occurred to the other major powers.

With such a different conception of the possibilities of technology transfer, new methods of harnessing German science and technology would be needed for these agencies to fulfill their missions, and they settled around what I will call the 'Stagiaires plan,' 'stagiaires' being a French term for 'trainee' or 'intern'.

IV. The Stagiaires Plan and Scientific Control from Within

If scientific prowess could (and should) be neither destroyed nor effectively transplanted, the CNRS mission and Économie nationale suggested, it would be necessary to *control* scientific establishments *in place*. This, in turn, required the support of French researchers qualified to work in laboratories.⁴⁵ More specifically, a CNRS report (undated but located near the May 1946 reports in the archives) on the subject of 'Control of German research' outlines a plan in which French stagiaires (trainees) would be placed in German laboratories to complete their training.⁴⁶ Though a simple plan, its objectives were ambitious: 'The problem of limiting research is, above all, a problem of control of training and control of what is studied.'⁴⁷ By embedding French trainees in German labs, the proposal went, France would simultaneously have a direct window into exactly what type of research those labs were pursuing and gain highly competent scientists

⁴³ Derek Wood, letter to A. Percival, Esq., British Embassy. 29 May 1947. B[ritish] N[atational] A[rchives], P[ublic] R[ecords] O[ffice], BT 211, carton 24.

⁴⁴ "Report on Visit to Hoechst, Offenburg, Baden-Baden and Paris, 21-27 July 1946. BIOS Trip No. 2575," 27 July 1946. BNA, PRO, BT 211, carton 17.

⁴⁵ CNRS, "Note sur le contrôle de la recherche allemande," date unknown. ANFF, CNRS records, RG 19780283, carton 35.

⁴⁶ *Ibid.*

⁴⁷ *Ibid.*

and technicians who retained enough connection to France to utilize German advances in their home context.⁴⁸

This plan quickly gained acceptance beyond CNRS. In December 1946, the Commission for Foreign Affairs addressed this proposal. One attendee, M. Wurmser, insisted that they send abroad only those 'already formed,' as those too young might learn 'more than just techniques,' apparently a threatening prospect.⁴⁹ M. Rapkine, who had previously served as a sort of wartime scientific ambassador to the United Kingdom and helped smuggle scientists out of Vichy France, agreed in part, but recommended sending people 'intermediate' in their training as a compromise. After a long discussion, they found themselves worried that upon the stagiaires' return to France, it would be difficult for them to 'work profitably,' but hesitantly agreed to send those who wished to go to specific labs.

Results of the stagiaires plan were underwhelming from a control standpoint. In a meeting of the High Commission for Research in Germany, held in March 1947 – a commission that included representatives from most of the groups operating in the field of exploitation of German science – this effort received its first reviews. The stagiaires, 'whose official purpose [was] to learn German methods, but who had the aim of "pumping" information about German labs,' 'could not take part in any activity of this genre,' having been placed in a position wherein no one would confide in them and they learned little, either of science or illicit planning.⁵⁰ The trainees simply were not being included in any lab decisions that might be secret, since they were seen as agents of the control authority. By October 1947, seven months later, the plan's original purpose had been abandoned, though the basic program continued. In a meeting on October 13, General Humbert, speaking for this committee, 'remarked that the training of French students and engineers in German laboratories didn't present any real value from the point of view of control'.⁵¹

By this point, however, much of the non-military infrastructure for exploiting German science and technology was being (or had already been) dismantled. The CNRS mission's initial goals included control and exploitation of German science, but according to M. Decombe, its leader in 1950 writing in retrospect, the mission had disappointed many.⁵² Its ambitions and effective mission shrank quickly to restocking French labs with physical equipment, and even in this it had mixed results. The ongoing bureaucratic struggles for control of the mission had led to some estrangement with the Ministry of Finances, and in 1945 the Minister withdrew permission for CNRS to import goods from the occupation zone as reparations or war booty, instead setting

⁴⁸ Economie Nationale, "Le Problème de la recherche technique et scientifique allemande," 10 March 1946. ANFF, CNRS records, RG 19780283, carton 35.

⁴⁹ "Procès-Verbal de la réunion de la sous-Commission des Relations avec l'Etranger," 14 Dec. 1946. ANFF, CNRS records, RG 19780283, carton 24.

⁵⁰ "Stagiaires, qui a pour but officiel de se former aux méthodes allemandes, mais pour but officieux de 'pomper', tout ce qu'ils peuvent dans les laboratoires allemandes ... ils n'ont pris aucun engagement de ce genre." "Compte rendu de la 1ere reunion de la commission superieure de la recherche scientifique en allemagne, tenue le 3.3.47 a Baden," 3 March 1947. ANFF, CNRS records, RG 19780283, carton 36.

⁵¹ "Reunion de la commission superieure de la recherche scientifique en allemagne en date du 13 Octobre 1947," 13 Oct. 1947. ANFF, CNRS records, RG 19780283, carton 36.

⁵² Decombe, Chef de la Sous-Section CNRS, FIAT (France) to M. Autheman (Decombe to Autheman), "A l'attention de Monsieur Autheman," 2 Feb. 1950. ANFF, CNRS records, RG 19780284, carton 115.

a firm price of 80% of the world market rate.⁵³ Labs and companies had placed orders for equipment expecting it to be free of charge, and so complained when CNRS attempted – with great difficulty and limited success – to collect this money. This effort to procure scientific equipment came to dominate the efforts of the CNRS mission. Bureaucracy, rather than any particular external pressures or challenges of technology transfer, absorbed this arm of technical exploitation, and though its struggles to remain intact by switching its location in the bureaucratic organizational charts succeeded through the dissolution of the French occupation zone, the CNRS mission had little significance in terms of technology transfer or scientific control.

V. Consequences of an *in situ* Approach

Though the French strategy of exchanging trainees and thereby indirectly encouraging the integration of German advances into the French economy was a disappointment to some of its planners, this does not mean it was a completely wasted effort. While France did not establish tight control over German science, there is considerably more reason to believe that these efforts built lasting bonds, both academic and industrial, between the two nations. In a history of Franco-German industrial cooperation from 1945 through the 1960s, Jean-Francois Eck traces the actual and perceived 'mediocre results' of the exploitation efforts and the contemporary disappointment of private industry.⁵⁴ However, from the late 1940s onwards, an 'interpenetration of interests' and compatible organization in the nations' chemical industries led to an explosion of joint ventures. As the same factors that excluded France from the Anglo-American 'special relationship' promoted a Western Europe under French and West German leadership, these nations grew together economically as well as politically. As Gerard Bossuat argues in his study of Franco-German military cooperation 1945-63, 'the Franco-German industrial cooperation was justified by the construction of Europe ... Franco-German relations were at the heart of the success of the modernization of French armaments,' using as an example one of the labs initially considered for transfer deep into France but instead left in place and turned into the 'Franco-German Institute for Research at Saint-Louis'.⁵⁵

Further, while exact budgetary numbers spent on exploitation are difficult to find, and would be even more difficult still to compare between nations, it is difficult to imagine that the approach taken by the French (outside of the military effort to improve electronics and rocketry technology via importing Germans) was as expensive as the American approach of sponsoring industrial investigative teams, copying field reports and patents, shipping prototypes, shipping technical personnel and their families to the US even before finding employment for them, and having a branch of the Department of Commerce dedicated to advertising and distributing this information.⁵⁶ These savings, in turn, might well have made possible the French CNRS and other

⁵³ "Compte Rendu sue la mission du CNRS en Allemagne," 25 Nov. 1946. ANFF, CNRS records, RG 19780284, carton 115.

⁵⁴ Eck.

⁵⁵ M. Gérard Bossuat, "Armements et relations franco-allemandes (1945-1963): Coopération et recherche de puissance.," in *Histoire de l'Armement en France de 1914 a 1962: Institutions, industries, innovations, relations internationales : actes du colloque du 19 novembre 1993*, (Paris: ADDIM, 1993), 156.

⁵⁶ Gimbel, *Science, Technology, and Reparations: Exploitation and Plunder in Postwar Germany*. See esp. p. 94-114.

scientific and technical missions to the United Kingdom and the United States, which were lightly funded in any event, yet reportedly yielded great benefits to French science and industry.⁵⁷ Yves Rocard and Louis Rapkine, scientists of some renown in France, each spent time on missions to the United Kingdom, not only performing the duties of a modern scientific attaché (such as fulfilling orders for journal subscriptions and arranging housing for visiting scientists), but also investigating British industrial technologies and helping make commercial connections to French industry.⁵⁸

Claims that these missions resulted in great value should not be taken at face value any more than other claims of enormous value from 'intellectual reparations,' but at the least they provided insight into the structure of industry in these other nations, maintained personal connections, and generated goodwill. Occurring at roughly the same time as American and British expressions of deep distrust for French intentions, the missions mark another area in which science and technology served as tools of diplomacy in this period, tying together nations reluctant to cooperate in more overtly 'political' realms. John Krige has compellingly demonstrated that American institutions (public and private) used science and technology as tools for knitting together an American-oriented, international (but anti-Soviet) network of scientific and technical elites in the 1940s onward, while relying on the nominally 'apolitical' nature of science as a shield against accusations of imperialism or meddling.⁵⁹ The French scientific missions to the US and UK provided similarly unobjectionable opportunity to maintain and advance industrial and scientific ties at a time of difficult diplomatic relations – a policy not so different, in fact, from that aimed at keeping tabs on German science and technology.

While difficult to quantify, the Franco-German collaborations created by French scientific control policy – by leaving laboratories in place and attempting to mold the education of both French and German scientists and engineers – seem likely to have created important benefits for both the French scientific community and economy. The stagiaires might have been lousy intelligence agents, but they still gained valuable experience and connections working with top German scientists, expanding the pool of scientific manpower in a vital period of rebuilding. The creation of several important Franco-German research institutes during this early postwar period, as well as the shared experiences in French and German labs of temporary German hires and temporarily embedded stagiaires might also have served as a meaningful step in the Franco-German economic cooperation so important to rebuilding both France itself and an integrated European marketplace. Even if the first class of *stagiaires* was not particularly successful in forging tight connections to the German researchers under whose training they were placed, the research institutes in which they were inserted continued on. Future classes, focusing on science

⁵⁷As evidence of this lack of funding, Jean LeComte, Director of Research for CNRS, was sent on a fact-finding mission to America and Canada in 1947 to learn of advances in infrared technology. Though he claims significant advances came from this trip, each of his several reports complains bitterly of not having enough money to visit with scientists in off hours, eat well, or travel comfortably, damaging the networking benefits of the trip. Jean Lecomte, Directeur de Recherches au CNRS, "Rapport presente a la Direction generale des Relations culturelles," Nov. 1947. ANFF, CNRS records, RG 19780284, carton 56. Of course, his claims of great value obtained from these trips should be taken at face value no more than the claims of enormous value from 'intellectual reparations' examined elsewhere in this study.

⁵⁸ Pestre.; ANFF, CNRS records, RG 19780284, cartons 57-60.

⁵⁹ Krige.

without intelligence duties and perhaps chosen from those younger students that French planners initially feared might be too impressionable, had opportunities to make connections on significantly better terms. John Gimbel makes a similar suggestion for the American case that the business connections made by the much briefer FIAT investigators in the field served as a 'conveyer-belt for future business connections,' as has Werner Abelhauser about the importance of these 'immaterial reparations' in reintegrating West Germany into the world economy.⁶⁰

VI. Conclusions

The international scale and ambitions of the Allied experiments in scientific intelligence is itself remarkable. FIAT (US) 'processed over 29,000 reports, confiscated 55 tons of documents, and made over 3,400 trips within Germany...through June 30, 1946.'⁶¹ The United Kingdom issued a press release that was re-printed in the *Daily Express* claimed to have investigated 12,000 targets and written 1,200 reports (American reports, they suggested, 'are more exhaustive but not so highly selective as the British') by October of that same year.⁶² Statistics for the French side are more difficult to come by, but as at least once indication, and in August 1946, FIAT (US) recorded about one-third as many French investigators and teams as British ones touring the US zone (33 French teams compared to 101 British).⁶³ Still, France played a significant role in these cooperative and competitive efforts. Especially in aeronautics and electronics, German scientific and technical personnel offered expertise of real (albeit difficult to quantify) value to a French nation seeking a resurgence of military might and international influence. The magnitude and limits of international cooperation in this effort make it an important inflection points in the perceived importance of science and technology for the newly-emerging national security state of the early Cold War. A desire to exploit targets in the French zone led the United States and United Kingdom to reach out to the new French government despite a level of mistrust, and this same sense of the elevated important of science and technology led to fear that these perceived war assets would fall into the hands of France and the Soviet Union.

Indeed, the Soviet Union, while less directly comparable to France than the American or British cases because of the vast differences in economic organization, state-industrial relations, and postwar diplomatic position, offers interesting parallels and differences in its scientific-

⁶⁰ Gimbel, *Science, Technology, and Reparations: Exploitation and Plunder in Postwar Germany*, 183-184.; Werner Abelhauser, "Immaterial Reparations and the Reintegration of West Germany into the World Market," in *Technology Transfer out of Germany after 1945*, ed. Matthias Judt and Burghard Ciesla, (Amsterdam: Harwood Academic Publishers, 1996). As Abelhauser points out, this perception of the reparations and dismantlement process as beneficial, even necessary, for the 'economic miracle' of West Germany in the 1950s developed in German historiography as well in the 1970s. See Wolfgang Benz, "Wirtschaftspolitik zwischen Demontage und Waehrungsreform," in *Westdeutschlands Weg zur Bundesrepublik 1945-1949*, ed. Institut fuer Zeitgeschichte [Institute for Contemporary History], (Munich: R. Oldenbourg, 1976).

⁶¹ Matthias Judt, "Exploitation by Integration? The Re-Oriented of the Two German Economies after 1945. The Impact of Scientific and Production Controls," in *Technology transfer out of Germany after 1945*, ed. Matthias Judt and Burghard Ciesla, (Amsterdam: Harwood Academic Publishers, 1996), 32.

⁶² Trevor Evans, "Smith and the Secrets of Schmidt," *Daily Express*, 9 Oct. 1945.

⁶³ "Re: Statistics of Clearances of French and British Technical Investigators for Period 0830 hours July 29 to 1200 hours," 24 Aug. 1946. RG 260, Vol. 17, Box 1, folder 15. NACP.

technical exploitation programs.⁶⁴ Much like the eventual French path, the Soviets initially decided to exploit German science, technology and 'know-how' in place (that is, in Central Germany), rather than moving it back to their own territory. Soviet managers and experts moved into important former Nazi rocketry and aviation facilities – including the BMW jet engine factories and the famous Mittelwerk V-2 production facilities in Nordhausen – and worked with local Germans to restart production.⁶⁵ Indeed, beyond simply restarting these facilities, the Soviets expanded them, building for example the 'Institute Rabe' and later 'Institute Nordhausen' around rocketry and ballistics research. Such facilities generally had Soviet military managers, but the workforce included thousands of Germans, from former low-level technicians to top scientists such as Helmut Grötupp, formerly of the Peenemunde facilities that had housed the von Braun team.⁶⁶

This early Soviet exploitation-in-place policy was dramatically overshadowed in October 1946 by Operation Osoaviakhim, a carefully planned, forced evacuation of ten to fifteen thousand German scientific and technical personnel along with entire factories, laboratories and equipment deep into the Soviet Union. Motivations for this plan are open to debate, but contemporary American intelligence analysis offers an intriguing argument that the primary motivation was worry over being accused of violating quadripartite agreements to liquidate German war industry exactly because of the lack of deindustrialization involved in the *in situ* approach, and thus less a rejection of the merits of an *in situ* approach than of its international politics.⁶⁷ Not only were top scientists or technicians transported east, but entire factories, laboratories, research institutes, teams of workers, workers' families, and these families' possessions were loaded onto trains nearly overnight. This approach was undoubtedly heavy-handed, but even in this extreme circumstance, it demonstrates the perceived importance of keeping teams and facilities together.

Even following Osoaviakhim, the military occupation apparatus in the Soviet Zone shifted tactics but continued attempts to exploit German science and technology in place. A network of Science and Technology Offices (NTOs) across the Eastern zone supervised contracts for German research institutes, individuals and industries to produce products for the Soviet Union, usually operated by German personnel but with Soviet leadership in order to facilitate control and technology transfer.⁶⁸ Such NTOs expanded beyond military topics to include areas such as polymers, plastics, textiles, meat and dairy products and machine-building. Eventually Soviet stock companies (SAGs) took over this role, and Soviet *in situ* exploitation of German science and technology continued in some regards through at least 1948, long after Osoaviakhim faded from the news. Though more heavy-handed, these NTOs and SAGs served many of the purposes of enduring control and exploitation initially envisioned by the French in establishing Franco-German research institutes from former German research facilities.

⁶⁴ This account relies heavily upon the chapter "The Soviet Use of German Science" in Naimark, 205-250. Because of the serious limits in access to former Soviet archives, Naimark openly admits that this account is incomplete and open to challenge by future historians, but it remains an excellent account given available sources, and certainly the best of which I am aware.

⁶⁵ *Ibid.*, 215-218.

⁶⁶ *Ibid.*, 219.

⁶⁷ *Ibid.*, 225-226.

⁶⁸ *Ibid.*, 230-232.

French policymakers, then, were not alone in crafting policy around a general belief that the contextual embeddedness of science and technology made the prospect of 'taking' technology a daunting, difficult, and uncertain prospect. The Soviet occupation, too, emphasized a team-based approach based on exploitation in place, embedding its own personnel among German scientists in order to gain the 'know-how' embedded in these contexts without disturbing its operation more than necessary. This approach to science and technology combined with the diplomatic context of the early Cold War to shape policy with serious international consequences. The deep distrust towards Soviet intentions expressed by scientists after Osoaviakhim might well have accompanied any attempt to commandeer German 'know-how' en masse, but by late 1946, the forced, mass importation of German personnel was far more prominent and provocative than if it had taken place during the immediate postwar period in which the US and UK were in the most heated stages of their own programs. Similarly, had Soviet planners placed less emphasis on keeping together as much of the context around the scientists as possible (in this case, importing entire teams and factories), Osoaviakhim might have drawn significantly less international attention. Soviet diplomats responded to American questions about Osoaviakhim by demanding, 'I am not asking the Americans and British at what hour of the day or night they took their technicians. Why are you so concerned about the hour at which I took mine?'⁶⁹ However justified such questions might have been, the hour did matter for propaganda purposes. The initial *in situ* approach, followed by shifting policy that still maintained belief in the importance of teams of scientists, became yet another wedge between the Soviet Union and its one-time allies, including similarly-inclined France.

In the question for military technology, French generals appear to have agreed with their British peers who were 'whole-heartedly behind the whole operation' aimed at exploiting military technology.⁷⁰ Considering the importance of novel, science-based technologies such as radar in fighting and winning the war, and the psychological impact and apparent potential of less mature weapons such as V-2 rockets or jet airplanes, attempts by postwar militaries to master these technologies are not terribly shocking, however unprecedented the tactics of mass importing personnel and equipment from an occupied foe to jump-start this research. Varied opinions on how to operate such efforts and their efficacy in accomplishing their goals still deserve careful consideration, but the motivations appear somewhat straightforward.

More in need of explanation, then, is the difference between France and its allies about the possibility and value of expanding its military exploitation efforts, which the British saw as 'very conveniently adaptable to deal with those longer term peace-time interests of science and industry,' to the exploitation of civil industrial technology as 'a natural extension' of such efforts.⁷¹ Certainly France had opportunity to operate programs similar to the American and British ones, and indeed created analogous agencies and cooperated fully in the tripartite

⁶⁹ *Ibid.*, 226.

⁷⁰ Board of Trade, "BIOS Exhibition: Notes of Telephone Conversation with Professor Linsted (formerly Chairman of CIOS and, later of BIOS)," 27 Nov. 1946. BNA, PRO, BT 211, carton 22.

⁷¹ American and British policy demands explanation in itself, of course, rather than being some kind of 'natural' course from which the French truly 'diverged,' but the intellectual origins of the Anglo-American policies are beyond the scope of this article, and to the extent that the topic here is the differences between their approach and the French one, either phrasing communicates the concept. *Ibid.*; Board of Trade, "Employment of German Scientists and Technicians in Civil Industry in the United Kingdom," 28 Aug. 1945. British National Archives, PRO, BT 211, carton 46.

planning and liaison meetings. Operational strategy and goals of these French agencies varied widely from their Western counterparts, however, and the chief reason seems to be a fundamentally different understanding of the social embeddedness of science and technology, and therefore the possibilities and limitations of technology transfer.

To some degree, each of the occupying nations struggled to craft policies that would balance the lure of acquiring perceived German superiority in science and technology with the challenges of technology transfer. Each recognized the importance of 'tacit knowledge,' a term for the 'know-how' developed through direct experience and difficult to transmit through writing or verbal description alone.⁷² Even the United States and United Kingdom – treated largely as one entity through this article because of their close cooperation and similar bureaucratic structuring – experienced some tension over this issue, as a growing British dedication to acquiring tacit knowledge conflicted with pledges to share knowledge with the United States, something much simpler to do when it meant simply copying blueprints and other embodiments of 'explicit' knowledge.⁷³ The Soviet Union attempted exploitation in place, then the recreation of entire German research communities within Soviet territory when forced by concerns of international relations, rather than focusing just on artifacts such as patents, prototypes and blueprints. Each of these nations, though, decided to invest in extensive efforts to learn from German technology. Only French policymakers (and with exceptions, as we have seen) believed so deeply in the contextual embeddedness of scientific-technical knowledge that the cost-benefit analysis came out against expending the significant resources deemed necessary to commit fully to such efforts.

With little analogous to the Anglo-American 'Special Relationship,' French policymakers had little reason to override skepticism of the other Allies' approaches to technology transfer. To transplant a scientist or even an entire laboratory, they believed, would be like hacking off the roots when transplanting a tree. Rather than attempt such wholesale recruitment, and constrained by a postwar diplomatic context in which they could not realistically hope to retain permanent political control over German institutions, they would have to pursue a policy of control and retraining in place. This approach, they admitted, would not accomplish the ideal goals of either co-opting or destroying German scientific potential, but it was, at least, seen as being feasible. As it turned out, this was not as successful as they had hoped in creating transparency or control in German labs, yet it might well have been a more effective strategy for the long-term benefit of French industry precisely because of that. In a political context in which being 'soft' on Germany would be politically damaging, this strategy nevertheless meant the active promotion of Franco-German scientific institutes and business relationships, presaging and aiding the developing economic Franco-German relationship at the core of the future European Union.

⁷² This conceptions of 'tacit knowledge,' see H.M. Collins, "Tacit Knowledge, Trust and the Q of Sapphire," *Social Studies of Science* 31, no. 1 (2001); Michael Polanyi, *The Tacit Dimension* (Chicago: University of Chicago Press, 1966).

⁷³ The differences and diplomatic tensions between the American and British efforts will be the subject of a forthcoming article, but the most exhaustive extant discussion of the British efforts to date is in Glatt.

Chapter 2: British Postwar Scientific Exploitation and Tacit Knowledge

Abstract: The efforts by the United Kingdom following the Second World War to exploit German science and technology for the benefit of British industry were a key site of a shifting understanding of state-sponsored technology transfer. Amidst Parliamentary and bureaucratic debates about the relationship between scientific knowledge and gaining economically useful technology, British industrial investigators scoured Germany for patents, blueprints, trade secrets, and in some cases, skilled personnel. Though this was initially conceived in part as a diplomatic tool to draw together American and British intelligence, the difficulties in transferring technology via written – and therefore easily reproducible – means forced a shift towards a more self-interested exploitation style emphasizing 'know-how,' or 'tacit knowledge.' These scientific exploitation efforts, in turn, were part of and influenced a broader process in which ideas of 'know-how' were permeating British intellectual property law and policy debates over the state's role in promoting export industry and scientific excellence.

I. Introduction

British policymakers in the final years of the Second World War saw in front of them enormous challenges and opportunities in terms of using science and technology to boost economic competitiveness. British inventions and innovations – radar most of all - had been absolutely crucial in the Allied victory, yet the "unsurpassed...genius" of British invention seemed to face daunting obstacles to reviving an export trade made all the more crucial by heavy war debts.⁷⁴ Germany, it was felt, had too frequently seized upon a characteristic British failure to utilize its own inventions and had built chemical and other industries into powerful cartels utilizing British ideas, thereby 'infiltrating' other countries and producing such terrifying marvels as the thousands of V-1 and V-2 missile launched against England. It was in this context, tied fundamentally to international questions of early Cold War positioning and diplomacy, that the United Kingdom launched a series of programs aimed at "scientific exploitation" of German science and technology and began reform of British intellectual property law.

These two fields – scientific exploitation and domestic patent law – are not necessarily an obvious pair, and their historiographies rarely overlap, yet both were focuses of government action driven by anxiety over increasing British exports, supporting colonial possessions, and

⁷⁴ Quote is from Hansard, *HL*, 29 April 1948, Vol. 155, col. 568-90, discussing exactly this issue of British inventions being neglected at home and capitalized on overseas, especially in Germany. On the importance of exports and anxiety over international competitiveness in business, see Cairncross; Margaret Gowing and Lorna Arnold, *Independence and Deterrence: Policy Making v. 1: Britain and Atomic Energy, 1945-52 (Vol 1)* (Palgrave Macmillan, 1974); Neil Rollings, *British Business in the Formative Years of European Integration, 1945-1973*, ed. Louis Galambos and Geoffrey Jones, *Cambridge Studies in the Emergence of Global Enterprise* (Cambridge: Cambridge University Press, 2007).

navigating international politics.⁷⁵ Further, both were shaped by (and themselves informed) increasing attention given to the idea of 'know-how,' or 'tacit knowledge' – that is, knowledge embedded in physical experience and intuition (such as riding a bicycle), as opposed to 'explicit knowledge' which can be conveyed easily in written form (such as the price of a particular bicycle), and can more clearly be patented.

The basic idea of 'know-how' was nothing new. The earliest British patents in the fifteenth century were intended specifically to entice foreign technicians to teach apprentices their crafts on British soil, and thereby transfer the technology to Great Britain.⁷⁶ The attention paid to know-how in the 1940s and 1950s was new, however, and this increasing attention paid to the differences between tacit and explicit knowledge had direct impact on shaping exploitation policy in postwar Germany, and thus on foreign relations with other countries involved in exploitation. Wrapped up in all of this were ongoing efforts in the 1940s to reform patent and trademark law in the United Kingdom, operating simultaneously with decision-making about IP

⁷⁵ One notable exception is Jörg Fisch, "Reparations and Intellectual Property," in *Technology transfer out of Germany after 1945*, ed. Matthias Judt and Burghard Ciesla, (Amsterdam: Harwood Academic Publishers, 1996). However, Fisch is interested in a valuable but separate issue of the legality of so-called 'intellectual reparations' as part of international law, relative to categories such as 'war booty' and 'unilateral removals.'

The history of ties between national security considerations and intellectual property law is an area in need of more research, but some quality work is emerging, such as Katherine Epstein, *Torpedo: Inventing the Military-Industrial Complex in the United States and Great Britain* (Cambridge, Mass.: Harvard University Press, 2014); Alex Wellerstein, "Patenting the Bomb: Nuclear Weapons, Intellectual Property, and Technological Control," *Isis* 99, no. 1 (2008).

⁷⁶ On British patent history, see especially Klaus Boehm, *The British Patent System: I. Administration* (Cambridge: Cambridge University Press, 1967); Christine MacLeod, *Inventing the Industrial Revolution: The English Patent System, 1660-1800* (Cambridge: Cambridge University Press, 1988), 6-11; Christopher Thomas Taylor and Aubrey Silberston, *The Economic Impact of the Patent System: A Study of the British Experience* (Cambridge: Cambridge University Press, 1973).

On changing philosophies of patents in the late 19th to 20th centuries, see Peter Drahos and John Braithwaite, "Intellectual Property, Corporate Strategy, Globalization: TRIPS in Context," *Wisconsin International Law Journal* 20, (2002); Peter Drahos and John Braithwaite, *Information Feudalism: Who Owns the Knowledge Economy?* (New York: New Press, 2003); Adrian Johns, *Piracy: The Intellectual Property Wars from Gutenberg to Gates* (Chicago: University of Chicago Press, 2009); B. Zorina Khan, *The Democratization of Invention: Patents and Copyrights in American Economic Development, 1790-1920* (New York: Cambridge University Press, 2005); Christopher May, "The Denial of History: Reification, Intellectual Property Rights and the Lessons of the Past," *Capital & Class* 30, no. 33 (2006); Christopher May and Susan K. Sell, *Intellectual Property Rights: A Critical History* (Boulder, CO: Lynne Rienner Publishers, 2006); Alain Pottage and Brad Sherman, *Figures of Invention: A History of Modern Patent Law* (Oxford: Oxford University Press, 2010). There are many excellent essays related to this topic in Mario Biagioli, Peter Jaszi, and Martha Woodmansee, eds., *Making and Unmaking Intellectual Property: Creative Production in Legal and Cultural Perspective* (Chicago: University of Chicago Press, 2011), including Mario Biagioli, "Patent Specification and Political Representation: How Patents Became Rights," p.25-41.

For early conceptions of technical knowledge embodied in craftsmen, see Long, "Invention, Authorship, "Intellectual Property," and the Origin of Patents: Notes toward a Conceptual History."; Long, *Openness, Secrecy, Authorship: Technical Arts and the Culture of Knowledge from Antiquity to the Renaissance*.

law for the British occupation zone in Germany, aimed at better harnessing the minds of both nations for British industrial gain.

As John Farquharson argues, the situations in both Germany and the UK were too complex to reduce political tensions about exploitation of Germany to one of 'Exploiters' vs. 'Governor,' as John Gimbel had described the American exploitation efforts.⁷⁷ Still, the end of direct technological exploitation efforts in Germany is usually explained in terms of shifting priorities towards protecting and building up the zonal economy, eclipsing the desire to build up British industry through German tech. In contrast, this chapter argues that while increasing attention being paid to know-how in technology transfer did, indeed, reduce the ambitions of the exploitation agencies, they did not imply an end to efforts to reverse the perceived flow of invention from Britain to Germany. Instead, policymakers both in Germany and London turned to intellectual property as a more permanent solution for establishing relationships between British and German firms that would allow for the transfer of personnel and licensing of 'know-how' (the latter explored in more detail in Chapter 6). As diplomatic events made it clear that prolonged occupation of a solely British zone (and thus direct exploitation and influence) was increasingly untenable, discussion within the Control Commission for Germany (British Element) on reinstating intellectual property (IP) law into the British Zone (and later Bizone and West Germany) both reflected and shaped debates in Parliament about the future of British domestic IP law, each deeply influenced by ongoing fears of British industrial decline.

This fear of British 'decline' was widespread at the time and difficult to gain distance from because it also pervades much of the subsequent historiography, at least until recent year, but is more important in explanatory terms a perception and motive than as a historical reality. As Richard Toye has commented, "'Declinism' – in which Britain's loss of economic predominance is attributed to conservatism, amateurism and the old school tie – has been out of fashion as an explanatory paradigm...[but] the discourse of declinism was itself so firmly embedded into the actual history of the period under discussion – as contemporaries arrived at (frequently misleading) explanations of what was happening to them – that it is hard to escape the shadow of the debate."⁷⁸ This is certainly the case for policymakers in London and the occupation authorities in Germany, and as we will see: British motives for exploitation, retrospective judging of it as a 'missed opportunity,' and contemporary interest in patent law revisions were all fundamentally wrapped up in anxiety over preventing further British industrial 'decline.'

The idea that British invention was being utilized elsewhere but neglected at home, and that Britain had 'missed opportunities' to blame for a declining relative world position, is a trope that goes back at least to the First World War, was widespread in the 1940s and 50s, and continues to the present in much writing outside of specialists in British industrial history.⁷⁹ The

⁷⁷ Farquharson; Gimbel, *Science, Technology, and Reparations: Exploitation and Plunder in Postwar Germany*.

⁷⁸ Richard Toye, "The Broadening of Economic History," *Contemporary European History* 17, no. 3 (2008).

⁷⁹ The historiography embracing this trope of British culture and politics insufficiently embracing technology, and thus declining in the world, is too great to cite and engage with in full here, ranging at least from David Mowery blaming "the failure of government policy" for "the separation of British laboratory science and British technological practice," "the former...of extremely high quality, ...the

importance of the chemical industry – and the insufficiency of the British chemical industry in meeting wartime demand for explosives, dyes, poison gasses, and *ersatz* products to replace those limited by blockades – during the First World War brought industrial science to the forefront of national security concerns. In response, British lawmakers instituted extreme, autarkic policies in the chemical industry and other fields, such as the Dyestuffs Import Regulation Act of 1921, which forbade wholesale the importation of dyes. They also created the Department of Scientific and Industrial Research (DSIR) and Research Associations in attempts to emulate what they saw as the German model of promoting industrial research.⁸⁰ As we will see, each of these institutions would shape the debates regarding the short- and long-term use of German ingenuity for British industry.

It is worth pausing to clarify some terminology. In both the contemporary archival records and subsequent historiography, the term 'science and technology' is used to encompass academic science, industrial research, engineering, and manufacturing processes; 'German scientists' is taken to mean both academic physicists and factory-level technicians with some knowledge of a skilled manufacturing process.⁸¹ This broad usage was not entirely unreflective – as will be discussed, the relationship between science and technology was open for debate in Parliamentary discussions of these issues – but it would be deceptive to use the terms today without highlighting their expansive meanings in this context. Additionally, the British English meaning of 'scheme' and the technical use of the terms 'exploitation' and 'war booty' diverge from common American English in that none are intended to connote moral judgment. They are used here in the amoral/technical sense in which they were (mostly) used at the time. There exists a popular historiography related to these 'intellectual reparations' very much focused on the morality of this 'plunder' and employing 'Nazi scientists,' but moral issues are relevant here only

latter often...severely deficient," for "Britain's failure to match the level of industrial research achieved in US manufacturing," written in the 1980s, to Corelli Barnett arguing much the same thing in 2002. See David Mowery, "Firm Structure, Government Policy, and the Organization of Industrial Research: Great Britain and the United States, 1900-1950," *Business History Review* 58, (1984). Correlli Barnett, *The Lost Victory: British Dreams, British Realities, 1945-1950* (Pan Books, 1996); Correlli Barnett, *The Collapse of British Power - Pride and Fall Sequence* (Pan Books, 2002); Correlli Barnett, "The Wasting of Britain's Marshall Aid", BBC http://www.bbc.co.uk/history/british/modern/marshall_01.shtml (accessed April 7 2014).

The historiography countering this narrative has expanded in recent years, but an effective starting point is Edgerton, *Science, technology, and the British industrial "decline", 1870-1970*. The essay on sources on pages 73-86 contains a thorough discussion of declinist writings. Other key works rebutting the declinist model include Stephen Broadberry, *Market Services and the Productivity Race 1850-2000: British Performance in International Perspective* (Cambridge: Cambridge University Press, 2006); Edgerton, "Science and the nation: towards new histories of twentieth-Century Britain."; David Edgerton, *Warfare State: Britain, 1920-1970* (Cambridge University Press, 2005); Glatt; Rollings; Toye.

⁸⁰ Ulrich Marsch, "Transferring Strategy and Structure: The German Chemical Industry as an Exemplar for Great Britain," in *The German Chemical Industry in the Twentieth Century*, ed. John Lesch, (Dordrecht: Kluwer Academic Publishers, 2000).

⁸¹ As one example of this, see David Cassidy's excellent pair of articles on control of German science, in which he clarifies simply by writing, "in this paper, 'science' refers to both science and technology." Cassidy, "Controlling German science. I: US and allied forces in Germany, 1945-1947."; Cassidy, "Controlling German science, II: Bizonal occupation and the struggle over West German science policy, 1946-1949."

insofar as they are of interest to the actors involved in the exploitation schemes.⁸² Finally, I will refer to 'BIOS-related' programs as an umbrella term for the agencies directly involved in exploiting German science and technology, rather than list the acronyms and affiliations of each agency every time.

II. Scientific Exploitation and Conceptions of Technology Transfer

The postwar effort by the victorious Allied powers to exploit German science and technology has rightly been dubbed one of the largest-scale attempts at technology transfer in history.⁸³ The United States, Great Britain, and to a lesser degree France, worked together to construct an inter-connected apparatus to harness the perceived value of German technology, while the Soviet Union pursued a strategy of joint USSR-East German institutions with more direct methods including forcibly shipping entire teams of technical personnel and factories into Soviet territory.⁸⁴ Most of the historiography of the Western Allies' efforts works from the American perspective, which fruitfully highlights the magnitude of the project and the dramatically increased perceived importance of science and technology to state power in the postwar world.⁸⁵ The American effort, like the British, cast a net over an extremely broad set of fields, including synthetic fuel, die-casting equipment, ceramics, forest products, high-tension cables, motors, butter-making machinery, color film processing, precision grinding and machine tools, jet aircraft, wind tunnels, circuit-breakers, and many more.⁸⁶ However, this perspective can only carefully and partially be extrapolated to the British or French cases, despite the close cooperation of the nations' efforts and the bureaucratic similarity in their exploitation agencies. France faced the unenviable job of rebuilding factories and confidence in a postwar state from the rubble left by the German occupation and subsequent Allied invasion.⁸⁷ The United

⁸² The term 'intellectual reparations' comes from Gimbel, *Science, Technology, and Reparations: Exploitation and Plunder in Postwar Germany*. Works interested moral questions (mostly focusing on the American case) include: Bower; Friedrich Georg, *'Unternehmen Patentraub' 1945 : Die Geheimgeschichte des groessten Technologieraubs aller Zeiten* (Tuebingen: Grabert, 2008); Gimbel, *Science, Technology, and Reparations: Exploitation and Plunder in Postwar Germany*; Hunt; James McGovern, *Crossbow and Overcast* (New York, W. Morrow, 1964).

⁸³ Gimbel, *Science, Technology, and Reparations: Exploitation and Plunder in Postwar Germany*, ix-x.

⁸⁴ Among the best treatments of the Soviet exploitation of German industry include: Naimark; Steiner; Stokes, "Assessing the Damages: Forced Technology Transfer and the German Chemical Industry."

⁸⁵ Preeminent among existing historiography on the American case is Gimbel, *Science, Technology, and Reparations: Exploitation and Plunder in Postwar Germany*.; other notable works include the essays in Judt and Ciesla, eds., *Technology Transfer Out of Germany After 1945*.; and Cassidy, "Controlling German science. I: US and allied forces in Germany, 1945-1947."; Gimbel, "The American Exploitation of German Technical Know-How after World War II."; Herrmann.; Hunt.; Bower.; Lasby.; Neufeld, "The Nazi aerospace exodus: towards a global, transnational history."

⁸⁶ Gimbel, *Science, Technology, and Reparations: Exploitation and Plunder in Postwar Germany*, 22-23.

⁸⁷ The French case has the least developed historiography of the major Allied nations, but still some quality work. I address some of these issues in Douglas O'Reagan, "French Scientific Exploitation and Technology Transfer from Germany in the Diplomatic Context of the Early Cold War," *The International History Review*, (2014). See also Chevassus-au-Louis; Defrance; Eck; Ludmann-Obier, "Le contrôle de l'industrie chimique en zone française d'occupation en Allemagne (1945-1949)"; Ludmann-Obier, "Un aspect de la chasse aux cerveaux : les transferts de techniciens allemands, 1945-1949."; Ludmann-Obier, *Die Kontrolle der chemischen Industrie in der französischen Besatzungszone 1945-1949*; Ludmann-Obier, "La mission du CNRS en Allemagne (1945-1950)."; Pestre; Villain,

Kingdom, while more intact than France and facing similar problems to the United States of reconverting war industry onto civilian footing, faced an enormous wartime debt relative to GDP, a desire to maintain international and imperial influence, and new perceived threats from the Soviet Union necessitating maintaining close ties to the United States.⁸⁸

Like in the American and French cases, British attempts at utilizing German science and technology were a veritable alphabet soup of acronyms for agencies, both civilian and military, with complex and evolving lines of authority. As such, the following summation will necessarily ignore some important nuance, but will hopefully provide a least a useable outline. A joint wartime effort between the United Kingdom and United States, led by the Combined Intelligence Objectives Sub-committee (CIOS) of the intelligence division of the Shared Headquarters, Allied Expeditionary Force (SHAEF) aimed at exploiting German military advances for the war on Japan. With the dissolution of the combined command in July 1945, CIOS split into American and British components. The latter of these, now called the British Intelligence Objectives Sub-committee (BIOS), shifted from strictly military intelligence oversight to the supervision of the Board of Trade, but continued to receive logistical support from the so-called 'T' Force units of the British occupation forces in Germany. BIOS and Board of Trade leadership began considering expanding this military exploitation to civilian industry, planning to work in conjunction with the United States' Field Information Agency, Technical (FIAT), which had essentially taken over for the American half of CIOS. A direct liaison group dubbed FIAT (British) (or 'FIAT (BR)') mirrored FIAT (US), though BIOS remained the primary agency in charge of exploitation. The Board of Trade then set out to recruit investigators from industry who would be given military uniforms, ceremonial rank, housing, and transportation to investigate German targets identified by CIOS and BIOS, after which they would write reports for use by the rest of their industries.

In an independent but related effort also sponsored by the Board of Trade, a panel chaired by Sir Charles Darwin - descendent of the famed naturalist – considered and then orchestrated an

"France and the Peenemuende Legacy."; Villain, "L'apport des scientifiques allemandes aux programmes de recherche relatifs aux fusées et avions à réaction à partir de 1945."

⁸⁸Existing historiography related to the British side includes: J. Agar and B. Balmer, "British Scientists and the Cold War: The Defence Policy Research Committee and Information Networks, 1947–1963," *Historical Studies in the Physical Sciences* 28, no. 2 (1998); Richard J. Aldrich, "British intelligence and the Anglo-American 'Special Relationship' during the Cold War," *Review of International Studies* 24, no. 3 (1998); Cassidy, "Controlling German science. I: US and allied forces in Germany, 1945-1947."; Cassidy, "Controlling German science, II: Bizonal occupation and the struggle over West German science policy, 1946-1949."; Michael Dockrill, *British Defence Since 1945 (Making Contemporary Britain)* (Wiley-Blackwell, 1991); Edwards; Farquharson; Glatt; Gowing and Arnold; Michael Hopkins, *Cold War Britain, 1945-1964 : new perspectives* (New York: Palgrave Macmillan, 2003); Jones; Roy MacLeod, "'All for Each and Each for All': Reflections on Anglo-American and Commonwealth Scientific Cooperation, 1940-1945," *Albion: A Quarterly Journal Concerned with British Studies* 26, no. 1 (1994); Paul Maddrell, "Britain's exploitation of occupied Germany for scientific and technical intelligence on the Soviet Union" (1998); Maddrell, "British-American Scientific Intelligence Collaboration during the Occupation of Germany."; Bernhard Rieger, *Technology and the Culture of Modernity in Britain and Germany, 1890-1945* (Cambridge: Cambridge University Press, 2005); Willam Paul Snyder, *The politics of British defense policy, 1945-1962* (Ernest Benn, 1964); Turner, ed; Uttley.

effort to recruit German scientific and technical personnel for the benefit of British industry.⁸⁹ Within the British occupation zone in Germany, the Control Council for Germany and Austria (CCfG) initially assisted but later resisted these direct exploitation efforts – the rationale for this shift will be discussed later, but is usually given as its mandate to rebuild the zone's economy, and attempts to reduce occupation costs to the British taxpayer. The major players in the British side, then, were essentially BIOS, in charge of overall exploitation; FIAT (BR) as liaison to the US, and later France; the Darwin Panel independently focusing solely on German personnel; the Board of Trade as the government agency in charge of overall policy and industry liaison; and the Control Council in charge of running the German zone.

The president of the American Chemical Society argued in October 1945 that "the results of research which have been carried out by someone else...are priceless" and could be conveyed to great benefit, and this enthusiasm largely characterizes the American approach to FIAT and related programs. French policymakers, in contrast, expressed severe doubt about removing scientists and technical personnel from their contexts, as this rendered them 'practically sterile.'⁹⁰ British decision-makers, in this context, began with an enthusiasm similar to the Americans', yet faced with difficulties in effectively transferring German technology, increasingly came to feel that effective exploitation would require focusing to hands-on, tacit knowledge - "know-how," as it is frequently described in British files, including quotation marks - in addition to detailed, written reports. This shift, in turn, created a dilemma. Written reports could be copied and distributed equally to all interested parties, both within British industry and to allied nations. Indeed, selling such reports could be a valuable source of hard currency in an export-hungry economy. "Know-how," in contrast, was fundamentally personal. As a matter of internal policy, this meant re-imagining the methodology and cost-effectiveness of the BIOS programs, with "benefit to industry" becoming "benefit to firms;" to what policy-makers thought was a less principled, more biased, and more easily corruptible system. As a matter of diplomacy, it meant frustrations with American policymakers of a different mindset, angry accusations from Soviet leaders of British (and American) cheating on reparations, and worry over permanent 'missed opportunities' in the French Zone.

Initial British proposals for exploiting German technology for civilian industry (as opposed to defense technology) focused around finding methods for benefiting the entirety of relevant industries, rather than individual firms, primarily on principled rather than practical grounds. As a result, they emphasized duplicable, written reports. In August 1945, the Board of Trade initially circulated a position paper on employing German scientists and technicians in civil industry that suggested the opposite approach. Granting recruited technical personnel to

⁸⁹ For those familiar with the American case, the Darwin Panel is most analogous to 'Operation Paperclip,' while the BIOS efforts are most similar to FIAT. The French created a FIAT (France) – more correctly the Comité de Coordination Scientifique – but operated it very differently from the US or UK. Outside of a very small number of exceptional cases, the Soviet Union did not cooperate with the Western Allies in these efforts, though as I will discuss, did purchase the published results of American and British investigations.

⁹⁰ Dewey to Wallace and others, 23 Oct. 1945, RD 59, file 862.542/10-2445, NA; citation from Gimbel, *Science, Technology, and Reparations: Exploitation and Plunder in Postwar Germany*, 24-25. For the French ideas of decontextualized scientists becoming intellectually sterile, see Economie Nationale, "Le Problème de la recherche technique et scientifique allemande," 10 March 1946. ANFF, CNRS records, RG 19780283, carton 35. See also O'Reagan.

individual firms, the Board of Trade argued, would provide "in many cases the only way to get the full value out of these experts - and there is no point in having them here otherwise," yet the Foreign Secretary objected that the knowledge acquired through state means must belong to the state and be for the public good.⁹¹ The Foreign Office won the day, and the committee focusing on acquiring German personnel - later to become the 'Darwin Panel' - concluded that whenever possible, such Germans would work for government Research Associations and Research Establishments rather than private firms.⁹²

This decision to serve industries rather than firms, cast in terms of "fairness," avoiding "jealousy" and favoritism, and making the "ethical" choice, was built into the structure of BIOS and the Darwin Panel scheme.⁹³ Though investigative teams were felt to lose productivity beyond 3-4 members, they sometimes sprawled in order to "be fully representative of the industry concerned i.e. they must include representatives of the main Trade Associations and the main NON-Association firms" [emphasis in original].⁹⁴ Whenever possible, competing firms were placed on the same team, with the anticipated result of each holding the other accountable for including everything in the final reports.⁹⁵

Extensive publicity efforts sought to bring this material to the attention of even "smaller firms - and it is probable that individually and collectively they have the most to benefit from this insight into German methods - [who] will not use the material unless it is brought pretty forcibly to their notice."⁹⁶ BIOS began shipping copies of reports to libraries in industrial cities throughout the UK by late 1946, a policy that led to requests for inclusion from county libraries miffed at being left out as well as requests for fewer copies from city libraries lacking both demand and shelf space.⁹⁷ A small exhibit of reports and prototypes in Bristol, bulletins in the Board of Trade Journal, and occasional press releases supplemented efforts to advertise BIOS reports to all potentially interested parties.⁹⁸ Official policy discriminated against providing aid

⁹¹ Derek Wood, "Minute Sheet," 9 Jan 1946. The National Archives (TNA): Public Records Office (PRO) BT 211/47.

⁹² "First Meeting of Panel to Consider the Employment of German Scientists, Specialists and Technicians for Civil Industry in the United Kingdom," 3 Dec 1945. TNA: PRO BT 211/24; "Note of Meeting to Discuss the Formation of a Panel to Deal with the Employment of German Scientists Specialists and Technicians in the United Kingdom," 21 Nov 1945. TNA: PRO BT 211/24.

⁹³ "Record of a meeting to discuss further actions in connection with BIOS Group VII investigation of German wartime patent specifications," 17 Apr 1946. TNA: PRO BT 211/44; German Division, Board of Trade, "Facilities for Technical Investigations in Germany by Individual British Firms," 23 Oct 1946. TNA: PRO BT 211/21; DJ Ezra to Derek Wood, 13 Mar 1947. TNA: PRO BT 211/24.

⁹⁴ [Unknown] to VB Bennett, 16 Sept. 1946. TNA: PRO BT 211/24.

⁹⁵ WG Glennie, Deputy Regional Controller, 'Bristol Exhibition of Industrial Intelligence Work in Germany,' 28 Dec 1946. TNA: PRO BT 211/22.

⁹⁶ Derek Wood to Mr. Somervell, "Distribution of Industrial Information from Germany," 19 Oct 1946. TNA: PRO BT 211/24.

⁹⁷ PW Bennett to The Under-Secretary, Board of Trade, 31 July 1946; EG Davies to Miss EF Magg, Acting County Librarian, Wakefield, 17 Apr 1946. TNA: PRO BT 211/11; Gilbert LuDunn, Borough Librarian to The Assistant Secretary, German Department, Board of Trade, 26 June 1947. TNA PRO: BT 211/162.

⁹⁸ WG Glennie, Deputy Regional Controller, 'Bristol Exhibition of Industrial Intelligence Work in Germany,' 28 Dec 1946. TNA: PRO BT 211/22

"Darwin Panel Scheme: Draft Statement for Publicity," April 1948. TNA PRO: BT 211/476.

to firms that "refused to take part in BIOS investigations for fear of letting in their competitors...however much common humanity may lead us to sympathize with their attitude."⁹⁹ Written reports on German technical processes flowed through the country, and BIOS officials anticipated significant economic value to flow with them.

Reception for these reports wasn't entirely positive, however, and within months of the creation of BIOS, complaints that reports of any kind were insufficient became more urgent. The first formal meeting of the Darwin Panel in December 1945 addressed this issue straight away. The Chairman, Sir Charles Darwin, "agreed that it was far better actually to employ Germans in industries where the full power of their experience and criticism could be brought to bear, then to interrogate them. This was the only method of discovering the use of the people whom the Panel was considering."¹⁰⁰ Bringing these people over was a necessity for control purposes, he felt, as their knowledge and expertise would otherwise live on despite any industrial dismantling - the knowledge lived in the people, not the materials or patents.¹⁰¹ While debating an industry proposal to allow investigators to make follow-up visits in July 1946, a representative of the Ministry of Fuel and Power argued that "BIOS reports are valuable up to a point, but for firms seeking to copy a machine or introduce a process developed by the Germans a further and more detailed examination is almost certain to be essential... BIOS Reports vary greatly in their practical value to industrialists and...few, if any, are likely to provide adequate information...to introduce and develop a German process in this country."¹⁰² The Board of Trade by this point agreed: "The information contained in BIOS reports...is quite insufficient to permit potential new users, particularly those with limited research facilities, to set up and operate the process."¹⁰³ A report from October 1946 added that "experience has shown that if industry was left to prepare the reports they were of little value to firms which had not taken part."¹⁰⁴

This could be read as a series of complaints about the quality of the reports rather than written reports in general, but leaders from industry and BIOS-related agencies believed that British reports were the best to be had, and even the Americans agreed with this assessment. Derek Wood, head of BIOS, boasted in October 1946 that "BIOS reports are widely recognized as being superior to those produced by the Americans. Our system of putting competing interests in the same team has undoubtedly done much to prevent concealment of the really interesting topics...Industry has lived up to its side of the deal, firms and associations sparing neither trouble

"Minutes of the 6th Meeting of the Panel to Consider Employment of German Scientists, Specialists and Technicians in the United Kingdom," 30 Jan 1946. TNA: PRO BT 211/24.

⁹⁹ Control Office for Germany and Austria, "Requests from British Firms for Facilities to Obtain Technical Information from Germany," 26 June 1946. TNA: PRO BT 211/21.

¹⁰⁰ "First Meeting of Panel to Consider the Employment of German Scientists, Specialists and Technicians for Civil Industry in the United Kingdom," 3 Dec 1945. TNA: PRO BT 211/24

¹⁰¹ Economy and Industrial Planning Staff, "The German Clock and Watch Industry," Jan 1946. TNA: PRO BT 211/37.

¹⁰² CH Noton to Derek Wood, 17 July 1946. TNA: PRO BT 211/21.

¹⁰³ German Division, Board of Trade, "Facilities for Technical Investigations in Germany by Individual British Firms," 23 Oct 1946. TNA: PRO BT 211/21

¹⁰⁴ Derek Wood to ER Wood, "Interrogation of German Scientists and Technicians in the UK," 18 Oct 1946. TNA: PRO BT 211/24.

nor expense to make the reports comprehensive and instructive."¹⁰⁵ US bibliographies of available materials were considered useless, combining too much material in too superficial a form; head of the US efforts John Green admitted that he was "envious of the polished materials you make available."¹⁰⁶ The French, it was felt, could or would not even produce reports for their own industry due to "lack of organization, personnel and equipment."¹⁰⁷ The Soviet Union cast a vote of confidence for British reports by means of purchasing every one at a cost estimated over \$400,000 per year.¹⁰⁸

Instead, complaints about the limited utility of BIOS reports reflected a conscious, ongoing struggle with the difficulty of capturing technology in written form. Industrial firms and trade associations pushed aggressively for finding methods of transferring tacit knowledge. At various points, they requested on-site inspections of German plants, embedding their engineers in these plants for weeks or months; hiring individual technicians; and limiting such activities for rival firms and allied countries. Textile and chemical company Courtauld's wrote to BIOS requesting additional inspections of IG Farben's plants, as even after sending a team, the information necessary for building a new facility "can only be obtained from the Dormagen technicians."¹⁰⁹ The Association of British Chemical Manufacturers got quite heated in their demands for follow-up investigations by individual firms to supplement BIOS reports. Such reports, an October 1946 letter argues, were very rarely sufficient to transfer a technology or process, and "we have not spent all the time and trouble in organizing investigating teams merely to produce a row of reports on the shelf... First hand investigation would eliminate a great deal of the usual trial and error in setting up a plant here... much of the 'know how' is impossible to put into words."¹¹⁰ "In practice... no amount of 'given' information can ever be a substitute for the information obtained in the hard school of practical experience."¹¹¹ Nor was this a suggestion in which the author considered outside what readers would embrace - "the arguments above seem to be so conclusive that there can be no reply".¹¹² Similar statements by other industrial representatives repeated these sentiments throughout the life of the Darwin Panel and BIOS agencies.

Such complaints led to structural changes, starting in July 1946 and continuing until the programs' conclusions, designed to put investigators on-site in Germany for extended periods with fewer requirements for report writing. At a BIOS meeting in that month, one officer expressed ongoing concern about "abusing" their role as occupier by aiding individual British firms and re-emphasized that the Darwin Panel had only ever been agreed to with assurances of

¹⁰⁵ Derek Wood to Mr. Somervell, "Distribution of Industrial Information from Germany," 19 Oct 1946. TNA: PRO BT 211/24

¹⁰⁶ Trevor Evans, "Smith and the Secrets of Schmidt," *Daily Express*, 9 Oct. 1945. TNA: PRO BT 211/24; John Green to Derek Wood, 31 Dec 1946. TNA: PRO BT 211/24.

¹⁰⁷ Derek Wood to K Unwin, Esq, 10 Oct 1946. TNA: PRO BT 211/25.

¹⁰⁸ Alexander King to HL Verry, 26 Apr 1946. TNA: PRO BT 211/17.

¹⁰⁹ MN Salmond to Derek Wood, "Further Visits to IG Farben, Dormagen," 21 May 1946. TNA: PRO BT 211/21.

¹¹⁰ J. Davidson Pratt, The Association of British Chemical Manufacturers to Derek Wood, 7 Oct 1946. TNA: PRO BT 211/21.

¹¹¹ J. Davidson Pratt, The Association of British Chemical Manufacturers to Derek Wood, "Follow-Up Visits," 24 Oct 1946. TNA: PRO BT 211/21.

¹¹² J. Davidson Pratt, The Association of British Chemical Manufacturers to Derek Wood, 7 Oct 1946. TNA: PRO BT 211/21.

industries, rather than individual firms, being the benefactors. Still, this principle being accepted, there was "general agreement" among those present that BIOS was "not really of any general benefit" anyway, as the firms sponsoring investigators received almost exclusive advantage.¹¹³ "In all honesty," a later report admitted, "BIOS investigations are...to some extent equally discriminatory in favouring firms represented in teams as opposed to firms who have to read reports."¹¹⁴ "The practicable advantages of the Scheme were set off against the criticisms...of the discrimination to be shown to the favoured few," and despite fears that "it was wrong in principle that a specific firm should be able to acquire...trade secrets which were not for sale," the scheme was approved provided arrangements were made to pay the German firms.¹¹⁵

This shift did not go unnoticed within Germany, as orders to benefit specific firms upset some British officials even within investigative agencies. Decades later, when recounting his wartime experiences to historian Sean Longden, one British T-Force official recalled a case that has especially frustrated him at the time: A civilian, Mr. HL Muschamp, visited Germany as an investigator in the textile manufacturing industry, and while there, began ordering the logistics 'T-Force' unit to ship valuable machine tools to HL Muschamp, Ltd.¹¹⁶ The officer in charge objected, pointing out that T-Force was a military force meant to serve the broader public good, and could only ship to official government agencies. Two days later, "T-Force HQ received a message from London: 'Consign the machinery tools to Ministry of Supply, c/p HL Muschamp Ltd.'"¹¹⁷

III. Impact of a Tacit Knowledge Focus on Foreign Relations

Neither BIOS nor its American or French counterparts should be taken in isolation, as each drove the others' policies and ambitions in direct and indirect ways. Proponents of scientific exploitation aimed at civil industry in both the United States and United Kingdom promoted the expansion of the military-oriented exploitation by arguing that the other was already doing so, and an opportunity was going to be quickly lost.¹¹⁸ France began its exploitation efforts at the behest of its western allies, creating FIAT (FR) to coordinate efforts, but never escaped suspicion from the others that considerably lower enthusiasm for the project was a disguise for stealthy

¹¹³ "Report on a Meeting of Technical Investigations in Germany by Individual Firms," July 1946. TNA: PRO BT 211/21.

¹¹⁴ "Technical Investigations in Germany by Individual Firms," July 1946. TNA: PRO BT 211/21.

¹¹⁵ "Report on a Meeting of Technical Investigations in Germany by Individual Firms," July 1946. TNA: PRO BT 211/21.

¹¹⁶ This account is from Sean Longden, *T-Force : the race for Nazi war secrets, 1945* (London: Constable, 2010). Longden wrote his account of T-Force activities on commission of T-Force veterans, using their files and recollections. While I cannot independently confirm this episode outside these veterans' memories, it seems highly plausible based on my own archival research in T-Force papers, and in any even speaks to what stuck out about the experience to these T-Force personnel: the shift from military priorities to catering towards specific civilian firms.

¹¹⁷ *Ibid.*, 265-266.

¹¹⁸ For the UK argument that it was "understood that the Americans are already attracting" such German personnel, and the UK faced "missing a valuable opportunity," see "Employment of German Scientists and Technicians in Civil Industry in the United Kingdom," 28 Aug 1945. TNA: PRO BT 211/46. For the similar American claim, see Gimbel, *Science, Technology, and Reparations: Exploitation and Plunder in Postwar Germany*, 30-33.

attempts to steal away scientists; whether they had "valuable information which they wish to keep to themselves, or whether they think we can be lured yet further with what may prove to be mediocre bait."¹¹⁹ From the British perspective, CIOS had been a building block of the Anglo-American "Special Relationship" in intelligence sharing that had blossomed during the war, and BIOS-related programs were initially another avenue to bind the nations more closely together. The developing perceived need to shift focus to a tacit knowledge focus, then, came at a price – written reports could be shared with allies and published fruitfully around the world, but personnel with personal experience and British engineers implanted in German factories could not. The British decision to deprioritize written reports in favor of "know-how," then, made in this international context, is even more striking a demonstration of the elevated importance of science- and technology-based exports for the postwar state.

Given the close cooperation in exploiting military technology, and that even British policymakers argued from the start that exploiting civilian industrial technology was "a natural extension" of this program, it might seem obvious that similar cooperation would extend to exploiting civilian industrial technology.¹²⁰ Yet there was actually considerable debate about whether to include the Americans at all, and the extent of the "moral obligation" for full and open cooperation was never a fully settled issue.¹²¹ The stated purpose for the third meeting of the Darwin Panel was to consider *whether* - not 'when' or 'how' - lists of German scientists required for employment in the UK should be exchanged with the Americans.¹²² The matter "was settled for defense," but there were "fundamental differences of outlook held by civil industry and several additional difficulties," among them "whether, if co-operation was decided on as a policy between Governments, the American Government was capable of supervising adequately the activities of big business."¹²³ In the end, the Panel voted six to four in favor of sharing the information fully: "Those concerned with Trade Departments voting against, and those who were voting on general principles voting for the motion."¹²⁴ The Board of Trade concurred later that month "the balance of advantage undoubtedly lay in full co-operation," precisely because the value to be gained by reading American reports was assumed to be tremendous, even at the cost of the competitive of advantage of keeping reports to themselves. So eager were they for American involvement based on that prospect that the Board intended to override political obstacles faced by their American counterparts by leaking information to US business leaders, who (it was assumed) would then put pressure on the government to participate.¹²⁵

Once operational, the American and British exploitation agencies generally enjoyed high levels of cooperation and mutual admiration, but the competitive dynamic that had led to each nation's efforts to expand to civil industry continued to drive policy and constrain choices. The first meeting of the Darwin Panel spent much of its time worrying if proposed contracts were "at

¹¹⁹ LR Poole to Derek Wood, 2 Aug 1946. TNA: PRO BT 211/17.

¹²⁰ "Employment of German Scientists and Technicians in Civil Industry in the United Kingdom," 28 Aug 1945. TNA: PRO BT 211/46.

¹²¹ DJ Ezra to Derek Wood, 13 Mar 1947. TNA: PRO BT 211/24.

¹²² "Minutes of the 3rd Meeting of the Darwin Panel to Consider Employment of German Scientists, Specialists and Technicians in the United Kingdom," 17 Dec 1945. TNA: PRO BT 211/24.

¹²³ *Ibid.*

¹²⁴ *Ibid.*; "Minutes of the Interdepartmental Meeting held at the Board of Trade on December 20th..." 20 Dec 1945. TNA: PRO BT 211/24.

¹²⁵ "Minutes of the Interdepartmental Meeting held at the Board of Trade on December 20th..." 20 Dec 1945. TNA: PRO BT 211/24.

least as favourable as the Americans were alleged to be giving," and if they were working quickly enough as "speed was the essential factor since the Americans were approaching these people with good offers."¹²⁶ When debating a shift in July 1946 towards normalizing relations with German industry to allow hiring personnel for regular salaries (as it was felt that they would be more helpful if hired than when questioned and their documents copied), the Board of Trade discussed reports that "private American businessmen were active in their zone" undertaking "private negotiations of the kind envisaged," thus "the Americans must have found some means of paying the Germans for their technical services" (in fact they did not).¹²⁷ The embassy in Washington was instructed to feel out the US on the idea of paying German scientists, but by no means to let the Americans know that BIOS intended to do so.¹²⁸ In late 1946, as the Control Commission for Germany asserted more strongly that "continued piracy of German methods" must wind down in favor of building up the German economy, they nevertheless admitted that it was impossible to cease operations if the US continued, since this could give America a monopoly on hiring, and thus the end date must be coordinated bilaterally.¹²⁹

This dynamic of close coordination-by-competition began fraying as written reports in general, and especially those issuing from the US Department of Commerce (in charge of FIAT), fell in the Board of Trade's esteem. American bibliographies were considered "useless," as they contained too much information with insufficient depth and clarity.¹³⁰ By mid-1946, as BIOS shifted under pressure from industry towards maximizing tacit knowledge and recognizing the limits of written reports, new proposals envisioned "a subsequent phase to which...the BIOS plans of equal participation rights to all United Kingdom and United States industries cannot be extended."¹³¹ By September 1946, bibliographies of FIAT records issued by the US Department of Commerce were officially "not to be made available to industry in this country...in view of their unsatisfactory character."¹³² While inevitable that British industry would get some copies anyway, and orders from these bibliographies would still have to be fulfilled where possible, opinions of the value of US cooperation were not overly generous. A retrospective report from BIOS at the end of 1946 concluded that there was a "common belief...that the Americans are in most forms of exploitation always one jump ahead of us and that they invariably make the scale of our effort look small," but in reality the 10,000 British investigators dramatically outnumbered the about 600 from the US.¹³³ Moreover, the methodological switch was bound to be fruitful –

¹²⁶ "First Meeting of Panel to Consider the Employment of German Scientists, Specialists and Technicians for Civil Industry in the United Kingdom," 3 Dec 1945. TNA: PRO BT 211/24

¹²⁷ "Report on a Meeting of Technical Investigations in Germany by Individual Firms," July 1946. TNA: PRO BT 211/21.

¹²⁸ Derek Wood to ST Norman, Esq., British Commonwealth Scientific Office, 20 Nov 1946. TNA: PRO BT 211/24.

¹²⁹ Derek Wood to ST Norman, Esq., British Commonwealth Scientific Office, 21 Oct 1946. TNA: PRO BT 211/24.

¹³⁰ "Copy of Brief Handed to Major J. Day, Board of Trade before departure for Washington," March 1946. TNA: PRO BT 211/41; JH Wheatcroft, "Lists of Classified and Unclassified CIOS Reports, Amendment No. 3," 6 Apr 1946. TNA: PRO BT 211/13.

¹³¹ MN Salmond to Derek Wood, "Further Visits to IG Farben, Dormagen," 21 May 1946. TNA: PRO BT 211/21.

¹³² "Memorandum for Mr. Norman," Sept. 1946. TNA: PRO BT 211/17.

¹³³ WG Glennie, Deputy Regional Controller, "Bristol Exhibition of Industrial Intelligence Work in Germany," 28 Dec 1946. TNA: PRO BT 211/22

"it must inevitably have been much to our advantage, at this present time of reconversion to peace-time production, to have this vast number of technical men from our own factories walking round German plants getting first-hand knowledge of the methods of German industry."

"Your guiding principle," one memorandum ordered BIOS sub-divisions, "should be that a substantial 'bite out of the apple' is better than a 'smell all round.'"¹³⁴ This focus on in-depth "first-hand knowledge" rather than breadth of information led to "very vigorous...very critical" reactions to American decisions over the course of the BIOS-related programs. The diplomatic stakes here were not alliance-breaking by any means – despite their disagreements, both American and British representatives on a number of levels celebrated the continued good relations enjoyed by BIOS/FIAT, even ending their collaboration with a party in London (the costs of which led to complaints from Treasury). Still, the initial planning and ideal scenario was one in which both nations shared and shared alike, bringing their economies up to the cutting edge and enhancing the 'Special Relationship' along the way. A shift to emphasizing tacit knowledge was no idle decision.

The inability to capture tacit knowledge in BIOS reports had more explicit and obvious - albeit indirect - impact on diplomatic relations with the Soviet Union. As early Cold War tensions escalated, partly caused by controversy over reparations, an article in the state newspaper *Pravda* on 21 March 1947 accused the United States and United Kingdom of exactly the exploitation of German technical 'secrets' at allies' expense of which British policymakers had worked to avoid suspicions. The head of the UK Delegation to the Council of Foreign Ministers immediately requested that the Control Council provide him additional information on *Pravda's* claims that "BIOS reports [were] valueless since the information they give is totally inadequate".¹³⁵ The official British response was to point out that, as mentioned, the Soviet embassy routinely bought both American FIAT and British BIOS publications at a cost that the head of FIAT (US) estimated at \$400,000 USD per year ("a fact which will not be forgotten when the time comes to consider the loan of money to Russia").¹³⁶ Considering the earlier internal statements about the value of BIOS reports (i.e. "few, if any, are likely to provide adequate information for a firm wishing to introduce and develop a German process in this country"), this seems a less than exhaustive rebuttal.

V. IP Law and the Postwar Occupation of Germany: A British Perspective

Though aspects of the BIOS and Darwin Panel schemes for the exploitation of German science and technology operated through the early 1950s, most of their functions wound down substantially in 1947 to 1948. Conventional accounts of the postwar technical exploitation, both in the American and British cases, wrap up with the story of the Control Commission asserting the importance of normalizing the German economy in order to protect the zonal / West German economy from the 'harm' of exploitation, and thereby to spare taxpayers the costs of occupation.

¹³⁴ JH Wheatcroft to G Mansell, "Reports awaiting industrial distribution," 6 Sept 1946. TNA: PRO BT 211/13.

¹³⁵ DL Haviland to Sir Mark Turner, 22 March 1947. TNA: PRO BT 211/235. Regarding the claims of over-classification, the CCfG responded that 321/2694 final reports were classified and 2/3 not graded higher than Restricted, a response "I think...supplies ammunition for a reasonably honest answer to the Russian allegations."

¹³⁶ Alexander King to HL Verry, 26 Apr 1946. TNA: PRO BT 211/17.

John Gimbel's chapter on the American programs' wind-down is titled "Governors Versus Exploiters."¹³⁷ John Farquharson rejects this framework as "not a valid summary of the British occupation," but does so largely because the situation was "by no means so one-sided that 'exploitation' is necessarily an appropriate word" considering British investments into Germany and the option for German firms, too, to purchase BIOS reports (which some in fact did).¹³⁸ Certainly the Control Commission for Germany (British Element) (CCfG) fits this model to some degree, as it increasingly resisted direct exploitation efforts to the frustration of some firms. Worried about the morality of British policy and "criticism that Germany was being exploited for the benefit of British industry to the exclusion of our Allies," its director suggested that British firms should pay the German firms they visited for their information, and the Chairman of at least one BIOS group agreed in principle - "the time is coming when relations between firms in this country and those in Germany will have to be placed on a more normal footing if further useful information is to [be] obtained by individual firms."¹³⁹

This framework of the CCfG as "governors" protecting the interests against the "exploiters" misses a fundamental motivation for CCfG's stance, however. While the CCfG was bureaucratically opposed to BIOS-like agencies, they were not actually opposed to exploitation of German science and technology for the benefit of British industry. Quite the opposite, they worked from the war's end through the 1950s to set up a patent and trademark system within Germany that would, among other goals, "open the door to a substantial flow of German ingenuity" into the UK, which could "hardly fail to be other than a benefit to the trade and industry" of the nation.¹⁴⁰ These policies, guided at least in part by the sudden perceived importance of 'know-how' seen in BIOS investigations and in Parliamentary debates on how to reshape British patent law for the postwar world, were indeed interested in building Germany's economy and sparing taxpayer subsidies, but were just as much about establishing a permanent harness for German minds.

British patent law had long been strongly influenced by real and perceived threats of technology transfer to Germany, or attempts to bring technologies (via technologists) to Great Britain. "Letters of Protection" under King Edward III in the fourteenth century encouraged foreign craftsmen to settle in England and teach apprentices, a practice renewed in the mid-sixteenth century.¹⁴¹ According to historian Christine MacLeod, "acquisition of superior Continental technology was the predominant motive for the issue of patents under the guidance of Elizabeth I's chief minister," and this aim heavily influenced early patent policy through the nineteenth century, including in granting monopolies in the 1560s to mineral companies gaining expertise from German technicians.¹⁴² This rationale began to fade by the mid-seventeenth

¹³⁷ Gimbel, *Science, Technology, and Reparations: Exploitation and Plunder in Postwar Germany*, 115-134.

¹³⁸ Farquharson: 42.

¹³⁹ RH Bright, Chairman, BIOS Group V, "Industrialists Visits to Germany," 30 July 1946. TNA: PRO BT 211/21.

¹⁴⁰ EG Lewin to All Regional Research Officers, "Applications by Germans for Patents in Foreign Countries," 9 Aug 1947. TNA: PRO FO 1032/93.

¹⁴¹ MacLeod, *Inventing the Industrial Revolution: The English Patent System, 1660-1800*, 10-11. See also The British Library Board, *British Patents of Invention, 1617-1977: A Guide for Researchers* (London: The British Library, 1999); Boehm.

¹⁴² MacLeod, *Inventing the Industrial Revolution: The English Patent System, 1660-1800*.

century, as more internal considerations – costs employed in inventing, jobs created, encouraging local invention – became the predominant justification and fewer foreign artisans received patents.¹⁴³

Still, British industrialists in the early 20th century - primarily from the chemical industry – saw patents as a viable tool for technology transfer once again, and successfully lobbied for a 1907 Patents and Designs Bill requiring that patents be invalidated if they were not actively worked on British soil. Explicitly aimed at transferring German (and American) 'know-how,' the act caused several German companies to build small factories in the UK to retain their patents. The bill was hotly contested in Parliament, but a key argument in its favor was bitterness over the loss of several technologies – especially chemical technologies – that had been invented in the United Kingdom but only worked and then patented in Germany. Once it became clear that the Board of Trade (which was in charge of the Patent Office) was not actually enforcing the law, however, these factories quickly closed.¹⁴⁴ Though the Patent Law of 1907 had marginal impact on British industry and international competitiveness, the concerns that prompted its proposal re-emerge in the wake of the Second World War.

Though the Second World War spurred invention and innovation around the world, patent and trademark protections around the world were suspended or highly altered by wartime considerations. "Trading with the Enemy" statutes sprang up around the world. Both allied and neutral nations confiscated German trade-marks and patents, which were seen as "weapon[s] of economic penetration...of immense strategic value".¹⁴⁵ In the Americas alone, Ecuador, Nicaragua, and Venezuela each seized German trademarks between 1944 and 1947, in addition to the American transfer of such patents and trademarks to the Office of the Alien Property Custodian.¹⁴⁶ Upon Germany's defeat and occupation, the United States seized the German patent office, microfilmed its contents, and shipped copies to London (in fact creating considerable ire by denying France and the Soviet Union full access, and only due to "excellent relations" with the US was the UK "accorded, unofficially, certain privileges").¹⁴⁷ Meanwhile, the world-renowned German patent system was shuttered pending de-Nazification (though in fact, as Kees Gispens has argued, the Nazis had enacted a number of important amendments to German patent law favoring the individual inventor over the corporation, which were mostly kept intact beyond removing obvious ideological wording). From 1945 to 1949, it was

¹⁴³ Ibid., 13.

¹⁴⁴ Antje Hagen, "Patents Legislation and German FDI in the British Chemical Industry before 1914," *The Business History Review* 71, no. 3 (1997); Paul A. Zimmermann, *Patentwesen in der Chemie. Urspruenge, Anfaenge, Entwicklung* (Ludwigshafen: BASF Aktiengesellschaft, 1965). Regarding American 'know-how,' Prime Minister Lloyd-George objected to allowing a patent to simply be worked within the Empire because it would allow Americans to work in Canada and thereby lose the benefit of America's patents in the UK. *Hansard, HC, 09 August 1907, Vol. 180, col. 645-76.*

¹⁴⁵ "German Patents and the German Patent Office," 11 Nov 1947. TNA: PRO FO 1032/93

¹⁴⁶ "Treatment of German Trade Marks: Brief for the UK Delegation to the Council of Foreign Ministers, November, 1947," 11 Nov 1947. TNA: PRO FO 1032/93.

¹⁴⁷ EG Lewin to All Regional Research Officers, "Status of the German Patent and Trade Mark Systems," TNA: PRO FO 1032/93.

impossible for Germans (or anyone else) to register new patents or trademarks within Germany, or for Germans to patent abroad.¹⁴⁸

Recreating Germany's patent and trademark system was not a universal goal during the occupation period. Soviet representatives to quadripartite talks consistently resisted reestablishment, which the British Foreign Office attributed with increasing frustration to a combination of ideological opposition to capitalist ideas of intellectual property and as an intended bargaining chip to be used in unrelated quadripartite negotiations.¹⁴⁹ If a patent office were to be created, Soviet negotiators demanded that the USSR have veto power on the grant of any applications, which the UK interpreted as an effort to build "a window into the mind of West German investors" while still denying them patent protection.¹⁵⁰ France resisted any centralized bureaucracy that could result in a strong German state, including a central patent office, and pushed for a new International Patent Office in Brussels to handle German (and other) patents. Though the British Foreign Office attributed this initiative to "French jealousy" of the prewar German Patent Office in contrast to France's system, which "has always been something of a joke with the more advanced and patent-minded Nations," France was busy exploiting German ingenuity in their own way.¹⁵¹ The French military occupation authority opened an office in the French Zone in early 1946 where Germans could pay to register patents and trademarks, an opportunity many German investors and engineers eagerly utilized as a basis for future claims for patent priority internationally, thereby effectively drawing German "invisible capital" from across the divided nation into French management.¹⁵²

If the Russians and French resisted recreating an autonomous German Patent Office in part because of a desire to exploit German ingenuity through zonal mechanisms, the British CCfG saw legal protections for intellectual property as exactly what would allow better British exploitation of German science and industrial advances. For the CCfG, reestablishing some kind of patent office was "an obvious decision," necessary for constructing "a modern State" – in West Germany, at least, as a unified Germany became a less and less likely prospect.¹⁵³ Further, as BIOS' mission statement only covered investigations of activities of German firms and installations made during the war years, its legal authority was highly questionable for newer inventions. The CCfG saw a need for a legal framework for British industry to license or buy German intellectual property would "open the way to the flow of German inventive ingenuity

¹⁴⁸ On German patent law, see Berghahn, "West German Reconstruction and American Industrial Culture, 1945-1960."; Hans-Joachim Braun, *The German Economy in the Twentieth Century: The German Reich and the Federal Republic* (Routledge, 1990); Kees Gispens, *Poems in Steel: National Socialism and the Politics of Inventing from Weimar to Bonn* (New York: Berghahn Books, 2002); Deutsches Patentamt, *Hundert Jahre Patentamt* (München: Heymann, 1977).

¹⁴⁹ [Untitled], 7 June 1947. TNA: PRO FO 1043/93; EG Lewin to All Regional Research Officers, "Status of the German Patent and Trade Mark Systems," TNA: PRO FO 1032/93.

¹⁵⁰ Ibid.

¹⁵¹ Ibid.

¹⁵² Regional Research Office, Research Branch to Australian Political Adviser, Australian Military Mission, "Applications by Germans for Patents and Trade-Marks in Foreign Countries," 20 Aug 1947. See also O'Reagan.

¹⁵³ EG Lewin to All Regional Research Officers, "Status of the German Patent and Trade Mark Systems," TNA: PRO FO 1032/93.

into the UK for our benefit."¹⁵⁴ Until then, without patent protections, Germans were perceived to be hiding inventions from the occupation authorities, which not only damaged export industries, but was in violation of Law No. 25 concerning the control of scientific research in the British Zone of Occupation. Internally, the Control Commission admitted that Law No. 25 was "not really necessary" and "largely designed to combat a danger which does not exist," but it was useful simply as a symbol of quadripartite agreement, and additionally kept control of scientific research out of the bureaucratic hands of intelligence agencies, who were "not in general staffed by men of a type who are able to maintain good relations with high-grade German scientists...we regard the maintenance of such relations as a cardinal point of our policy."¹⁵⁵ In any case, encouraging open contravention of the law was considered bad policy, and the CCfG worried about the bad blood generated by "some inventions disclosed to CCfG in confidence [that were] reported to be getting into the hands of British Industrialists through official channels."¹⁵⁶

VI. Patents versus Know-how in the 1940s United Kingdom

While the Control Commission for Germany and Foreign Office debated the best way to encourage and harness German ingenuity for the sake of rebuilding the (bi)zonal economy and aiding the British export trade, lawmakers in Parliament were struggling to write a new Patent Law, debated for years before passage in 1949. While the discussion of this law did not follow exactly the same lines as those within the Control Commission's crafting of law for Germany, it was crafted with the express intent of incorporating wartime experiences, protecting BIOS investigations, and negotiating a role for the state in promoting technology transfer in a world in which the United Kingdom's relative economic and political system faced new challenges.

Part of what was at stake in the 1940s Parliamentary discussions of patent law was the very meaning and purpose of patent, trademark, and copyright law. During the early war years, anxiety over German use of patents and trademarks created impressions of patents as powerful tools for state manipulation. The House of Lords debated in 1943 how to combat the threats outlined in the popular, hyperbolic exposé of Germany's 'infiltration' of American industry, *Germany's Master Plan: the Story of Industrial Offensive*.¹⁵⁷ The Ministry of Economic Warfare warned in 1944 that there was "considerable evidence of German infiltration into Spanish industry" taking the form of "making available processing and patent rights and supplying technical plant, advisers and engineers." (It was, however, "not possible to assess with exactitude the degree of control obtained by such methods.")¹⁵⁸ Wartime racial propaganda inflected debates on how best to protect British inventive brilliance from "the ingenious barbarians" of Germany who lacked such a spark but could engineer well, and the Japanese, who were "very

¹⁵⁴ "Patents-Policy," Undated. TNA: PRO FO 1032/98; EG Lewin to President, Economic Sub-Commission, "Patent, Trade-Mark, etc. Protection for Germans in the UK," 2 Oct 1947. TNA: PRO FO 1032/98.

¹⁵⁵ Control Commission for Germany (British Element) Scientific and Technical Research Board, "'Re work of Research Branch and our future policy covering control and encouragement of German Science,'" 18 June 1948. TNA: PRO BT 211/30.

¹⁵⁶ "Patents-Policy," Undated. TNA: PRO FO 1032/98.

¹⁵⁷ Borkin and Welsh.

¹⁵⁸ Regarding German 'infiltration' into Spain, see Hansard, HC, 03 February 1944, Vol. 396, col. 1431W

good imitators."¹⁵⁹ The result was the abrogation of patent law inside of occupied Germany and seizure of German patents internationally.

Adding to the uncertainty was a growing awareness of the importance of science for technology, partly as a result of wartime developments including radar and (eventually) atomic weapons, leading lawmakers to see a crucial role for science – both 'pure' and 'applied' – in patent law, at a time when the proper role of the state in promoting science was itself under heated debate. The perceived threat of British industrial 'decline' hung over the debate. "If we are to [succeed in] developing research," a Member of the House of Commons argued in 1944, "we shall have...to reconsider the whole question of our patent laws," and debate on patent law amendments led the House to spend much of the day debating such broad conceptual questions as "What is 'research,'" "What does the speaker mean by a 'scientific mentality,'" "is economics not a science," and what it would take to be a "scientific nation."¹⁶⁰ In all, the House spent "the first time that a full day's Debate has been devoted to the subject of research and scientific knowledge" in the service of rethinking patent law.¹⁶¹ Basing their arguments on experiences with German patenting and frustrated with British companies being overly conservative with innovation, they argued that patents in general were used far too often by established interests to smother rather than promote inventions, which was "sinning against the light." Instead, several members thought the nation would be best served by focusing on developing trained technicians of "second class minds" who had the experience and adaptable skills – in other words, the 'know-how,' though they did not use the term in this session – to supplement actually make economic and practice use of the innovations of the "first class minds" produced at UK universities.¹⁶²

This interest of Members of Parliament in incorporating conceptions of 'know-how' into patent and trademark law both mirrored and drew directly from the concerns of the BIOS administrators and Control Commission officials. It was felt that there was no time to waste in relying solely on long-term incentives a patent might provide, even assuming the patent justification model of inspiring inventors rather than rewarding businesses, because the UK's future had "never before...been affected so vitally by export considerations."¹⁶³ Too often, it was felt, British inventions had only been taken to production abroad, especially in Germany, but even once foreign patents expired on worthwhile processes, British industry often lacked the know-how and will to seize the opportunity. Reform of the patent law would allow Britain to harness the "unsurpassed genius" of the British people, while BIOS investigations had granted "three years of very great advantage" by revealing the "secret processes and prototype machines of the whole of German industry."¹⁶⁴ Yet this was not enough. Noting the American experience with the Chemical Foundation in the wake of the First World War during debate about the new Patents bill, Viscount Maugham remarked on the questionable utility of patents, and added that if Britain's seized chemical patents were similarly marginal in value, "something ought to be done

¹⁵⁹ Hansard, HL, 29 May 1945, Vol. 136, col. 246-59

¹⁶⁰ Hansard, HC, 19 April 1944, Vol. 399, col. 216-312

¹⁶¹ Hansard, HC, 19 April 1944, Vol. 399, col. 216-312

¹⁶² Hansard, HC, 19 April 1944, Vol. 399, col. 216-312

¹⁶³ Hansard, HC, 19 April 1944, Vol. 399, col. 216-312

¹⁶⁴ Hansard, HL, 29 April 1948, Vol. 155, col. 568-90. Regarding BIOS, Hansard, HC, 02 March 1949, Vol. 462, col. 482-504

about it."¹⁶⁵ He did not specify precisely what remedy might be possible, but German patents, at least, were not to be trusted to transfer knowledge without accompanying expertise.

In broader discussion, Viscount Swinton reported in the House of Lords that in the United States, patents were "rather falling into desuetude," as companies preferred to "rely on being first in the field and having the know-how" (Lord Stagbolgi replied that this was only because "in the United States the only thing that matters in the protection of patent rights is 10,000,000 dollars").¹⁶⁶ Lord Chorley advised that inventions were often "of no importance," but rather "a matter of building up an immense expertise and 'know-how.'"¹⁶⁷ Public funds ought to go to building a Fischer-Tropsch process chemical plant, one member argued in agreement, the purpose being "not necessarily for processes which are altogether new, but in order to gain the 'know-how' of treating coal in that way."¹⁶⁸

The final Patents and Designs Bill of 1949 was a substantial series of amendments rather than a radical change, and was based heavily on a series of reports from a committee to investigate the matter headed by Sir Kenneth Swan, appointed by the Board of Trade in April 1944.¹⁶⁹ Explicit mentions of BIOS were mostly reserved for separate bills passed in 1946, 1948, and 1953 retroactively ensuring the legality of BIOS investigations, which passed (unlike in 1907) without partisan contention despite reservations about the "thoroughly immoral proceedings" of taking private property without compensation and the possibility of indemnifying illegitimate exploitation of German patents and knowledge.¹⁷⁰ Still, the 1949 act settled matters such that "the British patent system...remained structurally unaltered" afterwards, though amendments in the 1970s and later sought to bring British law in line with expanding international treaties, and the law adapted to a world economy increasingly interested in selling knowledge.¹⁷¹

By the late 1950s, the debate on developing and transferring technology (and thus promoting British exports) no longer focused just on patents and trademarks. The term 'know-how' appeared in several Parliamentary debates by the mid-1940s, though usually referred to as 'that American term, 'know-how.' In discussing the economic situation of 1947, Viscount Swinton felt the need to define this "American expression" as "invaluable intangible assets born of long and varied experience... [the] great aggregate... of thousands of individuals, individual enterprise, knowledge and, I would almost say, instinct." It was difficult to define precisely, but like a bad bill, one would know it "by the smell."¹⁷² By 1956, Sir Lionel Heald urged revision of

¹⁶⁵ Hansard, HL, 29 April 1948, Vol. 155, col. 568-90

¹⁶⁶ Hansard, HL, 29 April 1948, Vol. 155, col. 568-90

¹⁶⁷ Hansard, HL, 29 April 1948, Vol. 155, col. 591-7

¹⁶⁸ Hansard, HC, 19 April 1944, Vol. 399, col. 216-312

¹⁶⁹ Board; Terje Gudmestad, "Patent Law of the United States and the United Kingdom: A Comparison," *Loyola of Los Angeles International and Comparative Law Review* 5, (1982); Thomas M. Meshbesh, "The Role of History in Comparative Patent Law," *Journal of the Patent and Trademark Office Society* 78, (1996); Pottage and Sherman.

¹⁷⁰ Hansard, HC, 19 April 1944, Vol. 399, col. 216-312; Hansard, HL, 05 Feb 1946, Vol. 139, col. 197-216; Hansard, HC, 03 June 1946, Vol. 423, col. 1589-90; Hansard, HL, 12 May 1953, Vol. 132, col. 395-420

¹⁷¹ Board, 7; Boehm, 4-5.

¹⁷² Hansard, HL, 30 October 1947, Vol. 152, col. 349-410

a Restrictive Trade Practices bill to account for a practice, "common nowadays, for there to be attached to...patent agreements an agreement for the exchange of know-how." Heald, quickly joined by other Members, hoped to allow British industry both to learn from abroad and to package British 'know-how' as an export good in itself.¹⁷³ As we will see, the timing of this rise of know-how in the United Kingdom fits precisely with the American experience, though the very fact of its discussion in policy debates and explicit inclusion in trade bills marks more government-level policy attention than know-how would receive in the United States for decades to come.

VII. American vs. British "Know-how"

Though this chapter does not focus primarily on the American case – see the next chapter for more detail there – and cannot go into the level of detail necessary to fully compare and contrast American and British exploitation policy and the sources from which they derived, emerging and contrasting concepts of tacit knowledge and 'know-how' were important drivers in that nation's policies as well.¹⁷⁴ The stated target of American investigations, repeated with some variation across agencies' mission statements and orders to investigators, was "German industrial processes, inventions, engineering, and 'know-how.'"¹⁷⁵ The meaning of "know-how" in the American context was not quite the same as its usage in the United Kingdom, however, or at least not consistently. In listing 'know-how' as a central part of the missions of exploitation efforts, American policymakers demonstrated a clear awareness of the importance of this intangible, yet different understandings of this concept, and technology transfer in general, shaped American exploitation policy in different ways than in the UK.

Though some American scientific exploitation efforts dated back to the entry of the United States into the war, the Acting Chairman of the War Production Board complained to the Secretary of War in September 1944 that "no effort has yet been made to obtain the so-called 'know how' which can only be obtained on the ground by qualified engineers and technologists working directly with the military forces."¹⁷⁶ The Commanding General of the Army Air Forces suggested expanding the mission of ALSOS, the unit sent to Europe with the invading forces to investigate reports of a German atomic weapons program, but the G-2 (Intelligence) Division of the Army was not willing to expand ALSOS's mission beyond purely "scientific" objectives.¹⁷⁷

¹⁷³ Hansard, HC, 01 May 1956, Vol. 552, col. 215-58; Hansard, HC, 13 June 1956, Vol. 554, col. 659-701

¹⁷⁴ For a fuller discussion of the American efforts, pending the publication of my own research, see Cassidy, "Controlling German science. I: US and allied forces in Germany, 1945-1947."; Cassidy, "Controlling German science, II: Bizonal occupation and the struggle over West German science policy, 1946-1949."; Gimbel, *Science, Technology, and Reparations: Exploitation and Plunder in Postwar Germany*; Herrmann; Lasby; Stokes, *Divide and prosper : the heirs of I.G. Farben under Allied authority, 1945-1951*; Stokes, "Assessing the Damages: Forced Technology Transfer and the German Chemical Industry."

¹⁷⁵ L.R. Warden, "Foreign Economic Administration," 29 July 1945. General Records, Department of Commerce, Record Group 40 (RG 40), box 3, National Archives at College Park, College Park, MD (NACP); "Appendix A: Basic Directive, Technical Industrial Intelligence Committee," undated. RG 40, box 62, NACP.

¹⁷⁶ James S. Lay, "Joint Intelligence Committee: Acquisition of German Technical Information of an Industrial Nature (Reference: JIC 220 Series)," 12 Oct 1944. RG 40, box 62, NACP.

¹⁷⁷ Ibid.

In response, the Joint Intelligence Committee established the Technical Industrial Investigations Committee (TIIC) on October 30, 1944, with a mandate to "receive, approve, and coordinate all governmental requests ... for investigations ... pertaining to industrial processes, patents, inventions, engineering, and 'know-how.'"¹⁷⁸ TIIC, in turn, instructed the representatives recruited from industry to distribute advertisements to other firms about efforts "to secure technical data and industrial 'know-how' which will be of value" to US industry.¹⁷⁹ Clearly acquiring this 'know-how' was a chief priority early on, and conceived of as a matter distinct from patents, processes, or purely 'scientific' knowledge; as something requiring skilled personnel on the ground in Germany to exploit effectively.

Effective acquisition of such personal knowledge was a difficult task, however, and even more so the mandate to make this knowledge available to all interested government (and later industrial) end users. Though not using the term, the general manager of the National Machine Tool Builders' Association expressed the chief problem facing exploitation as being "that these engineers come out of the Germany full of things they want to report but have a great deal of difficulty in expressing it in words."¹⁸⁰ His solution was to send "a skilled copy man from an advertising agency" to London to try to express things in "clear, explicit English that other people will understand," but this does not seem to have solved the issue. Similarly, the Good-All Electric Manufacturing Company were not especially impressed by reports of German machines, but wanted to send mechanics over to London to look at things in person regardless, as "mechanics can often visualize how something can be made if they look a thing over easier than they can if they have to look it over from photographs."¹⁸¹ These businesses, too, seemed to share a concept of 'know-how' with which their British counterparts were simultaneously struggling.

Not all American policymakers shared this conception of 'know-how,' however. For some, the term seems to have been something much more similar to a synonym for 'knowledge' or 'details.' "The design data obtained on sweep back wings...is a very important addition to our 'know how,'" wrote one investigator.¹⁸² Americans failed to copy one machine, argued another, because of "an inability to comprehend certain details and lacked the know-how which is available both in the report and in Germany."¹⁸³ This stands in sharp contrast to complaints that 'know-how' *cannot* be placed into reports. Some documents used the term in vaguer senses, such as a complaint that one report "does not give specific information on 'know-how,' new industrial processes," or another that while the earliest TIIC investigations "found that their written reports could not physically contain all of the information necessary for a complete story," later documents did include this know-how.¹⁸⁴

¹⁷⁸ L.R. Warden, "Foreign Economic Administration," 29 July 1945. RG 40, box 3, NACP; "Appendix A: Basic Directive, Technical Industrial Intelligence Committee," undated. RG 40, box 62, NACP.

¹⁷⁹ Letter to W.J. Donald, 21 June 1945. RG 40, box 12, NACP.

¹⁸⁰ Tell Berna to Lt. Gen. Levin H. Campbell, 20 July 1948. RG 40, box 12, NACP.

¹⁸¹ R.A. Goodall to U.S. Department of Commerce, 12 Oct 1946. RG 40, box 3, NACP.

¹⁸² US Department of Commerce, "Fruits of Victory: Intelligence, Research and Development," undated. RG 40, box 3, NACP.

¹⁸³ Ibid.

¹⁸⁴ "USSBS Reports Relating to Japanese Machinery Industry – Machine Tools," undated. RG 40, box 12, NACP; W.H. Reynolds to Robert Reiss, 5 Sept 1946. RG 40, box 3, NACP.

These different usages of this term explain at least part of what appeared to British eyes as American inconsistent policy decisions and shifts more compellingly than simple incompetence. The American organizations each sought to enact Executive Order 9568, issued by President Harry Truman on August 25, 1945:

It is the policy of this Government...that there shall be prompt, public, free and general dissemination of enemy scientific and industrial information. The expression "enemy scientific and industrial information," as used herein, is defined to comprise all information concerning scientific, industrial and technological processes, inventions, methods, devices, improvements and advances...if such information is of enemy origin or has been acquired or appropriated by the enemy.

For those who understood 'know-how' as an important component of these "industrial and technological processes," defined by hands-on, experiential knowledge, acquiring personnel was the central – and perhaps only – way to truly fulfill their mission. One manufacturer, for example, was advised that specific individuals probably couldn't be brought over to the United States unless "it was reasonably certain that they had some 'know-how' that we wanted," in which case apparently the rules could be stretched.¹⁸⁵ Within Germany, the economic division of the Control Council for Germany "stressed that much more real value will be obtained from the interrogation of technicians and scientists than will be gleaned from examination of documents, apparatus or plans, in the absence of responsible key personnel."¹⁸⁶ Such scientific and technical personnel should, in turn, "be exiled" from Germany and "given first class jobs here" or with one of the other Allied nations, both for control purposes and as human "war reparations," their salaries paid by sale of German assets.¹⁸⁷ The same logic could work in reverse, however, as in FIAT's opposition to Project Paperclip (the American rough equivalent of the Darwin Panel) on the grounds that German personnel working in America would learn American technology and upon their return, transmit it back to Germany, thereby illegally aiding Germany's armaments industry.¹⁸⁸

In comparison, the parts of the American program that saw 'know-how' as identical to knowledge, or less important for America in any case, were free to continue pursuing written reports in a way more akin to early British efforts. Such factions are probably not possible to identify strictly along bureaucratic lines, with one organization acting one way and another in sharp contrast, but rather by individuals who possibly never fully debated the means and limits of technology transfer. For investigators from the Koppers Company, German oil refining techniques "were considerably behind our American practices," yet the *data* from their experiments was still worth copying and might save some time – know-how might be important, in this take, but if the American technology and 'know-how' was already superior, then the objective all along should have just been to gain what explicit information could be of value.¹⁸⁹ For those not operating under the conception that German technology was superior, but simply

¹⁸⁵ Howard A. Pringle to W.C. Taylor, undated. RG 40, box 35, NACP.

¹⁸⁶ Economics Sub-Division, "Technical and Scientific Research in Germany After the War," undated. Records of the US Occupation Headquarters, World War II, Record Group 260 (RG 260), FIAT Administrative Records 1945-1947, box 17/3, folder 16, NACP.

¹⁸⁷ Ibid.

¹⁸⁸ Ralph M. Osborne to Col. E.W. Gruhn, 28 Sept 1945. RG 260, box 17/2, folder 25, NACP.

¹⁸⁹ G.R. Powell to Robert Reiss, 9 Sept 1946. RG 40, box 3, NACP.

that German labs had performed from useful experiments worth analyzing their findings, the shallow-but-broad American investigative plan was the most reasonable. Such sentiments are less frequently expressed in the sources than disappointment at not finding superior German technology, but cannot be discounted as a force behind American decision-making. Such investigations might have been perceived as less useful by British policymakers still hoping to acquire entire export industries and industrial technologies, but make sense within their context, and help explain some of the variety in American approaches.

VIII. Conclusions

The Board of Trade, and especially its head during much of this era, Sir Stafford Cripps (himself Britain's most prominent patent lawyer), connects the disparate policy worlds of Control Commission officials interested in governing the British Zone of Germany, BIOS personnel and industrial investigators hoping to aid British exports and military technology, diplomatic officials focusing on retaining close ties with America, and members of the Houses of Parliament negotiating change to domestic patent law. Until September 1947, the Foreign Office left most considerations of German patents and trademarks, both within and outside of Germany, to the purview of the Board of Trade "in view of the extreme technicality of the subject," intervening at that point to help re-establish patents because of the "urgency of expanding German exports."¹⁹⁰ Darwin Panel meetings generally had more members present from the Board of Trade than any other agency; BIOS was itself a Board of Trade operation and its findings publicized in the Board of Trade Newsletter; Sir Stafford Cripps, President of the Board from 1945 to 1947, answered Parliamentary inquiries about the state of German patents and urged amendments to the Patent Law to indemnify companies utilizing BIOS information. Further, the worlds of industry and Parliament had considerable overlap. The honorable Member for Heywood and Radcliffe, Mr. Wooton-Davies, as just one example, drew upon his experience as an industrial chemist when arguing that a new Patent Law would be necessary for Britain to become a "scientific nation" and aid inventors.¹⁹¹ Other Members drew upon their experience as patent lawyers, industrialists, and university professors in these discussions.

This linkage of intellectual property law and 'intellectual reparations' policy, in turn, adds a twist to existing narratives on the importance of the BIOS efforts for the British postwar economy, both in terms of tempering claims of immense value and resisting the 'missed opportunity' narrative. Those eager to list technologies investigated by BIOS teams, tally their development costs within the German industrial research establishment, and assign that value as the benefit of intellectual reparations need to take into account the difficulties experienced by British investigators in capturing 'know-how,' which certainly did not eliminate the benefit of investigations, but limited them substantially by shaping policy to cater to a smaller number of individual (usually larger) firms. Meanwhile, laments at the British failure to follow an American lead in capturing German technology – though more common in popular history than more recent studies by professional historians – or otherwise emphasizing the lack of planning by BIOS officials tend to underestimate the way that intellectual property law and policy supplemented – rather than prevented or ended – efforts to harness German ingenuity long-term.

¹⁹⁰ "Science Students at the Technische Hochschulen and Universities in the British Zone," Jan. 1947. FO 1032/93.

¹⁹¹ *Hansard*, HC, 19 April 1944, Vol. 399, col. 216-312

Existing historiography discussing the importance of scientific and industrial exploitation efforts in Germany diverge considerably even in broader terms. While admitting some examples of successful exploitation, such as Courtauld's acquisition of West German rayon technology, Ian Turner argues that "British reparations policy was an abject failure," and "attempts to exploit the German economy were unsystematic and largely unsuccessful."¹⁹² As mentioned, John Farquharson agrees about the overall results of reparations, but on the specific point of 'intellectual reparations,' makes a less concrete argument that "on the whole the UK authorities did not lag behind their allies in this field...the British also collected hidden reparations...and learned much," especially given the British intellectual property shared with others without compensation to balance the acquisitions from Germany.¹⁹³ Certainly the most thorough study of these efforts, Carl Glatt's nearly 1200-page dissertation, "Reparations and the Transfer of Scientific and Industrial Technology from Germany: A Case Study of the Roots of British Industrial Policy and of Aspects of British Occupation Policy in Germany between Post-World War II Reconstruction and the Korean War," tends to play up the economic importance of these efforts with its thorough listing of examples of seemingly successful transfer, while downplaying the importance of the admittedly chaotic nature of the exploitation bureaucracy.¹⁹⁴

This chapter does not attempt any ultimate tally of economic value to replace or supplement these, but the issues examined here related to contemporary and subsequent observers' understanding of technology transfer impacts these tallies at a fundamental level. I have tried to emphasize the wide gulf between investigating a technology and gaining economic value from it (much less the exclusive, zero-sum value implied by accusations of "plunder" and "war booty").¹⁹⁵ Certainly, investigators from many countries poured over German factories, blueprints, patents, and warehouses; interrogated scientists and technical personnel, hired individual for industry, and sometimes embedded their own engineers in German facilities. Yet these are not the same thing as "taking" German technology, and estimations built from totaling the cost German firms paid to produce their research, or the wide variety of fields investigated, or the large number of investigators and copies of publications purchased, all fail to take into account that communication depends on reception as much as transmission.

This is not a completely unique insight, but it is one more easily glossed over by early BIOS planners and by historians excited by their research topic's importance than it seems to have been for British businessmen on the ground in Germany, struggling to bridge the technological worlds of shattered, early-postwar Germany and Great Britain. Glatt, for instance, predicates the importance of files and patent documents thusly: "Provided a firm possess the

¹⁹² Ian D. Turner, "British Policy Towards German Industry, 1945-9: Reconstruction, Restriction or Exploitation?," in *Reconstruction in Post-war Germany*, ed. Ian D. Turner, (New York: Berg, 1989), 67, 88.

¹⁹³ Farquharson.

¹⁹⁴ Glatt. See especially p.188-189 for his estimation of the value of intellectual reparations, 184-187 for some examples of technologies copied from Germany by British firms or the military (especially the later, as defense technologies seem to be the majority of items listed).

¹⁹⁵ For example, the titles of Gimbel, *Science, Technology, and Reparations: Exploitation and Plunder in Postwar Germany*.; Krammer.

concomitant 'know-how', or could obtain it..."¹⁹⁶ Yet aside from mentioning that the seizure of prototypes from Germany and the limited Darwin Panel scheme had "precisely this" as their object, the difficulty of this step is not emphasized.¹⁹⁷

Once 'taken,' documents had to be processed, and once processed, sent to interested and needful parties, yet German technology was not so broadly helpful as might have been anticipated. "The number of documents in any batch which are of real value to industry is very small," the head of one processing unit reported in February 1946, "possibly not higher than 5%. This fact cannot be determined from the title of the documents but only from expert evaluation."¹⁹⁸ A Members of Parliament by 1953, while discussing patent reforms, commented that "it is now generally agreed that the results [of investigations in Germany] were disappointing, and that although the reports of the teams may have infringed copyrights, they added little to our industrial knowledge."¹⁹⁹ Perhaps there was, indeed, great value in the "negative information" that "in very many fields investigation has disclosed that our own technicians have little to learn from the Germans," but it is immensely more difficult to estimate if so.²⁰⁰

Whatever the actual 'value' of these particular technologies – and there are many indications in all three of the western Allied nations that German technology was generally far less impressive than they had anticipated and hoped - the question of how best a state might aid industry in *making use of* new technology is one at the center of both BIOS-related schemes and the patent reforms underway in the UK in the 1940s and early 1950s. Both American and British policymakers were initially optimistic about their ability to overcome this gap between 'investigating' and 'making use of,' that the 'best' technology would simply win out and be a major boost to domestic industry, and thus entire industries could benefit fairly and evenly by publishing the results of German research. In the face of the challenge of putting this into action, however, British policy changed course to aiding individual firms through promoting longer on-site visits and establishing legal frameworks to license German technology. Helping individual firms might have seemed unfair, or at least ripe for corruption, but as one official argued, trying to help everyone would ultimately help no one.²⁰¹ This ideological commitment to equal, world-

¹⁹⁶ Glatt, 358.

¹⁹⁷ Glatt's detailed and useful chapter on the Darwin Panel scheme (p.839-974) itself concludes that the hiring of German technicians where they were most needed – on the shop floor in skilled manufacturing industries – was effectively prevented by trade unions and their political allies. Defense technologies, perhaps unsurprisingly, were most aided by the importation of German personnel, as Chapter 1 here suggested was the case for France. In any event, the importation of German personnel would have been a limited vector of 'know-how' at best, given the breadth of industries surveyed and small numbers of Germans brought over. For instance, the dyestuffs industry – one of Britain's most important postwar exports – received four Germans. The chemical industry as a whole received 93. Automobiles, another vital postwar export industry, received eight. These statistics are from the charts in Glatt, p.965-972.

¹⁹⁸ JT Keyd to GS Mansell, 28 Feb 1946. TNA: PRO BT 211/41.

¹⁹⁹ Hansard, *HL*, 12 May 1953, Vol. 132, col. 395-420

²⁰⁰ WG Glennie, Deputy Regional Controller, 'Bristol Exhibition of Industrial Intelligence Work in Germany,' 28 Dec 1946. TNA: PRO BT 211/22

²⁰¹ "Report on a Meeting of Technical Investigations in Germany by Individual Firms," July 1946. TNA: PRO BT 211/21; Derek Wood to CS Low, Esq., 6 March 1947. TNA: PRO BT 211/24.

wide distribution of the fruits of German research via published reports was not just an internal commitment; it was the basis of the reciprocity agreement between the American and British investigatory programs.

A loss of faith in the ability to help entire industries was just as much a loss of faith in learning from the American investigations and providing full value in kind. Later Soviet accusations of the US and UK retaining the sole value from their investigations were certainly self-serving and somewhat unfair, but they were not particularly untrue. To the considerable frustration of British policy-makers, German technology proved considerably less malleable to the ends of good diplomacy than they had anticipated. A "bite of the apple" was worth more than a "whiff all around," but it was considerably more difficult to make friends by sharing.

Chapter 3: American Postwar Scientific Exploitation and the Myth of German Technological Superiority

Abstract: Since the 1990s, historiography about American (and British and French) reparations policy towards Germany following the Second World War has emphasizes the 'intellectual reparations' taken in terms of patents, industrial investigations, and the hiring of German scientific and technical personnel in Western countries. Both the popular and academic histories about this topic focus on the 'value' of these reparations, yet this emphasis includes both evidentiary and theoretical problems. While American companies expressed great enthusiasm for investigations of German science and technology, they also frequently wrote about their disappointment with what they found in Germany; and in any case, the fundamental differences between intellectual and material property must be taken seriously in accounting for gains and losses. The greatest discovery of American industrial investigators in Germany was not a cache of new technologies or scientific secrets, but rather a new perception of American technology and industry as leading the world. Whatever the 'value' of these reparations in monetary terms, this reorientation of America's perceived place in the world is likely far more important in the diplomatic context of the quickly developing Cold War.

I. Introduction

It was no secret from any reasonably informed American citizen by 1950 that the US government had been (and still was) investigating German science and technology, both in order to learn the 'secrets' of Nazi Germany's V-2 missiles and to aid American industry in general. Articles in the *Washington Post*, *Wall Street Journal*, and *New York Times* bore titles in the mid-1940s like the following: "Experts To See Thousands of Enemy Patents;" " Reich War Secrets: TIIC (Called 'Tick') Roots Out Technical Ideas For Allied Use: Agency Finds Most Booty In Liquid Fuel, Lubricants, Aircraft, Synthetic Rubber: May Aid Peacetime Industry;" and " Nazi Scientists Aid Army on Research: Now Making Rockets for United States."²⁰² Protests of the use of these "Nazi scientists" were equally visible, prompting their own articles in these leading newspapers.²⁰³

²⁰² Howard W. Blackeslee, "Experts To See Thousands Of Enemy Patents," *Washington Post*, April 11, 1943, accessed September 26, 2013 at <http://search.proquest.com/docview/151695025>; Henry Hemmill, "Reich War Secrets: TIIC (Called 'Tick') Roots Out Technical Ideas For Allied Use: Agency Finds Most Booty In Liquid Fuel, Lubricants, Aircraft, Synthetic Rubber: May Aid Peacetime Industry," *Wall Street Journal*, July 18, 1945, accessed September 23, 2013 at <http://search.proquest.com/docview/131561233>; Frederick Graham, "Nazi Scientists Aid Army on Research: Now Making Rockets for United States," *New York Times*, December 4, 1946, accessed September 23, 2013 at <http://search.proquest.com/docview/107705862>.

²⁰³ For example, George Gallup, "Citizenship Opposed for Nazi Scientists," *New York Times*, December 30, 1946, accessed September 26, 2013 at <http://search.proquest.com/docview/107494565>; "Public Disapproves, 10 To 7, Importing of Nazi Scientists," *Washington Post*, January 11, 1947, accessed September 26, 2013 at <http://search.proquest.com/docview/151901554>.

The connection between these investigations and reparations was made equally prominent when Soviet Foreign Minister V.M. Molotov accused the United States and United Kingdom of taking about ten billion dollars' worth of 'hidden' reparations by means of German patents and industrial knowledge.²⁰⁴ American and British representatives admitted the seizures, but emphasized that they had sold reports of their investigations openly, including to the Soviet Union, and so they had gained no exclusive benefit. The image of the "Nazi scientist" working outside of Germany remained alive in popular culture, from Stanley Kubrick's *Dr. Strangelove* to Ira Levin's *The Boys from Brazil*, but in academic histories of reparations and Western postwar occupation policies, these technical investigations mostly disappeared. Nicholas Balabkins' *Germany Under Direct Controls* (1964), for example, discusses American efforts to reduce German technological "know-how" as part of a Morgenthau-plan-derived effort to reduce industrial capacity, but does not mention efforts to move or 'take' German science or technology.²⁰⁵ Alex Cairncross, a Treasury Representative in Berlin during reparations talks, wrote his excellent study *The Price of War* about the planning of postwar reparations, but his model of "the flood of reparations from the Eastern zone to Russia and the trickle from the Western zones as they absorbed massive injections of capital from outside" does not take into account intellectual property as a particularly significant issue of reparations.²⁰⁶

The standard narrative of treatment of occupied Germany by the Allied forces, as told through at least the 1990s, follows basically the narrative used by Cairncross. In it, the United States focused first on suppressing German industry and economic recovery, then reversed course to building up its zone's economy and government, feeling a stronger need for a buffer zone and bulwark against the Soviet Union than for extracting money from the defeated foe. Great Britain emphasized diplomatic, quadripartite governance, but also rebuilding the zonal economy to take the burden of occupation off of British taxpayers. The Marshall Plan is emblematic, in this narrative, of the Western push to rebuild the bizonal/trizonal economy, in contrast to a Soviet Union that aggressively sought to exploit the resources from its considerable zone of control, and ruthlessly extracted reparations in both equipment and personnel in order to rebuild their shattered industry.²⁰⁷

²⁰⁴ Ferdinand Kuhn, Jr., "Red Charge That US Has Taken \$10 Billion in Patents is Refuted: PATENTS," *Washington Post*, March 19, 1947, accessed September 26, 2013 at <http://search.proquest.com/docview/151929215>; "U.S. SAID TO SEIZE GERMAN PATENTS: Russian Says That Billions in Reparations Have Been Taken Since Occupation," *New York Times*, February 16, 1947, accessed September 26, 2013 at <http://search.proquest.com/docview/107814400>.

²⁰⁵ Nicholas Balabkins, *Germany Under Direct Controls: Economic Aspects of Industrial Disarmament, 1945-1948* (New Brunswick, N.J.: Rutgers University Press, 1964).

²⁰⁶ Cairncross, 16.

²⁰⁷ For examples of the claim that America made no reparations demands, see Harry S. Truman, *Memoirs. Vol. 2 1946-1952: years of trial and hope* (New York: Signet Books, 1965), 238.; or Richard R. Burt, "Beyond the Zero Hour: The Creation of a Civil Culture in Postwar Germany," speech given at the German-American Institute, Amerika Haus, Nuernberg, 23 May 1986, 40.

For examples of this broader narrative in even fairly recent historiography, see Balabkins; J. Farquharson, "Anglo-American Policy on German Reparations from Yalta to Potsdam," *English Historical Review* 112, no. 448 (1997); Josef Foschepth, ed. *Kalter Krieg und deutsche Frage: Deutschland im Widerstreit der Maelchte* (Goettingen: The German Historical Institute, London, 1985);

The publication of John Gimbel's *Science, Technology, and Reparations: Exploitation and Plunder in Postwar Germany* in 1990 brought considerable historical attention back to these "intellectual reparations," emphasizing the breadth and scale of these efforts, both within many different American agencies and across the Western Allies, cooperating and competing with the United Kingdom and France as well as other allied or neutral countries. Gimbel resuscitated Molotov's claim, freely admitting that any exact dollar value assigned to this novel form of reparations would be largely speculative, but despite that, arguing that a \$10 billion estimate was "probably not far from the mark."²⁰⁸

Gimbel's argument spawned a variety of responses, including attempts to explore this history from the Canadian and British perspectives, a case study of a particular technology (the magnetophone) exploited through these programs, and a collection of essays titled *Technology Transfer Out of Germany After 1945*.²⁰⁹ A 1993 article in the history of science journal *Isis* by RW Home and Morris Low tackled the "Postwar Scientific Intelligence Missions to Japan," though not in direct conversation with Gimbel et al. While this scholarship includes many innovative and interesting new questions and approaches, most still centered around one of Gimbel's main arguments: the value of these 'hidden reparations,' the tangible and intangible benefits gained from these efforts at perhaps the broadest, most ambitious attempt at technology transfer in history.

In many ways, the "value question," taken in terms of dollars and cents, is among the least important aspects of the Allied postwar exploitation efforts. Whether the net 'gain' for America, the UK, and France was billions of dollars in profit or thousands lost, these efforts represent a key site and cause of the drawing together of the Western powers under the leadership of the United States for the benefit of their individual and mutual scientific/technical benefit. Whatever the depth of distrust that officials from the US and UK might have had for their French counterparts, they were willing to forge relationships to extend their exploitation to the French Zone. These efforts highlight the dramatically increased importance of science and technology for the postwar state, and were fundamental in prompting the extension of the roles of intelligence services in each nation into the scientific realm. Decision-making over the largely contradictory aims of suppressing German technical ability and supporting the perceived 'democratizing' influence of science in post-Nazi society was an important element in quadripartite planning for creating a new Germany (and then two German states) as the early Cold War developed.

Otto Nübel, *Die amerikanische Reparationspolitik gegenüber Deutschland 1941-1945* (Frankfurt am Main: Metzner, 1980).

The Soviet case is mostly outside the scope of this chapter. Perhaps the best holistic account is the chapter "The Soviet Use of German Science" from Naimark, 205-250. Other quality sources include Gimbel, *Science, Technology and Reparations*, and Jon Elster, *Retribution and Reparation in the Transition to Democracy*.

²⁰⁸ Gimbel, *Science, Technology, and Reparations: Exploitation and Plunder in Postwar Germany*, 170.

²⁰⁹ Glatt; Steven T. Koerner, "Technology Transfer from Germany to Canada after 1945: A Study in Failure?," *Comparative Technology Transfer and Society* 2, no. 1 (2004); David L. Morton, "'The Rusty Ribbon': John Herbert Orr and the Making of the Magnetic Recording Industry, 1945-1960," *The Business History Review* 67, no. 4 (1993).

The value question did matter to the historical actors involved in these programs, however, and is important in that regard at the least. The methods generally used for estimating these valuations have two key flaws. First, little of this discussion takes seriously the fundamental differences between intellectual property and material property. Documents copied by American investigators in Germany might record the results of a million marks' worth of research and development, but unless they were read, understood, and implemented in the American context, the value 'taken' from Germany cannot really be claimed to be that million marks, nor had the German firm necessarily lost a pfennig. If the Soviet Union lost much of its potential 'gain' from material reparations by shipping entire German factories east, only to have the equipment rust in rail depots unused, much the same dynamic must be taken into account with 'intellectual reparations.'

Second, there is considerable evidence both within the archival records of the investigatory agencies and in contemporary trade journals that in most fields, for most investigators, the greatest discovery from their trips to Germany was that there was so very little to discover. Taken in the context of this first point – that technologies *investigated* are not the same as technologies *taken*, or technologies *lost* by those investigated – the greater importance of the value question might be in how very little was gained by the American and British investigators despite their great ambitions and vigorous, multiplying, overlapping efforts. The extent of the efforts at scientific exploitation point to a myth of uniform German technological and scientific superiority prevalent across policymakers and industrial leaders in the prewar years, and perhaps one of the greatest outcomes of these investigations was the shattering of this belief, and the reconfiguration of American industry's perceptions of its role in the world – and thus the extent to which policy should favor stymying rather than encouraging international technology transfer.

II. FIAT, TIIC, and other Acronyms for Technological Investigation

Efforts at extracting German science and technology for industrial purposes were a mess of overlapping jurisdictions, military and civilian organizations, obfuscating acronyms and code-names, and shifting bureaucratic lines of authority over even the few short years between 1944 and 1949 during which the programs were most active. There is no hope of a completely clear narrative including all of the major branches of these efforts, even limiting the attempt to solely the United States (which, in any case, is not truly possible, as the efforts operated in tandem with the British from the start). For the moment, then, this chapter will focus on partially untangling the American case, while future chapters will expand upon the British and French efforts. When productive, comparisons to the British case will remain, but fuller explanations of the bureaucracy behind them will wait until those chapters. Before attempting to stream-line and clarify the narrative, let us first embrace the bureaucratic mess behind these efforts, if only to appreciate the complexity faced by Germans trying to decipher their obligations, and policymakers trying to enact any sort of coordination and simplification to the system. Remembering each of the following agencies is not crucial, as I will reintroduce them when relevant, and will otherwise refer to the broader efforts as "FIAT-related" or "FIAT-like" programs.

During the war itself, the Supreme Headquarters, Allied Expeditionary Force (SHAEF) operated so-called "T-Forces," groups of intelligence specialists, technicians, interrogators,

translators, engineers, bomb squads, and combat troops drawn from Eisenhower's Allied Expeditionary Force. The primary duty of these T-forces was to identify and secure intelligence targets in occupied territories, and this mandate extended to targets of primarily scientific and industrial value, not just those of purely military importance.²¹⁰ The T-Forces, though a unit of the Special Sections Sub-division of SHAEF's G-2 (Intelligence) unit, were assigned targets by the Combined Intelligence Objectives Subcommittee (CIOS), a joint British-American task force. CIOS was comprised of a British component, the British Intelligence Objectives Subcommittee (BIOS), and an American component, the Technical Industrial Intelligence Committee (TIIC), the latter of which was established by the Joint Chiefs of Staff under the Joint Intelligence Committee (JIC). TIIC was comprised of representatives from the Foreign Economic Administration (FEA), Naval Intelligence, Army G-2, the Army Air Staff, Department of State, Office of Strategic Services (OSS, the predecessors to the CIA), the War Production Board, and the Office of Scientific Research and Development (OSRD).

Within the Special Sections Sub-division, there also existed a Scientific Intelligence Advisory Section (SIAS) and the Enemy Personnel Exploitation Section (EPES), the latter of which was responsible for operating internment camps named DUSTBIN and ASHCAN where scientific and technical personnel were gathered for interrogation, including Nazi Minister of War Production Albert Speer. The entire Special Sections Sub-division was discontinued on 2 June 1945, with its functions incorporated into the newly established Field Information Agency, Technical (FIAT), which was a joint US-UK agency designed from its inception to break into national components upon the dissolution of SHAEF. After this happened on 15 June 1945, FIAT became FIAT (US) and FIAT (BR). After much prolonged debate over the desirability of working with the French, eventually FIAT (FR) joined these agencies, and each exchanged liaison officers.²¹¹ FIAT (US) was an agency under the purview of the Office of the Military Government, United States (OMGUS), the military government of the US Zone of Occupation.

Separate from these was the Joint Intelligence Objectives Agency (JIOA), established by the Joint Chiefs of Staff in 1945 under the Joint Intelligence Committee, making it the bureaucratic brother of TIIC. JIOA in turn organized Project Overcast, a top-secret effort to find the scientists and engineers connected with the V-weapon rockets and bring them to into American control, among them Wernher von Braun and his team from the Peenemunde rocket testing facility in Germany. When then name Overcast leaked to the public, the project was renamed as Project Paperclip, and its mission expanded to denial of German scientists and technicians to foreign countries as well as acquiring them for the United States, and eventually to include industrial technology as well as military. Paperclip operated in cooperation with British colleagues, but along military lines largely independent of FIAT or TIIC.

Finally, in the United States, President Truman issued Executive Order 9568 on 8 June 1945 instructing the Department of Commerce to establish a Publication Board under its Office

²¹⁰ Gimbel, *Science, Technology, and Reparations: Exploitation and Plunder in Postwar Germany*, 4.

²¹¹ For more detail on the creation of FIAT (FR) and Anglo-American debates over how far they could trust France to cooperate in the exploitation efforts, see the chapter on French exploitation. For more details about the establishment of FIAT, see History of the Field Information Agency Technical (FIAT) (8 May 1945 – 30 June 1946) 1st Installment (Hereafter: "History of FIAT"), in: U.S. Army Center of Military History, call number 8-3.2 AC v 1 c 2

of Technical Services (OTS), which would be responsible for releasing to industry all scientific and technical information developed by the United States during the wartime, pending declassification and national security limitations. Executive Order 9604, issued 25 August 1945, expanded the scope of these orders to include the publication of 'enemy' science and technology.

Beyond all of these, there were many smaller efforts operating semi- or fully independently in the late wartime and early postwar years with some mandate for investigating German science and technology. The ALSOS mission investigated reports of a German atomic research program.²¹² The Strategic Bombing Survey nominally sought to measure the impact of the bombing campaigns, but over time expanded its mission to investigate German industry at large.²¹³ A Technical Oil Mission investigated that technology; Army Ordnance sent groups, as did a US Navy Technical Mission.²¹⁴ The proliferation of these overlapping, duplicative efforts was a problem FIAT was created to help solve, but bureaucratic struggles meant it was never entirely capable of wrangling these forces.

This complex constellation of agencies notwithstanding, most of the history of US efforts at technical exploitation can be focused on just a few agencies. TIIC and FIAT shared personnel and had functionally identical missions, each assigned to coordinate the efforts of other groups, with the primary functional difference being that TIIC was stateside and FIAT based in Germany. The Department of Commerce's Office of Technical Services (OTS), headed by John Green, was the public face of these efforts, advertising completed FIAT reports to industry and issuing press releases to inform the public. Operation Paperclip has attracted by far the most public attention, both in terms of reactions at the time and in subsequent, popular exposes and academic histories of the 'hiring of Nazi scientists.'²¹⁵ The 'T' Forces are less specifically important, but reoccur throughout histories of this period because they handled transportation, housing, shipping, and general logistics for all of these agencies throughout the occupation period.

In the US, TIIC (and later John Green's OTS) communicated with industrial leaders and trade associations to identify targets worth investigating in Germany, then to recruit technical personnel who would take trips of two to three months in Germany. Upon arrival in Germany (or more often, in London on the way to German), these investigators received basic instructions, a uniform and nominal military rank equivalent to colonel, and introductions to T Force units who would handle their transportation and housing. Teams of investigators with related interests would travel to pre-approved facilities, where they had authority to question technical personnel and managers, copy (but not remove) any paperwork, and tag machinery for reparations seizures.

²¹² Samuel Goudsmit, *Alsos* (Los Angeles CA: Tomash Publishers, 1983); John D. Hart, "The ALSOS Mission, 1943-1945: A Secret U.S. Scientific Intelligence Unit," *International Journal of Intelligence and Counterintelligence* 18, no. 3 (2005); Boris Pash, *The Alsos Mission* (New York: Award House, 1969).

²¹³ Gian Peri Gentile, "Advocacy or Assessment? The United States Strategic Bombing Survey of Germany and Japan," *Pacific Historical Review* 66, no. 1 (1997); David MacIsaac, *Strategic Bombing in World War II: The Story of the United States Strategic Bombing Survey* (New York: Garland Publishing Co., 1976).

²¹⁴ Krammer.

²¹⁵ Bar-Zohar; Bower; Gimbel, *Science, Technology, and Reparations: Exploitation and Plunder in Postwar Germany*; Herrmann; Hunt; Kurowski; Lasby; Peltzer; Presas i Puig.

Upon returning to the US, investigators would write up reports about their findings, which the Publications Board would publish and publicize, allowing their acquired knowledge to benefit all of US industries, and indeed those of the entire world. Investigators wishing to travel to the US or French zones would apply for passes through the FIAT liaison officers, and then the French or British authorities would care for them during their visits.

This was all in theory, of course, and in reality things did not work quite so smoothly. Some individuals or teams of investigators took off to unapproved facilities, exploiting these 'targets of opportunity' despite FIAT's objections.²¹⁶ Many investigators never bothered to write their final reports, or wrote terse and unhelpful summaries that provided little detail.²¹⁷ Transportation and communication were major bottlenecks, as FIAT lacked the authority to command the military government officials to provide resources, moving TIIC's chairman from being "enthusiastic at the establishment of FIAT" to being convinced that the founding of FIAT to coordinate efforts in Germany actually made their job much more difficult.²¹⁸ Only frequent appeals to President Truman's support - and through him, that of top generals - eventually secured FIAT offices and access to a truck pool.²¹⁹ In most reports, the Germans interrogated were helpful and open, but the coercion implied by the interrogators wearing military uniforms was no bluff, and scientists who refused to cooperate ended up in jail, or at the least under surveillance. The three Western occupying powers generally cooperated with each other's investigations, but there are scattered reports of French teams covertly hiring German scientists being kept in American or British camps for future employment, or technicians being put into 'protective custody' (meaning jail) for threatening to do so rather than revealing their industrial knowledge.²²⁰

Still, despite these day-to-day difficulties, hundreds of investigators from the United States joined thousands from the United Kingdom in touring Germany from the end of the war through 1949, and scientist 'denial' programs continued to operate long afterwards to various degrees.²²¹ Hundreds of thousands of documents went through the data processing centers, only a fraction of which were judged valuable enough to be worth translating and releasing, but which resulted in thousands of final CIOS, FIAT, and BIOS reports.²²² These, in turn, sold quickly. By

²¹⁶ "TIIC/C 8th Meeting," 26 April 1945. General Records, Department of Commerce, Record Group 40 (RG 40), box 31, National Archives at College Park, College Park, MD (NACP).

²¹⁷ Gimbel, *Science, Technology, and Reparations: Exploitation and Plunder in Postwar Germany*, 109-112.

²¹⁸ Edward L. Bowles to Brigadier R.J. Maunsell, 25 June 1945. Records of the US Occupation Headquarters, World War II, Record Group 260 (RG 260), FIAT Administrative Records 1945-1947, box 17/1, folder 54, NACP.

²¹⁹ "TIIC 34th Meeting," 24 August 1945. RG 40, box 30, NACP.

²²⁰ Lt. Col. Royal S. Copeland to Scientific Branch, 6800 FIAT, "Subj: Herman EHRENSPECK, V-Weapon Research," 11 July 1946. RG 260, box 17/1, folder 25, NACP.

²²¹ While not an ideal work in some ways, Hunt's *Secret Agenda* demonstrates the longevity of aspects of the Paperclip program. See: Hunt.

²²² "1947 Budget Estimates, Presented to Dept. of Commerce," October 1946. RG 40, box 58, NACP.

January 1950, BIOS (the British equivalent of FIAT, though a FIAT (BR) did exist for liaison purposes) had dispatched over 46,000 copies of summaries and abstracts to industry.²²³

III. American and British Disappointment in German Technology

The extensive efforts undertaken by the United States, United Kingdom, France, and the Soviet Union, it could be argued, are themselves demonstration of the enormous value to be attained. Gimbel stops short of making a claim that German technology was uniformly superior to what American industry already utilized, but "accept[s] what Vannevar Bush and others more qualified...have had to say...[that] modern industries developed variously and unevenly, and in this particular case Germany was ahead in certain areas [of industry] while the Americans led in others."²²⁴ In accounting for the value of these efforts, companies at the time reported dollar amounts of research and development 'saved,' utilizing generally unstated methodologies; agencies seeking self-justification requested and gathered these statements into larger estimations; and modern historians, while usually admitting that any concrete, reliable numbers are impossible to label, have often taken these same basic methodologies as the correct ones to approach the subject.

This feverish interest in German science and technology should be examined more closely before using it as evidence of larger historical trends. This is not a story, ultimately, of the United States, Great Britain, and France getting a free lunch at Germany's expense, but rather of a longstanding myth of German technical superiority bursting upon closer inspection, and of the reorientation of the West's scientific and technical communities in the wake of these changing perceptions. In most industrial fields, for most investigators, the biggest surprise to be found in Germany was not its host of scientific secrets. The biggest shock was one of disappointment, the discovery that American and British technology was, by and large, more advanced and more suited to their countries than anything to be found in the land of "ingenious barbarians."²²⁵

The American agencies in charge of technological exploitation put considerable effort into evangelizing this opportunity to industry and soliciting statements of the value of their investigations at home, yet even in letters responding to such requests for feedback, this contradiction – great value overall, but really not much to learn – is a frequent motif, even to the point of being confounding. "I found nothing, in its entirety, acceptable to us and our industry," wrote one chain manufacturing company investigator, yet later added, "Retrospection has provided the conclusion that the trip was of considerable value, especially to my company, and that the value was in the mechanical designs and details in tooling, no single one of which might be considered of consequence."²²⁶ "Germany's advances in her war-time automotive industry do

²²³ "Report on Work of Technical Information and Documents Unit," January 1950. The National Archives (TNA): Public Records Office (PRO), Board of Trade Record Group 211 (BT 211), folder 337.

²²⁴ Gimbel, *Science, Technology, and Reparations: Exploitation and Plunder in Postwar Germany*, xi.

²²⁵ This term, utilized to describe German "inventiveness" contrasted to British "genius," was stated in *Hansard*, HL, 29 April 1948, Vol. 155, col. 568-90.

²²⁶ "Progress Report No. 1, Technical Industrial Intelligence Branch," 29 March 1946. RG 40, box 3, NACP.

not measure up to those of America," began another investigator, and they "can never hope to surpass America." Yet he concludes, "What FIAT is doing – what FIAT is finding – will be of inestimable value to American engineers and industrialists. American industry is surely not taking full advantage of this government service...That is one thing that has surprised me greatly."²²⁷ An investigator in high pressure hydraulics who had expected German technology to be "far advanced over America" instead found that German industry employed equipment that had "a much lower safety factor than does American industry" – yet rated his trip "well worth while."²²⁸

Exploring beyond the bounds of the archival records of the agencies involved in exploitation makes this contrast even sharper. An article in the *Christian Science Monitor* in March 1946 describes the disappointment felt by the membership of the Society of Automotive Engineers upon hearing from its investigators.

[An investigator] had heard so much 'propaganda' from Germany that he had almost been convinced that they had something quite superior to offer, but that his visit had made him disappointed in the accomplishments of the Germans... all evidence indicates...that German vehicles were generally inferior to our own in point of dependability and relative freedom from troubles. All in all, meetings indicated that it was time for American engineers to drop all feeling of inferiority left over from the days when it was conceded generally that as craftsmen and engineers Germans had no equals.

Trade journals for industries involved in key industries targeted by FIAT contain many statements skeptical of value. In *Automotive and Aviation Industries*, a March 15, 1945 article surveying production techniques in the German aircraft industry commented that "the quality of sheet metal work...is considerably below the standards of United States manufacturers," "a very evident lack of knowledge of the use of chip breakers in tool grinding was noted everywhere," and "machine tools are very similar to those of the United States," even to the extent of German machines being copies of the American-made Browne and Sharpe automatic lathes.²²⁹ A report in May 1946 mourning the loss of several of these "technical men" investigating German technologies to enemy fire during the last stages of the war, emphasizes their bravery and the importance of their mission, yet even here mentions their "general impression...that enemy machine tools were not up to our standards and held little of value to machine designers."²³⁰ In the machine tools industry, the article "Nazi Repots Disappointing" in *American Machinist* critiques FIAT reports as "interesting, but not one in ten contains data of use to American industry."²³¹ An issue later: "Generally speaking, there appeared to be no outstanding developments [in German machine tools] apart from normal improvements."²³² The journal *Industrial Medicine* included a letter to the editor in September 1945 from Colonel Edward D. Churchill, writing about his tour of six German military hospitals: "There was considerable

²²⁷ "Press Release, Max A. Walz," undated. RG 260, box 17/3, folder 13, NACP.

²²⁸ "Press Release, PG Reynolds," undated. RG 260, box 17/3, folder 13, NACP.

²²⁹ *Automotive and Aviation Industries*, "Survey of Productions Techniques Used in German Aircraft Industry," March 15, 1945, p.172

²³⁰ *Automotive and Aviation Industries*, "What Price Glory?" by Joseph Geschelin, May 15, 1946, p. 37

²³¹ *Ibid.*

²³² *American Machinist*, "German Machine Tools," February 14, 1946, p.2.

expectation that the German doctors, with the German medicine's world-wide pre-Hitler fame and the well-known German thoroughness and energy, would have some pretty phenomenal achievements of their own to report from their war hospitals," but he found German methods "about 20 years behind the American procedure."²³³ One investigator for the American Instrument Company gave talks on his experiences to the Scientific Apparatus Makers of America and found great interest there – but "the 'human interest' phase of the trip was of much more interest than the technical phase."²³⁴

The chemical industry is one in which German firms, including the famous IG Farben cartel, certainly lead the world in at least several important technologies, and indeed German chemical industry investigations received heavy coverage in American trade journals. The editor of *Chemical and Metallurgical Engineering*, Sidney Kirkpatrick, was an eager booster for FIAT, writing several editorials encouraging industrial cooperation with FIAT and use of its reports. Both this journal and *Chemical and Engineering News* reported extensively on details of German processes in multi-page detail, and including a bibliography of newly available FIAT/BIOS reports in each issue. These reports are referred to as being "of tremendous interest to chemical engineers in this country," "anxiously awaited by the U.S. chlorine industry," "a remarkable development of an acetylene industry," and the result of "one of the most beneficial programs for American science and industry," with some of these articles written by representatives from companies such as Dow Chemical and Tennessee Eastman Corporation.²³⁵

Even in chemicals, however, there are signs of sincere disappointment in German science and technology. As just one example, an editorial in *Chemical and Engineering News* from July 1945, sardonically titled "Ueber Alles?", begins, "Once more myth of Germany's well-advertised superiority in chemical matters has been exploded by the reports of the mission of American technologists who inspected the Buna plants and laboratories prior to V-E day... There is no indication that German synthetic rubber techniques will be of material help to the American rubber industry because our present processes are superior in so many respects."²³⁶

This disappointment in German science and technology was not solely an American phenomenon. In the United Kingdom, the archives of the agencies involved in scientific exploitation, trade journals, and press share the American initial enthusiasm, followed by expressions of sharp disappointment mixed in with the reports of great value acquired. The document processing centers for items copied by investigative teams reported that "the number of documents in any batch which are of real value to industry is very small – possibly not higher than 5%."²³⁷ In a House of Lords debate on a bill to protect users of BIOS reports from copyright and other intellectual property lawsuits, Lord Edward Jessel fought the measure on principle (he saw personal property as off limits even during total war), noting that "In fact, I think it is now

²³³ *Industrial Medicine*, "Doctors Under Nazism," Sept. 1945, p.28.

²³⁴ WH Reynolds to Robert Reiss, 5 September 1946. RG 40, box 3, NACP.

²³⁵ *Chemical and Metallurgical Engineering*, "German Fibers," November 1945, p.292; *Chemical and Metallurgical Engineering*, "German Chlorine," Oct. 1945, p.104-106; *Chemical and Metallurgical Engineering*, "Acetylene: Industry in Wartime Germany," Oct. 1945, p.116-119; *Chemical and Engineering News*, "FIAT," August 25, 1946, p.3297.

²³⁶ *Chemical and Metallurgical Engineering*, "Ueber Alles?" July 1945, p.114-115.

²³⁷ JT Kyd to GS Mansell, 28 February 1946. TNA: PRO BT 211, folder 41.

generally agreed that the results were disappointing, and that although the reports of the teams may have infringed copyrights, they added little to our industrial knowledge."²³⁸ The Association of British Chemical Manufacturers wrote to the head of BIOS in October 1946 that "the number of really 'novel' processes is comparatively few."²³⁹ A former head of CIOS and BIOS praised the German tradition of ingenuity in producing synthetics and ersatz products, but noted that this meant that many of their developments "were ones which we would not necessarily want to follow."²⁴⁰ It should be said, however, that these disparagements of German science and technology are much rarer in British sources than American ones, and British expressions of frustration with BIOS originate much more frequently with its methodology and efficiency rather than the lack of potential for German technology to be useful.²⁴¹

In July 1947, FIAT sent a final report of its activities to the US Zone's Military Government (OMGUS) Chief of Staff outlining its assessment of its accomplishments. Perhaps reflecting the priorities of the Military Government to which this report was sent, the first paragraph highlights a very different take on FIAT's 'value' – rather than being "all take and no give, ... it is sincerely felt that some phases of the FIAT program...have been and will be of tremendous importance to the revival of German science and perhaps, to a lesser degree, to economic recovery." German industry, it argued, might have acquired "some small gain...from visits by American investigators since, through this means, German industrialists have gathered some insight into parallel activities in the United States and thus have gained a better idea of what the German concern can best or most economically do on a world market." The value to the US, in contrast, "may be a moot question," as if nothing else, it aided the War and Navy Department in securing war booty such as "rockets, war chemicals, aircraft...and wind tunnels." Counted in terms of the "reasonable percentage of data resulting from expenditures by Germans in research," its value in reparations to US industry "is measured in the billions of dollars. It would perhaps be not far wrong to consider that the US Government and industry will financially receive 1000 times more value than it expended in the project."²⁴² Even here, however, FIAT admitted that "the general impression was that American industry with its massive production lines and high degree of mechanization was far ahead."

IV. Reevaluating the 'Value' Question

In emphasizing the value of the "invisible reparations" 'taken' from Germany, Gimbel does not entirely ignore contrary statements from the sources, but he does dismiss them without much consideration. As a footnote, he mentions an investigator who wrote to him in 1981 about the "great disappointment" felt by American industrial representatives in Germany, yet Gimbel moves past this by mentioning (but not specifying) having seen "considerable documentary

²³⁸ Hansard, HC, 12 May 1953, Vol. 182, col. 395-420.

²³⁹ J. Davidson Pratt, The Association of British Chemical Manufacturers to Derek Wood, "Follow-Up Visits," 24 October 1946. TNA: PRO BT 211, folder 21.

²⁴⁰ "BIOS Exhibition: Notes on Telephone Conversation with Professor Linsted," 27 November 1946. TNA: PRO BT 211, folder 22.

²⁴¹ For more on the specific struggles of the British efforts at scientific exploitation, see Chapter 3 on British Postwar Scientific Exploitation.

²⁴² Ralph Osborne to Chief of Staff, OMGUS, "Final Report of FIAT," 1 July 1947. RG 260, box 17/1, folder 50, NACP.

information to the contrary."²⁴³ He quotes a Dow Chemical expert who wrote that "the Germans were well advanced and entirely competent and in possession of information which can be profitably utilized in this country," yet does not elaborate on the writer's stated reasons for writing this: the "'popular and entirely natural tendency on the part of many technicians and industrialists in this country to disparage' the value and importance of what they had brought out of Germany."²⁴⁴ At one point Gimbel mentions the "many other former participants who later cast doubt on the value of German know-how to the United States," but does not elaborate on the causes for this criticism, nor engage especially with their critiques.²⁴⁵ Perhaps some level of 'natural' chauvinism or familiarity bias indeed contributes to explaining such "great disappointment" experienced in Germany, but the frequency of such expressions surely also points to genuine surprise, and to a corresponding shift in expectations of international markets, and of what government policies would best represent American business interests.²⁴⁶

We should, of course, take seriously the possibility that the sources disparaging their findings in Germany have additional motivations beyond accurate reporting. There is real evidence, for instance, that a mix of nationalism and self-promotion from American industry might have incentivized businesses to downplay the value of German developments, even as TIIC and similar agencies sought to justify their existences through inflating the investigations' findings. The National Machine Tool Builders' Association expressed a strong desire to have German machines be shipped to the US for study, but was concerned about plans to display these confiscated German machine tools in public museums, because "they might get entirely too much attention and create in the minds of the average citizen the idea that American machine tools are not as good as German."²⁴⁷ Bradley Dewey, part-owner and investigator from Dewey and Almy Chemical Company, expressed his suspicions to TIIC that the reason one process had not been thoroughly investigated "is that most of the other fellows are afraid of the process stepping on some of their own pet secret processes."²⁴⁸ Inter-industry rivalries might have led those sending investigators abroad to report less value in order to keep out competitors: The Communication sub-committee of TIIC took the extra step of checking "through attorneys, that we are not under restriction to be sure that Panels are a fair representation of industry," and members battled over whether to include particular companies, including large ones such as Westinghouse (one member was strongly against it for unstated reasons).²⁴⁹ Finally, at one exhibition of German food-related technologies in Atlantic City, discussion became "highly explosive," with one "impressive looking individual" attacking German cans as being inferior to products from his native Norway, and another man – later found to be associated with the US can

²⁴³ Gimbel, *Science, Technology, and Reparations: Exploitation and Plunder in Postwar Germany*, 9.

²⁴⁴ *Ibid.*, 150.

²⁴⁵ *Ibid.*, 9.

²⁴⁶ This expression of "great disappointment" is a quote from an interview Gimbel conducted in 1981 with a former investigator. Gimbel mentions several such comments throughout his work, but moves past them by mentioning (but not specifying) having seen "considerable documentary information to the contrary." *ibid.*

²⁴⁷ Tell Berna to Capt. RD Syer, 31 July 1945. RG 40, box 12, NACP.

²⁴⁸ Bradley Dewey to Dr. Roger Adams, 19 December 1945. RG 260, box 17/14, folder 14, NACP.

²⁴⁹ "TIIC/C 8th Meeting," 26 April 1945. RG 40, box 31, NACP.

companies – hung around the exhibit insisting to other visitors that "American industry will always produce tinplate cans cheaper than the cans on display can be produced."²⁵⁰

Recognizing this potential for individual companies' self-interest to override policy, initial planners for FIAT within the G-2 (Intelligence) division of SHAEF warned that "the success of FIAT will of course depend in part upon the extent to which it is able to function exclusively in the national interest (during the SHAEF period in the national interest of the United States and of Great Britain), as ever against the interest of any particular individuals or business concerns."²⁵¹ This was a particular concern for British policymakers, who placed great emphasis on benefiting entire industries rather than individual firms, though came to see aiding individual firms as the only possible path forward.²⁵² Whether or not such interests contributed towards the expressed disinterest in German technology, for example to discourage competitors, is impossible to say with certainty. Considering the publication of such skepticism so broadly, from so many firms, and in so many different types of publications, this seems likely to be a minor factor at most.

V. Sources for the Myth: Germany's Apparent Edge

The idea of German technological superiority in the mid-twentieth century was widespread, and its though most recent scholarship in economic and military history significantly downplays widespread German industrial dominance by the 1940s and 1950s, contemporary observers were hardly foolish to believe that Nazi investment might have sharpened an existing lead in a range of technologies. As Adam Tooze points out in his economic history of Nazi Germany, *Wages of Destruction*, even historians with decades of hindsight have often accepted the notion. "It is hardly an exaggeration to say that historians of twentieth-century Germany share at least one common starting point: the assumption of a peculiar strength of the Germany economy."²⁵³ Built on the prewar reputation of brands like IG Farben, Krupp, Siemens, and Carl Zeiss, as well as wartime technologies that later became worldwide standards like the V-1 and V-2 rockets, Panther and Tiger tanks, Me 210 jet fighter, and Mark XXI U-boat, the idea of German technological superiority was a "myth that appealed to numerous themes in postwar German political culture: regret at a chance of a victory wasted, the consolation provided by the supposed superiority of 'German technology,' the self-righteous commemoration of the horror of Allied bombing."²⁵⁴ The rapid fall of France in 1940 gave a strong impression of technological superiority and innovative planning, even if more recent military historians instead see it more as a reflection of a "fatal interlocking of Allied and German operational planning," while in truth Germany started the war in 1939 with "no substantial technical superiority over the better-established military powers of the West."²⁵⁵

²⁵⁰ Joe Mayer, "Summary on OTS Exhibit at Food Exposition, Atlantic City, January 19-23," undated. RG 40, box 11, NACP.

²⁵¹ TJ Betis to Maj. Gen. Clayton Bissell, 3 June 1945. RG 260, box 17/1, folder 54, NACP.

²⁵² See Chapter 2 on British investigations.

²⁵³ Adam Tooze, *The Wages of Destruction: The Making and Breaking of the Nazi Economy* (New York: Penguin Group, 2006), xxii.

²⁵⁴ *Ibid.*, 612.

²⁵⁵ *Ibid.*, 661.

Articles in the leading American newspapers throughout the 1930s reflected Germany's reputation for engineering and technological innovation, especially but not exclusively in chemicals. Article titles from the period speak for themselves: "Oil Men To Study Hydrogenation: Twelve Executives Headed By Frank A. Howard Will Inspect Process In Germany" (16 July 1930); "Reports Germans Lead In Chemistry: Editor of Research Papers Says They Have Regained Pre-War Eminence," (11 April 1930); "Germany: Laboratory of The World" (28 December 1930); "Industrial Uptrend Is Noted In Germany" (15 April 1935); "German Chemicals In Demand" (6 September 1937); "German-Developed Synthetic Rubber To Be Made In U.S." (5 April 1939); "U.S. Held Enriched by German Exiles: Flight of Chemists Is Called Boon to Science Here" (13 August 1939).²⁵⁶ Many similar examples could be found in leading interwar American (or British) newspapers reflecting a mix of reality (German firms such as IG Farben did, of course, have some world-leading patented products and major market share even after the losses they experienced from the First World War), fears, expectations, and later Nazi propaganda. This argument should not be exaggerated – certainly there were many articles during this same period lauding American science and technology, and during the war

Any policymaker, businessman, or scientist drawing conclusions from the media leading into the Second World War could only conclude that German technology was of the highest caliber, with much for American to learn.

The genuinely innovative wartime technologies mentioned above (the V-2, Mark XXI U-boat, etc), though not developed quickly enough or brought into production on a sufficient scale to have a major impact on the war, were each part of wartime Nazi propaganda campaigns about 'super-weapons.' As such, they, too, likely fed the perception of American policymakers and businessmen that Germany was getting ahead, not least because of the ongoing American development of its own super-weapon: the atomic bomb. The Manhattan Project's origins in fears over Germany getting atomic weapons first are well documented, and one of the first scientific intelligence units sent to Europe with the invasion forces was the ALSOS mission to investigate the progress of a German atomic bomb.²⁵⁷ The Second World War was a powerful catalyst for an ongoing process in America of science becoming an increasingly important tool for state purposes, and the atomic bomb left a lasting impression that scientific leadership was closely linked to military power – scientific leadership that had for decades been held by Germany, as had been unmistakably advertised (and in retrospect, partly neutered) by the wave

²⁵⁶ "Oil Men To Study Hydrogenation: Twelve Executives Headed By Frank A. Howard Will Inspect Process In Germany," *Wall Street Journal*, 16 July 1930; "Reports Germans Lead In Chemistry: Editor of Research Papers Says They Have Regained Pre-War Eminence," *New York Times*, 11 April 1930; Emil Ludwig, "Germany: Laboratory of The World," *New York Times*, 28 December 1930; "Industrial Uptrend Is Noted In Germany," *New York Times*, 15 April 1935; "German Chemicals In Demand," *New York Times*, 6 September 1937; "German-Developed Synthetic Rubber To Be Made In U.S.," *Wall Street Journal*, 5 April 1939; "U.S. Held Enriched by German Exiles: Flight of Chemists Is Called Boon to Science Here," *New York Times*, 13 August 1939.

²⁵⁷ Goudsmit; Hart; Richard Rhodes, *The Making of the Atomic Bomb* (New York: Simon & Schuster, 1986); Walker, *Nazi Science: Myth, Truth, and the German Atomic Bomb*.

of brilliant scientists who had fled the Nazi regime and contributed to the war effort in the West.²⁵⁸

Widespread American impressions of German scientific and technical prowess is understandable, then, but should not be mistaken for such a lead still existing in truth. For one thing, leadership of Germany's industry and state fretted at least since the early twentieth century about the opposite trend: that of America passing them by forever. Around 1900, prominent German chemists worried that "German chemistry had been frequently surpassed by countries abroad," mostly meaning the United States, and worked to organize a Reich Chemical Association in response.²⁵⁹ The Kaiser Wilhelm Society was founded in 1911 using similar rhetoric of falling behind foreign competition, and was modelled in part on the founders' understanding of the American model of funding science through semi-independent foundations and industry-academic pairings.²⁶⁰ German firms increasingly sent investigators on long research trips to American firms in the early-to-mid-1900s in an effort to learn manufacturing techniques and industrial advances.²⁶¹ Gustav Krupp, head of Krupp AG heavy industries, was only one of many leading industrialists who took such a trip, and investigators at both on-the-ground engineering and management levels of several industries conducted lengthy investigations of American factories in the 1920s to 1940s in growing numbers.²⁶²

VI. Relative Economies in Historical Perspective

Definitive statements about the relative development of 'German technology' and 'American technology' are impossible, not least for the generality of the terms under discussion. Economic historians, historians of science/technology, and other scholars have studied the twentieth century German economy in some depth in recent decades, however, and their results can give valuable context in understanding the sources of American perceptions of Germany as being ahead and the changing reality of such a viewpoint.

If Germany possessed a general, substantial technological superiority in any non-military field, it is likely in the chemical industry, which was the source for a great deal of Germany's nineteenth and twentieth century reputation for scientific industry. Yet even here recent historical work has shifted the periodization for the American eclipse of German leadership towards the first half of the twentieth century. Dietrich Stolzenberg has shown that "a substantial transfer of knowledge was already under way" by the 1910s from Germany to the United States, emphasizing that American students of chemists such as Alfred von Bayer, Emil Fischer, and

²⁵⁸ On the exodus of German scientists fleeing from Nazi persecution, see Kevles, *The Physicists: The History of a Scientific Community in Modern America, Revised Edition*, 275-282; Macrakis; Neufeld, "The Nazi aerospace exodus: towards a global, transnational history."; Siegmund-Schultze, *Mathematicians Fleeing from Nazi Germany*; Walker, *Nazi Science: Myth, Truth, and the German Atomic Bomb*.

²⁵⁹ Quoted in Macrakis, 14.

²⁶⁰ *Ibid.*, 14-21.

²⁶¹ Berghahn, "Technology, Reparations, and the Export of Industrial Culture. Problems of the German-American Relationship, 1900-1950."

²⁶² This quote is taken from Berghahn, *The Americanisation of West German Industry: 1945-73*, 29.

other German masters brought much know-how back in this period.²⁶³ Mira Wilkins, Peter Morris, and Volker Berghahn have each made similar arguments for different aspects of the chemical industry – from the American mastery of the originally German technology for producing Buna S synthetic rubber to pharmaceuticals – reframing the periodization to emphasize the 1910s to 1930s as a period in which there was a fundamental shift towards American equality, if not leadership, in chemical industrial technology and productivity.²⁶⁴ American advances shouldn't be over-stated - Raymond Stokes convincingly argues that while "there may have been a relative decline in the absolute dominance of the cutting edge of the organic chemical industry by the German chemical producers in other countries...the Germans continued into the post-1945 period to be major players in international technological markets."²⁶⁵ Still, the American chemical firms developed rapidly in the first half of the twentieth century, and perhaps even faster than they themselves realized relative to their German models.

Outside of chemicals, the importance of German innovations in aerospace in the 1930s and 1940s is undisputed.²⁶⁶ Undoubtedly there were other areas, of greater and lesser significance and scale, in which German industrialists had innovations of use to other lands. A September 1946 editorial in *Technical Services*, a publication of the Department of Commerce's Publications Board advertising the services of the Office of Technical Services (and thus FIAT-related programs), justifies the exploitation efforts with just this argument:

Because OTS collects and publicizes so many German technical developments, we are often asked if we believe in the 'superiority' of German science. Returning investigators agree that German science and technology were, in most respects, far behind ours. In seeking to meet the demands of the military in metallurgy and aeronautics, and in attempting to find substitutes for petroleum and other critically short materials, German scientists produced inventions, ideas, processes, and formulas which were unique, outstanding, and valuable. American industry can and will benefit from examining these developments and adopting some of them.

²⁶³ Dietrich Stoltzenberg, "Scientist and Industrial Manager: Emil Fischer and Carl Duisberg," in *The German Chemical Industry in the Twentieth Century*, ed. John Lesch, (Norwell, MA: Kluwer Academic Publishers, 2000).

²⁶⁴ Berghahn, "Technology, Reparations, and the Export of Industrial Culture. Problems of the German-American Relationship, 1900-1950."; Peter J T Morris, "Transatlantic Transfer of Buna S Synthetic Rubber Technology, 1932-45," in *The Transfer of International Technology: Europe, Japan, and the USA in the Twentieth Century*, ed. David J. Jeremy, (Edward Elgar, 1992); Mira Wilkins, "German Chemical Firms in the United States from the Late 19th century to Post-World War II," in *The German Chemical Industry in the Twentieth Century*, ed. John Lesch, (Dordrecht: Kluwer Academic Publishers, 2000).

²⁶⁵ Raymond Stokes, "Gravity and the Rainbow-makers: Some thoughts on the trajectory of the German chemical industry in the twentieth century," in *The German Chemical Industry in the Twentieth Century*, ed. John Lesch, (Norwell, MA: Kluwer Academic Publishers, 2000).

²⁶⁶ Burghard Ciesla, "German High Velocity Aerodynamics and Their Significance for the US Air Force, 1945-52," in *Technology transfer out of Germany after 1945*, ed. Matthias Judt and Burghard Ciesla, (Amsterdam: Harwood Academic Publishers, 1996); Neufeld, "The Nazi aerospace exodus: towards a global, transnational history."; Uttley.

This contention that the investigations were simply seizing an easy opportunity is somewhat more difficult to defend when compared with perceptions of Japanese industry, however. Though Japan faced military occupation that would have provided for similar levels of exploration and coercion of industrial scientists and technicians – indeed, the US could have acted without having to deal with British, French, and Soviet occupation zones – the impression from the start was that "any large-scale exploitation of Japanese science and industry would not be a justifiable expenditure of government funds."²⁶⁷ TIID (the Technical Industrial Intelligence Division, the same basic apparatus as TIIC, but renamed after its move to the Commerce Department) sent out questionnaires to American industry asking whether they believed investigations of Japanese industry were worthwhile, and if so, what should be researched. Most responses were non-committal but supportive. Boeing Aircraft, Spencer Thermostat, and many others expressed belief that "investigation in Japan might be very beneficial," though few were terribly eager. American Airlines, like many others, was "not too keen at the present moment."²⁶⁸ Ultimately, a few 'scouting' trips were organized, particularly in fishery and boat-making industries, but nothing on anything approaching the scale of the FIAT programs was organized. If it were simply the ordinary, minor advances any nation might have over another that was at stake, surely investigative efforts in Germany would have been on a scale similarly limited to those in Japan.²⁶⁹

Given the disruption to international markets and institutions caused by the First World War, Great Depression, and build-up to the Second World War, and the difficulty of interpreting comparative economic statistics (then or even today in retrospect) to untangle issues like per capita productivity (and whether it even relates to technology, or derives from other factors), it seems entirely plausible that American industry had unknowingly 'caught up' to German industrial technology by the Second World War in most fields in which it had been 'behind,' and the reputation for German engineering that survives to the present carried on regardless.

A more fundamental issue with assessing the value of German technology is the basic idea that there is a 'best' technology, a concept taken apart by historians and philosophers of technology in favor of emphasis on the mutual shaping of society and technology. The previously-mentioned BIOS official's comment that German developments in ersatz products were "were ones which we would not necessarily want to follow" reflects this notion, as even before the war truly warped the German economy, the lack of access to foreign markets through an empire like Britain or France's had fed ideological bases for autarchic policies.²⁷⁰ Carl Bosch

²⁶⁷ JC Green to Assistant Chief of Staff, G-2, War Department, 14 May 1946. RG 40, box 12, NACP.

²⁶⁸ Lloyd Worden to Robert Reiss, 17 April 1947. RG 40, box 12, NACP.

²⁶⁹ It should be noted that a much stronger case for the importance of the investigations in Japan appears in R. W. Home and Morris F. Low, "Postwar Scientific Missions to Japan," *Isis; an international review devoted to the history of science and its cultural influences* 84, no. 3 (1993). I cannot completely reconcile the differences, other than to note the same distinctions made elsewhere in this chapter between studying a technology and adopting it. Certainly there were analogous efforts to the ALSOS missions to see how far Japan had pursued an atomic bomb, but those were short-lived. The efforts discussed in Home and Low seem to be focused mostly on military and economic intelligence, rather than industrial investigations analogous to FIAT's scale or scope.

²⁷⁰ "BIOS Exhibition: Notes on Telephone Conversation with Professor Linsted," 27 November 1946. TNA: PRO BT 211, folder 22.

pursued hydrogenated coal technology aggressively in the 1920s in the expectation that oil would soon run out and prices skyrocket, only to have it become tremendously inefficient during the subsequent oil boom.²⁷¹ IG Farben received major investments from a Nazi regime dedicated to freeing itself from reliance on foreign oil in the context of abundant brown coal, but these were hardly universal circumstances. In the 1970s, in the wake of the OPEC oil embargo, synthetic fuels became politically important once again and researchers at Texas A&M's Center for Energy and Mineral Resources turned back to documents seized during the occupation of Germany, with funding for translation and documentation of these files coming from Dow Chemicals, Diamond-Shamrock Corporation, Union Carbide, and the university itself.²⁷²

Synthetic fuels from coal were unquestionably an impressive and important technological achievement, and it is no surprise that chemical firms in Allied countries were interested in the development – but the 'value' of this technology fluctuated wildly with political and macroeconomic circumstances, across national borders and time. Given the other peculiarities of Germany's economic circumstances, including use of slave labor in the production of even high-tech V-2 rockets, likely more than a few German technologies were the 'best' in the world, if by 'best' we mean 'best suited to the conditions of wartime Nazi Germany.' The distance between that 'best' and 'best for America's postwar economy' might understandably not have been so obvious to American industrial representatives until they made it to Germany.

VII. Implications of Technological Leadership

In August 1951, John Green, the head of the Office of Technical Services that had handled the distribution efforts for the Department of Commerce's Publications Board (and thus for TIIC / FIAT), was a guest on *The Eleanor Roosevelt Show* to discuss the National Inventor's Council. Mrs. Roosevelt at one point asked Green if he thought important inventions would emerge from other nations, to which Green replied that he did: "We have a pardonable feeling that we have a monopoly on brains but of course it isn't so and there are some marvelous individual thinkers in Europe who are hard at work today and we can always hope that we will be able to borrow the knowledge of Europe, and I sometimes think of that as a sort of a reciprocal Marshall Plan to be able to take ideas of Europe." Roosevelt responded with a telling remark on Germany's new status: "Yes in the old days we did, once upon a time think of Germany, when they were allowed to think before the Hitler days....of them as very good scientific research people and inventors."²⁷³ One quote hardly proves a general sentiment, but the wider public was no longer immersed in representations of German technology as an unbeatable rival.

What does it matter if American industry did systematically misunderstand the effectiveness of its industrial technology vis-a-vis Germany in the 1940s? Historically, the most important result is likely the implications of such a perception on what steps the state can and

²⁷¹ Tooze, 115-116.

²⁷² Gimbel, *Science, Technology, and Reparations: Exploitation and Plunder in Postwar Germany*, 73-74.

²⁷³ The Eleanor Roosevelt Papers Project, "Interview with John C. Green, 22 August 1951, The Eleanor Roosevelt Show"

http://www2.gwu.edu/~erpapers/documents/displaydoc.cfm?_t=radio&_docid=rad025 (accessed 29 April 2014).

should take to promote economic growth, be it through trade policy, direct investment in industrial research, promoting certain frameworks for international law (particularly intellectual property law), or at the more concrete scale, whether to invest resources into sprawling and duplicative efforts to study an occupied and defeated foe for technological booty.

Measuring the "value" of technological exploitation is a difficult enterprise, ultimately impossible to accomplish with any real precision. Yet most estimations that come to conclusions in terms of dollars, pounds, and francs work from deeply flawed premises. Science and technology might fall under the umbrella of the term 'intellectual property,' but intellectual property is not the same as personal property in fundamental ways, and cannot be accounted for in the same way. A machine tool taken as reparations has a certain value, possible to estimate in terms of market rates including depreciation and obsolescence. Its removal or destruction is a loss to German industry (though if obsolete, its replacement by newer technology might be to the long-term benefit of the economy); if it is utilized in America, it is to the benefit of American industry (assuming its value is greater than the non-trivial transaction costs of seizure, disassembly, shipping, reassembly, and appropriation). Intellectual property defies even these 'easy' accountings. Investigation of a technology or process robs the inventor only of the exclusivity of his knowledge; he loses nothing unless and until the technology is successfully transferred into another context, and it spawns direct competition with his own company.

We can add the market value of patents copied and blueprints microfilmed to the research and development costs that went into investigated technologies and generate enormous sums of value "taken" through these "reparations," and indeed this is how some contemporary estimations came to their conclusions. Doing so, however, is a complete misrepresentation of the value to American industry or of the 'loss' to the German economy. Meanwhile, the costs of investigations in Germany were very real, and not just in terms of the dollar costs to the economy of sponsoring investigators' airfare, salaries of the intelligence bureaucracy involved, or reproduction costs of microfilms and printed reports. Each investigation also cost diplomatic capital, goodwill and legitimacy within Germany, and the time American researchers spent abroad instead of advancing their own work.

It is important not to go too far in disparaging the economic value of the FIAT investigations. They very likely significant (if limited) benefits for American industrial technology, even taking into account the disappointments and difficulties discussed above. One source of value acquired from these investigations is an indirect one – speaking with German technicians and studying Germany technology could inspire American engineers even when they saw nothing of particular value. Many of the responses to TIIC's requests to companies for reports about the value of completed investigations cite this as a key gain (though it is an open question the extent to which such documents are expressions of genuine sentiment rather than polite responses to prompting, and keeping in mind the selection biases of companies who bothered to respond to such requests and whose letters remained in TIIC's files for archiving). Du Pont Chemicals concluded its assessment by noting that though there were few direct gains, "The important thing is that we have obtained the basic ideas for further development in engineering from this Technical Mission."²⁷⁴ Sidney Kirkpatrick, editor of *Chemical & Metallurgical Engineering*, admitted that a 'white carbon black' made in America had used

²⁷⁴ JB Quig to Howland Sargeant, 19 February 1946. RG 40, box 3, NACP.

completely different processes than found in Germany, but the credited the German development for "at least planting the seed of the idea."²⁷⁵ Similarly, the American Smelting and Refining Company developed a product using a process "not at all related to the German process," but says the German demonstration gave them the "confidence to embark on the project and I believe you will find this type of thing is the most common benefit obtained from the TIIC investigations."²⁷⁶ Several other reports mention "stirring the imagination" as a possible end result of reports, even when admitting that the reports themselves were usually far too little information to actually allow the recreation of a technology in America.²⁷⁷

Outside of the specific case of investigations in Germany, there are broader implications of American perception of technological leadership. As Chapter 6 will discuss in more detail, faith in the transformative power of American 'know-how' allowed a compromise between budget hawks in Congress who resisted expanding Marshall Plan-esque direct aid to non-European countries and those who saw developing third-world economies as the best way to resist the spread of communism. The world's leading technological power could share that knowledge, the theory went, rather than directly sharing wealth. Further, the United States has a long history of borrowing industrial technology from other nations, including the famous case of Francis Cabot Lowell copying British textile machinery at the turn of the nineteenth century. Technological leadership meant licensing opportunities, however, and the United States in the early postwar years began aggressively pursuing international agreements on intellectual property to regulate such licenses more strictly, and better control the legal transfer of science and technology. This, too, tied directly into Cold War diplomacy, as fears of communist industrial espionage led to the attempted embargo of high-tech goods to Soviet-controlled countries via the Coordinating Committee for Multilateral Export Controls.

²⁷⁵ SD Kirkpatrick to Robert Reiss, 26 November 1946. RG 40, box 3, NACP.

²⁷⁶ Albert J Phillips to Robert Reiss, 4 September 1946. RG 40, box 3, NACP.

²⁷⁷ WH Reynolds to Robert Reiss, 5 September 1946. RG 40, box 3, NACP.

Chapter 4: Documentation, the Exploitation of German Science, and the Information Problem of the Twentieth Century

Abstract: Investigations in Germany produced an immense amount of information. As prior chapters have suggested, organizers in America and Great Britain alike were initially optimistic about distributing the fruits of Germany's research throughout relevant industries and research institutions, but they ran into problems in capturing the knowledge in written form and in finding audiences genuinely interested in what they'd discovered. This chapter takes a step back to look at a broader process that fundamentally shaped and was shaped by the efforts at exploiting German science: the national and international structures of library and information science that had already been rapidly evolving in prewar years to distribute scientific and technical findings. The Second World War destroyed a scientific publishing ecosystem that had been under growing stress from rapid growth and internationalization of science, leading FIAT/BIOS planners to embrace the technological fixes that libraries had been experimenting with in the interwar years. The wartime experience with handling the dispersion of scientific and technical information – and specifically the postwar efforts in Germany – drove together intelligence, scientific publishing, and library/information science, with serious, long-term implications for how science functioned in the postwar world.

I. Introduction

Science grew astonishingly quickly in the twentieth century, both in overall output and in its international character. Derek J. de Solla Price calculated in 1961 that the number of scientific journals increased at a rate of about 5.6% per year, meaning twice as many journal titles every 13 years from 1650 to 1950.²⁷⁸ Similarly, using various scientific abstracting services, he found a doubling in journal articles abstracted every 15 years.²⁷⁹ Work in subsequent decades into the new field of 'scientometrics,' or measurements of the size and scope of science, have adjusted these numbers somewhat, but remain consistent with the concept of exponential growth through the nineteenth and twentieth centuries.

When planners in the US and UK (and to a lesser extent, in France) began plotting the exploitation of German scientific and technical information in the 1940s, they did so in the context of several decades of keen awareness of, and reaction to a new and very serious problem for international science: information overload. Simply keeping up with developments within a single sub-specialty became extremely challenging, especially as the scientific communities in the United States and Soviet Union increasingly produced first-class work that could not be ignored by traditional centers in Britain, Germany, or France. The problem was simple, if the solution less so: What institutions and tools – networks of libraries, information technologies, new scientific societies, expanded scientific journals – would facilitate this massive amount of new knowledge reaching the attention of those who could use it? The attempted, international

²⁷⁸Derek J. de Solla Price, *Science since Babylon* (New Haven, CT: Yale University Press, 1961)..

Citation from Peder Olesen Larsen and Markus von Ins, "The rate of growth in scientific publication and the decline in coverage provided by Science Citation Index," *Scientometrics* 84, no. 3 (2010).

²⁷⁹ Derek J. de Solla Price, *Little Science, Big Science* (New York: Columbia University Press, 1963).

solutions that emerged – specifically, the Documentation movement (taken to include the expansion of Special Libraries in the United States), and the growing role of for-profit firms in scientific publishing – are critical in understanding how and why the scientific exploitation of Germany proceeded as it did.²⁸⁰ These efforts within Germany, in turn, had a significant lasting influence on the international development of the information and library sciences in the postwar world.²⁸¹

For the FIAT-like efforts, this existing tradition of efforts to tame the circulation of scientific data shaped the tools available, the personnel involved, and the basic assumptions about what could be accomplished. The Documentation movement, which largely flourished in Europe but had analogues (with some overlapping and intermingling of personnel) to the American Special Libraries movement, sought to use new technologies – especially microfilm, which could be quickly reproduced, was extremely compact, and thus easily transported and shared – and international standards in bibliography and metadata to make all of the world's information quickly and universally accessible. Many of those in the Documentation movement came from science and industry, where the problems with cataloguing information presented most acutely, and perhaps unsurprisingly, many of these same people enlisted in the efforts to extract Germany's science and technology in the early postwar. They brought with them their optimism that information could be reproduced and made accessible, and their enthusiasm for microfilm as a transformative tool. Their influence, both direct and indirect, is vital in understanding the choices made by FIAT's administrators.

The exploitation efforts in Germany, in turn, influenced the international communication networks for science and technology – and the budding fields of information and library science in general – in varied but important ways. Perhaps most importantly, they brought the state into the game. In the first half of the twentieth century, the perceived crisis in scientific

²⁸⁰ The Documentation movement has been well-studied in the history of the information sciences, but key starting points in the literature include Michael Buckland, "Documentation, Information Science, and Library Science in the U.S.A.," in *Historical Studies in Information Science*, ed. Trudi Bellardo Hahn and Michael Buckland, (Medford, NJ: Information Today, Inc., 1998); Michael Buckland and Ziming Liu, "History of Information Science," in *Historical Studies in Information Science*, ed. Trudi Bellardo Hahn and Michael Buckland, (1998); Irene Farkas-Conn, *From Documentation to Information Science: The Beginnings and Early Development of the American Documentation Institute - American Society for Information Science* (New York: Greenwood, 1990); Sylvie Fayet-Scribe, "The Cross-Fertilization of the U.S. Public Library Model and the French Documentation Model through the French Professional Associations between World War I and World War II," in *Historical Studies in Information Science*, ed. Trudi Bellardo Hahn and Michael Buckland, (Medford, NJ: Information Today, Inc., 1998); W. Boyd Rayward, "The Origins of Information Science and the International Institute of Bibliography/International Federation for Information and Documentation (FID)," in *Historical Studies in Information Science*, ed. Trudi Bellardo Hahn and Michael Buckland, (Medford, NJ: Information Today, Inc., 1998); Richards; Robert V. Williams, "The Documentation and Special Libraries Movement in the United States, 1910-1960," in *Historical Studies in Information Science*, ed. Trudi Bellardo Hahn and Michael Buckland, (Medford, NJ: Information Today, Inc., 1998); Robert V. Williams, Laird Whitmire, and Colleen Bradley, "Bibliography of the History of Information Science in North America, 1900-1997," in *Historical Studies in Information Science*, ed. Trudi Bellardo Hahn and Michael Buckland, (1998).

²⁸¹ The differences between 'library science' and 'information science' are less relevant for this chapter, so I will generally use the latter.

communication was a problem that the communities involved attempted to handle themselves through such efforts as librarians embracing new technologies (microfilm) and methodologies (universal decimal filing systems, such as Dewey's), or scientific societies or industries founding and expanding abstracting services. During the Second World War, however, acquiring scientific and technical information became a national security priority, largely (but by no means exclusively) targeting German science. The exploitation efforts in Germany were hardly the only factor in play, but they did contribute substantially to the intermeshing of intelligence communities and scientific communication structures in the postwar world.

More directly, the simple logistics of handling the massive amount of information gathered in Germany was a catalyst for change in scientific communication and broader information science. Sweeping collection of material was enabled by the availability and prominence of microfilm technology, but the dreams of sharing German science with the world ran up against the limits of practical logistics. As with the promises of electricity from atomic energy, information never truly became "too cheap to meter," as the hassles of processing, copying, shipping, and storing microfilm became too great in postwar budgetary conditions. With money to be made, some private ventures joined in the efforts to utilize German knowledge, with consequences changes in scientific publishing to the growth of machine translation, and through it, growing dominance of the English language in science.

II. The Documentation Movement through the Second World War

The remarkable advances in physics, genetics, and other fields in the early twentieth century, combined with major industrial scientific achievements in fields such as chemicals (dye-making and explosives, for example), led to an outpouring of scientific and technical literature.

The founding of the International Federation for Information and Documentation (FID) in 1895 in Belgium by lawyer Paul Otlet is frequently used as the starting point for discussion of the 'Documentation movement,' though the issue it sought to tackle – increasing difficulty navigating the quantity of scholarship in the social sciences – of course preceded this date.²⁸² Otlet soon found an eager audience in libraries across several nations, and not just in universities – especially in the United States, the growth of private industrial research laboratories brought an accompanying growth of the "Library as an Adjunct to the Industrial Laboratory," the title of a 1910 article in *Library Journal*.²⁸³ The FID sought to impose the orderliness of the classification regimes in the natural sciences on its literature, and organized five International Conferences on Bibliography (in 1898, 1897, 1900, 1908, and 1910) in an effort to coordinate efforts. Initial efforts to centralize international bibliography into one, grand Institute of Bibliography eventually failed (though the offices did exist for some years), but the FID drove advances in bibliography, database management, and information retrieval as it enlisted such institutions as the Library of Congress and British Museum in attempts to list all scientific knowledge, broadly construed. Nor was the FID the only site of enthusiasm for this Documentation movement, as chapters or institutes with similar missions sprung up throughout Europe. An International Institute of Documentation, representative of the development of 'documentation' as a new field,

²⁸² Rayward.

²⁸³ G.E. Marion, "The Library as an Adjunct to Industrial Laboratories," *Library Journal* 35, no. 9 (1910).. Citation from Williams, "The Documentation and Special Libraries Movement in the United States, 1910-1960," 174.

defined the term as "the assembling, classification and distribution of documents of all kinds in all areas of human activity."²⁸⁴

These grand ambitions were fed by enthusiasm for the seemingly limitless possibilities of a newly economical technology: microfilm.²⁸⁵ Though microfilming technology had been around since the mid-nineteenth century, and had been promoted as a solution to scientific record-keeping by astronomer James Glaisher in 1851, the technology did not achieve widespread popularity until the late 1920s, when Eastman Kodak developed an economical 'Recordak' microfilm camera.²⁸⁶ From Kodak's initial market of banks photographing checks, the technology was embraced in the 1930s by libraries, including the US Department of Agriculture Library, the Library of Congress, the British Library, and the Bibliothèque Nationale in Paris. For those invested in information dispersion and retrieval, microfilm offered a relatively cheap way to store, copy, and transport large amounts of information, leading to visions of libraries transformed to rooms of viewing machines with a central card catalog, the microfilm for each entry simply taped to its card.²⁸⁷ At an International Exposition and the World Congress of Universal Documentation held in Paris in August 1937, the Rockefeller Foundation, American Chemical Society, and University of Chicago together hosted an exhibit promoting microfilm as a solution to the growing informational problem. A similar conference organized by Jean Gerard, president of the Maison de la Chimie and l'Union française des organismes de documentation, even hosted a talk by author H.G. Wells on the importance of making knowledge accessible through the promise of microfilm.²⁸⁸

In the UK, the development of documentation as a field accompanied efforts by such scientists as Oxford chemist Henry Tizard – later a noted (and knighted) scientific attaché and diplomat - to make international scientific journals more accessible to British scientists, using a new Association of Special Libraries and Industrial Research. The ascension of the Science Museum Library in London as an effective national science library was a result of efforts to centralize and coordinate the loaning and duplication of scientific periodicals through distributing microfilmed copies.²⁸⁹ In the United States, Watson Davis founded an American Documentation Institute in 1937, expanding on his mission as editor of Science Service, an organization dedicated to science education and popularization. The ADI drew funding from the Carnegie, Rockefeller, and American Chemical Foundations, and coordinated with the Library of Congress, Departments of Agriculture and Education, and various public health agencies.²⁹⁰

This context directly informed and shaped the wartime scientific exploitation efforts. When the American Office of Strategic Services (OSS), the predecessor to the Central Intelligence Agency, created a committee to exploit 'open-source' (meaning publically available, such as newspapers or government publications) foreign intelligence in 1942, it drew upon the

²⁸⁴ *Ibid.*

²⁸⁵ Richards, 14-15.

²⁸⁶ Alan M. Meckler, *Micropublishing: A History of Scholarly Micropublishing in America, 1938-1976* (Westport, CT: Greenwood Press, 1982); Richards, 14-15.

²⁸⁷ Meckler. One of the practicalities overlooked by these microfilm enthusiasts, as many historians can attest, is the quality of the end-user experience relative to traditional books.

²⁸⁸ Richards, 16.

²⁸⁹ *Ibid.*, 28.

²⁹⁰ *Ibid.*, 37-38.

burgeoning Documentation community to develop distribution systems for intelligence from British and other foreign sources.²⁹¹

The links between those interested in Documentation, scientific intelligence, scientific societies, and postwar 'information science' are such that perhaps the most effective way of showing concrete links is through a few sample career paths. Allen Kent, one of the most important figures in American information science in the postwar years, moved from the Air Corps to the American Chemical Society to a CIA-funded position at the Massachusetts Institute of Technology, then to found an important information school at the University of Pittsburgh also using intelligence funding.²⁹² One of Kent's colleagues in Pittsburgh, Jesse Shera, had served in the OSS working with IBM machines in information sorting. Anthony Debons served as a "technology reclamation officer" in postwar Germany before moving on to study experimental psychology and other fields with funding from the Office of Naval Research before moving into scientific computing in the 1950s.²⁹³ Institutionally, the British library and provincial libraries throughout the United Kingdom were the venues in which BIOS reports were made available to the public, and were obviously also interested in information science and distribution more generally; similarly, the Library of Congress and library of the Department of Agriculture had deep ties to FIAT/TIIC while also sponsoring research on more effective storage and copying systems.

These ties in personnel and institutions brought the almost utopian idealism and ambition of the Documentation movement, to make accessible the entirety of mankind's knowledge through newly embraced (if not created) technology, to the intelligence missions aimed at German science. This was not always a smooth fit, yet these linkages are crucial in understanding some of the missions and decisions of the FIAT efforts. The network of natural scientists, information scientists, and librarians now drawn into the world of espionage and intelligence were able to apply the techniques (especially in efficient microfilming and shipping) to intelligence, but were, perhaps, too efficient in collection. The immense volume of German scientific and technical data gathered was too much to process and distribute effectively given the resources available, and much of the longer-term significance of the collection efforts lies not in the economic value of the files microfilmed, but in the lessons learned from the attempt.

III. FIAT Reviews: Idealism Meets Intelligence

Then influence of the Documentation movement and its personnel on the scientific exploitation of Germany is most clearly seen in one of the least controversial, most widely celebrated aspects of FIAT and BIOS: the so-called *FIAT Reviews of German Science*. These reviews were attempts at a holistic account of wartime advances in a wide variety of academic science, written by German scientific leaders and distributed throughout the world for free or at-cost – hardly the kind of work one might expect from military intelligence agencies whose primary objectives centered on acquiring military advances for use against Japan and civilian industrial technology for use at home. There were certainly pragmatic reasons for creating these

²⁹¹ Ibid., 79.

²⁹² William Aspray, "Command and Control, Documentation, and Library Science: The Origins of Information Science at the University of Pittsburgh," *IEEE Annals of the History of Computing* 21, no. 4 (1999).

²⁹³ Ibid.

Reviews, and they served useful symbols of openness and generosity for American, British, and French diplomats, but the objectives, style, and results all mirror the earlier work of the FID and its affiliates.

The FIAT Reviews of German Science were born at least partly out a need to find busy-work for German scientists deemed too important to let roam free (potentially ending up in the employ of other powers, or in the rationale of the time, working on underground German war-related research), yet not valuable enough to be dealt with in a summary fashion. A group of scientists (40% of whom were reported to hold PhDs and speak English) "frozen" in Heidenheim since July 1945 by the American military government complained in March 1946 that their "scientific and technical talents [had] been completely wasted," and a top secret report by the US Signal Corps to FIAT (US) discussing this problem highlighted that this was just one of many such groups throughout Germany.²⁹⁴ To find some use for these men, the report's authors suggested organizing these men into a "FIAT Technical Institute" to prepare summaries of German scientific literature generated during the war, as well as English translations of more important articles. The reviews aimed to cover the entirety of the natural sciences, including 27 volumes on medicine and pharmaceuticals, 24 on chemistry, 16 on physics, 8 on earth sciences, 7 on mathematics, and 4 on biology, to be printed in translation abroad as *Naturforschung und Medizin in Deutschland, 1939-1946* inside of Germany.

For British policymakers, the *FIAT Reviews* were useful as cover for less universally laudable work as well as scientific intelligence in themselves. They could, it was argued, "hardly be looked upon as exploitation as it is done with the very willing co-operation of the German authors who are anxious to see their work recognized in print."²⁹⁵ In addition to generating goodwill within Germany and in international affairs, such a stance made the continued operation of exploitation agencies palatable to a Control Commission for Germany that was turning away from exploitation, to the extent that by January 1947, "whereas almost anything was at one time considered fair game, investigators [were] now discouraged from enquiring into details of new peaceful German inventions."²⁹⁶

The eagerness of FIAT officials to inventory German science even extended into areas where conflict emerged between ideals of openness and concerns of national security. Future Nobel laureate in Physics Walther Bothe and Professor S. Flügge were asked to inventory their area of expertise in 1947: nuclear physics. The editing was careful in phrasing – Mark Walker has dubbed the *FIAT Reviews of Nuclear Physics* "apologetic apologia written for scientists by scientists" in that it carefully ignores the military motivations and applications for the German research – but its more than 400 pages included contributions from almost every scientist involved in wartime German nuclear research.²⁹⁷ The American authorities were certainly nervous about the publication, and Ralph Osborne, chief of FIAT (US), sent the US War Department staff an early draft and warning about the limits of his control: "If many or major

²⁹⁴ "Memorial: concerning the present situation of the German scientists and technical experts evacuated from the Thuringia area by the U.S. army," January 1946. RG 260, box 17/11, folder 1, NACP.

²⁹⁵ "Scientific & Technical Research Board: Review of Scientific & Technical Research in Germany since May, 1945," 15 Jan 1947. TNA: PRO BT 211/30.

²⁹⁶ *Ibid.*

²⁹⁷ Mark Walker, *German National Socialism and the Quest for Nuclear Power, 1939-49* (Cambridge: Cambridge University Press, 1990), 210-212.

changes are required a difficult diplomatic situation may be anticipated. Actually, the only manner in which any control is exerted over this manuscript is through the present publisher being located in the US Zone."²⁹⁸ Still, the report was both published and distributed along with the FIAT reports.

Curiously, even more controversial than nuclear science were the "humane sciences." In December 1946, General Gaston de Verbigier de St. Paul, director of FIAT (FR), wrote to Col. Osborne of FIAT (US) requesting cooperation in researching and writing a "FIAT Review of Humane Sciences."²⁹⁹ Osborne's primary objection to such a review was expediency – he felt "a very strong sense of the urgency of time" in getting the FIAT Review series published, and wished to avoid expanding its scope at that relatively late date. Beyond this, however, was "the controversial nature of any findings in these sciences," which made it "not possible for me to cooperate with you...but would be happy to see the [CNRS] undertake this as a French effort."³⁰⁰ The exact definition of "humane sciences" under consideration and the reasons for its controversy are not entirely clear; perhaps the Nazi medical tests at the center of war crimes trials were the intended target. In any case, the reasoning speaks directly to the rationale of the FIAT Reviews. These were not to be controversial reports, or cover controversial material. They were to inform, certainly, but only within the limits of 'apolitical' science.

Despite paper shortages and difficulties finding local printing facilities, FIAT (US) produced 1,100 sets of FIAT Reviews to be shared equally among the three FIATs. Each received 250 copies, while 33 more were presented as gifts to UNESCO for other nations to utilize, 57 copies were earmarked for each occupation zone, and 20 additional copies for each zone's military government. Aside from the cost of such an undertaking, the equality with which France was treated, the designation of many copies for use in improving German science, and the continued exclusion of the Soviet Union, mark the extent to which the American government remained aware of the diplomatic role these FIAT Reviews could play. As we will turn to next, the Allied powers struggled with the immense scale of industrial research acquired by FIAT and BIOS efforts, but in the domain of the natural sciences at least, distributing information was both possible and politically useful.

IV. The Postwar Information Overload

The amount of information gathered in Germany is staggering. Investigative teams of scientists and industrial technicians determined what information would be microfilmed on-site during visits to factories and plants, then shipped the microfilm to headquarters for processing and publication. In the case of one visit to Degussa (Deutsche Gold- und Silber-Scheidenanstalt), this meant about 110,000 pages of material from the main office and two production facilities combined; at the Dr. Alexander Wacker Gesellschaft für elektrochemische Industrie, GmbH, about 20,000 pages.³⁰¹ Surveying just 67 plants, FIAT estimated that they would select from 33 million pages of material out of 3 billion pages screened, a process they estimated would take

²⁹⁸ "FIAT Review of Nuclear Physics," 24 June 1947. RG 260, box 17/02, folder 10, NACP.

²⁹⁹ Ralph Osborne to Gen. de Verbigier de St. Paul, 27 Jan 1947. RG 260, box 17/05, folder 19, NACP.

³⁰⁰ *Ibid.*

³⁰¹ Gimbel, *Science, Technology, and Reparations: Exploitation and Plunder in Postwar Germany*, 64-66.

about eleven years.³⁰² This was deemed improbable, but efforts to limit the scale of document collection to make it possible to digest were only partly successful.

By the end of 1946, the British Board of Trade was relieved to hear that they had halved the estimated amount to be microfilmed – to half a million documents and reports related to German developments with an average length of ten pages, or five million frames of microfilm. This, with characteristic British understatement, was "even so...more than enough to give us a first class 'headache.'"³⁰³ On the US front, those publicizing the exploitation efforts in such trade publications as *College and Research Libraries* explained delays by pointed to the "tens of thousands of tons of reports and publications" involved.³⁰⁴ By late 1946, a meeting of the Technical Industrial Investigation Committee (TIIC) reported the microfilming about half finished, having filmed 775,000 pages of chemical industry documents alone, as well as hundreds of thousands each from other fields.³⁰⁵ Taking this 50% estimation at face value, TIIC aimed to film about 7.8 million frames of material. Among these were a mix of scientific, technology, and intelligence assets: "pending patent applications for the war years, doctors' dissertations in the natural sciences and medicine, wartime issues of several hundred scientific and industrial journals which are not presently available in the United States, all technical documents from the German Government ministries," and the documents selected by British and American FIAT investigators.³⁰⁶ Even discounting the additional material taken in by military intelligence units and other nations' investigators, this would combine to almost 13 million frames of microfilm, or printed out, a stack of paper about 1.4km high.

This is an impressive amount of material collected, and microfilm proved to be an effective way to copy and ship this immense amount of material back to each nation's headquarters. Once there, though, serious problem arose, because few end users were interested in ordering microfilm rolls with hundreds or thousands of pages of files on them, labelled by industry but rarely more precisely than that. Worse, as of 1958, 49% of American scientists claimed to know at least one foreign language, so even if numbers were slightly higher in the mid-1940s and that language was most commonly German, most end users would need this material translated as well as indexed, selected, copied, and shipped.³⁰⁷

Problems began even in August 1945 for the US, with the Americans apologizing that reproduction of reports had "bogged down quite badly recently."³⁰⁸ Delays on delivering documents ordered by industry or scientific societies grew to over a year, leading one trade journal to jokingly celebrate that at least they "will be made available to historians that are active in our grandchildren's time".³⁰⁹ Initial investigations had found "a great volume of documents" that "soon pyramided to a volume beyond the physical ability of the limited teams to

³⁰² Ibid.

³⁰³ L.R. Poole to G.S. Mansell, 20 Dec 1946. TNA: PRO BT 211/17.

³⁰⁴ Shaw: 106-107.

³⁰⁵ "History: The work in Germany is necessarily....," undated. RG 40, box 3, NACP.

³⁰⁶ Ibid.

³⁰⁷ Michael Gordin, *Scientific Babel: The Language of Science* (Profile Books, 2014), 316.

³⁰⁸ T.G. Haertel to Lloyd R. Worden, 22 Oct 1945. RG 40, box 2, NACP; Tell Berna to Joseph T. Mayer, 13 May 1946. RG 40, box 12, NACP.

³⁰⁹ Ibid.

examine."³¹⁰ "Recognizing its limitations," FIAT (US) decided eventually to bring all materials to the US for processing, rather than handling it in conjunction with the British efforts, though this "effectively exclude[d] the possibility of British positive-copying the US films and microfilming the cards."³¹¹

Initial planning between the US Department of Commerce's Publications Board and BIOS indicated that the US would provide weekly bibliographies for free to American and British industry, from which industry could place orders, with the topics limited to German scientific and technical documents (taken to mean industrial science).³¹² Tightening budgets led the US to change policies to charging for the bibliographies, while their scope expanded to include the academic science journals, intelligence reports, and other technical documents – "a complete hotch-potch, not only of intelligence from Germany but also from US, United Kingdom, Japanese, and even neutral sources" – a reflection of the Documentation activists' goals of cataloguing all the world's information.³¹³ As US bibliographies expanded to include all of this new information, they became (in British eyes) "completely unsustainable...and likely to become even more so."³¹⁴ The result was a bibliography from which orders could be placed, but the documents themselves could not be found, and BIOS eventually banned the distribution of US Department of Commerce bibliographies within the UK. Summing up the British perception of American efforts at organization, bibliography, and indexing, a Board of Trade official explained internally that FIAT (US) did "not see things from the customer's view-point."³¹⁵

In response to British complaints, the head of the Department of Commerce's Publications Board, John Green, resorted to more old-fashioned methods. A hired "sleuth" was able to track down some IG Farben documents, and vague promises made to make similar efforts for future document hunts.³¹⁶ Otherwise, he turned to Mrs. Dorothy Gordon, who "had built up this Department from its inception and possessed a quite exceptional personal knowledge of the history of practically every report, and knew into which channels to direct a search for supplementary data."³¹⁷ The contribution of such a librarian was invaluable, but the talent of one woman for finding files was hardly bibliography of the world's scientific knowledge. The end of duplication with the British, in turn, raised an issue of data vulnerability: if the copy was "ruined by damage in the out-of-date apparatus now held, we shall be completely at a loss to service industry with that particular document."³¹⁸

³¹⁰ "The Chemical Problem in Germany," undated. RG 40, box 3, NACP.

³¹¹ "Record of a meeting on documents at FIAT," 5 Feb 1946. TNA: PRO BT 211/17.

³¹² "Copy of a brief handed to Major J. Day, Board of Trade before departure for Washington: Dissemination to Industry of Intelligence from Unclassified German Documents," undated. TNA: PRO BT 211/17.

³¹³ *Ibid.*

³¹⁴ "Memorandum for Mr. Norman," undated. TNA: PRO BT 211/17.

³¹⁵ Unintelligible to Derek Wood, 10 Feb 1947. TNA: PRO BT 211/24.

³¹⁶ L.R. Poole to George L. Powell, October 1946. TNA: PRO BT 211/17.

³¹⁷ "How Easily Can We Obtain Copies of German Industrial Documents from the US Office of Technical Services?: A brief summary compiled from the reports of H.W. Hirsch. (F.D.U.) from Washington during the period 1st October 1946-1st February, 1947," undated. TNA: PRO BT 211/17.

³¹⁸ "G.D. 743/46. Mr. Wood agrees that is is...," undated. TNA: PRO BT 211/42.

Alfred King, head of this British Scientific Office, wrote to the head of the German Division of the Board of Trade in September 1946 suggesting a pause in operations while they considered investing in an innovation that "may change our attitude toward the whole transaction" with FIAT (US): "cards designed for mechanical sorting."³¹⁹ These mechanically-sorted cards had caused quite a splash at a symposium on technical bibliography at the American Chemical Society meeting of 1946, and King immediately saw the possibilities. "The mass of technical material now being accumulated is so great that unless some efficient method for choosing one card out of millions is adopted, the information is not readily accessible and is in the end lost to science and industry."³²⁰ Ultimately, BIOS would go on as it had, but the international scientific bibliography movement with its focus on new information technologies continued to shape the expectations and policies of the efforts to exploit German science.

In any event, by the best estimates of the US Technical Industrial Investigative Committee (TIIC), even in 1947 there were "literally hundreds of tons of undigested data scattered in a number of repositories in Germany, France, England, and Japan."³²¹ The US "admitted that [they] had attempted to publish far too much material," and yet far more remained out there to be collected.³²² The efforts to exploit German science and technology had adopted the ambitions of the early utopian bibliographers, aiming to gather and index all the scientific and technical knowledge of mankind, and they had adopted its more recent tools in microfilming and distribution. In face of Congressional budget cuts the late 1940s, these ambitions proved far too lofty to accomplish, and the exploitation efforts – though far from useless, it should be emphasized again, and quite successful in some areas – choked on the glut of information. When the oil crisis of the 1970s caused some researchers to look back to German mid-century developments, researchers found masses of untranslated, largely untouched files on oil research in American archives.³²³

While the basic framework for microfilm-based sharing distributed through specialized libraries borrowed more from the scientific world, the world of intelligence impressed itself upon the wartime and early postwar collection of German data in the form of pervasive secrecy and classification. Given the overlap between civilian and military technologies in the Second World War, and that many firms with potentially valuable civilian technology had switched to military production during the war, some amount of information control is unsurprising. Further, shortages of scientifically-trained administrators in the British and (brand new) American intelligence community undoubtedly meant some decision-makers for classification policy had less than perfect understanding of the distinctions between the harmless and potentially deadly. Indeed, widespread classification (or over-classification, as many would later argue) of scientific and technical data did not begin with the attempts to study German wartime advances – this was, for example, a constant complaint of Robert Oppenheimer and other scientists involved in the

³¹⁹ A. King to G.S. Mansell, 16 Sept. 1946. TNA: PRO BT 211/17. On this general British attitude, see Chapter 2.

³²⁰ *Ibid.*

³²¹ "1947 Budget Estimates: General Justification, Technical and Scientific Services," undated. RG 40, box 58, NACP.

³²² L.R. Poole, "Memorandum: I have today had a long conversation...," 7 July 1948. TNA: PRO BT 211/17.

³²³ Arnold Kramer, "German Energy Secrets Recycled," *German Studies Review* 2, no. 2 (1979).

Manhattan Project.³²⁴ Still, it seriously hampered efforts at effectively and efficiently distributing scientific intelligence taken from Germany, and created a significant point of contention between the United States and United Kingdom, despite their close cooperation in most intelligence matters during this period.

Much of the problem originated, again, in practicalities of the processing and distribution of such a bulk of information, and included complaints by both the Americans and British of the other being too loose with security measures (yet decrying over-classification). One American memorandum from TIIC for the Communications Subcommittee in August 1945 expressed frustration at over-classification, noting that "a large part of the information contained in the English language reports and other documents marked 'SECRET' or 'CONFIDENTIAL' is in fact not properly classifiable at all. (Some indeed should be marked 'TRIVIAL')." ³²⁵ The Aeronautics Subcommittee warned that "any classification on the information you send us slows down the method of distribution," possibly to the point of uselessness. ³²⁶ Yet the British received polite but strenuous complaints about the Halstead Exploitation Centre for Germany documents, which owing to staff shortages, distributed all of its materials without classification and left security measures up to receiving organizations. ³²⁷

Similarly, though the British complained that over 20% of reports on German firms (including those based in France) were stamped with security classifications by Americans, they were quite upset by American unilateral decisions to downgrade classification of materials. Rather than acquiesce to the US-proposed security classifications, BIOS officials wished "to make it quite clear that as far as CIOS and Evaluation Reports are concerned...it is not proposed automatically to agree to the US security classification. On the contrary...we propose to retain the existing UK security grading...regardless of any re-grading given by the US authorities." ³²⁸ Further objections to Americans declassifying reports occurred intermittently throughout the

³²⁴ Peter Galison, "Removing Knowledge," *Critical Inquiry* 31, (2004); Long, *Openness, Secrecy, Authorship: Technical Arts and the Culture of Knowledge from Antiquity to the Renaissance*; R. MacLeod, "Secrets among Friends: The Research Information Service and the "Special Relationship" in Allied Scientific Information and Intelligence, 1916-1918," *Minerva* 37, no. 3 (1999); Robert W. Seidel, "Secret Scientific Communities: Classification and Scientific Communication in the DOE and DOD," in *Proceedings of the 1998 Conference on the History and Heritage of Science Information Systems*, ed. Mary Ellen Bowden, Trudi Bellardo Hahn, and Robert V. Williams, (Medford, NJ: Information Today, 1999); Koen Vermeir and Daniel Margocsy, "States of Secrecy: An Introduction," *The British Journal for the History of Science* 45, no. 2 (2012); Wellerstein; Alex Wellerstein, "Knowledge and the Bomb: Nuclear Secrecy in the United States, 1939-2008" (Harvard University, 2010); Peter J. Westwick, "Secret Science: A Classified Community in the National Laboratories," *Minerva* 38, no. 4 (2000): 366.

³²⁵ "Appendix A: Memorandum for: The Communications Subcommittee, Technical Industrial Intelligence Committee," 18 August 1945. General Records, Department of Commerce, Record Group 40 (RG 40), box 23, National Archives at College Park, College Park, MD (NACP).

³²⁶ G. D. Taylor to T. G. Haertel, 4 July 1945. RG 40, box 23, NACP.

³²⁷ "Proposed Visit of Secretary, BIOS to Washington," undated. The British National Archives (TNA): Public Records Office (PRO) BT 211/24.

³²⁸ H.S. Stewart-Jones, "Appendix 'A' to Minutes of the Working Party," 26 August 1946. TNA: PRO BT 211/13.

1945-1948 span.³²⁹ The extent to which this was a serious concern about information leaking to the public is unclear, the Foreign Office was still quite hopeful of the possibilities of exploitation in 1947 – argued one official:

Prima facie, since the microfilms and prints are advertised as being available without reservation of any kind, we have no real grounds for refusing supply to other nationals. There is, however, a strong feeling that these original German documents and drawings represent a form of reparations – perhaps ultimately the only really valuable form of reparations we shall obtain – and that it would nullify their value if they were to be disseminated to overseas competitors of our own industry. We have tried to meet this situation by administrative delays, thus giving our own industry a flying start.³³⁰

This attempt at transparency on the American side seems to have been motivated at least in part by the U.S. Department of Commerce's Publications Board, responsible for distributing the FIAT reports but finding itself frustrated. Within the "great reservoir of scientific and technical knowledge...developed during the past five years" was surely the "molecules" form which new industries and "jobs for all" could spring, explained the Publications Board to the library and information sciences community, yet this knowledge was being "dammed up by the walls of secrecy."³³¹ Qualified staff with security clearance, knowledge of German, and scientific or technical training was exceptionally hard to come by, and a great deal of knowledge classified by virtue of coming through intelligence channels never received a declassification review. Similarly, the declassification of papers from the Manhattan Project led to only a trickle of papers emerging by the end of 1946.³³²

V. Commercial Publication of Technical Information

The problems in information processing and publication confounding FIAT were opportunity for some entrepreneurs. The Publications Board of the US Department of Commerce began recruiting companies, trade groups, and scientific societies in July 1948 seeking volunteers to scan through microfilm sent from Germany and write out abstracts, bibliographic entries, and other metadata for use in processing.³³³ Budget cuts meant that the only compensation offered was "being the first to scrutinize the material" (other than those who had screened and microfilmed it in Germany, presumably), and at least some firms accepted this offer, sometimes also borrowing Commerce Department microfilm-reading equipment.

One company, Caducean Press, brought advertising panache to its resale of a specific set of FIAT records: the results of the Nazi medical experiments, including those for which the researchers had been sentenced at the Nuremberg war crimes trials just a year prior. The firm

³²⁹ J.H. Wheatcroft, "Lists of Classified and Unclassified CIOS Reports," 6 April 1946. TNA: PRO BT 211/13.

³³⁰ [Unclear] to MAM Robb, Esq., Foreign Office, 24 February 1947. TNA: PRO BT 211/161.

³³¹ Ralph Shaw, "The Publications Board," *College and Research Libraries* (April 1946): 105.

³³² Richard G. Hewlett and Oscar E. Anderson, *A History of the United States Atomic Energy Commission, Vol. I: The New World, 1939-1946* (Berkeley, CA: University of California Press, 1962), 1-2, 647; Col. W.S. Hutchinson, "The Manhattan Project Declassification Program," *Bulletin of the Atomic Scientists* II, (1946). Citation from Westwick: 367.

³³³ Gimbel, *Science, Technology, and Reparations: Exploitation and Plunder in Postwar Germany*, 70-72.

advertised records "long kept secret," such as, "From Himmler's cave on a hillside near Dachau, records of physiological experiments on inmates of concentration camps...From the laboratories of the Kaiser Wilhelm Institute, pathological anatomy of rare conditions found in the brains of mental patients who were executed." For a "nominal cost" for translation and distribution, Caducean would send these files to customers. Those whose consciences might have stirred were assured that "the director of one of America's great research centers" had endorsed the idea of America learning from Germany's medicine.³³⁴

Another entrepreneur, Earl Maxwell Coleman, founded a profitable business called Consultants Bureau on the realization that the "twenty-one tons of captured German war documents" were being re-translated by each individual customer who ordered a copy, as there was no centralized funding to pay for bulk translation.³³⁵ Finding that the American Petroleum Institute alone had one hundred microfilm reels of one thousand pages per reel in need of translating, Coleman's business was one of the first in an industry of mass translation. The Consultants Bureau had an important role in forming the scientific translation industry that historian Michael Gordin has traced in allowing the shift postwar shift towards an English-dominated scientific community, rather than the mix of publications in English, French, German, Russian, and other languages, but it was only profitable once it moved into different aspects of technical translation: "German died on the vine...American companies had already acquired the know-how laid out in the documents."³³⁶ As with information science and documentation more generally, Michael Gordin argues that the mid-1950s led to a sea change in the types of solutions to researchers sought to solve problems of scientific translation, from individual decisions (such as learning Russian) to state solutions (such as sponsoring services to translate entire journals).³³⁷ In the UK, this means a translation service run through the Department of Scientific and Industrial Research; in the US, NSF-funded translation centers at the Library of Congress in the late 1940s.

French scientific abstracting and bibliography turned towards state-run solutions in the late 1940s as well, though in response to wartime scientific intelligence struggles rather than postwar investigations of Germany. Jean Gerard, secretary general of the Maison de la Chimie (a foundation and conference center dedicated to assisting chemical scientists and engineers through international organization), had been a man well-connected in the chemical world before the Second World War, as well as an activist in the Documentation movement.³³⁸ Through his connections in both French and German academic and industrial research centers, he was able to maintain one of the world's best chemical reference libraries and bibliographies, and to establish SOPRODOC, a for-profit indexing and abstracting service. The wartime isolation from France from foreign scientific journals led him to seek cooperation from German authorities in reactivating the Maison's subscriptions to German journals. Gerard was not alone in this – in

³³⁴ "American, German, and Japanese Medical Reports: Publication List," 19 Dec 1946. RG 40, box 63, NACP.

³³⁵ Earl Maxwell Coleman, "The Mass Production of Translation - For a Limited Market," *Publishing Research Quarterly* 10, no. 4 (1995).

³³⁶ *Ibid.*, 25. For more on Coleman and the scientific and technical translation industry in which he was a part, see Gordin.

³³⁷ Gordin, 357.

³³⁸ Aside from directly cited archival material below, see the chapter "Wyart contre Gerard, ou la guerre des bibliographies" in Chevassus-au-Louis, 127-137., and Richards.

October 1940, a new director of the Bibliothèque Nationale, L.R. Faij, reported that 40 other institutions sought to reopen scientific communication with Germany. The success of these efforts both allowed French scientists some window into international developments and, perhaps not coincidentally, gave Gerard's SOPRODOC a near monopoly within occupied France.

SOPRODOC had no access to Western scientific journals, however, and here it ran into competition from an illegal service operated by the CNRS. Frederic Joliot-Curie assigned this bibliographic job to Jean Wyart, a young crystallographer, who was able to exploit prewar international scientific relationships to import knowledge from the Allied power.³³⁹ Together, the *Bulletin* and SOPRODOC covered virtually the entire scientific world, neatly divided along the lines of wartime alliances, and whether by negligence or disinterest, the Germans never ordered Wyart to cease his well-known and popular efforts. In the postwar, though, the centralized model of CNRS bibliography had the considerable moral edge over what was seen as Gerard's collaborationist alternative. After bitter protests from Gerard, which led to consultations between the CNRS and the American Chemical Society, SOPRODOC was shut down and France, too, moved towards centralized, state solutions to scientific bibliography and abstracting.³⁴⁰

VI. Conclusions

The problem of information exchange in the ever-growing sciences did not go away, and indeed became a central issue in the newly important field of science policy. Vannevar Bush, former head of the wartime Office of Scientific Research and Development (OSRD) – and whose recommendation had spurred President Truman to issue Executive Order 9569 creating the Publications Board – highlighted this problem in his famous policy statement, *Science, the Endless Frontier*.³⁴¹ "International exchange of scientific information is of growing importance," he wrote, and he saw a role for an active government in pursuing it, via "the arrangement of international science congresses, in the official accrediting of American scientists to such gatherings, in the official reception of foreign scientists of standing in this country, in making possible a rapid flow of technical information, including translation service, and possibly in the provision of international fellowships."³⁴²

The linkages between the development of information science (growing from the Documentation movement) and the scientific exploitation efforts in Germany are rarely necessary-and-sufficient causal relationships, yet they are pervasive. You could explain the FIAT Reviews without these links; you could find a reason why files about Jean Gerard's postwar tribulations are scattered throughout the French FIAT records; you could write off the spur to commercial machine translation of scientific texts as simply an idea and technology whose time had come. Certainly the FIAT-like efforts were hardly the *only* cause for intelligence community

³³⁹ Richards, 113.

³⁴⁰ Fayet-Scribe has made a similar point: "Gerard thus had a federating approach to documentation at a time when the profession was resolutely on the side of centralization and nationalism" Fayet-Scribe, 188.

³⁴¹ Richards, 126.

³⁴² Vannevar Bush, *Science, the Endless Frontier* (Washington, D.C.: Government Printing Office, 1945), 19. On this work's political impact, see Daniel J. Kevles, "The National Science Foundation and the Debate over Postwar Research Policy, 1942-1945: A Political Interpretation of *Science - The Endless Frontier*," *Isis* 68, no. 241 (1977).

investment in mechanical sorting (and eventual computer encoding) of bibliographic entries for information retrieval, or increased state attention being paid to funding abstracting services. Yet all of these make far more sense when pieced together.

FIAT was not the origin or endpoint of these broader trends, but it was a junction through which they passed, and due to the unprecedented extremity of the information problems FIAT faced – trying to handle not just the incredible amount of scientific information already problematic before it piled up for several years, but then also all of the assorted information of potential intelligence value beyond that – it served as a catalyst for shaping the future of international structures for scientific communication. When military intelligence agencies targeted scientific and technical information during the occupation of Germany, they were dealing with pre-existing problems, and drew upon pre-existing solutions. Among these were using the international network of scientific-technical specialist libraries to distribute abstracts and bibliographic information, and drawing upon those working in these institutions to contribute their time towards this end. Also borrowed was a faith that through microfilm, all collections are possible.

If the impact of documentation on FIAT is reasonably clear, the impact of FIAT on postwar information science is both more difficult and probably of greater overall historical significance. Robert V. Williams, writing on the history of the Special Libraries and Documentation movements within the United States, argues that "in the limited pre-war activities [of US groups] there was a definite orientation towards large-scale dissemination projects using microfilm. Postwar activities, however, showed signs of more detailed focus on the organization, control, and use of scientific documents."³⁴³ He does not specifically attribute this to postwar investigations in Germany, but he does point to what those at the time and subsequent writers have dubbed a period of "information turmoil" generated by "a tremendous increase in the volume of scientific information, particularly in the form of technical reports." Irene Farkas-Conn, in her history of the American Society for Information Science, makes this argument more directly.³⁴⁴ During the war, the massive amounts of information gathered by the Air Force, OSS, and other forces (presumably including FIAT) enlisted the British association of special librarians and the American Library of Congress in microfilming efforts, resulting in 300,000 Japanese and "13 million pages of censorship intercepts on microfilm [being] deposited in the National Archives under the presidential seal."³⁴⁵ Dealing with this influx of material, bibliography efforts to make material available to the intelligence community, and a mandate from the assistant secretary of state to reduce duplication among these special libraries meant "for the first time US librarians examined from a broad point of view how the research libraries could best serve US scholarship and developed a national plan."³⁴⁶ These challenges also led to an expansion of early computing technology.

The bureaucratic lineage between wartime scientific intelligence efforts aimed at Germany and postwar government-run scientific information programs is direct, as Pamela

³⁴³ Williams, "The Documentation and Special Libraries Movement in the United States, 1910-1960," 174-175.

³⁴⁴ Farkas-Conn, 99-119.

³⁴⁵ Ibid.

³⁴⁶ Ibid., 106.

Richards has shown.³⁴⁷ The Office of Technical Services which had been assigned to run the Publications Board of the US Department of Commerce existing until 1965, when it was expanded into a Clearinghouse of Federal Scientific and Technical Information, which in 1971 became the National Technical Information Service. Each of these units was responsible for providing summaries of foreign technical reports to industrial subscribers and research institutions. The Air Force document processing facilities in London and at Wright Field eventually merged into a Central Air Documents Office, which became a unit of the Armed Services Technical Information Agency, then renamed the Defense Documentation Center in 1965. In 1958, a President's Science Advisory Committee investigated whether such an agency should be created in the model of the Soviet All-Union Institute of Scientific and Technical Information, but recommended instead strengthening the scientific information distribution role of the National Science Foundation.³⁴⁸ The NSF's Office of Scientific Information Services resulted from this recommendation.

British government involvement in scientific communication had a natural home in the Department of Scientific and Industrial Research (DSIR), which preexisted the Second World War, and in its wartime centralization of information into the Science Museum as a de facto national science library.³⁴⁹ The DSIR's Information Division absorbed the bureaucratic remnants of the Board of Trade's processing of German information, and in 1955 it began planning a national lending library for science, opened in 1962 at Boston Spa in Yorkshire.³⁵⁰

The growth of information technology in the decades since the Second World War raises an interesting (if fundamentally unanswerable) question: If the occupation of Germany happened with today's information technology available, would the results have been significantly different? Certainly, modern scanning techniques and optical character recognition would have made the results more searchable, and digital technology would have allowed storage and searching to be less of an issue. Publication would not even be a problem, per se, if the resulting information could be hosted on the Internet. This might still be naive, however. Much of the most important knowledge acquired during these investigations came from hands-on visits to factories and inspiration for new products rather than copying German developments, and neither could easily be digitized. Further, the greater tools for search would have to deal with massively more information – a problem all too familiar to those struggling with yards of boxes of archival files, much less the quantity that passed through FIAT's now-obsolete system. Nor should we discount the human element – the inefficiencies of processing massive data through military intelligence channels, and filtering important information from noise. Information science has undoubtedly advanced since the 1950s, but technology alone may be no more a solution for technology transfer today than it was sixty years ago.

³⁴⁷ Richards, 125-135.

³⁴⁸ Ibid., 128.

³⁴⁹ James E. Till, "Predecessors of Preprint Servers," *Learned Publishing* 14, no. 1 (2001): 130.

³⁵⁰ Bernard Houghton, *Out of the Dinosaurs: The Evolution of the National Lending Library for Science and Technology* (London: Clive Bingley, 1972), 17. Citation from Till: 131.

Chapter 5: To Suppress, Exploit, or Support? The Uses of Science in Occupied Germany

Abstract: The links between science, intelligence, diplomacy, and economic power explored in Chapter 4 did not emerge from a vacuum. At the same time the Allied powers found themselves deciding on the future of Germany's industry and scientific communities, each faced challenges at home to negotiate questions of science policy, such as how promotion of science could be linked to democracy and economic growth. This chapter examines how these domestic science policy questions interacted with control policy towards Germany and German science, and the various ways in which science became entangled in new or changing ways with state power in the early Cold War.

I. Introduction

In retrospect, the similarities and bureaucratic interconnection among FIAT, BIOS, the Technical Oil Mission, the ALSOS mission to study German atomic research, and other scientific intelligence efforts within Germany make them worth discussing as a unified phenomenon, but from the perspective of the time, these efforts were woven into a complex apparatus for governing and controlling Germany, and specifically German science. This chapter, though less focused around a single argument than the others, is an attempt to explore how the different layers of politics involved – the rapidly-evolving international issue of Germany's place in the postwar; the politics of postwar science policy on the home front; and each nation's internal divisions over policy towards Germany – led to mixed, sometimes internally-contradictory policies of suppressing, exploiting, and nurturing German science.

The idea of 'science' brought with it certain connotations and rhetoric in the context of the late 1940s and early 1950s, and these were utilized by American, British, French, and German actors alike in negotiating postwar science policy – both science policy for their occupation zones of Germany and science policy back home. These connotations were not always clear-cut or stable, and this allowed different actors to argue that 'science' could be and mean many different things for a new German state: a path to resurgent military power; a direct source to economic growth; a force for morality and democratizing Germans; an apolitical, international network governed by reason; a source for prestige; or a diplomatic lever, depending on which was most convenient.³⁵¹

³⁵¹ On the different perceptions of science and governance in this era, see e.g. RH Beyler, "Hostile Environmental Intellectuals? Critiques and Counter-Critiques of Science and Technology in West Germany after 1945," *Berichte zur Wissenschaftsgeschichte* 31, no. 4 (2008); Mark B. Brown, *Science in Democracy: Expertise, Institutions, and Representation* (Cambridge, Mass.: MIT Press, 2009); Sheila Jasanoff, *Designs on Nature: Science and Democracy in Europe and the United States* (Princeton, NJ: Princeton University Press, 2005); Kevles, "The National Science Foundation and the Debate over Postwar Research Policy, 1942-1945: A Political Interpretation of *Science - The Endless Frontier*."; Kevles, *The Physicists: The History of a Scientific Community in Modern America, Revised Edition*; Edwin Layton, "Mirror-Image Twins: The Communities of Science and Technology in 19th-Century America," *Technology and Culture* 12, (1971).

On the Allied discussion of postwar German science, see Ulrich Albrecht, Andreas Heinemann-Grüder, and Arend Wellmann, *Die Spezialisten : Deutsche Naturwissenschaftler und Techniker in der Sowjetunion nach 1945* (Berlin: Dietz, 1992); Ash; A. Beyerchen, "German Scientists and Research

The idea of science as a path to economically valuable technology, tied to industry, patents, trade secrets, and other conventions of business and intellectual property law, was the basis for the scientific and technical exploitation programs, and the governing military authorities in each occupation zone considered both industrial and academic science as an integral part of overall economic policy. This was true both for those intending to crush and restrain a German recovery and those trying to encourage an economically self-sustaining occupation with limits only on 'war-related' science and industry. Supporting or suppressing science was never a simple binary, however. Different ideas about what roles science could or should play in governance combined with the shifting diplomacy of the powers deciding on divided Germany's future, and Germany as often became a place where the individual nations' own anxieties and ambitions for controlling science were projected and tested.

Historians have recently paid increasing attention to these ways in which science interacted with diplomacy, and particularly in the use of science as 'soft power'.³⁵² John Krige applied this framework to the early postwar era, in which the Rockefeller and Ford Foundations (acting partly as agents of the United States intelligence community) utilized the idea of science as an apolitical field to avoid protest to American funding for it, and thereby to generate goodwill and an American-oriented elite across Western Europe in the postwar decades. "Science was embedded in, and instrumentalized for, the projection of American power in postwar continental Europe," he has argued, emphasizing that this was a project of mutual co-creation of American leadership (or 'hegemony') rather than a more overt or coercive imperialism.³⁵³

Institutions in Allied Occupation Policy," *History of Education Quarterly*, (1982); Cassidy, "Controlling German science. I: US and allied forces in Germany, 1945-1947."; Cassidy, "Controlling German science, II: Bizonal occupation and the struggle over West German science policy, 1946-1949."; Giuliana Gemelli, "American Foundations and European Scientific Integration: Actors and Networks (1920s-1970s)," in *Réseaux économiques et construction européenne: Economic Networks and European Integration*, ed. Michel Dumoulin, (Bruxelles: P.I.E.-Peter Lang, 2004); Krige; John Krige, "Building the Arsenal of Knowledge," *Centaurus* 52, (2010); Macrakis; Maddrell, "Britain's exploitation of occupied Germany for scientific and technical intelligence on the Soviet Union"; Paul Maddrell, *Spying on science : Western intelligence in divided Germany 1945-1961* (Oxford; New York: Oxford University Press, 2006); Pestre.

³⁵² The term 'soft power,' taken to mean the ability to convince, coopt, or coerce rather than use physical violence to force, was coined in Joseph Nye, *Bound to Lead: The Changing Nature of American Power* (New York: Basic Books, 1990). Nye expanded upon the idea in Joseph Nye, *Soft Power: The Means to Success in World Politics* (New York: Perseus Books, 2004).

In addition to Krige's work (see footnote 3), examples of science as soft power in the history of science and technology include Ronald Doel and Kristine C. Harper, "Prometheus Unleashed: Science as a Diplomatic Weapon in the Lyndon B. Johnson Administration," *Osiris* 21, no. 1 (2006); Jacob Darwin Hamblin, "Environmentalism for the Atlantic Alliance: NATO's Experiment with the 'Challenges of Modern Society'," *Environmental History* 15, (2010); Sheila Jasanoff, "Biotechnology and Empire: The Global Power of Seeds and Science," *Osiris* 21, no. 1 (2006); Clark A. Miller, "'An Effective Instrument of Peace': Scientific Cooperation as an Instrument of American Foreign Policy, 1938-1950," *Osiris* 21, no. 1 (2006); Simone Turchetti and others, "On thick ice: scientific internationalism and Antarctic affairs, 1957-1980," *History and Technology* 24, no. 4 (2008).

³⁵³ Krige, *American Hegemony and the Postwar Reconstruction of Science in Europe*, 3. See also John Krige, "Atoms for Peace, Scientific Internationalism, and Scientific Intelligence," *Osiris* 21, no. 1

America was not alone in instrumentalizing science in Germany, both within and beyond the efforts to extract economic value from German industrial advances. For France, science was closely linked to prestige and legitimacy, both within Germany and at home. Preventing a resurgence of Germany military power was an absolute priority, but given the attitudes towards science explored in Chapter 1 – including a disbelief in the practicality of either appropriating or suppressing German science beyond the early postwar years – the destruction of German science was never a serious goal. Instead, Germany became a place to experiment with the same issues France was struggling with at home: whether science was best served through a centralized, state-run funding scheme or through decentralized, competitive programs. Similarly, in a world where France was no longer a major colonial or diplomatic power, international science was seen as a path to 'soft power' leadership in much the same way America envisioned (if on the European rather than world scale), but where did this leave German science? Chapter 2 has already discussed one aspect of how the United Kingdom hoped to control German science, and how policy in Germany mutually shaped that at home – in the area of intellectual property law and policy – but in science policy more generally, considerations of controlling science went hand-in-hand with controlling and shaping Germany.

Meanwhile, throughout each of these nations, the looming specter of the Soviet Union shaped both science policy and scientific exploitation, making 'denial' of scientific personnel to the Soviets at least as high a priority as benefitting themselves.³⁵⁴ Nor were the Germans passive subjects waiting to be molded by the occupying powers. Scientists, politicians, and industrialists there, too, sought to shape the future of German science using whichever view of science was most useful at the time.³⁵⁵ All of these interacting forces (and many more beyond) make a story far more complex than one of simple opportunistic looting, whether of physical tools or 'intellectual reparations.' Some amount of simplification and streamlining is necessary in any historical work in order to make it more comprehensible, but it is important not to mistake that for clarity in contemporary decision-making. Science was not just a source of economic value to the occupying nations, nor even to the exploitation agencies (FIAT, BIOS, etc.), but also served many other roles, and

(2006); John Krige, "The Peaceful Atom as Political Weapon: Euratom and American Foreign Policy in the Late 1950s," *Historical Studies in the Natural Sciences* 38, no. 1 (2008); Krige, "Building the Arsenal of Knowledge."; John Krige, "Technological Leadership and American Soft Power," in *Soft Power and US Foreign Policy: Theoretical, Historical and Contemporary Perspectives*, ed. Inderjeet Parmar and Michael Cox, (New York: Routledge, 2010); John Krige and Helke Rausch, eds., *American Foundations and the Coproduction of World Order in the Twentieth Century* (Goettingen: Vandenhoeck & Ruprecht, 2012).

³⁵⁴ On the Soviet exploitation of German science, see especially Albrecht, Heinemann-Grüder, and Wellmann; Cassidy, "Controlling German science. I: US and allied forces in Germany, 1945-1947."; Naimark; Steiner; Stokes, "Assessing the Damages: Forced Technology Transfer and the German Chemical Industry."

³⁵⁵ The literature on German scientists' and politicians' efforts to rebuild scientific institutions after the Second World War is vast. Some key examples include Cathryn Carson, *Heisenberg in the Atomic Age: Science and the Public Sphere* (Cambridge: Cambridge University Press, 2010); Cathryn Carson and Michael Gubser, "Science advising and science policy in postwar West Germany: The example of the Deutscher Forschungsrat," *Minerva* 40, (2002); Rammer; Walker, *Nazi Science: Myth, Truth, and the German Atomic Bomb*; Walker, "The Nazification and Denazification of Physics."

II. American Conflicts of Science and Governance

The role of science and scientists in American democracy was an unsettled, hotly debated issue during and in the early aftermath of the Second World War, as has received considerable historical study, and these preoccupations and political struggles soon spilled over into Germany in more and less direct ways.³⁵⁶ In the US, scientist leaders such as Vannevar Bush gained prominence as head of the Office of Scientific Research and Development (OSRD) and pushed for a more permanent presence of scientists as advisors in government, a call soon echoed by several Manhattan Project veterans interested (among other issues) in directing the future of atomic research, but resisted by career military officers and bureaucrats.³⁵⁷ Similar debates about the proper role of science and scientists echoes in ongoing debates about rehabilitating Germany and German science.

In the initial invasion and occupation period, there was near unanimity among the Allies about policy towards Germany: it should be, at all costs, be prevented from ever being a threat to the world. In the American case, this was expressed through an executive directive called JCS 1067, a directive to the head of Shared Headquarters, Allied Expeditionary Force (SHAEF), General Dwight D. Eisenhower. An expression of the so-called Morgenthau Plan, JCS 1067 outlined how to accomplish US Treasury Secretary Henry Morgenthau's "Program to prevent Germany from starting World War III."³⁵⁸ Morgenthau – the most prominent thinker in their vein, but hardly the only proponent of it – proposed to reduce Germany to an agricultural economy, stripping away its industrial base and permanently suppressing any military output.³⁵⁹

This policy priority shifted towards favoring the rebuilding of the German economy – and eventually even the German military – as part of a denazified, democratic member of an

³⁵⁶ For just a few examples, see Andrew Jewett, *Science, Democracy, and the American University: From the Civil War to the Cold War* (Cambridge: Cambridge University Press, 2012); Daniel J. Kevles, "Cold War and Hot Physics: Science, Security, and the American State, 1945-56," *Historical studies in the physical and biological sciences* 20, no. 2 (1990); Kevles, *The Physicists: The History of a Scientific Community in Modern America, Revised Edition*; Stuart W. Leslie, *The Cold War and American science : the military-industrial-academic complex at MIT and Stanford* (New York: Columbia University Press, 1993).

³⁵⁷ James Hershberg, *James B. Conant: Harvard to Hiroshima and the Making of the Nuclear Age* (New York: Knopf, 1993); David Kaiser, "Cold War Requisitions, Scientific Manpower, and the Production of American Physicists after World War II," *Historical Studies in the Physical & Biological Sciences* 33, no. 1 (2002); David Kaiser, "Nuclear Democracy: Political Engagement, Pedagogical Reform, and Particle Physics in Postwar America," *Isis* 93, (2002).

³⁵⁸ Cassidy, "Controlling German science. I: US and allied forces in Germany, 1945-1947," 198.

³⁵⁹ For more on the Morgenthau Plan and the broader history of occupation policy, see Balabkins; Cairncross; W.L. Dorn, "The debate over American occupation policy in Germany in 1944-45," *Political Science Quarterly* 72, (1957); Gimbel, *The Origins of the Marshall Plan*; Conrad F. Latour and Thilo Vogelsand, *Okkupation und Wiederaufbau: Die Tätigkeit der Militärregierung in der amerikanischen Besatzungszone Deutschlands 1944-1947* (Stuttgart: Deutsche Verlags-Anstalt, 1973); Meehan; Henry Morgenthau, "Program to prevent Germany from starting World War III," in *Germany is our Program*, ed. Henry Morgenthau, (New York: Harper & Brothers Publishers, 1945); Edward Peterson, *The American occupation of Germany : retreat to victory* (Detroit: Wayne State University Press, 1977).

American-led counter to perceived Soviet expansionism and aggression.³⁶⁰ The details of this shift, which was more of a contested trend throughout the period rather than a binary change, are mostly outside the scope of this discussion. Both viewpoints saw science as a vital tool for achieving their goals, however, and both left deep impressions on the shape of science in the American zone of occupation.

By late 1944 some scientific leaders began pushing for a revised policy that would be less punishing towards German sciences.³⁶¹ Faced with election-season pressure from economic and scientific leaders for a softer approach to Germany than the ongoing Morgenthau-inspired suppression, President Roosevelt turned to Vannevar Bush, head of the Office of Scientific Research and Development (OSRD) and FDR's science advisor, for suggestions. On the advice of Frank Jewett, president of the National Academy of Sciences, Bush recommended Dr. Roger Adams, an organic chemist and head of the University of Illinois' Chemistry Department, to put together a new strategy for German science.³⁶² Little came of the recommendations that Adams – aided by a committee included I.I. Rabi and other luminaries of industrial and academic science – put together, but Adams did receive an appointment from OSRD, War Department, and State Department to serve in Germany as an "expert consultant."³⁶³ Adams received little welcome from General Clay, the head of the Office of Military Government, United States (OMGUS), the military government in the US zone. Writing his own assessment of science policy, Adams criticized the way that science was being handled, to some degree or another, by nearly every agency of government. Only FIAT was well organized, in his view, and its mission was hardly entirely benevolent.

Those who aimed to rebuild German science took refuge in two rhetorical tactics: casting German science as "corrupted" or "perverted" during the Nazi period – and thus recoverable to a true science that might have better results – and emphasizing the distinction between "pure" and "applied" science. The first of these tactics, emphasizing "perversion" of German science under the Nazi regime, drew evidence direction from FIAT investigations that (quite to their surprise) came across what they dubbed "scientific war crimes." On May 15, 1946, officials from the US, UK, and France - among them FIAT officials, representatives from the War Crimes divisions of the US and UK, and professors from the Pasteur Institute and the University of Edinburgh – held a meeting to discuss what to do with information gathered "which more on the commission of war crimes by German scientists," in particular "inhuman experimentation on living men and women."³⁶⁴ Instruction from the War Crimes Tribunals and legal divisions to FIAT eventually

³⁶⁰ John Gaddis, *The long peace : inquiries into the history of the cold war* (New York: Oxford University Press, 1987); John Gaddis, *The United States and the origins of the cold war : 1943-1946* (Ann Arbor Mich.: UMI Dissertation Services, 2003).

³⁶¹ This summary derives principally from Cassidy, "Controlling German science. I: US and allied forces in Germany, 1945-1947," 220-222.

³⁶² For more on Adams, see also Ronald Doel, "Roger Adams: Linking University Science with Policy on the World Stage," in *No Boundaries: University of Illinois Vignettes*, ed. Lillian Hoddeson, (University of Illinois Press, 2004); D. Tarbell, *Roger Adams : scientist and statesman* (Washington D.C.: American Chemical Society, 1981).

³⁶³ Cassidy, "Controlling German science. I: US and allied forces in Germany, 1945-1947."

³⁶⁴ "Meeting held in FIAT Conference Room at HOCHST at 1030 hours on Wednesday 15th May 1946 to consider bearing on the commission of war crimes by German scientists believed to be guilty of

amounted to asking all such evidence to be forwarded along and they would deal with the issues, but the episode informed FIAT officials with a sense of a broader 'civilizing' mission.

One of the major impediments to creating any effective policy regarding Germany was the structuring of the Allied Control Authority, whose component Allied Control Council (ACC) required unanimity in every decision. Science fell under its Economics Directorate (DECO), then a Committee on the Liquidation of War Potential in Germany (CLWP) formed to craft Allied science control policy. Though newly arrived in Germany, Adams was appointed head of this four-power CLWP in November 1945, a short-lived position from which he nonetheless helped craft the guiding legislation for science policy through most of the occupation period, Allied Control Law 25. Law 25's purpose was "the control of scientific research" in order "to prohibit scientific research and its practical applications for military purposes, to control them in other fields in which they may create a war potential, and to direct them along peaceful [economic] lines."³⁶⁵

Law 25 made distinctions between 'fundamental' and 'applied' research and development, placing heavier restrictions on the latter; and between research of a 'military nature,' 'peace-time applications,' neither, or both.³⁶⁶ War-related research was banned, peaceable research allowed, and those in between decided on a case-by-case basis – but the definitions of these terms were nebulous. As enforcement was left to the individual military governors, and combined with the dissolution of the combined command in July 1945, there was increasing room throughout these months for divergence in the Allied zones.

In the American case, the split between 'fundamental' and 'applied' science was an ongoing between the competing policy regimes of reducing and suppressing German war capacity (the 'Morgenthau school') and those who sought to rebuild Germany's economy as an economically independent defense partner and bulwark against Eastern Europe. One proposal created by the Economic division in June 1945, "Technical and Scientific Research in Germany after the War," captures the ways in which this 'pure' vs. 'applied' rhetoric allowed moderation between these control stances.³⁶⁷ "Pure" or "academic research...defined as the expression of man's curiosity about the universe" unrelated to any "ulterior motive" is altogether for the good, it argues, and "the source from which all advances in technology must come."³⁶⁸ "Even the rarified fields of pure research" under the Nazi regime has been subject to the "perversion of German science," the "prostitution of science," however, and this was the justification for long-term scientific control (until "unmistakable evidence of a genuine change of heart in Germany"). As evidence of this 'prostitution,' the report's author cites German scientists collecting Yellow Fever samples to use as a weapon, "so causing a holocaust at a time best suited to themselves."

inhuman experimentation on living men and women," 15 May 1946. RG 260, box 17/01, folder 26, NACP.

³⁶⁵ Published in *Official Gazette of the Control Council for Germany*, 6 (30 April 1946), 132-143. Citation from Cassidy, "Controlling German science. I: US and allied forces in Germany, 1945-1947," 200.

³⁶⁶ *Ibid.*, 225.

³⁶⁷ "P&I /ECON/2220: Technical and Scientific Research in Germany after the War," 19 June 1945. RG 260, box 17/04, folder 26, NACP.

³⁶⁸ *Ibid.*

American policymakers in Washington were, throughout this period, beginning discussions of how to shape European science towards American strategic ends. As John Krige has shown, this extended well beyond Germany and into every nation where Marshall funding might reach (which is to say, most of Western Europe but not the Eastern bloc, forbidden from taking Marshall plan funds in 1947).³⁶⁹ These efforts often came through intermediaries, especially the Rockefeller Foundation, whose grants to the French Centre National de Recherche Scientifique (CNRS) were explicitly aimed at reorienting the French scientific community towards an international community, using American methods and asking scientific question in an American manner. On the whole, Krige's aim was "to emphasize that the American project to rehabilitate science in Europe was not only about providing material resources, but also about building structures and changing attitudes and values among scientists in line with democratic values"³⁷⁰ "To support science in Europe it was therefore essential to operationally distinguish between the applied research even though everyone knew that the one was inextricably interwoven with the other."³⁷¹ One of the key methods employed by the US was the funding of scientist exchange programs, sponsoring international conferences, and drawing others into an international scientific community – "enroll[ing] national scientific elites on both sides of the Atlantic in the project of postwar European reconstruction."³⁷²

This analysis all fits smoothly with the above discussion of American efforts within Germany, and the broader Krige argument is compelling. The Americans were not the only ones playing this game, however. The French and British, too, aimed to enroll scientific elites within Germany and the other Allied powers in ways that would support their own economic and scientific interests. These nations, too, sought to use science as soft power to accomplish this goal. There are certainly important differences, naturally, as when France saw itself as working from a position of weakness to counter American strength by enlisting a Western European community under its leadership. Still, while this does not exactly argue against the importance and effectiveness of American efforts at building diplomatic preeminence through scientific soft power, it highlights the ways in which this was an international trend in this period. Science had been elevated to a primary state concern by the war, and the relevance of that for international affairs was lost on no one.

III. French Efforts at Shaping Science through International Exchanges of Students

From the American and British perspectives, including much of the existing historiography, French policy in Germany was one of obstruction – vetoes for any attempts at overall policy and aggressive resistance of any centralized German institutions.³⁷³ This framing has more than a grain of truth to it, but misses much of the complexity of French thinking on the question of handling German science. They, too, were occupied with how to accommodate and harness science for the purposes of the new French Republic, and as with the United States, these debates spilled over on their governance of German science.

³⁶⁹ Krige, *American Hegemony and the Postwar Reconstruction of Science in Europe*.

³⁷⁰ *Ibid.*, 39.

³⁷¹ *Ibid.*, 10.

³⁷² *Ibid.*

³⁷³ Examples in the historiography include Cairncross; Gordon Alexander Craig and Francis L. Loewenheim, *The Diplomats, 1939-1979* (Princeton, N.J.: Princeton University Press, 1994); Hitchcock.

As in the United States, there was no single funding entity for French science prior to World War II, and little direct state support for science. Many ministries had some research mandate and their own programs, as did each of the branches of the military, but despite the centralization of authority and finances in Paris, there was little coordination or centralized oversight. The Centre national de la recherche scientifique, or CNRS, was established in 1937 to serve in exactly this role.³⁷⁴ The hope was that the CNRS could reserve an ongoing relative decline of French science measured (then and now) against Germany, the United Kingdom, and the United States. The exact periodization and extent of this decline has been the subject of some historiographical debate since the 1970s, with more recent works by such scholars as Mary Jo Nye, Terry Shinn, George Weisz, Robert Fox, and Harry Paul highlighting the strengths of French science prior to the First World War in addition to relative weaknesses.³⁷⁵ Whatever the impact of the issues at stake in these debates – for instance, the importance and effect of provincial research institutions relying principally upon industrial funding, and thus heavily emphasizing applied over 'pure' science – there seems to be general agreement that despite a renaissance in French science beginning around 1870, there was, at a minimum, a significant decline in French science during the interwar years.³⁷⁶ This was especially true after the onset of the Great Depression, when funds from industry dried up, and rather than provide additional funding, the Ministry of Finance instituted a demand that would be equally unpopular when applied post facto in the postwar years: that research institutes pay the state for the German laboratory equipment that had been distributed to them through reparations.³⁷⁷

³⁷⁴ On the history of the CNRS, see Jean-Christophe Bourquin, "Le Comité National de la Recherche Scientifique: Sociologie et Histoire (1950-1967)," *Cahiers pour l'Histoire du CNRS 1939-1989* 3, (1989); Micheline Charpentier-Morize, "La contribution des 'laboratoires propres' du CNRS à la recherche chimique en France de 1939 à 1973," *Cahiers pour l'Histoire du CNRS 1939-1989* 4, (1989); Diane Dosso, "Louis Rapkine (1904-1948) et la mobilisation scientifique de la France libre" (University of Paris, 1998); Ludmann-Obier, "La mission du CNRS en Allemagne (1945-1950)."; Pestre; Jean Francois Picard, "La longue marche vers le CNRS (1901-1945)," *Cahiers pour l'Histoire du CNRS 1939-1989* 1, (1988); Antoine Prost, "Les origines des politiques de la recherche en France (1939-1958)," *Cahiers pour l'Histoire du CNRS 1939-1989* 1, (1988); Doris T. Zallen, "The Rockefeller Foundation and French Research," *Cahiers pour l'Histoire du CNRS 1939-1989* 5, (1989).

³⁷⁵ This summary draws primarily from C. R. Day, "Science, Applied Science and Higher Education in France 1870-1945, an Historiographical Survey since the 1950s," *Journal of Social History* 26, no. 2 (1992). More recent work on the development of French science and its relationship to the state includes Thibaud Boncourt, "L'internationalisation de la science politique : une comparaison franco-britannique (1945-2010)" (Université de Bordeaux, 2011); Pascal Griset and Yves Bouvier, "De l'histoire des techniques à l'histoire de l'innovation. Tendances de la recherche française en histoire contemporaine," *Histoire, économie & société* 31, no. 2 (2012); Philippe Mustar and Philippe Larédo, "Innovation and research policy in France (1980–2000) or the disappearance of the Colbertist state," *Research Policy* 31, no. 1 (2002); Dominique Pestre, "Science, Political Power and the State," in *Science in the Twentieth Century*, ed. John Krige and Dominique Pestre, (Amsterdam: Harwood Academic Publishers, 1997); Ludovic Tournès, "La fondation Rockefeller et la construction d'une politique des sciences sociales en France (1918 - 1940)," *Annales* 63, no. 6 (2008).

Beyond these, *La revue pour l'Histoire du CNRS* contains too many articles of interest since its creation in 1999 to list here.

³⁷⁶ Day: 376.

³⁷⁷ Picard: 7.

The mission of CNRS was "to induce, coordinate, and encourage pure and applied scientific research pursued by the different public agencies or private enterprises, and especially to facilitate the research and scientific work of interest to national defense and the national economy."³⁷⁸ Its bureaucratic position as a subsidiary of the Education ministry did not afford it much power to accomplish these aims, however, as many departments outside Education were reluctant to give up control of their own research units. Before any sort of meaningful compromises could be reached, Germany invaded, and the Vichy regime quickly reorganized CNRS in March 1941 in a more limited role, for example removing the section for applied sciences and establishing an independent agency to promote science in overseas colonies.

The early postwar years saw a return to bureaucratic struggles regarding the funding of French science. CNRS faced new responsibilities, including a reaffirmation of its prewar mission of coordinating all French science, and organizing French researchers in the French Zone of Occupation (FZO) to investigate German science and technology and handle scientific reparations. Meanwhile, the Ministry of Education and thus CNRS had come under the control of the communist faction of early postwar France, and its new leaders, Frederic Joliot-Curie and then Georges Teissier, aroused deep distrust in anti-communist factions inside France and abroad. Thus, in addition to diplomatic pressure from America to displace Joliot, other ministries – including the Commission for Atomic Energy (Commissariat à l'énergie atomique, CEA) and Ministry of Technology – resisted CNRS' efforts at truly integrating and coordinating French science.³⁷⁹

French scientists and policymakers were extremely sensitive about the ties between French science and international prestige. In April 1945, the director of the École supérieure des industries chimiques wrote to Joliot and Teissier in their roles as head of CNRS, responding to a request for the names of students who could serve as *stagiaires* in German laboratories, research institutes, and libraries. Such students would be very rare, he wrote, and really only very experienced scientists and engineers should be sent – only they could see through the "inevitable subterfuge and deception" of the Germans.³⁸⁰ The French should know, he continued – after all, they themselves had done the same in similar circumstances of occupation, and all was fair to preserve "le patrimoine du laboratoire, patrimoine matériel ou spirituel."³⁸¹ Better not to send anyone than to send young students, because the success of such trickery would hurt the prestige of France. The Économie Nationale, writing in 1946, similarly emphasized the vital need to regain in reality "the preeminence that we claim."³⁸²

This combined crisis of confidence and sudden authority over a section of Germany led, quite naturally, to comparative questions: What made German science more successful than French science? What could be learned? How could German science, now established as tremendously important for warfare, be controlled and prevented from contributing to resurgent

³⁷⁸ Prost.

³⁷⁹ Ibid., 3.

³⁸⁰ France 19780283 35 p190 4/19/45

³⁸¹ Loosely translated, "the heritage of the laboratory, material or spiritual."

³⁸² In French: "...nous soyons à même de prendre sur [Allemagne] la supériorité à laquelle nous prétendons." Economie Nationale, "Le Problème de la recherche technique et scientifique allemande," 10 March 1946. Archives Nationales de France, Fontainebleau (ANFF), Centre Nationale de Recherche Scientifique (CNRS) records, Record Group (RG) 19780283, carton 35.

German power? These questions were certainly not unique to France among the occupying powers, but the recent past and ongoing anxiety over the nation's role in the world gave them a particular urgency and importance.

Twin debates continued within the CNRS and other ministries, such as the Education Nationale and the Control Commission for the French Zone, about how best to reorganize French science on the one hand, and how best to reorganize German science (either to promote, control, or cripple it) on the other. At a meeting to discuss reorganizing the CNRS in the immediate aftermath of the liberation of France, the chief criticism of French science was that it was too dispersed, and that the CNRS of 1939 had inappropriately separated pure and applied science – France, they felt, no longer had enough researchers to support such divisions, whatever their desirability.³⁸³ As they began analyzing German science in early 1945 (in one of many subsequent reports on its nature, quality, strengths and weaknesses), in contrast, they felt that its key attribute was that it was centralized and efficient.³⁸⁴

CNRS was itself an attempt to centralize French science further, and Joliot, Teissier, and others discussed how that might be affected, including giving seats on the CNRS board to research labs outside of their authority and who had resisted inclusion. Even in the multiplication of bureaucratic entities this mission was prevalent, though – the mission of the Comité de coordination scientifique de la défense nationale (CCSDN), established on April 20, 1945, was not only to investigate German science and technology, but also "to coordinate scientific studies undertaken by the military departments," establishing liaisons between them and reducing redundancy.³⁸⁵

In the view of the École Nationale, as expressed in a policy document in March 1946, science policy in Germany should pursue four ends:

- 1) "To facilitate the missions of the occupation authority,
- 2) To permit the a direction of German research by an international authority, or failing that, by a French organization
- 3) To permit German researchers to survive out in the open, without any need to dissimulate,
- 4) To break the lines that exist between industry, commerce, and science in order to allow each to subsist to some degree without their combination allowing them to develop new weapons of penetration or attack against Germany's neighbors."³⁸⁶

This view was in response to a proposal by the Greater Committee for Inventions (Comité supérieure des Inventions), who had proposed a clause in an eventual peace treaty barring all research. The École Nationale, in contrast, was above all international-thinking – and that

³⁸³ "Reorganisation du Centre National de la Recherche Scientifique," 7 Sept 1944. ANFF, CNRS records, RG 19780284, carton 55.

³⁸⁴ "Organisation de la Recherche en Allemagne," 4 April 1945. ANFF, CNRS records, RG 19780283, carton 35.

³⁸⁵ "Note par le Comité de coordination scientifique de défense nationale," 9 Nov 1945. ANFF, CNRS records, RG 19780284, carton 56.

³⁸⁶ Economie Nationale, "Le Problème de la recherche technique et scientifique allemande," 10 March 1946. ANFF, CNRS records, RG 19780283, carton 35.

'international' future for France was very much as part of a unified Western European (as opposed to just Western) science. It recommended instead pushing for exchange of inventions and innovations through a professional, international organization; or failing that, a French one; or failing that, a "Franco-Belgian-Dutch-Luxumbourgean" one.³⁸⁷

The difference between theory and practice were clear in this planning. "From the point of view of security," a report on "the organization of scientific and technical research in Germany" argued, "it seems necessary to forbid or minimize scientific and technical research in Germany." "On the other hand, for those interested in the French economy, it would be preferable to maintain German research at an elevated level for the profit of France."³⁸⁸ Chapter 1 discusses how this line of thinking led the French to pursue a policy of technical exploitation in place, but it also was relevant to broader science control policies. The French economy was felt to be too feeble to maintain scientific research on the same level as the Americans – and thus the only path was to keep the Americans sharing their knowledge on the world market. This made supporting research in Germany indispensable, both to entice the Americans, and as part of a strategy of developing a close economic and scientific-technical collaboration with the United Kingdom (this, despite noting that they were all too aware that the UK seemed to be aiming for a political-economical fusion with the United States).³⁸⁹ A compromise between economic interest (pursued through science) and security, they felt, was both desirable and inevitable.

To this end, "The Allies, and notably France, will have the right to introduce technicians of their choice in centers of German research, and impose exchanges of German students; they can thereby form in Germany French technical groups and thereby render truly effective control, and profit French institutions with the experience of German personnel."³⁹⁰ Chapter 1 discusses in detail the French 'stagiaires' plan to insert French students into German research institutes to serve as intelligence agents and to acquire the knowledge and know-how of German scientists. Because of its relevance here, however, some repetition and expansion is necessary. Essentially, the CNRS, in combination with military and intelligence agencies, planned in 1946 to insert trainees ('stagiaires') into German laboratories, arguing that "The problem of limiting research is, above all, a problem of control of training and control of what is studied."³⁹¹ Though ultimately these students were deemed poor intelligence agents, they represent long-term thinking in which the impossibility of retaining control of Germany on the decades-scale underlay planning.

The French were not the only ones thinking along these lines, however. The American planners in the OMGUS Economic sub-division similarly framed the problem as one of the practicalities of long-term surveillance:

Year after year will go by without anything subversive in the scientific field being detected. Interest is bound to slack and it will be exceedingly difficult to maintain the necessary high standard of scientific control officers required.

³⁸⁷ Ibid.

³⁸⁸ "Note sur l'organisation de la recherche scientifique et technique en Allemagne," undated. ANFF, CNRS records, RG 19780283, carton 35.

³⁸⁹ Ibid.

³⁹⁰ Ibid.

³⁹¹ Ibid.

The only solution to this seems to be to grant research fellowships in German Universities to suitably selected candidates on the understanding that they would be also observers for the Controlling Powers.³⁹²

The supposed forces in Germany already long-term planning for the next war would not likely proceed for a decade, the author argues, and this is just the time when American and British control in Germany "should be strengthened and refreshed."

Contrary to the French reputation for vetoing all centralized German institutions, the CNRS actually sought a centralized research board for Germany, funded by special taxes and proceeds from patents.³⁹³ This organization, it was felt, could then be intermittently and eternally inspected by inter-allied teams. Further, this research would allow connections from German researchers to those in France and allied nations. This was far from a universal opinion within France. Education Nationale pushed the opposite view in June 1946: "it is important above all else to avoid the centralization of German research; any general liaison between different research establishments is forbidden as dangerous, even if the work done by the establishment in question appears to present no military interest."³⁹⁴ Still, the CNRS felt that such an organization would allow efficient research that could be applied in case of war, and if nothing else, would create a hierarchy among German *savants* and technicians who could constitute a powerful means of scientific mobilization at a moment's notice. This applied particularly to the Kaiser Wilhelm Institutes. Later in the year, when asked whether CNRS was in favor of creating a society to promote German science analogous to the CNRS itself, it expressed harsh disapproval, insisting that the policy to follow was "une politique de dispersion."³⁹⁵

Historians of diplomacy have often remarked on French obstruction to all forms of inter-allied organization or centralization within Germany, whether of a postal system or an integrated currency. Certainly this created serious diplomatic frustration between France and its Western allies through the establishment of a formal West Germany in 1949. In the case of German science, however, it might well have been more than simply a wish to suppress a resurgence of German power per se. Science policy in the French Zone of Occupation was an opportunity to project French beliefs about what made science effective and to manipulate these conceptions into tools to benefit France.

For all three of the Western Allied powers, the management and exploitation of science in Germany was an extension of domestic debates and anxieties about the role of science in government. In the French case, the broader context was one in which policymakers and scientists perceived themselves as falling further behind first Germany, then Britain, then the

³⁹² "PI/ECON/2037: Technical and Scientific Research in Germany after the War," undated 1945. RG 260, box 17/03, folder 16, NACP.

³⁹³ "Note sur l'organisation de la recherche scientifique et technique en Allemagne," undated. ANFF, CNRS records, RG 19780283, carton 35.

³⁹⁴ "Directives Generales pour l'organisation et le contrôle de la recherche allemande," 1 June 1946. ANFF, CNRS records, RG 19780283, carton 35.

³⁹⁵ J. Peres, "NOTE pour le Colonel CAGNIARD," undated. ANFF, CNRS records, RG 19780283, carton 35.

United States in international science, one aspect of a general anxiety about the loss of French influence and prestige on the world stage.³⁹⁶ The terms of the debate about French science centered on the extent to which French science should be centralized or distributed, hierarchical or independent, integrated with industry throughout or split into 'pure' and 'applied' structures – and these debates, in turn, became entangled with a political divide within postwar France between communist and socialists (who came to control the Ministry of Education) and those suspicious of – or outright hostile to – these communists.

For CNRS officials, one imperative seemed to apply to both French and German science: that international connections must be reforged, immediately and extensively. Though no connections were to be allowed between German institutes, one of the chief duties CNRS set for itself was to pair every German research institute with a French lab.³⁹⁷ Further, as of July 1945, CNRS favored "a modest and reasonable reconnection of German scientific relations with the rest of the world," leading to policies including sending copies of the *Bulletin Analytique* (a bibliographic and abstracting service) to universities including Freiburg, Tübingen, Mayence, Innsbruck, and Vienna; and engaging fully in the coordinated effort with the US and UK to publish "FIAT Reviews" of German wartime science to be published abroad. Inside Austria, CNRS felt, German scientists had "too much neglected communication with allied *savants*," and a primary goal was to connect Austrian and French scientists.³⁹⁸ This is particularly striking considering its contrast to the systematic exclusion of German scientists from the international scientific community following the First World War. International organizations expelled Germans during the war and disallowed entry afterwards. Journal delivery had been cut off in both directions during the war, and as historian Michael Gordin has illustrated, contributions to English-language journals sky-rocketed at the direct expense of the traditionally influential, German journals, marking a tectonic shift in the international orientation of science.³⁹⁹

At home, French policymakers began looking around by March 1946 for partners, including both the *stagiaires* plan for placing French trainees throughout German scientific establishments and industrial research institutes, and thoughts of a Franco-British scientific alliance.⁴⁰⁰ This became active policy in 1947 with negotiations for summer scientific student exchange programs with the Vacation Work Committee of at Imperial College, London, then the establishment of an Advisory Council for Science Policy to coordinate exchange.⁴⁰¹ Attempts to coordinate with the Swiss were more difficult because they had no centralized analogue to

³⁹⁶ Régis Boulat, "Jean Fourastié, la productivité et la modernisation de la France" ([s.n.], 2006); Chevassus-au-Louis; Dosso; Eck; Hecht; Hitchcock; Michael Kelly, *The cultural and intellectual rebuilding of France after the Second World War* (New York :: Palgrave Macmillan, 2004).

³⁹⁷ Centre National de la Recherche Scientifique, "Compte Rendu sur la mission du C.N.R.S. en Allemagne," 25 Nov 1946. ANFF, CNRS records, RG 19780284, carton 115.

³⁹⁸ Le Sous-Lieutenant Riviere, "Note sur la mission scientifique – C.N.R.S. Vienne," 22 July 1946. ANFF, CNRS records, RG 19780283, carton 35.

³⁹⁹ Gordin.

⁴⁰⁰ "Note sur l'organisation de la recherche scientifique et technique en Allemagne," 10 March 1946. ANFF, CNRS records, RG 19780283, carton 35.

⁴⁰¹ Le Conseiller Culturel à Monsieur le Directeur de l'Enseignement Technique, 11 Jan 1947. ANFF, CNRS records, RG 19780283, carton 24; Comité Supérieur des Etudes Techniques de Chimie en Allemagne, "Procès verbal de la réunion tenue le 17 Octobre 1947, et laboratoire central des services chimiques de l'état," 17 Oct 1947. ANFF, CNRS records, RG 19780283, carton 36.

CNRS, while negotiations with the Federation of American Scientists created opportunities for exchanges with the US.⁴⁰² A Bureau Scientifique de New York was established in late 1947, sponsored by the CNRS (though lightly, based on frequently complaints about insufficient funds).

All of this collaboration created its own anxieties in a nation aiming to create a new identity as a distinct, modern scientific nation in its own right, however. A member of the Advisory Council for Science Policy worried that exchanges with the Federation of American Scientists might be "intended to carry off Europe's scientists."⁴⁰³ When planning which students to send abroad, members of the CNRS' Comité de relations étrangères worried about sending too young and impressionable students, as "French identity is at stake."⁴⁰⁴ Prestige was also on the line – the CRE worried that if foreign visitors were treated more poorly than French researchers abroad, all of France would lose face.⁴⁰⁵

There were many contradictions, then, in French policy towards Germany. This was true in science no less than in any other field. Even those who disagreed about active policy seemed to see France's future as one built to a significant degree on science. Science would (if handled properly) grant prestige; it would knit together nations to counterbalance those with larger economies; it might even draw the British away from their wartime ties to America. To the extent that a unified 'French' policy towards science can be described, it was that expressed in a CNRS document around the end of 1945: the problem of creating serious limits on science is, above all, a problem of the control of the recruitment and training of young scientists.⁴⁰⁶

IV. British Leadership through Goodwill among Scientists

For the Science & Technology Research Board of the UK's Control Commission for Germany, as much as any other power, the scientific threat from Germany was something to consider in terms of decades and generations rather than months and years. From their perspective, however, this threat was more of a politically useful specter than a pressing reality, and this lack of fear of German science created opportunities for promoting British goals.⁴⁰⁷ It

⁴⁰² Comité Supérieur des Etudes Techniques de Chimie en Allemagne, "Procès-verbal de la reunion tenue le 17 Octobre 1947, et laboratoire central des services chimiques de l'état," 17 Oct 1947. ANFF, CNRS records, RG 19780283, carton 36.

⁴⁰³ "Commission des relations avec l'étranger, procès-verbal de la reunion du samedi 29 novembre 1947 a 9 h. 30 au C.N.R.S.," 29 Nov 1947. ANFF, CNRS records, RG 19780283, carton 24.

⁴⁰⁴ "Procès-verbal de la réunion de la sous-Commission des Relations avec l'Étranger," 14 Dec 1946. ANFF, CNRS records, RG 19780283, carton 24.

⁴⁰⁵ "Commission des relations avec l'étranger, procès-verbal de la reunion du samedi 29 novembre 1947 a 9 h. 30 au C.N.R.S.," 29 Nov 1947. ANFF, CNRS records, RG 19780283, carton 24.

⁴⁰⁶ CNRS, "Note sure le contrôle de la recherche allemande," undated. ANFF, CNRS records, RG 19780283, carton 35.

⁴⁰⁷ On British occupation policy more generally, see Balabkins; Cairncross; Cassidy, "Controlling German science. I: US and allied forces in Germany, 1945-1947."; Cassidy, "Controlling German science, II: Bizonal occupation and the struggle over West German science policy, 1946-1949."; Anne Deighton, *The Impossible Peace: Britain, the Division of Germany and the Origins of the Cold War* (Oxford: Oxford University Press, 1990); Dockrill; Edgerton, "Science and the nation: towards new histories of twentieth-Century Britain."; Edgerton, *Warfare State: Britain, 1920-1970*; Robert M.

had become apparent to them since at least 1946 "that the potential threat to peace from failure to control fundamental or reasonably small scale applied research is a slender one... The things of which we are afraid are; atomic energy, bacteriological warfare, guided missiles, chemical warfare, and the at-present unknown scientific advance which is going to produce the war winning weapon of the next war."⁴⁰⁸ The first four items would require substantial engineering and industry, which would be simple to detect; the last was the most important threat, but also one that, by definition, they would and could not see coming. Apparently taking the lesson from the war's scientific weapons that military applications of pure science were fundamentally unpredictable from a planning or policy standpoint, this conception of the relationship between science and technology freed the Science & Technology Board's planners of need for the long-term control of the type envisaged by its American and French counterparts.

This might have been at least partially a reflection of the staffing of the S&T Board – which had real influence on occupation policy – by scientific personnel who were jealous of retaining the autonomy and esteem of science. The fundamental law limiting German Research, Law 25, was "largely designed to combat a danger which does not exist," but the records it created about the organization of German research, and what other powers were investigating, "gives us records of real use... for defence intelligence purposes."⁴⁰⁹ This utility for Law 25, in turn, made it all the more important (in their own eyes) that the Science & Technology Board retain authority for enforcing the law - "otherwise it might be regarded as a function of the Intelligence organisation. That would not be desirable, because Intelligence organisations are not in general staffed by men of a type who are able to maintain good relations with high-grade German scientists...[and] we regard the maintenance of such relations as a cardinal point of our policy."⁴¹⁰

One clear example of the British occupying authorities actively pursuing the goodwill of German scientists was the reformation of the Kaiser Wilhelm Society (KWS) as the Max Planck Gesellschaft (MPG) in 1946.⁴¹¹ The Kaiser Wilhelm Society for the Advance of Science had been a scientific research institute founded in 1911, composed of a number of facilities focusing

Hathaway, *Great Britain and the United States: Special Relations since World War II* (London: Twayne Publishers, 1990); Hopkins; Johnson; Julian Lewis, *Changing direction: British military planning for post-war strategic defence* (Frank Cass, 2003).

⁴⁰⁸ Control Commission for Germany (British Element), Scientific and Technical Research Board, "Report of Research Branch and our future policy covering control and encouragement of German Science," 18 June 1948. TNA: PRO BT 211/30.

⁴⁰⁹ Ibid.

⁴¹⁰ Ibid.

⁴¹¹ On the refounding of the Max Planck Gesellschaft, see Carson, *Heisenberg in the Atomic Age: Science and the Public Sphere*; John L. Heilbron, *The Dilemmas of an Upright Man: Max Planck As Spokesman for German Science* (Berkeley, CA: University of California Press, 1986); Macrakis; Carola Sachse, "'Whitewash Culture': How the Kaiser Wilhelm / Max Planck Society Dealt with the Nazi Past," in *The Kaiser Wilhelm Society Under National Socialism*, ed. Carola Sachse, Mark Walker, and Susanne Heim, (Cambridge: Cambridge University Press, 2009); Rudolf Vierhaus and Berhard Vom Brocke, eds., *Forschung im Spannungsfeld von Politik und Gesellschaft - Geschichte und Struktur der Kaiser-Wilhelm-/Max-Planck-Gesellschaft* (Stuttgart: Deutsche Verlagsanstalt, 1990); Berhard vom Brocke and Hubert Laitko, eds., *Die Kaiser-Wilhelm-/Max-Planck-Gesellschaft und ihre Institute: Das Harnack-Prinzip* (Berlin: de Gruyter, 1996).

on specific sub-fields of natural sciences. During the Third Reich, the KWS had avoided destruction or nationalization through complex politics of acquiescence, but had also largely retained its autonomy and never been particularly active in war-related research.⁴¹² Still, in the denazification fervor of the early occupation, this was enough to cause the Americans to label the Society as a tool of fascism and call for its dissolution, an argument that found sympathetic ears in France. The Soviet Union saw value in a centralized German research institute, but preferred the German Academy of Sciences as a tool for molding the "German bourgeois intelligentsia" into good socialists.⁴¹³

The British resisted these efforts, though initially unsuccessfully - the inter-allied ACC passed a law dissolving the Kaiser Wilhelm Society on July 11, 1946, on justifications that it had performed war work and represented a kind of 'research trust'.⁴¹⁴ The now-former KWS still had support from prominent German scientists, however, including recently-elected society president Otto Hahn. Their lobbying pushed the head of the research branch of the British occupation authority, Col. Bertie Blount, to continue working towards a reconstitution of the society. Blount received what proved to be worthwhile counsel from Sir Henry Dale, a scientist with many political connections, that much of the Allied objection centered on the name 'Kaiser Wilhelm' and an obvious continuity from the Nazi era, rather than to the concept of a private research organization.⁴¹⁵ The society was refounded as the Max Planck Gesellschaft (MPG) in the British zone on September 11, 1946.

From this position, the MPG was able to expand into the other Western occupation zones, though not without some resistance. As discussions commenced about how to integrate the MPG into a unified 'bizonia' of the British and American zones, the Americans – by 1947 far more flexible than initially in regards to rebuilding German science – sought to export their own model of effective science, attaching former KWS labs to universities in the style of the Princeton Center for Advanced Study or the Stanford Research Institute. The French Minister of National Education approved a similar plan in June 1946.⁴¹⁶ The Science and Technology Board of the British Control Commission thought little of this plan, however, which they "would deplore as much as we should handing them over to industry."⁴¹⁷ This was because under such a plan, the Kaiser Wilhelm institutes "would...be dependent upon the Education Controllers in the various Laender, whereas it was generally agreed that from the scientific point of view it would be better

⁴¹² Macrakis.

⁴¹³ Ibid., 190. On denazification in science, see Ash; Johannes Baehr, Paul Erker, and Geoffrey Giles, "The Politics of Ambiguity: Reparations, Business Relations, Denazification and the Allied Transfer of Technology," in *Technology Transfer out of Germany after 1945*, ed. Matthias Judt and Burghard Ciesla, (Amsterdam: Harwood Academic Publishers, 1998); Cassidy, "Controlling German science. I: US and allied forces in Germany, 1945-1947."; A. Lacroix-Riz, "La dénazification économique de la zone d'occupation américaine : la perception française du phénomène," *Revue Historique* 283, no. 2 (1990); Walker, "The Nazification and Denazification of Physics."

⁴¹⁴ Macrakis, 191.

⁴¹⁵ Ibid., 193.

⁴¹⁶ Ministère de l'éducation nationale, "Directives Générales pour l'organisation et le contrôle de la recherche allemande," 1 June 1946. ANFF, CNRS records, RG 19780283, carton 35.

⁴¹⁷ Scientific & Technical Research Board, "Review of Scientific & Technical Research in Germany since May, 1945," 15 Jan 1947. TNA: PRO BT 211/30.

for them to be completely independent."⁴¹⁸ Science – and the goodwill of the scientists, who wished to retain autonomy – was to be the British policy. It was not without some active effort and cost, then – by German scientists foremost, but backed by the British occupation authorities – that the Max Planck Gesellschaft was refounded in the American and French Zones on February 26, 1948.

This maintenance of good relations with German scientists was a primary motivator in British science control policy, aimed at benefiting British science by making international connections under British leadership. "It is general experience," one British occupation authority policy document from June 1948 reports, "that, of all the different communities within the nations, it is the scientists who tend to be most international in outlook and most able to cooperate closely with one another." If they could ensure the goodwill of these "high-grade German scientists...(provided they do not belong to a politically highly undesirable type)," then for example, "we should further establish friendly relations with the French Control Commission."⁴¹⁹ There seemed to be quite a few of these German scientists, as well, representing a great potential resource of scientific manpower. Enrollment in the Technische Hochschulen had risen from 5,695 in 1934-35 to 6,383 in 1946-47; overall science and technology students had increased from 15,860 to 29,400 in the same period, almost a 90% increase.

In the context of a British zone still partially subject to the international debate over Germany's economic future, this created "a matter of serious consideration" about whether all of these students could be absorbed into the German economy – if not, they might be a source of scientific manpower open to international bidding.⁴²⁰ Their value was such, however, that this was less a worry than an opportunity. Planning turned to how to pursue most effectively "the desirability, which has been growing in importance, of ensuring that as many high-grade scientists as possible should come to the western zones, particularly the British Zone, and remain there."⁴²¹ The answer were ones that would have been familiar to the American planners within and advising the Rockefeller Foundation to pursue American aims: providing facilities, copies of journals and other publications, travel funds for scientific exchanges and visits, the reestablishment of scientific organizations, and aid finding "proper" employment, either within Germany or abroad (within the Western countries, naturally).⁴²²

In addition to these parallels to American uses of science as soft power, the British had a more old-fashioned empire to consider, and planning for dealing with German science took into account how best it could be used to benefit this empire.⁴²³ The British Control Commission was

⁴¹⁸ Scientific & Technical Research Board, "Minutes of 11th Meeting," 13 Jan 1947. TNA: PRO BT 211/30.

⁴¹⁹ Ibid.

⁴²⁰ Scientific & Technical Research Board, "Review of Scientific & Technical Research in Germany since May, 1945," 15 Jan 1947. TNA: PRO BT 211/30.

⁴²¹ Control Commission for Germany (British Element), Scientific and Technical Research Board, "Review of Research Branch and our future policy covering control and encouragement of German Science," 18 June 1948. TNA: PRO BT 211/30.

⁴²² Ibid.

⁴²³ The relationship between science and empire is a long and important one in British science. See Gabrielle Hecht, ed. *Entangled Geographies: Empire and Technopolitics in the Global Cold War* (Cambridge, Mass.: MIT Press, 2011); Joseph Morgan Hodge and Brett Bennett, eds., *Science and*

proud of its accomplishments in rebuilding German science, most notably through the formation of the Max Planck Gesellschaft, but worried about who would benefit in the end from these efforts in the event of a Soviet invasion of the West. The ambition, naturally, was that the scientists of Britain would benefit from the "close association" forged with German scientific elites, but the Science & Technology Board worried that if the Russians overran West Germany too quickly, the Soviets would be the main beneficiaries. In response, the Board suggested that over the next three to ten years, the British government create throughout the British Empire "a shadow organization of research institutes which could, if the situation deteriorates, be rapidly expanded at the expense of science in Germany." The extent to which this was put into effect is unclear, but the ambition was clear of benefitting colonial science as well as industry through exploiting and supporting German science.

V. Conclusions

Scientists pursuing an international community of science in which information and personnel could flow relatively freely long predated the Second World War, but the war gave states a reason to pursue this goal for their own ends. Being a benefactor of international science had legitimate value in terms of economic value – or so went the justification that saw technology as a direct offshoot of science – but being *seen* as a benefactor of science was more advantageous still.

One aspect of this was the new importance of "scientific manpower" as a zero-sum national security resource, akin to uranium deposits or air bases, meant that tapping into foreign pools of scientific personnel was increasingly urgent. America would pursue dramatic increases in the amount of scientifically trained citizens in the Cold War, especially as a reaction to Sputnik in the late 1950s, but this was less of a vital need in the early postwar period. In France and the United Kingdom, on the other hand, the war had left a serious need for scientific personnel with German know-how, yet the direct importation of German scientists – even if they were willing to come, and this was uncertain – was politically sensitive. In both cases, then, the efforts to establish exchange programs between German and domestic universities and research institutes served a national security role as well, creating home-grown scientists with experience in Germany.

There were important diplomatic benefits on a more abstract level still, however. Providing funding for exchanges, organizing international scientific conferences, sponsoring research, and building networks of benevolent scientific elites allowed some measure of leadership (and thus control) over the world of international science. The United States had the most resources available for this form of soft power diplomacy, with its powerful economy and scientific infrastructure advanced by the war, and through official governmental policy and back-door liaison with independent groups like the Rockefeller Foundation, it used these tactics to knit together a Western scientific world oriented towards America.⁴²⁴

Empire: Knowledge and Networks of Science in the British Empire 1800-1970 (New York: Palgrave Macmillan, 2011); Jasanoff, "Biotechnology and Empire: The Global Power of Seeds and Science."; Christopher Simpson, *Universities and Empire: Money and Politics in the Social Sciences during the Cold War* (New York: New Press, 1998).

⁴²⁴ Krige, *American Hegemony and the Postwar Reconstruction of Science in Europe*.

It was not alone in doing so, however. For the British and French, too, the control of science – at home and abroad – was fundamentally about the formation of the next generation of scientists. This applied to French thinking on how to keep German scientists from helping resuscitate a feared Teutonic military aggression, but it also applied at home, where the re-established CNRS fought bureaucratic battles with those who resisted centralized coordination of the nation's scientific future under the control of communists. The lack of resources during rebuilding was a serious concern, and French policymakers worried that an inability to fully reciprocate in international exchanges with full hospitality would hurt one of the primary goals of this science diplomacy: prestige and appearance of leadership. It was still deemed worth pursuing, however, and even worth pushing Germany to reconnect to this community (whether internationally, bi-laterally, or as part of a Western European community to balance against the Anglo-American and Soviet poles).

The United Kingdom unquestionably oriented itself more towards America in a number of ways during the war and early postwar years, but this was not an absolute doctrine. As discussed in Chapter 2, there were real debates, rather than an assumption, about whether or not to work with the Americans on exploitation of German industrial science and technology. As the economic benefits of the resultant compromise policies seemed to be serving only diplomatic – and not as fully, economic – goals, British exploitation efforts shifted towards policies favoring individual British firms at the expense of Anglo-American unity. In the realm of academic, 'pure' science, there was a similar tension regarding the exact extent to which the Anglo-American 'Special Relationship' should dominate British policy, as opposed to going their own way with some coordination with the Americans. Again, there was substantial cooperation between American and British occupation authorities on practical matters, but major differences in their understanding of the threats and possibilities of science led to stark contrasts in the treatment of German science. Free of the anxieties that seemed to plague the American occupiers, British authorities pursued inter-allied control of science only as far as it was useful diplomatically, while focusing primarily on creating goodwill from German scientists and lines between the research institutes in the UK and the zone.

Chapter 6: The Curious Life of Know-How - A Business and Legal History

Abstract: The Second World War marked a dramatic rise in the importance of "'know-how' agreements" in business and law, especially in the context of technology transfer. This was an international phenomenon that seems to have accelerated throughout the Cold War, though the legal protections for know-how varied significantly over time and across borders. This chapter examines the causes for this rise, including the attention drawn to know-how in the postwar efforts to exploit German science and technology, and traces the legal history of know-how in the American context.

I. Introduction

"Although know-how has an economic importance at least as significant as that of patents, it has remained to this date a poor relative of the latter, in terms of the attention paid to it by the law, in statutes, judicial decisions and scholarly works."⁴²⁵ This statement, written in the 1980s at the start of a technical examination of European know-how licensing, could apply equally to historical writing on intellectual property and in legal and business history. May and Sell's otherwise excellent synthetic history *Intellectual Property Rights: A Critical History* (2006) does not list know-how in its index, and the word rarely occurs in Biagioli et al's *Making and Unmaking Intellectual Property*.⁴²⁶ Three of the eight essays in *Quest for Economic Empire: European Strategies of German Big Business in the Twentieth Century* edited by Volker Berghahn use the term, only one more than once.⁴²⁷ Wyatt Wells' *Antitrust and the Formation of the Postwar World* reveals the importance of the term to actors at the time through its appearance in contemporary quotations, but mentions the term only twice outside of these quotes.⁴²⁸ Mira Wilkins' excellent *The Maturing of Multinational Enterprise: American Business Abroad from 1914 to 1970* brings up know-how in relation to chemical cartels, but the work's scope seems to

⁴²⁵ Guillermo Cabanellas and Jose Massaguer, *Know-How Agreements and EEC Competition Law* (New York: VCH Publishers Inc., 1991), v.

⁴²⁶ Biagioli, Jaszi, and Woodmansee, eds., *Making and Unmaking Intellectual Property: Creative Production in Legal and Cultural Perspective*; May and Sell, *Intellectual Property Rights: A Critical History*.

⁴²⁷ Berghahn, ed. *Quest for Economic Empire: European Strategies of German Big Business in the Twentieth Century*. Harm Schroeter uses the term once in "Europe in the Strategies of Germany's Electrical Engineering and Chemical Trusts, 1919-1939" on page 39 ("The Germans were able to preserve their lead as regards know-how in organic chemistry..."). Margit Koeppen uses it once ("In the long-term, global industry leaders seldom rely on partners when it comes to protecting facilities and know-how essential for gaining an edge...", quoting M. Porter, fn. 14) in "Strategies of Big Business in their International Setting During the 1980s." Peter Hayes addresses the issue the most in "The European Strategies of IG Farben, 1925-45," which perhaps makes sense given Hayes' scholarly expertise concerning IG Farben's operations and the particular importance of know-how in transferring chemical technologies.

⁴²⁸ Wells. The quotes are both from 1944 – see pp.10 and 99. The other uses are pp. 23, 44.

prevent it from discussing the topic in any more depth.⁴²⁹ Yet know-how has been, through the second half of the twentieth century, one of the most important and valuable intangible assets in international business; has played a key role in development theory and thus relations between first-world and third-world economies; and was the topic of serious debate in the legal scholarly community after its emergence in the wake of the Second World War.

The term 'know-how' has appeared frequently in this dissertation, popping up in Parliamentary discussions of the 'take' from BIOS, in American FIAT planning documents, in industrial leaders' letters bemoaning exploitation tactics that failed to take into account the most important factor in acquiring technology. This is a reflection of a central concern that seemed to be spreading internationally right around this period, with historical actors at the time still struggling to understand, clarify, and apply the concept (Chapter 2 discusses some of the ways that definitions varied between the UK and US in BIOS/FIAT planning), but increasingly using this term 'know-how' to capture it. Though not using the specific term, the French FIAT planners expressed a similar sentiment in their belief that scientific and technical knowledge had fundamental elements to it that were embedded in people, institutions, and the society around them, and hence transferring a scientist or even a lab would almost destroy their value for at least decades.

This chapter takes a wider lens than those preceding it in order to trace the emergence of know-how as a business asset and international legal conundrum from around the Second World War through about the end of the Cold War. In the same sense that we can retrospectively find 'scientists' and 'science' in history prior to the popular use of those terms (when those at the time would more likely be referring to 'natural philosophers' and 'philosophy'), we can find concepts in law and business prior to the second half of the twentieth century that very closely approximate current meanings of technical 'know-how.' What terms people use matters, however. 'Know-how' becoming a clear(er) concept – though always still vague and amorphous enough term to create legal difficulties – allowed legal scholars to begin debating frameworks for protecting it; businessmen to begin writing contracts to license it and take refuge in it as patent protection waned; and antitrust-minded judges to worry about its use as a cover for cartel-building.

The concept of 'know-how' had a moment from the late 1940s to early 1960s. The American judicial system had been wrangling with the concept of protection of know-how for decades in various forms, particularly through the related but separate concept of 'trade secrets,' but the mid-1950s to 1970s saw exponential growth in law review articles, monographs, judicial interpretations, administrative declarations, and revisions of intellectual property law specifically aimed at addressing the issue of 'know-how.' The US was not alone in doing so. The United Kingdom, France, and nearly every other country took notice of know-how and began adapting legal traditions to deal with it more explicitly. Patents, trade-marks, and trade secrets all had established legal protections and case histories, but know-how – though closely related to each of these in various ways – was something different, and something increasingly important. Business deals aimed at transferring technology frequently involved licensing or selling patents, but more and more commonly included 'know-how agreements' or 'know-how licenses.' Such licenses

⁴²⁹ Mira Wilkins, *The Maturing of Multinational Enterprise: American Business Abroad from 1914 to 1970* (Cambridge, Mass.: Harvard University Press, 1974).

frequently took the form of assurances that personnel (engineers or managers) from the licensor would be available – up to and definitely including lengthy, on-site visits to the new site – until the licensee was comfortable that they had full command of the techniques involved. More than a minor addendum, by the 1960s more than a few commenters in the legal and business communities noted that know-how agreements were the real product being exported, with patents the junior partner. In many cases, know-how licenses were sold without any reference to patents.

The definition of 'know-how' varies to some degree each time it is restated, but there is a unifying set of concepts at the core relating to the knowledge necessary to utilize a technology efficiently and economically. This knowledge usually comes from hands-on experience, from improvisation and trial-and-error, and frequently cannot be put into words. The following description from a 1960s law review article on licensing know-how is a common one:

It may consist of inventions, processes, formulas, designs, skilled manual methods, preferred sequences of industrial operations learned from practical experience, etc., whether patentable or not. It may be evidenced by blueprints, specifications, drawings, technical manuals of procedure, etc. It almost invariably involves trade secrets. It may involve accumulated technical experience and skills which can best, or perhaps only, be communicated through the medium of personal services.⁴³⁰

Another definition frequently cited in the American legal literature is the following:

Factual knowledge not capable of precise, separate description but which, when used in an accumulated form, after being acquired as a result of trial and error, gives to the one acquiring it an ability to produce something which he otherwise would not have known how to produce with the same accuracy or precision found necessary for commercial success.⁴³¹

The British legal system evolved its own definitions of know-how in the 1950s-60s. In *Stevenson Jordan Harrison v. Macdonald and Evans* (1952): "Know-How seems to me to indicate something essentially different from secret and confidential information. It indicates the way in which a skilled man does his job and is an expression of his individual skill and experience."⁴³² In *Rolls Royce v. Jeffrey; Roll Royce v. IRC* (1962), "'Know-how' is a fund of technical knowledge and experience acquired by a highly specialized production organization; although it may be, and usually is, noted down in documents, drawings, etc., it is in itself an intangible entity whose category may vary according to, and may even be determined by its use."⁴³³

⁴³⁰ Nash: 289.

⁴³¹ This definition is from *Mycalex Corp. of America v. Pemco Corp.*, 64 F. Supp. 420, 425 (D. Md. 1946), aff'd 159 F. 2d 907 (4th Cir. 1947), as cited in Edward Wolfe, "Restrictions in Know-How Agreements," *The Antitrust Bulletin* 12, (1967): 752.

⁴³² *Stevenson Jordan Harrison v. Macdonald and Evans*, 1 TLR 101 (1952). Cited from Stroud's Judicial Dictionary, 2nd Supplement (1965) in David Winter, "The Licensing of Know-How to the Soviet Union," *Journal of World Trade Law* 1, (1967): 162.

⁴³³ *Rolls Royce v. Jeffrey*, 1 WLR 425 (1962); *Rolls Royce v. IRC*, 1 WLR 425 (1962); Winter, 163.

The growth in the importance of know-how to both business and legal communities in the early postwar years is difficult to quantify, but possible to demonstrate through combinations of statistical data and qualitative evidence. As other chapters have demonstrated, know-how was a term on the tongues of businessmen in the United States and United Kingdom when dealing with investigations of German science and technology in the late 1940s and early 1950s, yet not so familiar as to have been accounted for seriously in early BIOS and FIAT planning. The concept was ready to explain problems with transferring technology, yet not so deeply ingrained as to help prevent them. By the 1960s and 1970s, meanwhile, dozens to hundreds of books and law review articles worked to clarify and argue the possible doctrines under which know-how might be protected – whether by analogy to property, patent, unfair competition, or possibly creating new kinds of statutory agreements via international agreements.

A few highly suggestive data points, if not absolutely definitive, make a strong case for this upswing in attention to know-how beginning precisely during the early postwar years and accelerating beyond. Francois Dessemontet's *The Legal Protection of Know-How in the United States of America*, published in 1976, contains an extensive bibliography of books and articles relating to this subject.⁴³⁴ For books related explicitly to legal discussions of know-how – extending across several nations and languages, from *El know-how tecnico* (1969) to *Know-how et propriété industrielle* (1971) to *Die Besteuerung des know-how* (1966) – Dessmontet finds three books published in the 1950s, seventeen in the 1960s, and nineteen just within the first half of the 1970s prior to the book's own publication.⁴³⁵ The count of law journal articles is even more compelling:

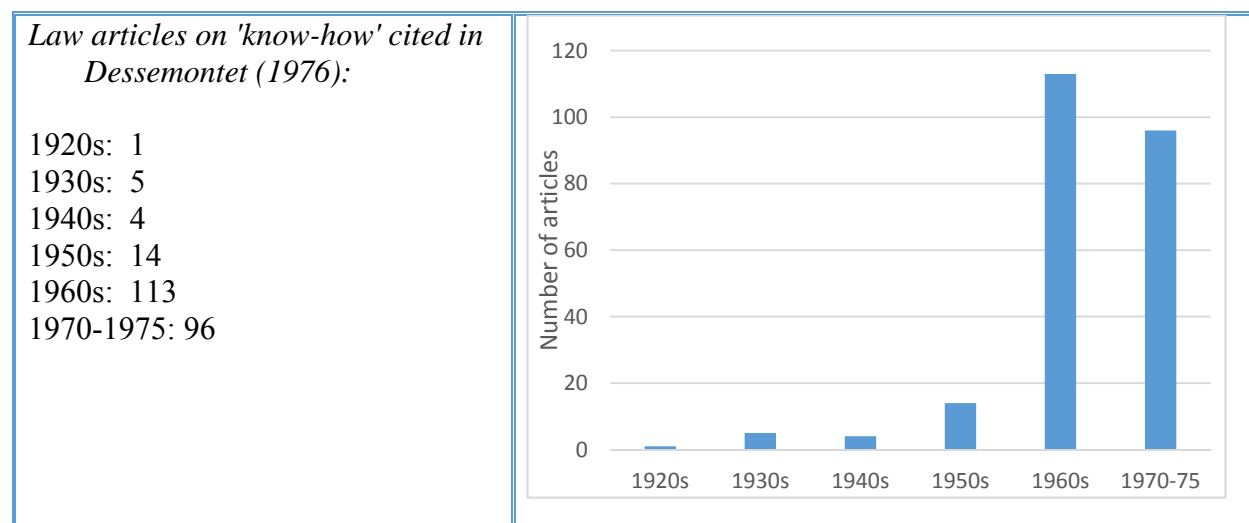
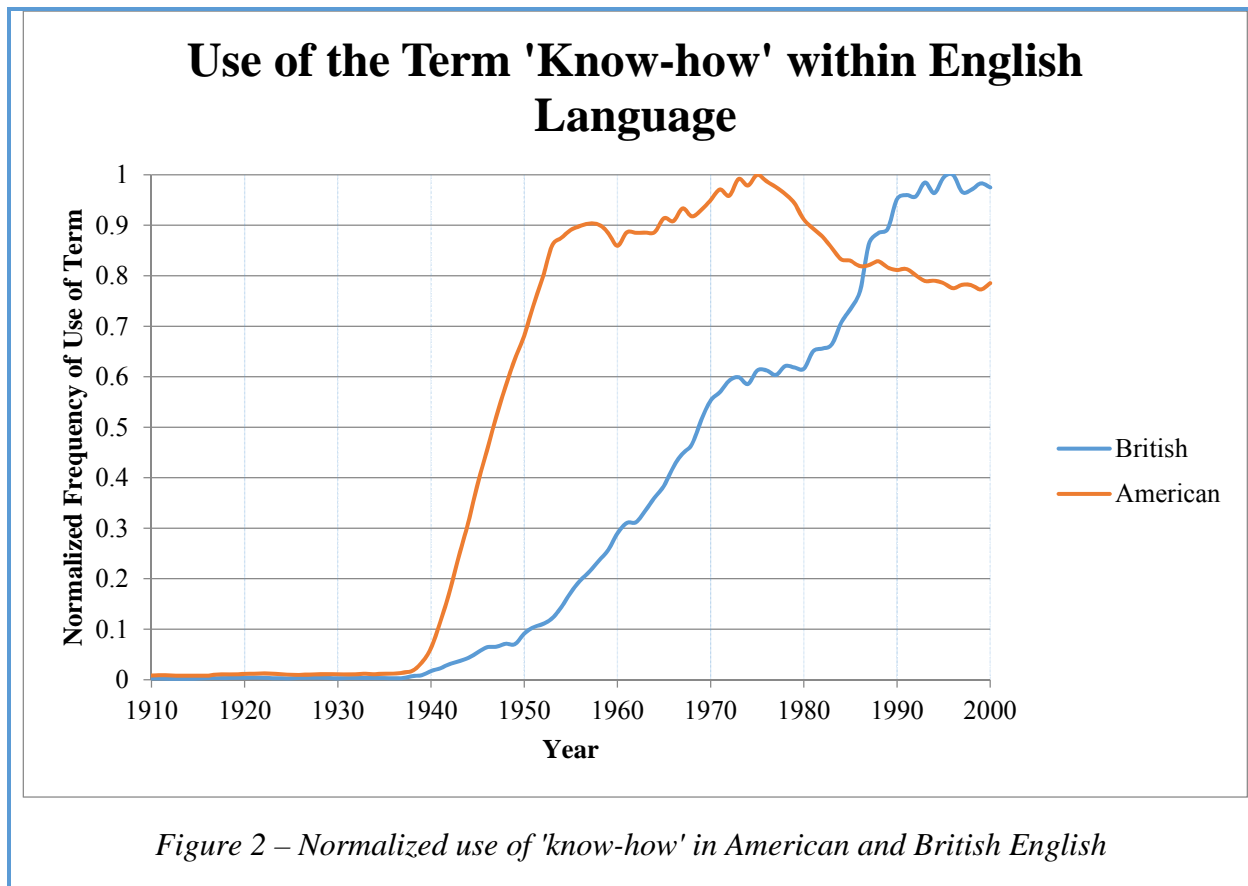


Figure 1 – Law articles cited in Dessemontet's *The Legal Protection of Know-How*

⁴³⁴ Francois Dessemontet, *The Legal Protection of Know-How in the United States of America*, trans., H.W. Clarke, 2nd ed. (South Hackensack, NJ: Fred B. Rothman & Co., 1976), 422-444.

⁴³⁵ E.D. Aracama-Zorraquin, “El know-how tecnico. Tentativa de sistematica juridica” (Thesis, 1969); Werner Boehme, *Die Besteuerung des Know-How* (Wuertzburg: C.H. Beck'sche, 1967); François Magnin, “Know-how et propriété industrielle” (Doctorate thesis, 1971).

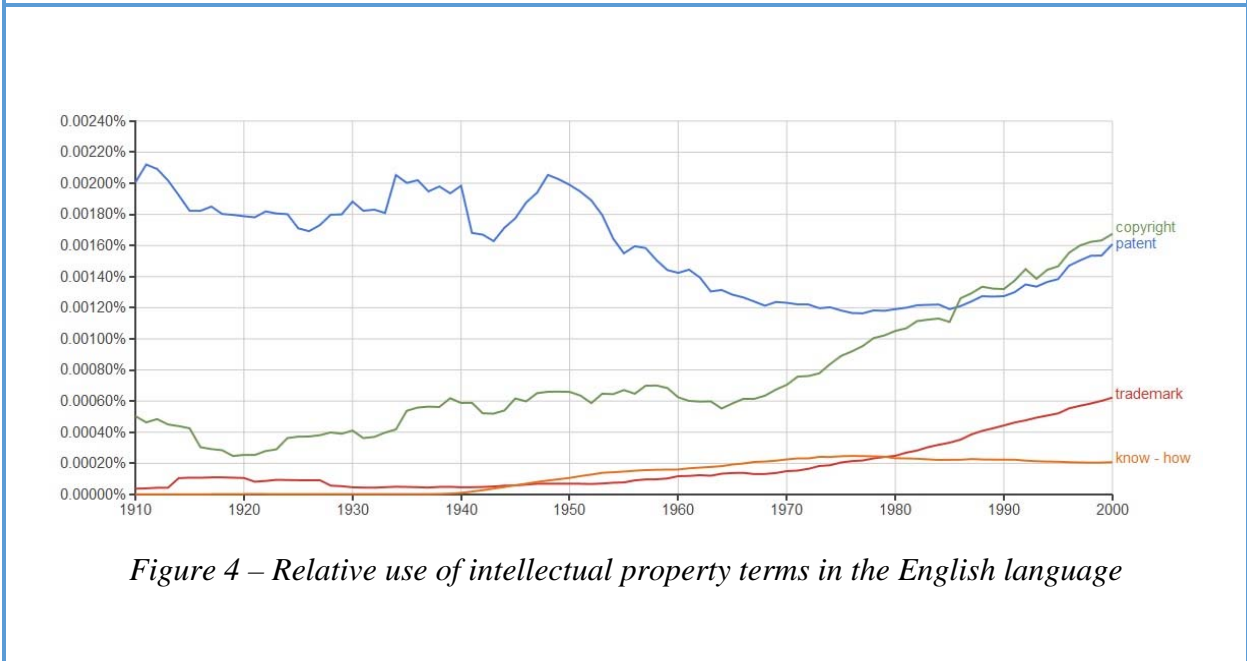
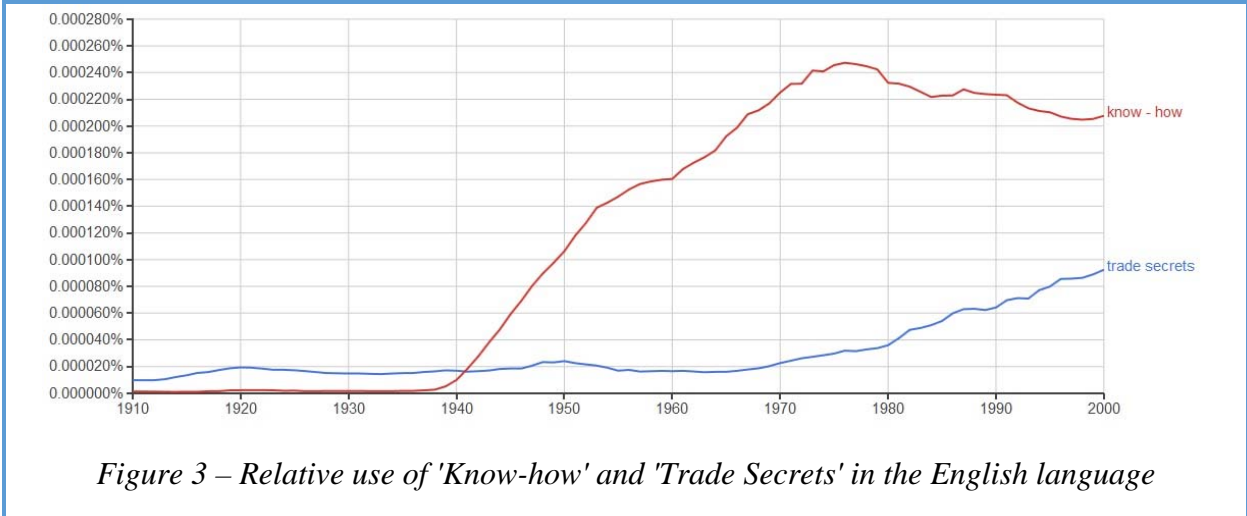
A more holistic approach would be the use of Google's N-Gram Viewer, which counts references to 'know-how' over a very large array of scanned books of all types. The following charts illustrate the rise of know-how.⁴³⁶



Note that this graph shows the normalized frequency of use (in other words, the line reaching '1' indicates the year in which the term 'know-how' was most frequently used, across all the books scanned by Google's N Gram tool, in American or British English), rather than being a direct comparison between American English and British English. The term was not necessarily used more frequently in absolute terms in British English than American English around 1985, but rather it was still increasing in how often it was being used in Britain and becoming a relatively less popular term in the US. The point to take away from the graph is that the term's usage spiked dramatically right around 1940, albeit more slowly in the British case.

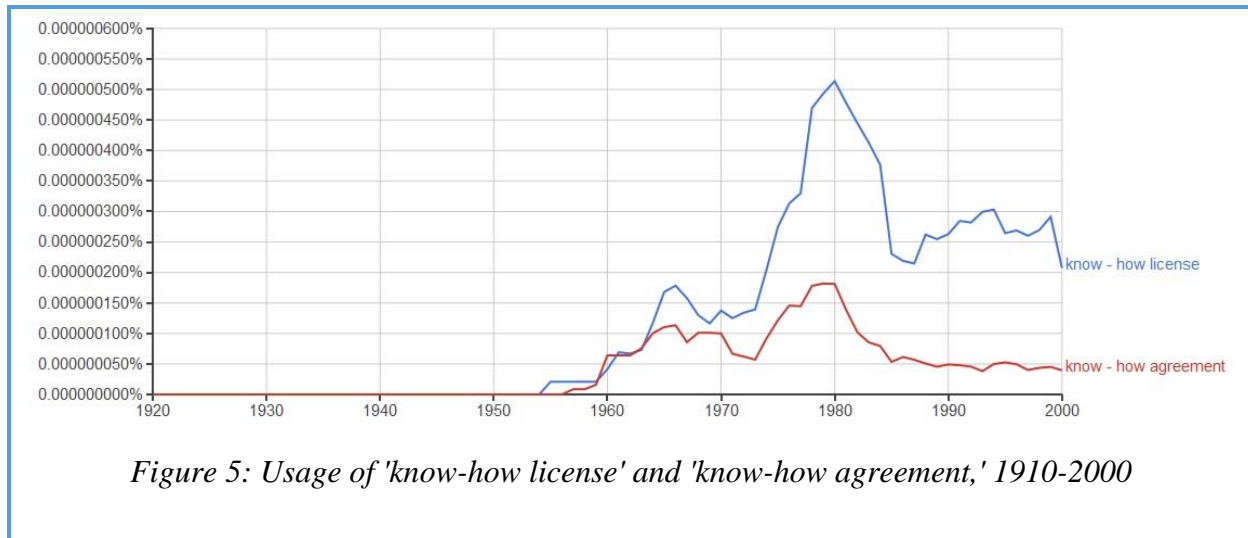
To get a better grasp of the overall importance of the term, we can compare it to other terms across the entire English language:

⁴³⁶ Accessed at http://books.google.com/ngrams/graph?content=%22know-how%22&year_start=1800&year_end=2000&corpus=18&smoothing=3 on 20 August 2013.



At least according to Figure 4, 'know-how' was never as commonly-used a term as 'patent' or 'copyright' in the English language, but it did become about as important as 'trademark' and rose right at the period when 'patent' slumped. This chapter attempts to demonstrate that this was, in fact, no coincidence.

For one final chart to limit these results to legalistic usage, we can look at the terms "know-how license" and "know-how agreement" to weed out unrelated uses such as "you need to know how to start a car."



These graphs are far from definitive on their own, as any number of factors could be at play – for example, Figure 4 suggests that 'trade secrets' might be substituting for 'know-how' from the 1970s onward, rather than the underlying issues changing – but they are compelling enough to merit additional investigation. Overall, these charts reveal a clear spike in publications addressing know-how in both the US and UK beginning in the 1940s, taking on clearer legal frameworks in the 1950s to early 1960s. As will be discussed later, the term extended well past the borders of these nations, becoming a truly international concern.

Understanding the rise and changing roles of know-how requires first stepping backwards, to the early history of trade secrecy and protection of non-patented business information before 'know-how' became a term used with any frequency. Once that has been established, I will examine the ways in which know-how became an international priority in postwar years, before returning to the limitations on protection for know-how in the American legal system. Contrast between the relatively weak legal status of know-how in the United States and the reality of expanding know-how licensing in international business will, I hope, emphasize the extent to which this was an international rather than simply American phenomenon. Future research addressing the legal situation of know-how in other nations would be valuable in judging the efficacy of American efforts to export its policies abroad in this era.⁴³⁷

⁴³⁷ On the spread of American legal systems in the postwar era, see Jacques DeIsle, "Lex Americana? United States Legal Assistance, American Legal Models, and Legal Change in the Post-Communist World and Beyond," *University of Pennsylvania Journal of International Economic Law* 20, no. 2 (1999); R. Daniel Kelemen and Eric C. Sibbit, "The Globalization of American Law," *International Organizations* 58, (2004); Anne-Marie Slaughter, "A Global Community of Courts," *Harvard International Law Journal* 44, (2003).

In intellectual property law specifically, see May and Sell, *Intellectual Property Rights: A Critical History*; Susan K. Sell, *Private Power, Public Law: The Globalization of Intellectual Property Rights* (Cambridge: Cambridge University Press, 2003); Susan K. Sell, "Intellectual Property and Public Policy in Historical Perspective: Contestation and Settlement," *Loyola of Los Angeles Law Review* 38, (2005).

II. Intellectual Property before 'Know-how' was 'Know-how'

Through the Second World War, cases in the American legal system relating to know-how were ones in which some secret or mostly-secret process or knowledge was misappropriated by a third party, then used to harm the original business. Judgments were based on English common law principles of equity rather than statutory law.⁴³⁸ Though the term 'know-how' rarely appears prior to the 1940s, similar concepts arose in the cases generally considered the backbone of common law protection of trade secrecy and against unfair competition. *Vickery v. Welch* (1837) is an important early example, in which Vickery, a chocolatier, sold exclusive use of his "art or secret manner of making chocolate, and all information pertaining to his said manner of making chocolate," to Welch. When Welch resold the information to others, Vickery sued, winning because the judge saw no public interest in disallowing exclusive sales of know-how.⁴³⁹ Similarly, in *Peabody v. Norfolk* (1868), the know-how to build machines to manufacture gunny cloth from jute butts was at stake in a case credited with "crystallizing the law of trade secrets in United States."⁴⁴⁰ The judge in this case did not find an *exclusive* right for the discoverer of "a process of manufacture, whether a proper subject for a patent or not," but did find "a property in it, which a court...will protect" against illicit use. The 1916 case of *Durand v. Brown* dealt with protection of another sort of 'know-how' – "just our knowledge of how to conduct the saw business...Simply our knowledge of the business, which of course we kept secret to ourselves...Nothing but the system was secret...The handling of the machines as well as the method of getting the work out, and somewhat the method of placing it on the market also."⁴⁴¹

The First World War did not result in an occupation of Germany, and as a result there were no investigations on the ground to examine German technology, but it did still lead to significant change in intellectual property law and practice. In particular, wartime experiences

⁴³⁸ Regarding American legal history and its relationship to British law, key works include Lauren Benton, *Law and Colonial Cultures: Legal Regimes in World History, 1400-1900* (New York: Cambridge University Press, 2001); Lawrence Friedman, *A History of American Law* (New York: Touchstone, 2005); William Novak, "The Legal Origins of the Modern American State," in *Looking Back at Law's Century*, ed. Austin Sarat, Bryant Garth, and Robert Kagan, (Ithaca, NY: Cornell University Press, 2002).

For unfair competition law's history, see JH Baker, *An Introduction to English Legal History, Fourth Edition* (Boston: Butterworths, 2002); Rogier W. de Vrey, *Towards a European Unfair Competition Law: A Clash Between Legal Families* (Leiden, The Netherlands: Koninklijke Brill NV, 2006); H Hovenkamp, *Enterprise and American Law, 1836-1937* (Cambridge, Mass.: Cambridge University Press, 1991); D Sokol and Ioannis Lianos, eds., *The Global Limits of Competition Law* (Stanford: Stanford University Press, 2012).

On the concept of trade secrets, see Doron S. Ben-Atar, *Trade Secrets: Intellectual Property and the Origins of American Industrial Power* (New Haven, CT: Yale University Press, 2004); Catherine Fisk, *Working Knowledge: Employee Innovation and the Rise of Corporate Intellectual Property, 1800-1930* (Chapel Hill: University of North Carolina Press, 2009); Michael Risch, "Why Do We Have Trade Secrets?," *Marquette Intellectual Property Law Review* 11, no. 1 (2007); Sharon K. Sandeen, "The Evolution of Trade Secret Law and Why Courts Commit Error When They Do Not Follow the Uniform Trade Secrets Act," *Hamline Law Review* 33, (2010).

⁴³⁹ *Vickery v. Welch*, 36 Mass. 523 (1 Pick. 1837).

⁴⁴⁰ *Peabody v. Norfolk*, 98 Mass. 452, 458 (Mass. 1868); quote from Robert G. Bone, "A New Look at Trade Secret Law: Doctrine in Search of Justification," *California Legal Review* 86, (1998): 252.

⁴⁴¹ *Durant v. Brown*, 236 F. 609, CCA 6th (1916). Citation from Nash: 289-290.

highlighted the insufficiency of patents for encapsulating and transferring technology. During the war, the US Office of the Alien Property Custodian seized German patents, holding them in proxy and collecting royalties on their owners' behalf. Following the war, as Kathryn Steen has examined in detail, the Custodian's office sold German chemical patents to a collective called the Chemical Foundation as a precaution against resurgent German power in the chemical industry and as a boost to domestic production, who in turn licensed the patents cheaply to American industry.⁴⁴² When sued by the German firms after the war, the Foundation successfully argued to the US Supreme Court that German patents were of little real value because they had been insufficiently detailed to allow a skilled practitioner to utilize the technology under patent, and thereby transfer the technology. Further, the Foundation argued with evidence produced by the American chemical industry, common practice in the industry included patenting many mediocre or useless procedures so that anyone looking for secrets to reverse engineer would get lost in the patent thicket and be unable to discover which patents were of real value in the first place. Given the importance of the chemical industry in national security and economic power, this was a high profile repudiation of the utility of patents for tech transfer purposes – at least without accompanying know-how, which was far more difficult to seize from a reluctant enemy.

In 1939, the American Law Institute issued volume IV of the *Restatement (First) of Torts*, a compilation of what a consortium of legal scholars, jurists, and judges decided was the core of contemporary common law. *Restatement First* set forth a standard for protection of trade secrets in cases of breach of confidence, discovery by improper means, or acquisition of a secret that the receiving party knew to be both secret and acquired illicitly. Thus, unlike with patents, trade secrecy was not a protection against another party acquiring your knowledge or know-how, but rather against them acquiring it in an improper manner.

The late eighteenth and early nineteenth centuries, then, saw the gradual accumulation of protections for manufacturing processes and trade secrets, advanced by businessmen who petitioned the courts for legal relief to problems of duplicating or transferring complex technologies. The mid-to-late 1930s, however, saw a pivot away from the protection of intellectual property within US courts, including the concepts closely linked to (and sometimes described as) know-how. This was the case both in the common law protections against unfair competition – undermined in part by the Supreme Court case *Erie Railroad Co. v. Tompkins*, as will be discussed later – and of patents.⁴⁴³ Cartels proliferated in the interwar period, and Susan Sell has argued that this cartel dominance combined with wartime anti-German sentiment to cause a "return...to the principles of weaker patent protection and free competition."⁴⁴⁴ German the US courts and Justice Department reacted with fervor, pushing principles of anti-trust. The Second World War intervened before either of these trends could advance far, leading to a suspension of most rules of peacetime business competition and intellectual property, but they foreshadowed postwar challenges.⁴⁴⁵

⁴⁴² Steen, "Patents, Patriotism, and "Skilled in the Art" USA v. the Chemical Foundation, Inc., 1923-1926."

⁴⁴³ *Erie Railroad Co. v. Tompkins*, 304 US 64 (1938).

⁴⁴⁴ Sell, "Intellectual Property and Public Policy in Historical Perspective: Contestation and Settlement," 305-6.

⁴⁴⁵ On the declining protection for patents in this period, see Drahos and Braithwaite, *Information Feudalism: Who Owns the Knowledge Economy?*, 57-58; May and Sell, *Intellectual Property Rights: A*

III. Know-How in Business and Development

The International Chamber of Commerce (ICOC), the largest business organization in the world, launched a study on the issue in 1955 explicitly demonstrating the new-found importance know-how had in international commerce – an importance that would even bleed into political questions of international development. It argued:

Technological improvements...commonly referred to as know-how, have become in recent times tremendously valuable subjects of industrial property supplementing patents and other rights, have assumed a great economic importance, and are the subject matter of an increasing number of very important agreements between business enterprises...Hardly any country so far has dealt in an adequate and comprehensive way with the protection of industrial know-how, although existing national laws on contract, breach of trust and unfair competition are sometimes applicable to the subject.⁴⁴⁶

The resolution resulting from this study, published in 1961, was part of a successful campaign by the ICOC to have the European Economic Community recognize know-how as a right equivalent to intellectual property.

Similar testimonials to the growing importance of know-how occur throughout the 1960s and 1970s. The journal of the International Trademark Association included an article in 1964 noting that "know-how is a subject of increasing importance in international agreements and international investment....it has come to be the handmaid of progress and the core of industrial competition."⁴⁴⁷ Another legal scholar in 1967 agreed: "There is a current and real interest in the licensing of know-how or technical information. The volume of such licensing is said to be increasing, particularly in dealings abroad."⁴⁴⁸

Know-how became an active focus of the newly-important field of 'development,' and as such, its importance rose with Cold War geopolitical divisions. Largely this is a reflection of the centrality of science and technology in development theory. As David Edkladh has emphasized, for policymakers in the 1950s (guided by social scientists' recommendations), "capital was not enough. The problem was most underdeveloped nations just did not have the capacity to employ the aid...Technical assistance was necessary to tutor people in modern techniques...this required 'sustained participation of private as well as public authorities.'"⁴⁴⁹ President Truman's inaugural address included a pledge to meet economic crisis around the world through scientific and technical assistance, and in 1950 the State Department created the Technical Cooperation

Critical History, 135-140; Sell, *Private Power, Public Law: The Globalization of Intellectual Property Rights*; Sell, "Intellectual Property and Public Policy in Historical Perspective: Contestation and Settlement."

⁴⁴⁶"Protection of Know-How, Executive Committee of the ICC, 21 February 1961." In International Chamber of Commerce, "Statements and Resolutions of the ICC, 1959-1961," in *XVIIIth Congress of the ICC* (Copenhagen: 1961), 98-99. For a discussion of the history and organization of the ICOC, see Dominic Kelly, "The International Chamber of Commerce," *New Political Economy* 10, no. 2 (2005).

⁴⁴⁷ Stephen P. Ladas, "Legal Protection of Know-How," *The Trademark Reporter* 54, (1964).

⁴⁴⁸ Wolfe.

⁴⁴⁹ David Ekbladh, *The Great American Mission: Modernization and the Construction of an American World Order* (Princeton, NJ: Princeton University Press, 2010), 174.

Administration to implement this goal.⁴⁵⁰ Jacob Hodge has noted similar faith in experts transferring technique and scientific knowledge in British colonial holdings in this era.⁴⁵¹

In the early 1950s, reports on technical assistance for under-developed countries began outlining the "successes there have been in the previous transfer of technical know-how among countries," which was "one of the weapons in an immense battle for freedom that is already well under way."⁴⁵² By the 1960s, one legal research commented that "Know-how has...assumed an aura of fascination in newly developing countries which see in it a mystical factor which may resolve or bridge over the difficult initial steps of technical and economic development."⁴⁵³ In developing countries, researchers in 1979 found that "approximately 90% of all licensed technology received is of the know-how variety."⁴⁵⁴ Similarly, the former Director General of the Mexican Registry of Technology Transfer estimated in 1976 that "more than 75% of technological licensing agreements do not involve patents and...fall within the category of know-how licensing contracts. Extensive research conducted at the international level demonstrates that in the future the trend will be to rely more on know-how licensing and to gradually reduce the use of patents as a main object in the contract (with exceptions in certain fields, such as pharmaceuticals)."⁴⁵⁵

Such interest was not limited to the developing world. A survey conducted in 1979 of 40 major American companies found that "frequently licensors are licensing primarily know-how."⁴⁵⁶ According to these companies' responses, 25% of all licenses for were solely know-how, and another 42% were mixed patent/know-how agreements. This fit with similar findings from a study of the British patents system, where researchers found that "many industrialists whom we consulted said quite categorically that the main purpose of licensing is to exchange

⁴⁵⁰ Michael E. Latham, *Modernization as Ideology: American Social Science and 'Nation Building' in the Kennedy Era* (Chapel Hill: University of North Carolina Press, 2000), 15.

⁴⁵¹ Joseph Morgan Hodge, *Triumph of the Expert: Agrarian Doctrines of Development and the Legacies of British Colonialism* (Athens, OH: Ohio University Press, 2007), esp. 207-277. Other key sources in the history of international development include Nick Cullather, *The Hungry World: America's Cold War Battle against Poverty in Asia* (Cambridge: Harvard University Press, 2010); Nils Gilman, *Mandarins of the Future: Modernization Theory in Cold War America* (Baltimore: The Johns Hopkins University Press, 2003); Hagood; Hodge and Bennett, eds., *Science and Empire: Knowledge and Networks of Science in the British Empire 1800-1970*; Stuart W. Leslie and Robert Kargon, "Exporting MIT: Science, Technology, and Nation-Building in India and Iran," *Osiris* 21, no. 1 (2006); Mitchell F. Rice, "Information and Communication Technologies and the Global Digital Divide: Technology Transfer, Development, and Least Developing Countries," *Comparative Technology Transfer and Society* 1, no. 1 (2003); Darlene Rivas, *Missionary Capitalist: Nelson Rockefeller in Venezuela* (Chapel Hill: University of North Carolina Press, 2001); Vernon W. Ruttan, *United States Development Assistance Policy: The Domestic Politics of Foreign Economic Aid* (Baltimore: Johns Hopkins University Press, 1996).

⁴⁵² Arnold Miles, "The Transfer of Technical Know-How," *Public Administration Review* 13, no. 1 (1953).

⁴⁵³ Ladas.

⁴⁵⁴ Joel A. Bleeke and James A. Rahl, "The Value of Territorial and Field-of-Use Restrictions in the International Licensing of Unpatented Know-How: An Empirical Study," *Northwest Journal of International Law & Business* 1, (1979).

⁴⁵⁵ Ibid.

⁴⁵⁶ Ibid.

know-how, etc., with patents a minor consideration added in the small print at the end of an agreement to lend an extra element of precision and security to the contract."⁴⁵⁷ According to a 1986 investigation by the West German Federal Association of Industry (*Bundesverband der deutschen Industrie*), pure know-how agreements comprised a full third of all technology agreements entered into by German firms.⁴⁵⁸

IV. Legal Framework for Know-How in Postwar America

The importance of know-how licensing in international trade led, quite naturally, to businesses and their lawyers questioning exactly how enforceable contracts for such licenses would be in American courts. Excited by the prospects, legal scholars and practicing business lawyers perceived "a discernable trend, both in the United States and abroad, to recognize a property right in know-how" in the 1950s, and know-how became a hot topic in the legal world.⁴⁵⁹ From the 1950s to late 1960s, legal scholars pored over decades of court cases, piecing together arguments for treating know-how as a property right – or if not as property, then under various other legal forms – and found precedent under which know-how could be legally "sold, licensed, assigned, taxed, transferred by mortgage, subject to levy and sale under a common law writ of execution, exchanged for stock shares in a corporation, the subject of a contract for purchase, [or] considered as good will or other asset in bankruptcy."⁴⁶⁰ Articles debated know-

⁴⁵⁷ Taylor and Silberston, 113-114.

⁴⁵⁸ Sebastiano Guttuso, "Die Rechtslage von Know-how-Verträgen nach den Wettbewerbsregeln des EWG-Vertrages," in *Die Stellung von Know-how-Verträgen im Kartellrecht : Ergebnisse einer internationalen Diskussion des FIW.*, ed. Sebastiano Guttuso, (Köln: C. Heymann, 1986), 45-50. Citati In general, US courts dramatically curtailed the power of patents to generate and perpetuate monopolies – or even significant economic advantage – from the 1940s to 1970s. During this "effective neutering of the US patent system, ... patents were frequently held to be invalid and infringers faced low penalties that usually amounted to payment of royalty, [and thus] US businesses sought other means of protection from competition, such as trade secret protection."⁴⁵⁸ This was not simply the verdict of insider intellectual property lawyers – John Green, who had led the Department of Commerce's efforts to distribute FIAT reports, complained (in his other role as head of the Inventor's Council) on *The Eleanor Roosevelt Show* in 1951 that "unfortunately our courts have had a tendency to, to disparage invention by throwing patents, which are one of the marks of invention out and indicating that they are rather unimportant."⁴⁵⁸ on from Cabanellas and Massaguer, 14.

⁴⁵⁹ Christopher G. Root, "The Validity of Transnational Technical Know-How Licensing Agreements in the United States Courts," *California Western International Law Journal* 2, (1971): 132.

⁴⁶⁰ Nash: 292. Nash includes citations to each of the cases that discuss these specific uses of know-how, spanning from 1822 (*Bryson v. Whitehead*, 1 Sim & Stu 74) to 1950 (*Lapin v. La Mour, Inc.*, 87 PQ 390, 11 FRD 339, Minn.).

how licensing,⁴⁶¹ anti-trust implications,⁴⁶² its status as 'property',⁴⁶³ and whether to treat know-how as a capital gain for taxation purposes,⁴⁶⁴ among many other topics.

These legal debates soon identified a number of central issues in establishing a framework for legal protection of know-how. One impediment was the already-clear trend in US courts away from patent protection – thus, if know-how were deemed analogous to patents (either explicitly, or through lack of precedent since know-how was something rarely discussed before, by default), it would face strict antitrust scrutiny.⁴⁶⁵ A separate issue was the extent to which know-how protection would interfere with patent law in general (e.g. discouraging patenting), thereby impacting the public interest in the maximal use of a new technology.⁴⁶⁶ Finally, patents had been used in the interwar period as a tool to limit competition not only through their actual enforceability, but simply as an excuse for contracts in which businesses divided up markets, set prices, and otherwise colluded, resulting in strict limits on what terms were legal in patent licenses. Since know-how was not equivalent to having a patent (after all, anyone could legally develop know-how on their own in theory, whereas even independently developed patented products could not be sold), these ruling might not apply in the same way, but the question was an open until precedents were set.

Trade secrets were an important component of this 1950s-60s legal discussion of know-how, but the terms were not identical. Some legal scholars argued that distinguishing between the terms "does not usually advance analysis significantly," but for those addressing issues of technology transfer via licensing agreements, there was an important distinction in know-how as "a convenient generic term...much broader than, and includ[ing], that information commonly referred to as 'trade secrets.'"⁴⁶⁷ In a know-how agreement, what might be common knowledge in the industry – whether or not 'secret' and thus protectable under unfair competition law – could be every bit as valuable as trade secrets for a company hoping to expand into a new field.

These discussions took on an increasingly grim and defensive tone as American courts through the 1960s and into the 1970s ruled consistently against both patents and the common law bases of trade secrets and unfair competition defenses against spreading know-how (such as through spying on a factory, or bribing a skilled employee to break an employment contract).

⁴⁶¹ Ladas; Hale A. Newcomer, "Legal Protection and Licensing of "Know-How" Internationally," *American Business Law Journal* 7, no. 3 (1969); Lajos Schmidt, "Licensing Know-How, Patents, and Trademarks Abroad," *University of Illinois Law Forum* 1959, (1959); John C. Stedman, "Legal Problems in the International and Domestic Licensing of Know-how," *A.B.A. Antitrust Section* 29, (1965); Wolfe.

⁴⁶² David R. Macdonald, "Know-how Licensing and the Antitrust Laws," *The Trademark Reporter* 54, (1964); Wolfe.

⁴⁶³ Robert E. Beach, "A Question of Property Rights: The Government and Industrial Know-How," *A.B.A. Journal* 41, (1955); Nash; Schmidt.

⁴⁶⁴ John F. Creed and Robert B. Bangs, ""Know-How" Licensing and Capital Gains," *Patent, Trademark, Copyright Journal of Research and Education* 4, (1960).

⁴⁶⁵ For discussions of the issue of anti-trust sentiment in the 1940s-50s and how it impacted patent policy and general IP law, see Macdonald; Stedman; Wolfe.

For discussions of anti-trust in historical work, see Harry First, "Trade Secrets and Antitrust Law," *New York University Law and Economics Working Papers* Paper 255, (2011); Wells.

⁴⁶⁶ Beach; Dessemontet; Miles; Schmidt.

⁴⁶⁷ Root: 129; Wolfe: 752-3.

The late 1970s and 1980s saw a revival of both unfair competition and general protection of intellectual property by the courts, though in somewhat new forms, such as the Uniform Trade Secrets Act promoted by lawyers and some businesses from the 1960s to its passage in the 1980s and 1990s.

The Supreme Court's decision in *Erie Railroad Co. v. Tompkins* in 1938, delivered just prior to the Second World war, threw into question the extent to which common law precedents applied in federal courts, including the common law of unfair competition on which the 1950s-60s legal scholars were basing most discussion of know-how.⁴⁶⁸ Much more of a problem for those hoping to sue for unfair were the cases of *Sears, Roebuck & Co. v. Stiffel Co.* and *Compco Corp. v. Day-Brite Lighting, Inc.* in 1964. In these cases, the Supreme Court ruled that state-level unfair competition laws, whether statutory or common law, would be stricken down if they impinged upon territory handled by federal patent principles. The broad language used in these decisions made legal spectators such as the International Trademark Association (INTA) extremely nervous, as it could be taken to mean any laws at all that regulated unpatentable knowledge were invalid. As Sharon Sandeen has pointed out, the widespread worry over how this ruling would affect lower courts was expressed in such ways as the INTA seeking out and publically applauding any subsequent decisions that might limit the effect of *Sears* and *Compco* on unfair competition law.⁴⁶⁹

This combination of cases – removal of federal-level common law precedents, while severely restricting what laws states might create on such matters – led to what Sharon Sandeen has dubbed the "Erie/Sears/Compco squeeze," and led thirty-six professional associations, including the American Patent Law Associate, United States Trademark Association, and the American Bar Association, to form a National Coordinating Committee to work on drafting a uniform trade secrets act.⁴⁷⁰ This would become the first statutory protection for trade secrets (and thus for a major aspect of know-how) in the United States, though it did not become the predominant law in US states (superseding the common law doctrines from *Restatement First*) until the late 1980s.⁴⁷¹

Three additional cases in the late 1960s to early 1970s further undermined the framework for legal protection of know-how. In *Lear, Inc. v. Adkins* (1969), the Supreme Court placed additional limits on the types of contract clauses that could be enforced in know-how licenses, such as clauses preventing the licensee from challenging the licensor's patents.⁴⁷² Worse, from the perspective of those in the burgeoning know-how licensing field, the three dissenting justices commented disparagingly on the idea "self-styled inventors" licensing their unpatented or unpatentable knowledge, arguing that it was fundamentally contrary to federal patent policy and an illegitimate restriction of trade.⁴⁷³ *Painton & Company v. Bourns, Inc.*, though a state-level rather than federal decision, went further, specifically invalidating an international know-how license because patent policy "allows compensation only for ideas which rise to the level of

⁴⁶⁸ *Erie Railroad Co. v. Tompkins*, 304 US 64 (1938).

⁴⁶⁹ Sandeen: 507-508.

⁴⁷⁰ *Ibid.*, 509.

⁴⁷¹ *Ibid.*, 538. As of 2013, the UTSA was law in 47 states, the District of Columbia, Puerto Rico, and the US Virgin Islands

⁴⁷² *Lear, Inc. v. Adkins*, 395 US 653 (1969).

⁴⁷³ *Ibid.*

invention."⁴⁷⁴ This reasoning, if taken as a general precedent, "effectively limited the period of time in which trade secret licenses could be enforced to the period ending one year after the trade secrets were first disclosed to the licensee – that is, the period of time that patent law allows for the filing of a timely patent application after the first public use or sale of an invention."⁴⁷⁵ This was seen by licensing lawyers as "a radical departure from the law applicable to know-how agreements" and generated considerable angst, as well as attempts to find work-arounds in contract law (such as clauses requiring arbitration or specifying choice of law or forum to make only foreign laws applicable to the contract's enforcement), though the overruling of *Painton* by the Second Circuit Court of Appeals in 1971 dampened their fears.⁴⁷⁶

Kewanee Oil v. Bicron Corp. (1972) was a milestone in reassuring licensors of technology and marking a turn from the accumulating limitations on know-how licensing agreements that had characterized the 1960s. In *Kewanee*, a division of Kewanee Oil was ordered to develop a process for developing synthetic crystals for detecting ionizing radiation. Over seventeen years, they did so at a cost approximated at \$1 million for research and development, and the employees signed agreements not to divulge any trade secrets learned during their work. Several employees broke off and formed their own company, within a year developing comparable crystals, and Kewanee sued. The district court granted Kewanee an injunction and damages for misappropriation of trade secrets, but the appeals court argued that Ohio's trade secrets law was itself invalid because it poached on the territory of federal patent law. The Supreme Court disagreed, as unlike with patents, trade secrets protection for know-how only prevents misappropriation of knowledge, while leaving open the possibility of others independently developing the same technology. As much know-how cannot be patented in any event, the fundamental differences between trade secret protections and patents were found to be such that the two did not conflict, and thus federal patent law did not preempt state level trade secret law.

Altogether, at least the trade secrets component of know-how received formalized (and eventually legislative) protection in American jurisprudence by the late 1970s to 1980s, but it seems to have been both most actively discussed and approaching its nadir in the courts precisely as the term rose in prominence and know-how licensing accelerated. Patents followed a similar trajectory, which is not necessarily surprising since judicial rulings on patents were frequently reused in cases related to know-how.⁴⁷⁷ Much of the reasoning behind curtailing patent protection was reused when analyzing know-how agreements, for example worry about use of know-how licenses with attached territorial divisions and price fixing to establish cartels, a practice actually employed after being imported from 1940s patent strategies.⁴⁷⁸ The fundamental differences between patents and know-how meant that while the cutting away of protection for patents made them economically less valuable, know-how could thrive even with a weaker legal protection. In a world that in no way saw a decreasing importance of technology in business, this weakening of IP law might well have driven increased reliance on alternate

⁴⁷⁴ *Painton and Co. v. Bourns, Inc.*, 309 F. Supp 271, 164 USPQ 595 (SDNY 1970).

⁴⁷⁵ *Kewanee Oil v. Bicron Corp.*, 478 F. 2d. 1074, 1086-87 (6th Cir. 1972). Sandeen: 516.

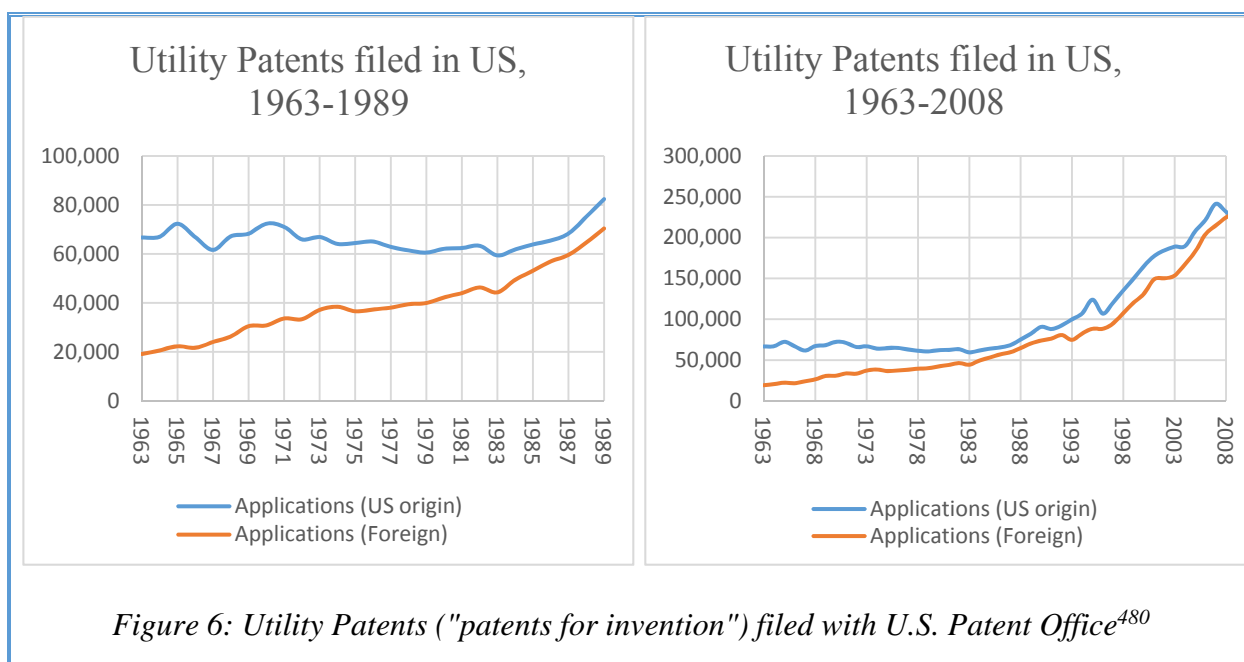
⁴⁷⁶ *Painton and Co. v. Bourns, Inc.*, 442 F. 2d. 216, 221 (2d Cir. 1971).

⁴⁷⁷ Ashish Arora, "Licensing Tacit Knowledge: Intellectual Property Rights And The Market For Know-How," *Economics of Innovation and New Technology* 4, no. 1 (1995); Macdonald; Sandeen.

⁴⁷⁸ See *Mycalex Corp. of America v. Pemco Corp.*, 64 F. Supp. 420, 425 (D. Md. 1946), aff'd 159 F. 2d 907 (4th Cir. 1947).

systems of law and practice for utilizing know-how, similar to how Sharon Sandeen has argued that weakness in patents was instrumental in provoking the lobbying efforts around trade secrets.⁴⁷⁹

To be sure, patents never went away in America, but their utilization declined during the 1960s and 1970s, with 66,715 patents filed by domestic companies in 1963 but only 66,935 in 1973 and 59,390 in 1983. During this period of absolute decline, the US economy continued to expand, so the relative decline in patent filing is steeper still. In contrast, the number of patents accelerated in the 1980s as court decisions made patent protection more enforceable and additional statutory provisions and treaties added to intellectual property protection on the international level:



V. Conclusions

Know-how was not a term coined in the mid-twentieth century (its roots in fact go back to at least the 1830s, according to the Oxford English Dictionary), nor was the general idea that workers in businesses developed skills that were economically valuable and difficult to explain or transfer. In a sense, know-how is, and has always been, at the heart of any business.⁴⁸¹ Historiographically, the relationship between technology, technique, and knowledge is at the heart of at least one strain of the history of technology, especially in regards to engineering and

⁴⁷⁹ Sandeen.

⁴⁸⁰ Data drawn from "Patent Counts by Country/State and Year, Utility Patents Report," <http://www.uspto.gov/web/offices/ac/ido/oeip/taf/reports.htm> (Accessed 7 Feb 2014).

⁴⁸¹ Credit belongs to John Brown for this framing.

engineering education – the lineage of Elting Morison through Eugene Ferguson, for example.⁴⁸² At stake here is not the ontology of know-how, but rather widespread awareness of it by business and legal professionals, and perception of it as a valuable asset in its own right that required a legal framework for its protection and efficient licensing.

This, fundamentally, is the link between this chapter and the broader dissertation – the implications of the growing *awareness* of 'know-how' as a problem in technology transfer. As other chapters have illustrated, this led to specific policy changes in British exploitation efforts, and some rethinking of intellectual property law in the 1940s, while the perceived superiority of American know-how became a point of pride for the newly (or at least more) confident business community. Widespread exposure of business representatives, politicians, and bureaucrats to the difficulty of transferring German technology likely had some impact on heightening perception of the importance of 'know-how' more broadly, but 'know-how' being the explanation expressed by investigators almost certainly emerges from a phenomenon much broader than the postwar investigation of Germany. Whatever the shaping of this perception of know-how's importance by FIAT/BIOS, this international story in the business and legal worlds merits study in its own right, and is necessary context in understanding the shifting demands that early postwar businesses were placing on the state in terms of promoting industrial growth.

Not term 'know-how' spread to languages other than English as well in the postwar years. This was an international business phenomenon, perhaps reflecting (or even partly emerging from) the expansion of multi-national corporations over the twentieth century that both produced more complex forms of industrial processes and had reason to reproduce them across international lines:⁴⁸³

⁴⁸² Eugene S. Ferguson, *Engineering and the Mind's Eye* (Cambridge, Mass.: The MIT Press, 1992); Elting E. Morison, *From Know-How to Nowhere: The Development of American Technology* (New York: Basic Books, Inc., 1975). Other key examples include John Brown, "Design Plans, Working Drawings, and National Styles of Engineering Practice in Great Britain and the United States, 1775-1945," *Technology and Culture* 41, no. 2 (2000); John Brown, Gary Lee Downey, and Mario Paula Diogo, "Engineering Education and History of Technology," *Technology and Culture* 50, no. 4 (2009); David Hounshell, *From the American System to Mass Production, 1800-1932: The Development of Manufacturing Technology in the United States* (Baltimore: Johns Hopkins University Press, 1985); David Hounshell, "Automation, transfer machinery, and mass production in the U.S. automobile industry in the post-World War II era," *Enterprise and Society* 1, no. 1 (2000); Carroll Pursell, "The Technology of Production," in *A Companion to American Technology*, ed. Carroll Pursell, (Malden, MA: Blackwell Publishing, 2005).

⁴⁸³ On the expansion of multinational business, see especially Hubert Bonin and Ferry de Goey, eds., *American Firms in Europe: Strategy, Identity, Perception and Performance: 1880-1980* (Geneva: Librairie Droz S.A., 2009); Peter J. Buckland, ed. *Business History and International Business* (New York: Routledge, 2011); Rollings; Neil Rollings, "Multinational Enterprise and Government Controls on Outward Foreign Direct Investment in the United States and the United Kingdom in the 1960s," *Enterprise and Society* 12, no. 2 (2011); Wilkins, *The Maturing of Multinational Enterprise: American Business Abroad from 1914 to 1970*; Mira Wilkins and Frank Ernest Hill, *American Business Abroad: Ford on Six Continents* (Detroit: Wayne State University Press, 1964).

On the extent to which these multinational corporations shaped the business cultures (or cultures more broadly), see especially the essays in Jonathan Zeitlin and Gary Herrigel, eds., *Americanization and its Limits* (Oxford: Oxford University Press, 2000). A more contentious work on this topic is Victoria de

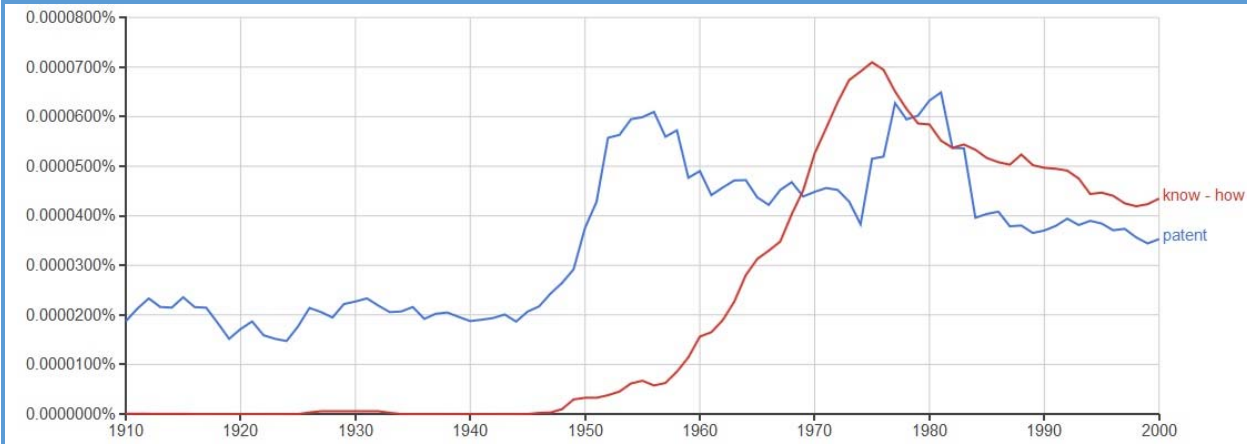


Figure 7: 'Know-how' and 'patent' in German, 1910-2000

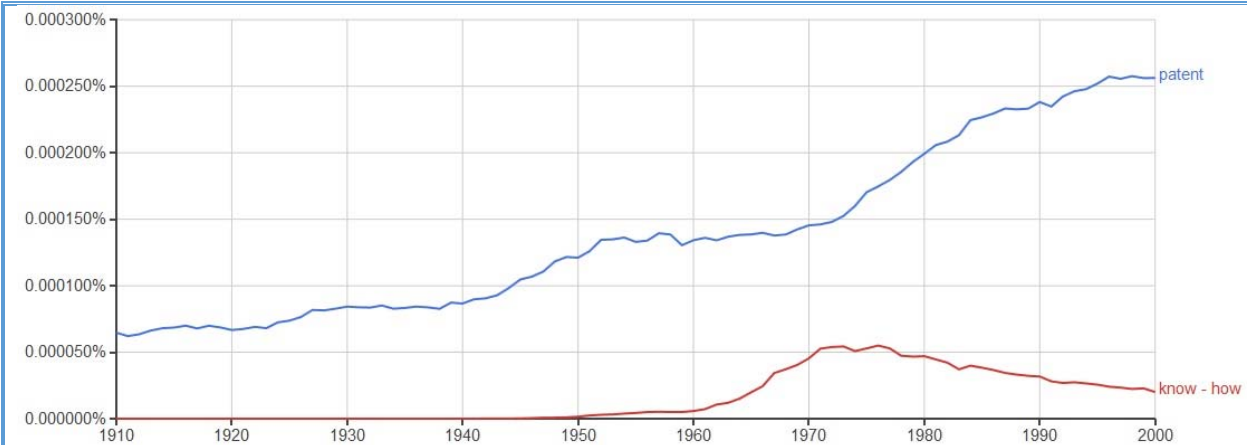
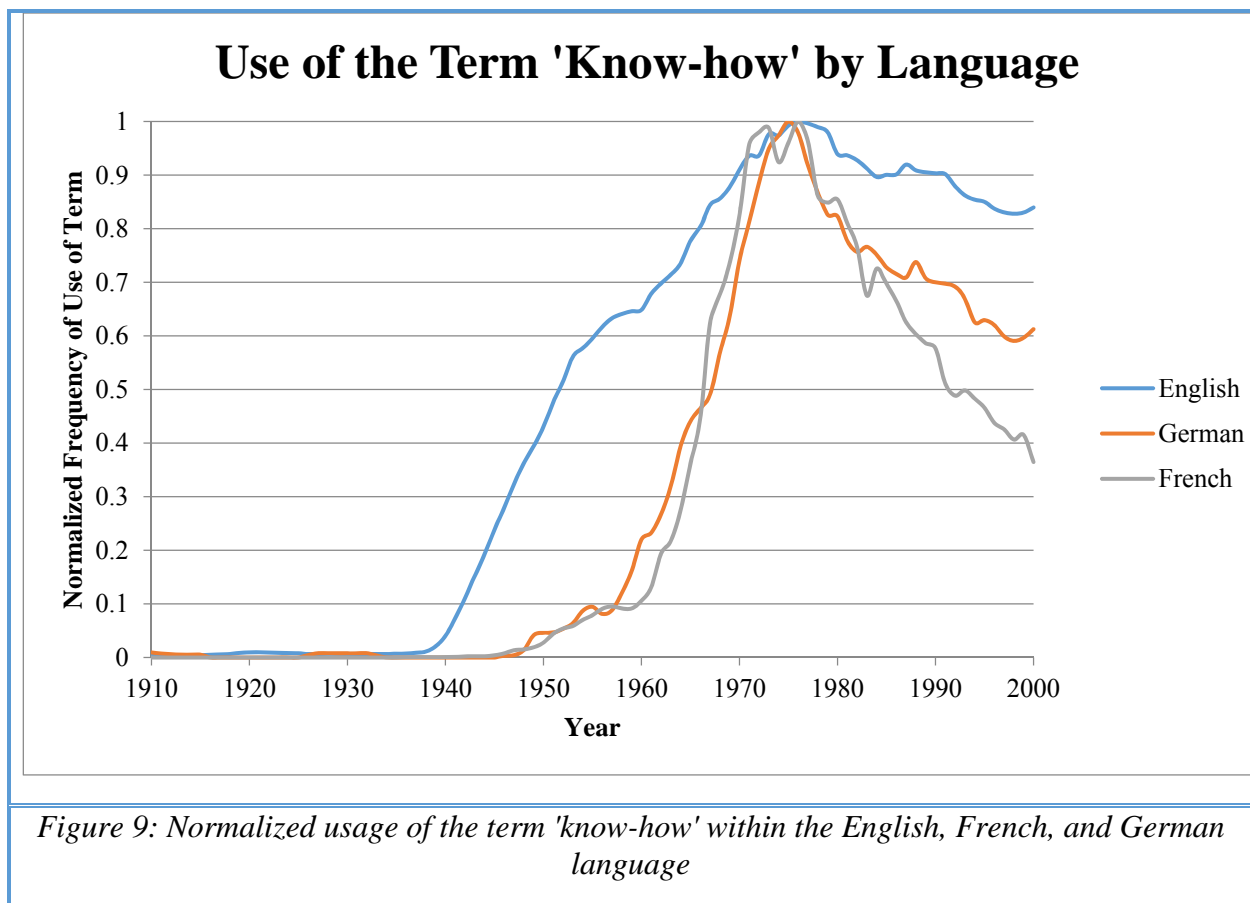


Figure 8: 'Know-how' and 'patent' in French, 1910-200

Grazia, *Irresistible Empire: America's Advance Through Twentieth-Century Europe* (Cambridge, Mass.: Harvard University Press, 2005).



Both languages see a spike in usage of the borrow-word in the second half of the century similar to that seen in American and British English, and indeed 'know-how' overtook 'patent' in German by the late 1960s. Also intriguing is that the term seems to have peaked in its usage nearly simultaneously across these languages in the mid-1970s. Perhaps further research can explore links between this trend and some of the major economic shocks of the 1970s.⁴⁸⁴

In economic terms, the consequences of the growth of attention to know-how are still less than exact, but perhaps easiest to see. This chapter has followed the winding fortunes of American legal bases for protection and licensing of know-how, but throughout these changing fortunes, know-how licensing became a significant part of American exports. The U.S. National Industrial Conference Board estimated total foreign licensing royalties at \$500 million in 1957, "of which know-how licensing undoubtedly constituted a substantial portion."⁴⁸⁵ Data from the U.S. Department of Commerce's Bureau of Economic Analysis similarly provides data on licensing fees paid to and by U.S.-based companies for 'industrial processes' from 1987-2005. Over this period, the net revenue in license fees for these industrial processes grew by 7.17%

⁴⁸⁴ Thomas Borstelmann, *The 1970s: A New Global History from Civil Rights to Economic Inequality* (Princeton, NJ: Princeton University Press, 2011); Niall Ferguson and others, eds., *The Shock of the Global: The 1970s in Perspective* (Cambridge, Mass.: Belknap Press, 2010).

⁴⁸⁵ Macdonald: 252.

annually, from \$10.2 billion in 1987 to \$64.8 billion in 2005.⁴⁸⁶ Data for 2012 – though tabulated differently enough to disallow direct comparison to the 1987-2005 numbers – shows that licensing of 'industrial processes' brought in greater revenue than 'general use computer software,' to give one indication of importance (\$42.8 billion to \$39.5 billion), and substantially more than either 'film and television tape distribution' or 'trademarks' (\$16.2 billion and \$16.8 billion, respectively).⁴⁸⁷ Exactly how much of the 'industrial processes' bring licensed were part of know-how agreements relative to other forms of licensing processes (perhaps simply though patents, with the know-how being common), is impossible to know, but it seems safe to say that know-how licensing remains an extremely important part of American exports. Licensing of manufacturing techniques and know-how certainly preceded the 1940s, as does much of the case law governing it under the rubric of unfair competition, so this growth certainly cannot be attributed solely to increased discussion using this language – but formalized legal frameworks and legal firms with experience and templates for know-how licensing seem likely to have contributed.

Such was the interest in embodied knowledge in the 1940s and 1950s in the United Kingdom that another very closely related term was first popularized: 'tacit knowledge.' Michael Polanyi, who popularized the term 'tacit knowledge' in his philosophical writings about science and technology, began his career shift from laboratory science to philosophy in the 1940s to 1950s in Great Britain.⁴⁸⁸ Beyond his ties to British science and economics, Polanyi was involved in mid-1940s debates about British intellectual property law.⁴⁸⁹ The links between Polanyi's conception and the growth of attention to know-how is just one of several research projects awaiting further historical research. Though the importance of know-how has not waned in recent decades, considerable work remains to be done in tracing its specific roles in the late- and post-Cold War world, as American intellectual property regimes became increasingly dominant. This chapter largely stops prior to the era of the Trade-Related Aspects of Intellectual Property Rights (TRIPS) agreements, but the importance of technology transfer seems unlikely to have declined. Whether know-how took new forms, declined in importance, or moved to new legal protection regimes in an era of general growth in protection for intellectual property and revitalization of patent law could have important implications for both the business and legal worlds today.

⁴⁸⁶ Using constant 2014 dollars (adjusting for inflation) for each of these numbers and adjusting by simply using the increase in the Consumer Price Index for each year, this would make approximately \$4.08 billion in 1957, \$20.6 billion in 1987, and \$76.2 billion in 2005. Other methods of adjusting for inflation will give different results, but the growth in the importance of exporting 'industrial processes' over the second half of the 20th century is clear. Data for 1987 to 2005 taken from http://www.bea.gov/international/international_services.htm

⁴⁸⁷ Data for 2013 taken from http://www.bea.gov/international/international_services.htm

⁴⁸⁸ Mary Jo Nye, *Michael Polanyi and his Generation: Origins of the Social Construction of Science* (Chicago: The University of Chicago Press, 2011).

⁴⁸⁹ Michael Polanyi, "Patent Reform," *Review of Economic Studies* XI, no. Summer (1944).

Conclusion

The complexity generated by so many organizations and individuals involved in some aspect of the scientific and technical exploitation of Germany, operating with so many different goals, motivations, and assumptions, means that pieces of evidence exist for many different overall judgments of their efficacy and importance. In particular, those who wish to emphasize the importance of these intellectual reparations through economic benefit to the exploiting countries can do so quite convincingly through gathering testimonials of enthusiastic companies, bureaucrats, and politicians involved in these efforts, helpfully preserved in the institutional archives of the investigatory agencies. The most compelling and balanced study in this line is Gimbel's foundational study of the American programs.⁴⁹⁰ An ambitious historian can supplement these testimonials with statistics tallying machinery removed from Germany under traditional reparations (or 'war booty') procedures, numbers of companies involved, and numbers of German personnel brought to other countries to add to 'scientific manpower' totals (and deny the same to the Soviets), as Carl Glatt has effectively done in his study of the British exploitation efforts.⁴⁹¹

This dissertation, by contrast, has mostly emphasized the evidence pointing the other direction, which is to say minimizing the *direct* economic value of these reparations (though I am no closer than anyone else to a specific dollar figure of any real consequences). There is plenty of evidence to find there, too. A researcher can see a great deal of cordiality, cooperation, and gratitude in the archives of FIAT, BIOS, the Comité de Coordination Scientifique (FIAT France), but there is also a great deal of frustration and disappointment. Bureaucratic duplication and infighting prevented efficient or speedy travel, study, processing and publication; many industries seemed unwilling to contribute investigators or translators, or order FIAT reports to the level the FIAT leadership had hoped; many investigators expressed disappointment that the German technology was not actually going to be particularly useful for their company or industry.

Too strong a reliance on emphasizing only the plaudits leads to historiographic framings like Steven Koerner's "Technology Transfer from Germany to Canada after 1945: A Study in Failure?," which seeks to answer "why the early hopes for Canada and the postwar reparations programme fell so short of expectations."⁴⁹² Koerner finds much the same as I argue in Chapter 3, concerning the United States – that investigators expressed great enthusiasm for German technology generally, but not much seems to have come of the investigative efforts (operated, as with other Commonwealth countries, through the auspices of BIOS). Koerner's paper is well researched, but the idea of great American and British gains leads him away from deeper questions: why did Canada expect such gains in the first place? Did policymakers have a coherent idea for how German technology would be transferred, and if so, on what did they base it? Was it an industry-driven plan, or the construction of an eager politician or bureaucrat? Was it driven by the military, with a civilian side thrown on to provide additional political support? Answers to these questions could tell us about changing state-industry(-academic?) relationships

⁴⁹⁰ Gimbel, *Science, Technology, and Reparations: Exploitation and Plunder in Postwar Germany*.

⁴⁹¹ Glatt.

⁴⁹² Koerner.

in Canada in the early postwar years, and could be usefully contrasted to attempts to build research relationships with American firms and universities.

I trust that this dissertation has not been entirely one-sided in its analysis, and I have been clear that there was substantial value found in specific industries and with specific technologies – above all, the seeds of the next generation of military technologies such as jets and submarines, under-developed in Nazi Germany but promising for the early Cold War. David Morton's study of magnetic tape recording is an excellent example from the world of civilian industry.⁴⁹³ Many companies expressed wholehearted enthusiasm for the information they gained while investigating Germany, and their claims must be taken just as seriously as the detractors. Many reports in the archives of TIIC, FIAT, BIOS, and other investigative agencies have stories of manufacturers saying that "one report alone saved him \$140,000, and Goodyear Company reported...[one report] would save them at least \$20,000 in research."⁴⁹⁴ A journalist for the *Daily Express* estimated the value for the United Kingdom at £100,000,000 as early as October 1945, though he admitted that estimations varied so wildly that he could as easily guess £1,000,000,000 without anyone able to disprove it.⁴⁹⁵ Still, in most fields investigated, it seems to be the case that the full process of technology transfer did not occur - going beyond collecting information, but also adopting, adapting, and utilizing it.⁴⁹⁶ Taking this into account makes for a very different picture of the exploitation of German science and technology.

The greater importance of these efforts was probably not the economic value accrued, but rather that the attempt was made at all; the lessons it taught those involved about technology transfer; the diplomatic consequences of pursuing these ends so aggressively; and the consequences of releasing this massive backlog of scientific and technical information for the intelligence communities and scientific communication institutions (including library networks). Thus without simply repeating the conclusions to each chapter, it is worth laying out more precisely exactly why and how the postwar investigations of German technology matter without anchoring them in a dollar figure.

One way of phrasing this importance on the national level without reducing it to money is simply asking what each country gained and lost. France, in this view, likely came out ahead.

⁴⁹³ Morton.

⁴⁹⁴ Lloyd Worden, "Memo to John Green, Report on Trip to Wright Field" 20 August 1946. General Records, Department of Commerce, Record Group 40 (RG 40), box 3, National Archives at College Park, College Park, MD (NACP).

⁴⁹⁵ Trevor Evans, "Smith and the Secrets of Schmidt," *Daily Express*, 9 Oct. 1945.

⁴⁹⁶ Examples of key historical works on technology transfer include Ken Alder, *Engineering the Revolution : Arms and Enlightenment in France, 1763-1815*, University of Chicago Press paperback ed. (Chicago: The University of Chicago Press, 2010); Eckert; Edwards; Freeze; Germuska; Glatt; Hagood; Harris; Judt and Ciesla, eds., *Technology Transfer Out of Germany After 1945*; Kristie Macrakis, *Seduced by Secrets: Inside the Stasi's Spy-Tech World* (Cambridge: Cambridge University Press, 2006); Palmer; Ramskjaer; Bruce E. Seely, "NASA and Technology Transfer in Historical Perspective," *Technology and Culture* 6, no. 1 (2008); Seely, "Historical Patterns in the Scholarship of Technology Transfer."; Bruce Edsall Seely, "World War II and Technology Transfer: A Historical Introduction," *Comparative Technology Transfer and Society* 2, no. 1 (2004); Seely, Klingner, and Klein, "'Push' and 'Pull' Factors in Technology Transfer Moving American-Style Highway Engineering to Europe, 1945–1965."; Zhang, Zhang, and Yao; Y. oko Yasuhara, "The Myth of Free Trade: The Origins of COCOM 1945-1950," (1991).

Depictions of France in other nation's archives – and thus in many histories of this period – tend to depict it as somewhere between incompetent and cleverly manipulative and underhanded in its treatment of German science, but the strategies the CNRS employed in the French Zone of Germany for controlling German science seem likely to have been quite useful long-term. As economic historian Alan Milward has argued, the postwar economic policies pursued by the French in seeking a European community "were the true determinants of a more lasting Western European settlement."⁴⁹⁷ In his study of the German chemical industry in the early postwar years, Raymond Stokes made this connection directly: "Throughout the period 1945 to 1948, German and French technical personnel played a pivotal role in Franco-German relations," and "French actions in Germany were bound up with the origins of postwar Franco-German *rapprochement*, which has been a key determinant of European political and economic development since 1945."⁴⁹⁸ To be sure, there was a diplomatic cost to not spending more fulfilling allies' requests for duplication of investigated papers and reports more quickly, and the *stagiaires* plan was a complete failure in terms of the trainees acting in their originally-planned capacity as intelligence agents in German labs. Still, the efforts to integrate Franco-German research institutes and rebuild German science, rather than attempting to coopt or destroy it permanently, worked to develop a network of scientific and industrial connections between the nations, and the reversal from postwar loathing of Germans to building a European community with France and Germany at the core happened with astounding speed.

British remembrances of the BIOS investigations are wrapped up in rhetoric of a 'missed opportunity' to prevent British 'industrial decline,' a trope David Edgerton has taxonomized and convincingly debunked in recent years, but British firms probably also gathered some real value, especially in later stages when BIOS worked to send as many investigators to Germany as possible.⁴⁹⁹ Exact figures for the number of investigators sent overseas are difficult to come by, but Gimbel cites 1,398 total American investigators through the end of May 1947, whereas Glatt lists 1,282 just for July to August 1945 with another 2,800 estimated from August 1945 through February 1946.⁵⁰⁰ Given the importance that know-how seems to have played in understanding and utilizing German developments, these investigations might not have been as helpful to small businesses (which could not usually afford to send someone to Germany, and which also might most benefit from such a trip) as the planners had hoped, but those who could afford to send investigators likely had more luck than those utilizing only reports. On the other hand, as Chapter 5 discussed, developing the goodwill of scientists and elites was a priority for the British occupation authorities, and ongoing BIOS efforts could not have been beneficial in that regard. It seems unlikely that the United Kingdom had a substantial, foreseeable 'missed opportunity' in terms of intellectual reparations, but there were costs paid for whatever knowledge was gained, not all of them financial.

⁴⁹⁷ Alan Milward, *The Reconstruction of Western Europe, 1945-1951* (London: Methuen, 1984), 167. Citation from Stokes, *Divide and prosper : the heirs of I.G. Farben under Allied authority, 1945-1951*, 86.

⁴⁹⁸ Stokes, *Divide and prosper : the heirs of I.G. Farben under Allied authority, 1945-1951*, 86-106.

⁴⁹⁹ Edgerton, *Science, technology, and the British industrial "decline", 1870-1970*; Edgerton, *Warfare State: Britain, 1920-1970*.

⁵⁰⁰ Gimbel, *Science, Technology, and Reparations: Exploitation and Plunder in Postwar Germany*, 79; Glatt, 163.

For the United States, the economic stakes were probably the lowest of anyone. Unlike the UK and France, America had not been bombed, it had lost a substantially smaller percentage of its population, in what international markets remained it faced dramatically reduced competition from European prewar trade rivals, and it had substantial financial and diplomatic capital to influence the reconstruction of the Western world. If all FIAT's hopes had been realized, perhaps it would have had a marginally larger economy still, but in any event its main problems were reconversion from war footing and integration of soldiers into the private economy rather than basic rebuilding as in France, or repaying enormous debts as in Britain.⁵⁰¹ This dissertation has argued that the United States probably did not gain a great deal economically from investigations in Germany (even in military research and development saved, it gained little in relative terms if the Soviets also were able to engineer from the German models), and this is a non-trivial expense. Still, it could afford the cost of even a generally wasteful bureaucracy to transport investigators and process files.

The greater consequences for America were in terms of lessons learned about how to communicate science and technology, which became increasingly relevant for international affairs. When America turned to rebuilding Western Europe's economies, and then to develop economies outside of Europe, technical know-how became a key tool employed. This was true in the development of the Anglo-American Council on Productivity, emerging from the suggestion of Sir Stafford Cripps (head of the Board of Trade and chief planner of much of the exploitation efforts in Germany) to send teams of British engineers and workers on extended trips to American factories.⁵⁰² It was true in the employment of on-the-ground technical experts as part of development efforts in Venezuela⁵⁰³ and elsewhere. Though US courts began the Cold War with an aggressive stance towards monopolies and therefore patents and know-how, the interest in protecting American technology was also a factor in American businesses lobbying for protection of know-how in the European Economic Community's competition laws.⁵⁰⁴

Additional Research

No topic of research is every fully exhausted, least of all one touching on so many historiographical threads, and there are many aspects of the postwar scientific intelligence efforts still awaiting study. The wartime intelligence collaboration between the United States and United Kingdom has received substantial historical attention,⁵⁰⁵ including in issues related to scientific

⁵⁰¹ On America's economic situation emerging from the war, see Michael Lind, *Land of Promise: An Economic History of the United States* (New York: Harper-Collins, 2012).

⁵⁰² Jim Tomlinson, "The Failure of the Anglo-American Council on Productivity," *Business History* 33, no. 1 (1991).

⁵⁰³ Rivas.

⁵⁰⁴ Cabanellas and Massaguer; David T. Keeling, *Intellectual Property Rights in EU Law* (Oxford: Oxford University Press, 2003); Wells.

⁵⁰⁵ Aldrich; Alan Bath, *Tracking the axis enemy : the triumph of Anglo-American naval intelligence* (Lawrence KS: University Press of Kansas, 1998); Hathaway; Jay Jakub, *Spies and saboteurs : Anglo-American collaboration and rivalry in human intelligence collection and special operations, 1940-45* (New York: St. Martin's Press, 1999); Ann Lane, *The rise and fall of the Grand Alliance, 1941-45* (New York: St. Martin's Press, 1995); MacLeod, "Secrets among Friends: The Research Information Service and the "Special Relationship" in Allied Scientific Information and Intelligence, 1916-1918."; G. Maguire, *Anglo-American policy towards the free French* (Basingstoke: MacMillan, 1995); D. Reynolds, "'A Special Relationship'?: America, Britain and the International Order since the Second

intelligence specifically,⁵⁰⁶ but the kinds of questions addressed in this dissertation could fruitfully be brought into discussions of how scientists and policymakers envisioned classified scientific information and technology transfer between these countries, and among industrialists within each country, as a prologue to the postwar efforts in Germany.

Even more valuable would be research that would allow the full inclusion of two more national perspectives: Germany and the Soviet Union. This dissertation has attempted to include both through the secondary literature that exists on each, but additional research parallel with the types of questions asked here could allow for some interesting insights into broader phenomena of diplomacy and science, intellectual property in international business, and the sources and impact of perceptions of national scientific and technological achievement.

Finally, while some excellent work has been done on classified science and scientific secrecy during the Cold War,⁵⁰⁷ additional research on the ties between scientific communication, information technology (which was also heavily influenced by data-heavy private industries like insurance providers), and intelligence communities could help clarify the ways this "iron triangle" reflected off of each other.⁵⁰⁸

World War," *International Affairs* 62, (1985); D. Stafford, "Roosevelt, Churchill and Anglo-American intelligence: The strange case of Juan March," *Intelligence and National Security* 15, no. 2 (2000); M. E. Weaver, "International Cooperation and Bureaucratic In-fighting: American and British Economic Intelligence Sharing and the Strategic Bombing of Germany, 1939–41," *Intelligence and National Security* 23, no. 2 (2008).

⁵⁰⁶ George Chalou, *Scientific and technical intelligence gathering* (New York: Garland Pub., 1989); Ronald Doel and Allan Needell, "Science, Scientists, and the CIA: Balancing international ideals, national needs, and professional opportunities," *Intelligence & National Security* 12, no. 1 (1997); Michael S. Goodman, "Jones' Paradigm : The How , Why , and Wherefore of Scientific Intelligence," *Intelligence and National Security* 24, no. 2 (2009); Jones; MacLeod, "'All for Each and Each for All': Reflections on Anglo-American and Commonwealth Scientific Cooperation, 1940-1945."; Paul Maddrell, "Western Intelligence Gathering and the Division of German Science," *Cold War International History Project Bulletin* 12, no. 13 (1997); Maddrell, "Britain's exploitation of occupied Germany for scientific and technical intelligence on the Soviet Union"; Maddrell, "British-American Scientific Intelligence Collaboration during the Occupation of Germany."; Maddrell, *Spying on science : Western intelligence in divided Germany 1945-1961*.

⁵⁰⁷ Brian Balmer, "A Secret Formula, a Rogue Patent and Public Knowledge about Nerve Gas: Secrecy as a Spatial–Epistemic Tool," *Social Studies of Science* 36, no. 5 (2006); Mario Biagioli, "From Ciphers to Confidentiality: Secrecy, Openness and Priority in Science," *The British Journal for the History of Science* 45, no. 2 (2012); Galison; Peter Galison, "Secrecy in Three Acts," *Social Research* 77, (2010); Stephen Hilgartner, "Selective Flows of Information in Technoscientific Interaction: Information Control in Genome Research," *The British Journal for the History of Science* 45, no. 2 (2012); Joseph Masco, "Lie detectors: on secrets and hypersecurity in Los Alamos," *Public Culture* 14, (2002); Seidel; Koen Vermeir, "Openness versus Secrecy? Historical and Historiographical Remarks," *The British Journal for the History of Science* 45, no. 2 (2012); Vermeir and Margoosy, "States of Secrecy: An Introduction."; Wellerstein, "Knowledge and the Bomb: Nuclear Secrecy in the United States, 1939-2008"; Westwick.

⁵⁰⁸ On the concept of the "iron triangle," meaning a combination of legislative power, bureaucracy, and interest groups, see Gordon Adams, *The Iron Triangle: The Politics of Defense Contracting* (New York: Council on Economic Priorities, 1981). In specific science-technology contexts, see especially Brian Balogh, *Chain Reaction: Expert Debate and Public Participation in American Commercial*

References

- Abelshauser, Werner. "Immaterial Reparations and the Reintegration of West Germany into the World Market." In *Technology Transfer out of Germany after 1945*, edited by Matthias Judt and Burghard Ciesla, 107-118. Amsterdam: Harwood Academic Publishers, 1996.
- Abelshauser, Werner, Wolfgang von Hippel, Jeffrey Allan Johnson, and Raymond Stokes. *Germany Industry and Global Interprise - Basf: The History of a Company*, 2004.
- Adams, Gordon. *The Iron Triangle: The Politics of Defense Contracting*. New York: Council on Economic Priorities, 1981.
- Agar, J., and B. Balmer. "British Scientists and the Cold War: The Defence Policy Research Committee and Information Networks, 1947–1963." *Historical Studies in the Physical Sciences* 28, no. 2 (1998): 209-52.
- Albrecht, Ulrich, Andreas Heinemann-Grüder, and Arend Wellmann. *Die Spezialisten : Deutsche Naturwissenschaftler Und Techniker in Der Sowjetunion Nach 1945*. Berlin: Dietz, 1992.
- Alder, Ken. *Engineering the Revolution : Arms and Enlightenment in France, 1763-1815*. University of Chicago Press paperback ed. Chicago: The University of Chicago Press, 2010.
- Aldrich, Richard J. "British Intelligence and the Anglo-American 'Special Relationship' During the Cold War." *Review of International Studies* 24, no. 3 (1998): 331-351.
- Alter, Peter. *The Reluctant Patron: Science and the State in Britain, 1850-1920*. Oxford: Oxford University Press, 1987.
- Aracama-Zorraquin, E.D. "El Know-How Technico. Tentativa De Sistemica Juridica." Thesis, 1969.
- Arora, Ashish. "Licensing Tacit Knowledge: Intellectual Property Rights and the Market for Know-How." *Economics of Innovation and New Technology* 4, no. 1 (1995): 41-60.
- Ash, Mitchell G. "Denazifying Scientists and Science." In *Technology Transfer out of Germany after 1945*, edited by Matthias Judt and Burghard Ciesla, 61-80. Amsterdam: Harwood Academic Publishers, 1996.
- Aspray, William. "Command and Control, Documentation, and Library Science: The Origins of Information Science at the University of Pittsburgh." *IEEE Annals of the History of Computing* 21, no. 4 (1999): 4-20.
-
- Nuclear Power, 1945-1975* (New York: Cambridge University Press, 1991); F. Hayden, " Policymaking Network of the Iron-Triangle Subgovernment for Licensing Hazardous Waste Facilities," *Journal of Economic Issues* 36, no. 2 (2002).

- Baader, Gerhard, Susan E. Lederer, Morris F. Low, Florian Schmaltz, and Alexander V. Schwerin. "Pathways to Human Experimentation, 1933-1945: Germany, Japan, and the United States." In *Politics and Science in Wartime*, edited by Carola Sachse and Mark Walker, 205-231. Chicago: University of Chicago Press, 2005.
- Baehr, Johannes, Paul Erker, and Geoffrey Giles. "The Politics of Ambiguity: Reparations, Business Relations, Denazification and the Allied Transfer of Technology." In *Technology Transfer out of Germany after 1945*, edited by Matthias Judt and Burghard Ciesla, 131-144. Amsterdam: Harwood Academic Publishers, 1998.
- Baker, JH. *An Introduction to English Legal History, Fourth Edition*. Boston: Butterworths, 2002.
- Balabkins, Nicholas. *Germany under Direct Controls: Economic Aspects of Industrial Disarmament, 1945-1948*. New Brunswick, N.J.: Rutgers University Press, 1964.
- Balmer, Brian. "A Secret Formula, a Rogue Patent and Public Knowledge About Nerve Gas: Secrecy as a Spatial–Epistemic Tool." *Social Studies of Science* 36, no. 5 (2006): 691-722.
- Balogh, Brian. *Chain Reaction: Expert Debate and Public Participation in American Commercial Nuclear Power, 1945-1975*. New York: Cambridge University Press, 1991.
- Bar-Zohar, Michael. *The Hunt for German Scientists*. London: Barker, 1967.
- Barnett, Correlli. *The Lost Victory: British Dreams, British Realities, 1945-1950*: Pan Books, 1996.
- _____. *The Collapse of British Power - Pride and Fall Sequence*: Pan Books, 2002.
- _____, "The Wasting of Britain's Marshall Aid", BBC
http://www.bbc.co.uk/history/british/modern/marshall_01.shtml (accessed April 7 2014).
- Bath, Alan. *Tracking the Axis Enemy : The Triumph of Anglo-American Naval Intelligence*. Lawrence KS: University Press of Kansas, 1998.
- Bauman, Zygmunt. *Modernity and the Holocaust*. Ithaca, NY: Cornell University Press, 1989.
- Beach, Robert E. "A Question of Property Rights: The Government and Industrial Know-How." *A.B.A. Journal* 41, (1955): 1024-1027.
- Bellamy, Matthew J. *Profiting the Crown: Canada's Polymer Corporation, 1942-1990*: McGill-Queen's Press - MQUP, 2005.

- Ben-Atar, Doron S. *Trade Secrets: Intellectual Property and the Origins of American Industrial Power*. New Haven, CT: Yale University Press, 2004.
- Benton, Lauren. *Law and Colonial Cultures: Legal Regimes in World History, 1400-1900*. New York: Cambridge University Press, 2001.
- Benz, Wolfgang. "Wirtschaftspolitik Zwischen Demontage Und Waehrungsreform." In *Westdeutschlands Weg Zur Bundesrepublik 1945-1949*, edited by Institut fuer Zeitgeschichte [Institute for Contemporary History], 67-89. Munich: R. Oldenbourg, 1976.
- Berghahn, Volker R. *The Americanisation of West German Industry: 1945-73*. Oxford: Berg Publishers, 1986.
- _____. "Technology, Reparations, and the Export of Industrial Culture. Problems of the German-American Relationship, 1900-1950." In *Technology Transfer out of Germany after 1945*, edited by Matthias Judt and Burghard Ciesla, 1-10. Amsterdam: Harwood Academic Publishers, 1996.
- _____. "West German Reconstruction and American Industrial Culture, 1945-1960." In *The American Impact on Postwar Germany*, edited by Reiner Pommerin, 65-81. Providence, 1997.
- _____, ed. *Quest for Economic Empire: European Strategies of German Big Business in the Twentieth Century*. Providence, RI: Berghahn Books, 1996.
- Beyerchen, A. "German Scientists and Research Institutions in Allied Occupation Policy." *History of Education Quarterly*, (1982): 289-299.
- Beyler, RH. "Hostile Environmental Intellectuals? Critiques and Counter-Critiques of Science and Technology in West Germany after 1945." *Berichte zur Wissenschaftsgeschichte* 31, no. 4 (2008): 393-406.
- Biagioli, Mario. "Science, Modernity, and the 'Final Solution'." In *Probing the Limits of Representation: Nazism and the 'Final Solution'*, edited by Saul Friedlander, 185-205. Cambridge: Harvard University Press, 1992.
- _____. "From Ciphers to Confidentiality: Secrecy, Openness and Priority in Science." *The British Journal for the History of Science* 45, no. 2 (2012): 213-233.
- Biagioli, Mario, Peter Jaszi, and Martha Woodmansee, eds. *Making and Unmaking Intellectual Property: Creative Production in Legal and Cultural Perspective*. Chicago: University of Chicago Press, 2011.
- Biddle, Wayne. *Dark Side of the Moon : Wernher Von Braun, the Third Reich, and the Space Race*. New York: W.W. Norton, 2009.

- Bleeke, Joel A., and James A. Rahl. "The Value of Territorial and Field-of-Use Restrictions in the International Licensing of Unpatented Know-How: An Empirical Study." *Northwest Journal of International Law & Business* 1, (1979): 450-491.
- Board, The British Library. *British Patents of Invention, 1617-1977: A Guide for Researchers*. London: The British Library, 1999.
- Boehm, Klaus. *The British Patent System: I. Administration*. Cambridge: Cambridge University Press, 1967.
- Boehme, Werner. *Die Besteuerung Des Know-How*. Wuertzburg: C.H. Beck'sche, 1967.
- Boncourt, Thibaud. "L'internationalisation De La Science Politique : Une Comparaison Franco-Britannique (1945-2010)." Universite de Bordeaux, 2011.
- Bone, Robert G. "A New Look at Trade Secret Law: Doctrine in Search of Justification." *California Legal Review* 86, (1998).
- Bonin, Hubert, and Ferry de Goey, eds. *American Firms in Europe: Strategy, Identity, Perception and Performance: 1880-1980*. Geneva: Librairie Droz S.A., 2009.
- Borkin, Joseph, and Charles A. Welsh. *Germany's Master Plan: The Story of Industrial Offensive*. New York: Duell, Sloan and Pearce, 1943.
- Borstelmann, Thomas. *The 1970s: A New Global History from Civil Rights to Economic Inequality* Princeton, NJ: Princeton University Press, 2011.
- Bossaut, M. Gérard. "Armaments Et Relations Franco-Allemandes (1945-1963): Coopération Et Recherche De Puissance." In *Histoire De L'armement En France De 1914 a 1962: Institutions, Industries, Innovations, Relations Internationales : Actes Du Colloque Du 19 Novembre 1993*, 147-206. Paris: ADDIM, 1993.
- Boulat, Régis. "Jean Fourastié, La Productivité Et La Modernisation De La France." [s.n.], 2006.
- Bourquin, Jean-Christophe. "Le Comité National De La Recherche Scientifique: Sociologie Et Histoire (1950-1967)." *Cahiers pour l'Histoire du CNRS 1939-1989* 3, (1989): 127-160.
- Bower, Tom. *The Paperclip Conspiracy : The Hunt for the Nazi Scientists*. Boston: Little, Brown, 1987.
- Braun, Hans-Joachim. *The German Economy in the Twentieth Century: The German Reich and the Federal Republic*: Routledge, 1990.

- Broadberry, Stephen. *Market Services and the Productivity Race 1850-2000: British Performance in International Perspective*. Cambridge: Cambridge University Press, 2006.
- Brown, John. "Design Plans, Working Drawings, and National Styles of Engineering Practice in Great Britain and the United States, 1775-1945." *Technology and Culture* 41, no. 2 (2000): 195-238.
- Brown, John, Gary Lee Downey, and Mario Paula Diogo. "Engineering Education and History of Technology." *Technology and Culture* 50, no. 4 (2009): 737-752.
- Brown, Mark B. *Science in Democracy: Expertise, Institutions, and Representation*. Cambridge, Mass.: MIT Press, 2009.
- Buckland, Michael. "Documentation, Information Science, and Library Science in the U.S.A." In *Historical Studies in Information Science*, edited by Trudi Bellardo Hahn and Michael Buckland. Medford, NJ: Information Today, Inc., 1998.
- Buckland, Michael, and Ziming Liu. "History of Information Science." In *Historical Studies in Information Science*, edited by Trudi Bellardo Hahn and Michael Buckland, 1998.
- Buckland, Peter J., ed. *Business History and International Business*. New York: Routledge, 2011.
- Bukharin, Oleg. "Us Atomic Energy Intelligence against the Soviet Target, 1945-1970." *Intelligence and National Security* 19, no. 4 (2004): 655-679.
- Bush, Vannevar. *Science, the Endless Frontier*. Washington, D.C.: Government Printing Office, 1945.
- Cabanellas, Guillermo, and Jose Massaguer. *Know-How Agreements and EEC Competition Law*. New York: VCH Publishers Inc., 1991.
- Cairncross, Alec. *The Price of War : British Policy on German Reparations, 1941-1949*. New York, NY: Blackwell, 1986.
- Carson, Cathryn. *Heisenberg in the Atomic Age: Science and the Public Sphere*. Cambridge: Cambridge University Press, 2010.
- Carson, Cathryn, and Michael Gubser. "Science Advising and Science Policy in Postwar West Germany: The Example of the Deutscher Forschungsrat." *Minerva* 40, (2002): 147-179.
- Cassidy, David. "Controlling German Science. I: Us and Allied Forces in Germany, 1945-1947." *Historical studies in the physical and biological sciences* 24, no. 2 (1994): 197-235.

- _____. "Controlling German Science, II: Bizonal Occupation and the Struggle over West German Science Policy, 1946-1949." *Historical studies in the physical and biological sciences* 26, no. 2 (1996): 197-239.
- Chalou, George. *Scientific and Technical Intelligence Gathering*. New York: Garland Pub., 1989.
- Charpentier-Morize, Micheline. "La Contribution Des 'Laboratoires Propres' Du CNRS À La Recherche Chimique En France De 1939 a 1973." *Cahiers pour l'Histoire du CNRS 1939-1989* 4, (1989).
- Chevassus-au-Louis, Nicholas. *Savants Sous L'occupation: Enquête Sur La Vie Scientifique Française Entre 1940 Et 1944*. Paris: SEUIL, 2004.
- Ciesla, Burghard. "German High Velocity Aerodynamics and Their Significance for the Us Air Force, 1945-52." In *Technology Transfer out of Germany after 1945*, edited by Matthias Judt and Burghard Ciesla, 93-106. Amsterdam: Harwood Academic Publishers, 1996.
- Coleman, Earl Maxwell. "The Mass Production of Translation - for a Limited Market." *Publishing Research Quarterly* 10, no. 4 (1995): 22-29.
- Collins, H.M. "Tacit Knowledge, Trust and the Q of Sapphire." *Social Studies of Science* 31, no. 1 (2001): 71-85.
- Commerce, International Chamber of. "Statements and Resolutions of the Icc, 1959-1961." In *XVIIIth Congress of the ICC*. Copenhagen, 1961.
- Crafts, Nicholas, and Gianni Toniolo, eds. *Economic Growth in Europe since 1945*. Cambridge: Cambridge University Press, 1996.
- Craig, Gordon Alexander, and Francis L. Loewenheim. *The Diplomats, 1939-1979*. Princeton, N.J.: Princeton University Press, 1994.
- Creed, John F., and Robert B. Bangs. ""Know-How" Licensing and Capital Gains." *Patent, Trademark, Copyright Journal of Research and Education* 4, (1960): 93-107.
- Cullather, Nick. *The Hungry World: America's Cold War Battle against Poverty in Asia*. Cambridge: Harvard University Press, 2010.
- Davis, Franklin M., Jr. "The Army's Technical Detectives." *Military Review* 28, (1948): 12-18.
- Davis, John. "Friedrich Max Müller and the Migration of German Academics to Britain in the Nineteenth Century." In *Migration and Transfer from Germany to Britain, 1660-1914*, edited by Stefan Manz, Margrit Schulte Beerbühl, John R. Davis and Walter de Gruyter. Munich: KG Saur Verlag, 2007.

- Day, C. R. "Science, Applied Science and Higher Education in France 1870-1945, an Historiographical Survey since the 1950s." *Journal of Social History* 26, no. 2 (1992): 367-384.
- De Grazia, Victoria. *How Fascism Ruled Women: Italy, 1922-1945*. Berkeley, CA: University of California Press, 1992.
- _____. *Irresistible Empire: America's Advance through Twentieth-Century Europe*. Cambridge, Mass.: Harvard University Press, 2005.
- de Vrey, Rogier W. *Towards a European Unfair Competition Law: A Clash between Legal Families*. Leiden, The Netherlands: Koninklijke Brill NV, 2006.
- Defrance, Corine. "La Mission Du CNRS En Allemagne (1945-1950)." In *La revue pour l'histoire du CNRS*, 5, 2001.
- Deighton, Anne. *The Impossible Peace: Britain, the Division of Germany and the Origins of the Cold War*. Oxford: Oxford University Press, 1990.
- DeIsle, Jacques. "Lex Americana? United States Legal Assistance, American Legal Models, and Legal Change in the Post-Communist World and Beyond." *University of Pennsylvania Journal of International Economic Law* 20, no. 2 (1999): 179-308.
- Dessemontet, Francois. *The Legal Protection of Know-How in the United States of America*. Translated by H.W. Clarke. 2nd ed. South Hackensack, NJ: Fred B. Rothman & Co., 1976.
- Dockrill, Michael. *British Defence since 1945 (Making Contemporary Britain)*: Wiley-Blackwell, 1991.
- Doel, Ronald. "Roger Adams: Linking University Science with Policy on the World Stage." In *No Boundaries: University of Illinois Vignettes*, edited by Lillian Hoddeson, 124-144: University of Illinois Press, 2004.
- Doel, Ronald, and Kristine C. Harper. "Prometheus Unleashed: Science as a Diplomatic Weapon in the Lyndon B. Johnson Administration." *Osiris* 21, no. 1 (2006): 66-85.
- Doel, Ronald, and Allan Needell. "Science, Scientists, and the CIA: Balancing International Ideals, National Needs, and Professional Opportunities." *Intelligence & National Security* 12, no. 1 (1997): 59-81.
- Dorn, W.L. "The Debate over American Occupation Policy in Germany in 1944-45." *Political Science Quarterly* 72, (1957): 482-501.
- Dosso, Diane. "Louis Rapkine (1904-1948) Et La Mobilisation Scientifique De La France Libre." University of Paris, 1998.

- Drahos, Peter, and John Braithwaite. "Intellectual Property, Corporate Strategy, Globalization: TRIPS in Context." *Wisconsin International Law Journal* 20, (2002): 451-480.
- _____. *Information Feudalism: Who Owns the Knowledge Economy?* New York: New Press, 2003.
- Eck, Jean-François. "Les Contacts Entre Groupes De L'industrie Chimique Français Et Allemands De 1945 À La Fin Des Années 1960: Entre Compétition Et Coopération." In *Réseaux Économiques Et Construction Européenne: Economic Networks and European Integration*, edited by Michel Dumoulin, 217-234. Bruxelles: P.I.E.-Peter Lang, 2004.
- Eckert, Michael. "Strategic Internationalism and the Transfer of Technical Knowledge: The United States, Germany, and Aerodynamics after World War I." *Technology and Culture* 46, no. 1 (2005): 104-131.
- Edgerton, David. *Science, Technology, and the British Industrial "Decline", 1870-1970*. Cambridge; New York, NY, USA: Cambridge University Press, 1996.
- _____. "Science and the Nation: Towards New Histories of Twentieth-Century Britain." *Historical Research* 78, no. 199 (2005): 96-112.
- _____. *Warfare State: Britain, 1920-1970*: Cambridge University Press, 2005.
- Edwards, Clive. "Technology Transfer and the British Furniture Making Industry, 1945-1955." *Comparative Technology Transfer and Society* 2, no. 1 (2004): 71-98.
- Ekbladh, David. *The Great American Mission: Modernization and the Construction of an American World Order*. Princeton, NJ: Princeton University Press, 2010.
- Epstein, Katherine. *Torpedo: Inventing the Military-Industrial Complex in the United States and Great Britain*. Cambridge, Mass.: Harvard University Press, 2014.
- Farkas-Conn, Irene. *From Documentation to Information Science: The Beginnings and Early Development of the American Documentation Institute - American Society for Information Science*. New York: Greenwood, 1990.
- Farquharson, J. "Anglo-American Policy on German Reparations from Yalta to Potsdam." *English Historical Review* 112, no. 448 (1997): 904-926.
- _____. "Governed or Exploited? The British Acquisition of German Technology, 1945-48." *Journal of Contemporary History* 32, no. 1 (1997): 23-42.
- Fayet-Scribe, Sylvie. "The Cross-Fertilization of the U.S. Public Library Model and the French Documentation Model through the French Professional Associations between World War

- I and World War II." In *Historical Studies in Information Science*, edited by Trudi Bellardo Hahn and Michael Buckland. Medford, NJ: Information Today, Inc., 1998.
- Ferguson, Eugene S. *Engineering and the Mind's Eye*. Cambridge, Mass.: The MIT Press, 1992.
- Ferguson, Niall, Charles S. Maier, Erez Manela, and Daniel J. Sargent, eds. *The Shock of the Global: The 1970s in Perspective*. Cambridge, Mass.: Belknap Press, 2010.
- First, Harry. "Trade Secrets and Antitrust Law." *New York University Law and Economics Working Papers Paper 255*, (2011).
- Fisch, Jörg. "Reparations and Intellectual Property." In *Technology Transfer out of Germany after 1945*, edited by Matthias Judt and Burghard Ciesla, 11-25. Amsterdam: Harwood Academic Publishers, 1996.
- Fisk, Catherine. *Working Knowledge: Employee Innovation and the Rise of Corporate Intellectual Property, 1800-1930*. Chapel Hill: University of North Carolina Press, 2009.
- Flachowsky, Sören. *Von Der Notgemeinschaft Zum Reichsforschungsrat: Wissenschaftspolitik Im Kontext Von Autarkie, Aufrüstung Und Krieg*. Stuttgart: Steiner, 2008.
- Foschepth, Josef, ed. *Kalter Krieg Und Deutsche Frage: Deutschland Im Widerstreit Der Mächte*. Goettingen: The German Historical Institute, London, 1985.
- Freeze, Karen Johnson. "Innovation and Technology Transfer During the Cold War: The Case of the Open-End Spinning Machine from Communist Czechoslovakia." *Technology and Culture* 48, no. 2 (2007): 249-285.
- Friedman, Lawrence. *A History of American Law*. New York: Touchstone, 2005.
- Gaddis, John. *The Long Peace : Inquiries into the History of the Cold War*. New York: Oxford University Press, 1987.
- _____. *The United States and the Origins of the Cold War : 1943-1946*. Ann Arbor Mich.: UMI Dissertation Services, 2003.
- Galison, Peter. "Removing Knowledge." *Critical Inquiry* 31, (2004): 229-43.
- _____. "Secrecy in Three Acts." *Social Research* 77, (2010): 941-974.
- Gemelli, Giuliana. "American Foundations and European Scientific Integration: Actors and Networks (1920s-1970s)." In *Réseaux Économiques Et Construction Européenne: Economic Networks and European Integration*, edited by Michel Dumoulin, 55-71. Bruxelles: P.I.E.-Peter Lang, 2004.

- Gentile, Gian Peri. "Advocacy or Assessment? The United States Strategic Bombing Survey of Germany and Japan." *Pacific Historical Review* 66, no. 1 (1997): 53-79.
- Georg, Friedrich. *'Unternehmen Patentraub' 1945 : Die Geheimgeschichte Des Groessten Technologieraubs Aller Zeiten*. Tuebingen: Grabert, 2008.
- Germuska, Pal. "Conflicts of Eastern and Western Technology Transfer Licenses, Espionage, and R&D in the Hungarian Defense Industry During the 1970s and 1980s." *Comparative Technology Transfer and Society* 7, no. 1 (2009): 43-65.
- Giffard, Hermoine. "Engines of Desperation: Jet Engines, Production and New Weapons in the Third Reich." *Journal of Contemporary History* 48, (2013): 821-44.
- Gilman, Nils. *Mandarins of the Future: Modernization Theory in Cold War America*. Baltimore: The Johns Hopkins University Press, 2003.
- Gimbel, John. *The Origins of the Marshall Plan*. Stanford: Stanford University Press, 1976.
- _____. "The American Exploitation of German Technical Know-How after World War II." *Political Science Quarterly* 105, no. 2 (1990): 295-309.
- _____. *Science, Technology, and Reparations: Exploitation and Plunder in Postwar Germany*. Stanford: Stanford University Press, 1990.
- Gispén, Kees. *Poems in Steel: National Socialism and the Politics of Inventing from Weimar to Bonn*. New York: Berghahn Books, 2002.
- Glatt, Carl. "Reparations and the Transfer of Scientific and Industrial Technology from Germany: A Case Study of the Roots of British Industrial Policy and of Aspects of British Occupation Policy in Germany between Post-World War II Reconstruction and the Korean War." European University Institute, Florence, 1994.
- Goodman, Michael S. "Jones' Paradigm : The How , Why , and Wherefore of Scientific Intelligence." *Intelligence and National Security* 24, no. 2 (2009): 236-256.
- Gordin, Michael. *Scientific Babel: The Lanugage of Science*: Profile Books, 2014.
- Goudsmit, Samuel. *Alsos*. Los Angeles CA: Tomash Publishers, 1983.
- Gowing, Margaret, and Lorna Arnold. *Independence and Deterrence: Policy Making V. 1: Britain and Atomic Energy, 1945-52 (Vol 1)*: Palgrave Macmillan, 1974.
- Griset, Pascal, and Yves Bouvier. "De L'histoire Des Techniques À L'histoire De L'innovation. Tendances De La Recherche Française En Histoire Contemporaine." *Histoire, économie & société* 31, no. 2 (2012).

- Grüttner, Michael, Rüdiger Hachtmann, Konrad H. Jaraus, Jürgen John, and Matthias Middell, eds. *Gebrochene Wissenskulturen: Universität Und Politik Im 20. Jahrhundert*. Göttingen: Vandenhoeck & Ruprecht, 2010.
- Gudmestad, Terje. "Patent Law of the United States and the United Kingdom: A Comparison." *Loyola of Los Angeles International and Comparative Law Review* 5, (1982): 173-196.
- Guttuso, Sebastiano. "Die Rechtslage Von Know-How-Verträgen Nach Den Wettbewerbsregeln Des Ewg-Vertrages." In *Die Stellung Von Know-How-Verträgen Im Kartellrecht : Ergebnisse Einer Internationalen Diskussion Des Fiw.*, edited by Sebastiano Guttuso. Köln: C. Heymann, 1986.
- Hagen, Antje. "Patents Legislation and German FDI in the British Chemical Industry before 1914." *The Business History Review* 71, no. 3 (1997): 351-380.
- Hagood, Jonathan D. "Why Does Technology Transfer Fail? Two Technology Transfer Projects from Peronist Argentina." *Comparative Technology Transfer and Society* 4, no. 1 (2006): 73-98.
- Hamblin, Jacob Darwin. "Environmentalism for the Atlantic Alliance: Nato's Experiment with the 'Challenges of Modern Society'." *Environmental History* 15, (2010): 54-75.
- Harris, J. R. *Industrial Espionage and Technology Transfer : Britain and France in the Eighteenth Century*. Aldershot, Hants, England; Brookfield, VT: Ashgate Pub., 1998.
- Hart, John D. "The Alsos Mission, 1943-1945: A Secret U.S. Scientific Intelligence Unit." *International Journal of Intelligence and Counterintelligence* 18, no. 3 (2005): 508-537.
- Hartcup, Guy. *The War of Invention: Scientific Developments, 1914-18*. London: Brassey's, 1988.
- Hathaway, Robert M. *Great Britain and the United States: Special Relations since World War II*. London: Twayne Publishers, 1990.
- Hayden, F. " Policymaking Network of the Iron-Triangle Subgovernment for Licensing Hazardous Waste Facilities." *Journal of Economic Issues* 36, no. 2 (2002): 477-484.
- Hayes, Peter. *Industry and Ideology: Ig Farben in the Nazi Era*. Cambridge: Cambridge University Press, 1987.
- Hecht, Gabrielle. *The Radiance of France: Nuclear Power and National Identity after World War II*. Cambridge, Mass.: The MIT Press, 1998.
- _____, ed. *Entangled Geographies: Empire and Technopolitics in the Global Cold War*. Cambridge, Mass.: MIT Press, 2011.

- Heilbron, John L. *The Dilemmas of an Upright Man: Max Planck as Spokesman for German Science*. Berkeley, CA: University of California Press, 1986.
- Heim, Susanne, Carola Sachse, and Mark Walker. *The Kaiser Wilhelm Society under National Socialism*. Cambridge: Cambridge University Press, 2009.
- Herrmann, Manfred. *Project Paperclip: Deutsche Wissenschaftler in Diensten Der U.S. Streitkräfte Nach 1945*. Nürnberg, 1999.
- Hershberg, James. *James B. Conant: Harvard to Hiroshima and the Making of the Nuclear Age*. New York: Knopf, 1993.
- Hewlett, Richard G., and Oscar E. Anderson. *A History of the United States Atomic Energy Commission, Vol. I: The New World, 1939-1946*. Berkeley, CA: University of California Press, 1962.
- Hilgartner, Stephen. "Selective Flows of Information in Technoscientific Interaction: Information Control in Genome Research." *The British Journal for the History of Science* 45, no. 2 (2012): 213-233.
- Hitchcock, William. *France Restored : Cold War Diplomacy and the Quest for Leadership in Europe, 1944-1954*. Chapel Hill: University of North Carolina Press, 1998.
- Hodge, Joseph Morgan. *Triumph of the Expert: Agrarian Doctrines of Development and the Legacies of British Colonialism*. Athens, OH: Ohio University Press, 2007.
- Hodge, Joseph Morgan, and Brett Bennett, eds. *Science and Empire: Knowledge and Networks of Science in the British Empire 1800-1970*. New York: Palgrave Macmillan, 2011.
- Home, R. W., and Morris F. Low. "Postwar Scientific Missions to Japan." *Isis; an international review devoted to the history of science and its cultural influences* 84, no. 3 (1993): 527-537.
- Hopkins, Michael. *Cold War Britain, 1945-1964 : New Perspectives*. New York: Palgrave Macmillan, 2003.
- Houghton, Bernard. *Out of the Dinosaurs: The Evolution of the National Lending Library for Science and Technology*. London: Clive Bingley, 1972.
- Hounshell, David. *From the American System to Mass Production, 1800-1932: The Development of Manufacturing Technology in the United States*. Baltimore: Johns Hopkins University Press, 1985.
- _____. "Automation, Transfer Machinery, and Mass Production in the U.S. Automobile Industry in the Post-World War II Era." *Enterprise and Society* 1, no. 1 (2000): 100-138.

- Hovenkamp, H. *Enterprise and American Law, 1836-1937*. Cambridge, Mass.: Cambridge University Press, 1991.
- Hunt, Linda. *Secret Agenda : The United States Government, Nazi Scientists, and Project Paperclip, 1945 to 1990*. New York: St. Martin's Press, 1991.
- Hutchinson, Col. W.S. "The Manhattan Project Declassification Program." *Bulletin of the Atomic Scientists* II, (1946).
- Jakub, Jay. *Spies and Saboteurs : Anglo-American Collaboration and Rivalry in Human Intelligence Collection and Special Operations, 1940-45*. New York: St. Martin's Press, 1999.
- Jasanoff, Sheila. *Designs on Nature: Science and Democracy in Europe and the United States*. Princeton, NJ: Princeton University Press, 2005.
- _____. "Biotechnology and Empire: The Global Power of Seeds and Science." *Osiris* 21, no. 1 (2006): 273-292.
- Jelavich, Peter. "National Socialism, Art and Power in the 1930s." *Past & Present* 164, (1999): 244-65.
- Jewett, Andrew. *Science, Democracy, and the American University: From the Civil War to the Cold War*. Cambridge: Cambridge University Press, 2012.
- Johns, Adrian. *Piracy: The Intellectual Property Wars from Gutenberg to Gates*. Chicago: University of Chicago Press, 2009.
- Johnson, Franklyn A. *Defence by Ministry: British Ministry of Defence, 1944-1974*: Holmes & Meier Publishers, 1980.
- Jones, R. V. *The Wizard War : British Scientific Intelligence, 1939-1945*. New York: Coward, McCann & Geoghegan, 1978.
- Judt, Matthias. "Exploitation by Integration? The Re-Orienting of the Two German Economies after 1945. The Impact of Scientific and Production Controls." In *Technology Transfer out of Germany after 1945*, edited by Matthias Judt and Burghard Ciesla, 27-48. Amsterdam: Harwood Academic Publishers, 1996.
- Judt, Matthias, and Burghard Ciesla, eds. *Technology Transfer out of Germany after 1945*. Amsterdam: Harwood Academic Publishers, 1996.
- Kaiser, David. "Cold War Requisitions, Scientific Manpower, and the Production of American Physicists after World War II." *Historical Studies in the Physical & Biological Sciences* 33, no. 1 (2002): 131-159.

- _____. "Nuclear Democracy: Political Engagement, Pedagogical Reform, and Particle Physics in Postwar America." *Isis* 93, (2002): 229-268.
- Karlsch, Rainer. *Faktor Öl: Die Mineralölwirtschaft in Deutschland 1859-1974*. München: CH Beck, 2003.
- Keeling, David T. *Intellectual Property Rights in Eu Law*. Oxford: Oxford University Press, 2003.
- Kelemen, R. Daniel, and Eric C. Sibbit. "The Globalization of American Law." *International Organizations* 58, (2004): 103-136.
- Kelly, Dominic. "The International Chamber of Commerce." *New Political Economy* 10, no. 2 (2005): 259-271.
- Kelly, Michael. *The Cultural and Intellectual Rebuilding of France after the Second World War*. New York :: Palgrave Macmillan, 2004.
- Kevles, Daniel J. "'Into Hostile Political Camps': The Reorganization of International Science in World War I." *Isis* 62, no. 1 (1971): 47-60.
- _____. "The National Science Foundation and the Debate over Postwar Research Policy, 1942-1945: A Political Interpretation of *Science - the Endless Frontier*." *Isis* 68, no. 241 (1977): 4.
- _____. "Cold War and Hot Physics: Science, Security, and the American State, 1945-56." *Historical studies in the physical and biological sciences* 20, no. 2 (1990): 239-264.
- _____. *The Physicists: The History of a Scientific Community in Modern America, Revised Edition*. New York: Knopf, 1995.
- Khan, B. Zorina. *The Democratization of Invention: Patents and Copyrights in American Economic Development, 1790-1920*. New York: Cambridge University Press, 2005.
- _____. "Selling Ideas: An International Perspective on Patenting and Markets for Technological Innovations, 1790–1930." *Business History Review* 87, no. Spring (2013): 39-68.
- Kirchberger, Ulrike. "Deutsche Naturwissenschaftler Im Britischen Empire: Die Erforschung Der Auszereuropäischen Welt Im Spannungsfeld Zwischen Deutschem Und Britischem Imperialismus." *Historische Zeitschrift* 271, (2000): 621-660.
- Koerner, Steven T. "Technology Transfer from Germany to Canada after 1945: A Study in Failure?" *Comparative Technology Transfer and Society* 2, no. 1 (2004): 99-124.

- Kramer, Arnold. "German Energy Secrets Recycled." *German Studies Review* 2, no. 2 (1979): 225-227.
- Krammer, Arnold. "Technology Transfer as War Booty: The U.S. Technical Oil Mission to Europe, 1945." *Technology and Culture* 22, no. 1 (1981): 68-68.
- Krige, John. *American Hegemony and the Postwar Reconstruction of Science in Europe*. Cambridge, Mass.: The MIT Press, 2006.
- _____. "Atoms for Peace, Scientific Internationalism, and Scientific Intelligence." *Osiris* 21, no. 1 (2006): 161-181.
- _____. "The Peaceful Atom as Political Weapon: Euratom and American Foreign Policy in the Late 1950s." *Historical Studies in the Natural Sciences* 38, no. 1 (2008): 5-44.
- _____. "Building the Arsenal of Knowledge." *Centaurus* 52, (2010): 280-296.
- _____. "Technological Leadership and American Soft Power." In *Soft Power and Us Foreign Policy: Theoretical, Historical and Contemporary Perspectives*, edited by Inderjeet Parmar and Michael Cox. New York: Routledge, 2010.
- Krige, John, and Helke Rausch, eds. *American Foundations and the Coproduction of World Order in the Twentieth Century*. Goettingen: Vandenhoeck & Ruprecht, 2012.
- Kurowski, Franz. *Alliierte Jagd Auf Deutsche Wissenschaftler: Das Unternehmen Paperclip*. München: Kristall bei Langen Müller, 1982.
- Lacroix-Riz, A. "La Dénazification Économique De La Zone D'occupation Américaine : La Perception Française Du Phénomène." *Revue Historique* 283, no. 2 (1990): 303-347.
- Ladas, Stephen P. "Legal Protection of Know-How." *The Trademark Reporter* 54, (1964): 160-183.
- Lane, Ann. *The Rise and Fall of the Grand Alliance, 1941-45*. New York: St. Martin's Press, 1995.
- Larsen, Peder Olesen, and Markus von Ins. "The Rate of Growth in Scientific Publication and the Decline in Coverage Provided by Science Citation Index." *Scientometrics* 84, no. 3 (2010): 575-603.
- Lasby, Clarence G. *Project Paperclip: German Scientists and the Cold War*. New York: Atheneum, 1971.
- Latham, Michael E. *Modernization as Ideology: American Social Science and 'Nation Building' in the Kennedy Era*. Chapel Hill: University of North Carolina Press, 2000.

- Latour, Conrad F., and Thilo Vogelsand. *Okkupation Und Wiederaufbau: Die Tätigkeit Der Militärregierung in Der Amerikanischen Besatzungszone Deutschlands 1944-1947*. Stuttgart: Deutsche Verlags-Anstalt, 1973.
- Layton, Edwin. "Mirror-Image Twins: The Communities of Science and Technology in 19th-Century America." *Technology and Culture* 12, (1971): 562-580.
- Lesch, John, ed. *The German Chemical Industry in the Twentieth Century*. Dordrecht: Kluwer Academic Publishers, 2000.
- Leslie, Stuart W. *The Cold War and American Science : The Military-Industrial-Academic Complex at MIT and Stanford*. New York: Columbia University Press, 1993.
- Leslie, Stuart W., and Robert Kargon. "Exporting MIT: Science, Technology, and Nation-Building in India and Iran." *Osiris* 21, no. 1 (2006): 110-130.
- Lewis, Julian. *Changing Direction: British Military Planning for Post-War Strategic Defence*: Frank Cass, 2003.
- Lind, Michael. *Land of Promise: An Economic History of the United States*. New York: Harper-Collins, 2012.
- Long, Pamela O. "Invention, Authorship, "Intellectual Property," and the Origin of Patents: Notes toward a Conceptual History." *Technology and Culture* 32, no. 4 (1991): 846-846.
- _____. *Openness, Secrecy, Authorship: Technical Arts and the Culture of Knowledge from Antiquity to the Renaissance*. Baltimore: Johns Hopkins University Press, 2001.
- Longden, Sean. *T-Force : The Race for Nazi War Secrets, 1945*. London: Constable, 2010.
- Ludmann-Obier, Marie-France. "Le Contrôle De L'industrie Chimique En Zone Française D'occupation En Allemagne (1945-1949)." University of Strasbourg III, 1986.
- _____. "Un Aspect De La Chasse Aux Cerveaux : Les Transferts De Techniciens Allemands, 1945-1949." *Relations internationales* 46, (1986).
- _____. *Die Kontrolle Der Chemischen Industrie in Der Französische Besatzungszone 1945-1949*. Mainz: V. Hase & Koehler, 1989.
- _____. "La Mission Du CNRS En Allemagne (1945-1950)." *Cahiers pour l'Histoire du CNRS 1939-1989* 3, (1989).
- MacCormac, John. "Russians Seize Nazi Assets, Austrians and U.S. Protest." *New York Times*, 7/7/46 1946.

- Macdonald, David R. "Know-How Licensing and the Antitrust Laws." *The Trademark Reporter* 54, (1964): 251-279.
- MacLeod, Christine. *Inventing the Industrial Revolution: The English Patent System, 1660-1800*. Cambridge: Cambridge University Press, 1988.
- MacLeod, R. "Secrets among Friends: The Research Information Service and the "Special Relationship" in Allied Scientific Information and Intelligence, 1916-1918." *Minerva* 37, no. 3 (1999): 201-233.
- MacLeod, Roy. ""All for Each and Each for All": Reflections on Anglo-American and Commonwealth Scientific Cooperation, 1940-1945." *Albion: A Quarterly Journal Concerned with British Studies* 26, no. 1 (1994): 79-79.
- Maclsaac, David. *Strategic Bombing in World War II: The Story of the United States Strategic Bombing Survey*. New York: Garland Publishing Co., 1976.
- Macrakis, Kristie. *Surviving the Swastika: Scientific Research in Nazi Germany*. Oxford: Oxford University Press, 1993.
- _____. *Seduced by Secrets: Inside the Stasi's Spy-Tech World*. Cambridge: Cambridge University Press, 2006.
- Maddrell, Paul. "Western Intelligence Gathering and the Division of German Science." *Cold War International History Project Bulletin* 12, no. 13 (1997): 352-352.
- _____. "Britain's Exploitation of Occupied Germany for Scientific and Technical Intelligence on the Soviet Union." 1998.
- _____. "British-American Scientific Intelligence Collaboration During the Occupation of Germany." *Intelligence and National Security* 15, no. 2 (2000): 74-94.
- _____. *Spying on Science : Western Intelligence in Divided Germany 1945-1961*. Oxford; New York: Oxford University Press, 2006.
- Magnin, François. "Know-How Et Propriété Industrielle." Doctorate thesis, 1971.
- Maguire, G. *Anglo-American Policy Towards the Free French*. Basingstoke: MacMillan, 1995.
- Maier, Helmut. *Forschung Als Waffe: Rüstungsforschung in Der Kaiser-Wilhelm-Gesellschaft Und Das Kaiser-Wilhelm-Institut Für Metallforschung 1900-1945/48*. Göttingen: Wallstein, 2007.
- Manchester, William. *The Arms of Krupp, 1587-1968: The Rise and Fall of the Industrial Dynasty That Armed Germany at War*. Boston: Back Bay Books, 2003.

- Marchard, Suzanne. "Nazi Culture: Banality or Barbarism?" *Journal of Modern History* 70, (1998): 108-118.
- Marion, G.E. "The Library as an Adjunct to Industrial Laboratories." *Library Journal* 35, no. 9 (1910): 400-404.
- Marsch, Ulrich. "Transferring Strategy and Structure: The German Chemical Industry as an Exemplar for Great Britain." In *The German Chemical Industry in the Twentieth Century*, edited by John Lesch, 217-241. Dordrecht: Kluwer Academic Publishers, 2000.
- Masco, Joseph. "Lie Detectors: On Secrets and Hypersecurity in Los Alamos." *Public Culture* 14, (2002): 441-167.
- May, Christopher. "The Denial of History: Reification, Intellectual Property Rights and the Lessons of the Past." *Capital & Class* 30, no. 33 (2006): 33-56.
- May, Christopher, and Susan K. Sell. *Intellectual Property Rights: A Critical History*. Boulder, CO: Lynne Rienner Publishers, 2006.
- McGovern, James. *Crossbow and Overcast*. New York, W. Morrow, 1964.
- Meckler, Alan M. *Micropublishing: A History of Scholarly Micropublishing in America, 1938-1976*. Westport, CT: Greenwood Press, 1982.
- Meehan, Patricia. *A Strange Enemy People: Germans under the British, 1945-50*. London: Peter Owen, 2001.
- Meshbesh, Thomas M. "The Role of History in Comparative Patent Law." *Journal of the Patent and Trademark Office Society* 78, (1996): 594-614.
- Metzler, Gabriele. "Deutschland in Den Internationalen Wissenschaftsbeziehungen, 1900-1930." In *Gebrochene Wissenschaftskulturen: Universität Und Politik Im 20. Jahrhundert*, edited by Michael Grüttner and et al, 55-82. Göttingen: Vandenhoeck & Ruprecht, 2010.
- Miles, Arnold. "The Transfer of Technical Know-How." *Public Administration Review* 13, no. 1 (1953): 50-53.
- Miller, Clark A. "'An Effective Instrument of Peace': Scientific Cooperation as an Instrument of American Foreign Policy, 1938-1950." *Osiris* 21, no. 1 (2006): 133-160.
- Milward, Alan. *The Reconstruction of Western Europe, 1945-1951*. London: Methuen, 1984.
- Morgenthau, Henry. "Program to Prevent Germany from Starting World War Iii." In *Germany Is Our Program*, edited by Henry Morgenthau. New York: Harper & Brothers Publishers, 1945.

- Morison, Elting E. *From Know-How to Nowhere: The Development of American Technology*. New York: Basic Books, Inc., 1975.
- Morris, Peter J T. "Transatlantic Transfer of Buna S Synthetic Rubber Technology, 1932-45." In *The Transfer of International Technology: Europe, Japan, and the USA in the Twentieth Century*, edited by David J. Jeremy: Edward Elgar, 1992.
- _____. "A Personal Historiography of the Chemical Industry since 1956." *Bulletin of the History of Chemistry* 32, no. 1 (2007): 10-20.
- Morton, David L. "'The Rusty Ribbon': John Herbert Orr and the Making of the Magnetic Recording Industry, 1945-1960." *The Business History Review* 67, no. 4 (1993): 589-589.
- Mowery, David. "Firm Structure, Government Policy, and the Organization of Industrial Research: Great Britain and the United States, 1900-1950." *Business History Review* 58, (1984): 504-531.
- Mustar, Philippe, and Philippe Larédo. "Innovation and Research Policy in France (1980–2000) or the Disappearance of the Colbertist State." *Research Policy* 31, no. 1 (2002): 55-72.
- Naimark, Norman M. *The Russians in Germany : A History of the Soviet Zone of Occupation, 1945-1949*. Cambridge, Mass.: Belknap Press of Harvard University Press, 1995.
- Nash, John B. "The Concept of "Property" in Know-How as a Growing Area of Industrial Property: Its Sale and Licensing." *Patent, Trademark, Copyright Journal of Research and Education* 6, (1962): 289-298.
- Neufeld, Michael J. *The Rocket and the Reich: Peenemünde and the Coming of the Ballistic Missile Era*. New York: Free Press, 1995.
- _____. *Von Braun : Dreamer of Space, Engineer of War*. New York: A.A. Knopf, 2007.
- _____. "The Nazi Aerospace Exodus: Towards a Global, Transnational History." *History and Technology* 28, no. 1 (2012): 49-67.
- Newcomer, Hale A. "Legal Protection and Licensing of "Know-How" Internationally." *American Business Law Journal* 7, no. 3 (1969): 227-239.
- Nilsson, Mikael. "The Power of Technology: U.S. Hegemony and the Transfer of Guided Missiles to Nato During the Cold War, 1953–1962." *Comparative Technology Transfer and Society* 6, no. 2 (2008): 127-149.
- Novak, William. "The Legal Origins of the Modern American State." In *Looking Back at Law's Century*, edited by Austin Sarat, Bryant Garth and Robert Kagan. Ithaca, NY: Cornell University Press, 2002.

- Nübel, Otto. *Die Amerikanische Reparationspolitik Gegenüber Deutschland 1941-1945*. Frankfurt am Main: Metzner, 1980.
- Nye, Joseph. *Bound to Lead: The Changing Nature of American Power*. New York: Basic Books, 1990.
- _____. *Soft Power: The Means to Success in World Politics*. New York: Perseus Books, 2004.
- Nye, Mary Jo. *Michael Polanyi and His Generation: Origins of the Social Construction of Science*. Chicago: The University of Chicago Press, 2011.
- O'Reagan, Douglas. "French Scientific Exploitation and Technology Transfer from Germany in the Diplomatic Context of the Early Cold War." *The International History Review*, (2014).
- Paletschek, Sylvia. "Was Heißt "Weltgeltung Deutscher Wissenschaft?" Modernisierungsleistungen Und -Defizite Der Universitäten Im Kaiserreich." In *Gebrochene Wissenschaftskulturen: Universität Und Politik Im 20. Jahrhundert*, edited by Michael Grüttner and et al, 29-54. Göttingen: Vandenhoeck & Ruprecht, 2010.
- Palmer, Scott W. *Dictatorship of the Air : Aviation Culture and the Fate of Modern Russia* Cambridge Centennial of Flight. Cambridge ; New York: Cambridge University Press, 2006.
- Pancaldi, Giuliano. "Wartime Chemistry in Italy: Industry, the Military, and the Professors." *Frontline and Factory: Comparative Perspectives on the Chemical Industry at War, 1914–1924*, no. May 1914 (2006): 61-74.
- Parshall, Karen Hunger, and Adrian C. Rice, eds. *Mathematics Unbound: The Evolution of an International Mathematical Research Community, 1800-1945*. Providence, RI: American Mathematical Society, 2002.
- Pash, Boris. *The Alsos Mission*. New York: Award House, 1969.
- Patentamt, Deutsches. *Hundert Jahre Patentamt*. München: Heymann, 1977.
- Peltzer, Lilli. *Die Demontage Deutscher Naturwissenschaftlicher Intelligenz Nach Dem 2. Weltkrieg*. Berlin: ERS - Verlag, 1995.
- Pestre, Dominique. "Science, Political Power and the State." In *Science in the Twentieth Century*, edited by John Krige and Dominique Pestre, 61-76. Amsterdam: Harwood Academic Publishers, 1997.
- _____. "Guerre, Renseignement Scientifique Et Reconstruction, France, Allemagne Et Grande-Bretagne Dans Les Annees 1940." In *De La Diffusion Des Sciences à*

- L'espionnage Industriel, Xve-Xxe SièCle : Actes Du Colloque De Lyon (30-31 Mai 1996) De La Sfhist*, edited by André Guillerme, 183-201. Fontenay-aux-Roses (France): ENS Editions, 1999.
- Peterson, Edward. *The American Occupation of Germany : Retreat to Victory*. Detroit: Wayne State University Press, 1977.
- Phillimore, Peter, and Patricia Bell. "Trust and Risk in a German Chemical Town." *Ethnos* 70, no. 3 (2005): 311-334.
- Picard, Jean Francois. "La Longue Marche Vers Le CNRS (1901-1945)." *Cahiers pour l'Histoire du CNRS 1939-1989* 1, (1988).
- Polanyi, Michael. "Patent Reform." *Review of Economic Studies* XI, no. Summer (1944): 61-76.
 _____. *The Tacit Dimension*. Chicago: University of Chicago Press, 1966.
- Pottage, Alain, and Brad Sherman. *Figures of Invention: A History of Modern Patent Law*. Oxford: Oxford University Press, 2010.
- Presas i Puig, Albert. *Reflections on a Peripheral Paperclip Project : A Technological Innovation System in Spain Based on the Transfer of German Technology*. Berlin: Max-Planck-Institute for the History of Science, 2008.
- Price, Derek J. de Solla. *Science since Babylon*. New Haven, CT: Yale University Press, 1961.
 _____. *Little Science, Big Science*. New York: Columbia University Press, 1963.
- Project, The Eleanor Roosevelt Papers, "Interview with John C. Green, 22 August 1951, the Eleanor Roosevelt Show"
http://www2.gwu.edu/~erpapers/documents/displaydoc.cfm?_t=radio&_docid=rad025
 (accessed 29 April 2014).
- Prost, Antoine. "Les Origines Des Politiques De La Recherche En France (1939-1958)." *Cahiers pour l'Histoire du CNRS 1939-1989* 1, (1988).
- Pursell, Carroll. "The Technology of Production." In *A Companion to American Technology*, edited by Carroll Pursell, 55-68. Malden, MA: Blackwell Publishing, 2005.
- Rammer, G. "Die Nazifizierung Und Entnazifizierung Der Physik an Der Universität Göttingen." Georg-August-Universität Göttingen, 2004.
- Ramskjaer, Liv. "Users and Producers of Plastics in Post-World War II Norway: Building a New Industry through Transfer of Technology." *Comparative Technology Transfer and Society* 3, no. 1 (2005): 76-102.

- Rayward, W. Boyd. "The Origins of Information Science and the International Institute of Bibliography/International Federation for Information and Documentation (Fid)." In *Historical Studies in Information Science*, edited by Trudi Bellardo Hahn and Michael Buckland. Medford, NJ: Information Today, Inc., 1998.
- Renneberg, Monika, and Mark Walker. *Science, Technology, and National Socialism*. Cambridge [England]; New York, NY, USA: Cambridge University Press, 1994.
- Reynolds, D. "'A Special Relationship'?: America, Britain and the International Order since the Second World War." *International Affairs* 62, (1985): 11-11.
- Rhees, David. "The Chemists' War: The Impact of World War I on the American Chemical Profession." *Bulletin of the History of Chemistry* 13-14, (1992).
- Rhodes, Richard. *The Making of the Atomic Bomb*. New York: Simon & Schuster, 1986.
- Rice, Mitchell F. "Information and Communication Technologies and the Global Digital Divide: Technology Transfer, Development, and Least Developing Countries." *Comparative Technology Transfer and Society* 1, no. 1 (2003): 72-88.
- Richards, Pamela. *Scientific Information in Wartime : The Allied-German Rivalry, 1939-1945*. Westport Conn.: Greenwood Press, 1994.
- Rieger, Bernhard. *Technology and the Culture of Modernity in Britain and Germany, 1890-1945*. Cambridge: Cambridge University Press, 2005.
- Risch, Michael. "Why Do We Have Trade Secrets?" *Marquette Intellectual Property Law Review* 11, no. 1 (2007): 1-74.
- Rivas, Darlene. *Missionary Capitalist: Nelson Rockefeller in Venezuela*. Chapel Hill: University of North Carolina Press, 2001.
- Rollings, Neil. *British Business in the Formative Years of European Integration, 1945-1973*. Cambridge Studies in the Emergence of Global Enterprise, Edited by Louis Galambos and Geoffrey Jones. Cambridge: Cambridge University Press, 2007.
- _____. "Multinational Enterprise and Government Controls on Outward Foreign Direct Investment in the United States and the United Kingdom in the 1960s." *Enterprise and Society* 12, no. 2 (2011): 398-434.
- Root, Christopher G. "The Validity of Transnational Technical Know-How Licensing Agreements in the United States Courts." *California Western International Law Journal* 2, (1971): 128-145.
- Ruttan, Vernon W. *United States Development Assistance Policy: The Domestic Politics of Foreign Economic Aid*. Baltimore: Johns Hopkins University Press, 1996.

- Ryan, Mike H. "The Role of National Culture in the Space-Based Technology Transfer Process." *Comparative Technology Transfer and Society* 2, no. 1 (2004): 31-66.
- Sachse, Carola. *Die Verbindung Nach Auschwitz: Biowissenschaften Und Menschenversuche an Kaiser-Wilhelm-Instituten*. Göttingen: Wallstein, 2003.
- _____. "'Whitewash Culture': How the Kaiser Wilhelm / Max Planck Society Dealt with the Nazi Past." In *The Kaiser Wilhelm Society under National Socialism*, edited by Carola Sachse, Mark Walker and Susanne Heim, 373-399. Cambridge: Cambridge University Press, 2009.
- Sandeen, Sharon K. "The Evolution of Trade Secret Law and Why Courts Commit Error When They Do Not Follow the Uniform Trade Secrets Act." *Hamline Law Review* 33, (2010): 493-543.
- Schabel, Ralf. *Die Illusion Der Wunderwaffen*. Munich: R. Oldenbourg, 1994.
- Schmidhuber, Jürgen, "Evolution of National Nobel Prize Shares in the 20th Century" <http://www.idsia.ch/~juergen/nobelshare.html> (accessed 10 May 2014).
- Schmidt, Lajos. "Licensing Know-How, Patents, and Trademarks Abroad." *University of Illinois Law Forum* 1959, (1959): 248-270.
- Schulze, Max-Stephan, ed. *Western Europe: Economic and Social Change since 1945*. London: Longman, 1999.
- Seely, Bruce E. "Nasa and Technology Transfer in Historical Perspective." *Technology and Culture* 6, no. 1 (2008): 1-16.
- Seely, Bruce Edsall. "Historical Patterns in the Scholarship of Technology Transfer." *Comparative Technology Transfer and Society* 1, no. 1 (2003): 7-48.
- _____. "World War II and Technology Transfer: A Historical Introduction." *Comparative Technology Transfer and Society* 2, no. 1 (2004): 67-70.
- Seely, Bruce Edsall, Donald E. Klingner, and Gary Klein. "'Push' and 'Pull' Factors in Technology Transfer Moving American-Style Highway Engineering to Europe, 1945–1965." *Comparative Technology Transfer and Society* 2, no. 3 (2004): 229-246.
- Seidel, Robert W. "Secret Scientific Communities: Classification and Scientific Communication in the DOE and DOD." In *Proceedings of the 1998 Conference on the History and Heritage of Science Information Systems*, edited by Mary Ellen Bowden, Trudi Bellardo Hahn and Robert V. Williams, 46-60. Medford, NJ: Information Today, 1999.

- Sell, Susan K. *Private Power, Public Law: The Globalization of Intellectual Property Rights*. Cambridge: Cambridge University Press, 2003.
- _____. "Intellectual Property and Public Policy in Historical Perspective: Contestation and Settlement." *Loyola of Los Angeles Law Review* 38, (2005): 267-323.
- Siegmund-Schultze, Reinhard. "'Scientific Control' in Mathematical Reviewing and German-U.S.-American Relations between the Two World Wars." *Historia Mathematica* 21, no. 3 (1994): 306-329.
- _____. "The Emancipation of Mathematical Research Publishing in the United States from German Dominance (1878–1945)." *Historia Mathematica* 24, (1997): 135-166.
- _____. *Mathematicians Fleeing from Nazi Germany*. Princeton, NJ: Princeton University Press, 2009.
- Simpson, Christopher. *Universities and Empire: Money and Politics in the Social Sciences During the Cold War*. New York: New Press, 1998.
- Slaughter, Anne-Marie. "A Global Community of Courts." *Harvard International Law Journal* 44, (2003): 191-220.
- Snyder, Willam Paul. *The Politics of British Defense Policy, 1945-1962*: Ernest Benn, 1964.
- Sokol, D, and Ioannis Lianos, eds. *The Global Limits of Competition Law*. Stanford: Stanford University Press, 2012.
- Spector, Scott. "Was the Third Reich Movie-Made? Interdisciplinarity and the Reframing of Ideology." *American Historical Review* 106, no. 2 (2001): 460-484.
- Spitz, Peter. *Petrochemicals: The Rise of an Industry*: John Wiley, 1988.
- Stafford, D. "Roosevelt, Churchill and Anglo-American Intelligence: The Strange Case of Juan March." *Intelligence and National Security* 15, no. 2 (2000): 36-48.
- Stedman, John C. "Legal Problems in the International and Domestic Licensing of Know-How." *A.B.A. Antitrust Section* 29, (1965): 247-254.
- Steen, Kathryn. "Patents, Patriotism, and 'Skilled in the Art' USA V. The Chemical Foundation, Inc., 1923-1926." *Isis* 92, no. 1 (2001): 91-122.
- _____. "Technical Expertise and Us Mobilization, 1917–18: High Explosives and War Gases." *Frontline and Factory: Comparative Perspectives on the Chemical Industry at War, 1914–1924*, (2006): 103-122.

- Steiner, Andre. "The Return of German "Specialists" from the Soviet Union to the German Democratic Republic: Integration and Impact." In *Technology Transfer out of Germany after 1945*, edited by Matthias Judt and Burghard Ciesla, 119-152. Amsterdam: Harwood Academic Publishers, 1996.
- Stokes, Raymond. *Divide and Prosper : The Heirs of I.G. Farben under Allied Authority, 1945-1951*. Berkeley: University of California Press, 1988.
- _____. *Opting for Oil: The Political Economy of Technological Change in the West German Chemical Industry, 1945-1961*. New York: Cambridge University Press, 1994.
- _____. "Assessing the Damages: Forced Technology Transfer and the German Chemical Industry." In *Technology Transfer out of Germany after 1945*, edited by Matthias Judt and Burghard Ciesla, 81-91. Amsterdam: Harwood Academic Publishers, 1996.
- _____. "Gravity and the Rainbow-Makers: Some Thoughts on the Trajectory of the German Chemical Industry in the Twentieth Century." In *The German Chemical Industry in the Twentieth Century*, edited by John Lesch. Norwell, MA: Kluwer Academic Publishers, 2000.
- Stoltzenberg, Dietrich. "Scientist and Industrial Manager: Emil Fischer and Carl Duisberg." In *The German Chemical Industry in the Twentieth Century*, edited by John Lesch. Norwell, MA: Kluwer Academic Publishers, 2000.
- Tarbell, D. *Roger Adams : Scientist and Statesman*. Washington D.C.: American Chemical Society, 1981.
- Taylor, Christopher Thomas, and Aubrey Silberston. *The Economic Impact of the Patent System: A Study of the British Experience*. Cambridge: Cambridge University Press, 1973.
- Till, James E. "Predecessors of Preprint Servers." *Learned Publishing* 14, no. 1 (2001): 7-13.
- Tolliday, Steven. "Transplanting the American Model? Us Automobile Companies and the Transfer of Technology and Management to Britain, France, and Germany, 1928-1962." In *Americanization and Its Limits: Reworking Us Technology and Management in Post-War Europe and Japan*, edited by Jonathan Zeitlin and Gary Herrigel. Oxford: Oxford University Press, 2000.
- Tomlinson, Jim. "The Failure of the Anglo-American Council on Productivity." *Business History* 33, no. 1 (1991): 82-92.
- Tooze, Adam. *The Wages of Destruction: The Making and Breaking of the Nazi Economy*. New York: Penguin Group, 2006.
- Tournès, Ludovic. "La Fondation Rockefeller Et La Construction D'une Politique Des Sciences Sociales En France (1918 - 1940)." *Annales* 63, no. 6 (2008): 1371-1402.

- Toye, Richard. "The Broadening of Economic History." *Contemporary European History* 17, no. 3 (2008): 423-432.
- Truman, Harry S. *Memoirs. Vol. 2 1946-1952: Years of Trial and Hope*. New York: Signet Books, 1965.
- Turchetti, Simone, Simon Naylor, Katrina Dean, and Martin Siegert. "On Thick Ice: Scientific Internationalism and Antarctic Affairs, 1957–1980." *History and Technology* 24, no. 4 (2008): 351-376.
- Turner, Ian D. "British Policy Towards German Industry, 1945-9: Reconstruction, Restriction or Exploitation?" In *Reconstruction in Post-War Germany*, edited by Ian D. Turner. New York: Berg, 1989.
- _____, ed. *Reconstruction in Post-War Germany : British Occupation Policy and the Western Zones, 1945-55*. New York: St. Martin's Press, 1989.
- Uttley, Matthew. "Operation 'Surgeon' and Britain's Post-War Exploitation of Nazi German Aeronautics." *Intelligence and National Security* 17, no. 2 (2002): 1-26.
- Vermeir, Koen. "Openness Versus Secrecy? Historical and Historiographical Remarks." *The British Journal for the History of Science* 45, no. 2 (2012): 165-188.
- Vermeir, Koen, and Daniel Margocsy. "States of Secrecy: An Introduction." *The British Journal for the History of Science* 45, no. 2 (2012): 153-164.
- Vierhaus, Rudolf, and Berhard Vom Brocke, eds. *Forschung Im Spannungsfeld Von Politik Und Gesellschaft - Geschichte Und Struktur Der Kaiser-Wilhelm-/Max-Planck-Gesellschaft*. Stuttgart: Deutsche Verlagsanstalt, 1990.
- Villain, Jacques. "France and the Peenemuende Legacy." In *History of Rocketry and Astronautics: Proceedings of the Twenty-Sixth History Symposium of the International Academy of Astronautics, Washington, D.C., U.S.A., 1992*, edited by Phillippe Young, 119-161. San Diego: Univelt, for the American Astronautical Society, 1997.
- _____. "L'apport Des Scientifiques Allemandes Aux Programmes De Recherche Relatifs Aux Fusées Et Avions À Réaction À Partir De 1945." In *La France Face Aux Problemes D'armement 1945-1950*, edited by Maurice Vaïsse. Bruxelles: Complexe, 1999.
- vom Brocke, Berhard, and Hubert Laitko, eds. *Die Kaiser-Wilhelm-/Max-Planck-Gesellschaft Und Ihre Institute: Das Harnack-Prinzip*. Berlin: de Gruyter, 1996.
- von Gizycki, Rainald. "Centre and Periphery in the International Scientific Community: Germany, France and Great Britain in the 19th Century." *Minerva* 11, no. 4 (1973): 474-494.

- Walker, Mark. *German National Socialism and the Quest for Nuclear Power, 1939-49*. Cambridge: Cambridge University Press, 1990.
- _____. *Nazi Science: Myth, Truth, and the German Atomic Bomb*. Cambridge, MA: Perseus Publishing, 1995.
- _____. "The Nazification and Denazification of Physics." In *Technology Transfer out of Germany after 1945*, edited by Matthias Judt and Burghard Ciesla, 49-60. Amsterdam: Harwood Academic Publishers, 1996.
- Wark, W. K. "British Intelligence on the German Air Force and Aircraft Industry, 1933–1939." *The Historical Journal* 25, no. 3 (1982): 627-648.
- Watt, David Cameron. *Britain Looks to Germany: British Opinion and Policy Towards Germany since 1945*. London: Oswald Wolff, 1965.
- Weaver, M. E. "International Cooperation and Bureaucratic in-Fighting: American and British Economic Intelligence Sharing and the Strategic Bombing of Germany, 1939–41." *Intelligence and National Security* 23, no. 2 (2008): 153-175.
- Wellerstein, Alex. "Patenting the Bomb: Nuclear Weapons, Intellectual Property, and Technological Control." *Isis* 99, no. 1 (2008): 57-87.
- _____. "Knowledge and the Bomb: Nuclear Secrecy in the United States, 1939-2008." Harvard University, 2010.
- Wells, Wyatt. *Antitrust and the Formation of the Postwar World*. New York: Columbia University Press, 2002.
- Werner, Anja. *The Transatlantic World of Higher Education: Americans at German Universities, 1776-1914*. New York: Berghahn Books, 2013.
- Westwick, Peter J. "Secret Science: A Classified Community in the National Laboratories." *Minerva* 38, no. 4 (2000): 363-391.
- Wilkins, Mira. *The Maturing of Multinational Enterprise: American Business Abroad from 1914 to 1970*. Cambridge, Mass.: Harvard University Press, 1974.
- _____. "German Chemical Firms in the United States from the Late 19th Century to Post-World War II." In *The German Chemical Industry in the Twentieth Century*, edited by John Lesch, 285-321. Dordrecht: Kluwer Academic Publishers, 2000.
- Wilkins, Mira, and Frank Ernest Hill. *American Business Abroad: Ford on Six Continents*. Detroit: Wayne State University Press, 1964.

- Williams, Robert V. "The Documentation and Special Libraries Movement in the United States, 1910-1960." In *Historical Studies in Information Science*, edited by Trudi Bellardo Hahn and Michael Buckland. Medford, NJ: Information Today, Inc., 1998.
- Williams, Robert V., Laird Whitmire, and Colleen Bradley. "Bibliography of the History of Information Science in North America, 1900-1997." In *Historical Studies in Information Science*, edited by Trudi Bellardo Hahn and Michael Buckland, 1998.
- Winter, David. "The Licensing of Know-How to the Soviet Union." *Journal of World Trade Law* 1, (1967): 162-178.
- Wolfe, Edward. "Restrictions in Know-How Agreements." *The Antitrust Bulletin* 12, (1967): 749-772.
- Zallen, Doris T. "The Rockefeller Foundation and French Research." *Cahiers pour l'Histoire du CNRS 1939-1989* 5, (1989).
- Zeitlin, Jonathan, and Gary Herrigel, eds. *Americanization and Its Limits*. Oxford: Oxford University Press, 2000.
- Zhang, Baichun, Jiuchun Zhang, and Fang Yao. "Technology Transfer from the Soviet Union to the People's Republic of China: 1949-1966." *Comparative Technology Transfer and Society* 4, no. 2 (2006): 105-167.
- Zimmermann, Paul A. *Patentwesen in Der Chemie. Urspruenge, Anfaenge, Entwicklung*. Ludwigshafen: BASF Aktiengesellschaft, 1965.
- oko Yasuhara, Y. "The Myth of Free Trade: The Origins of Cocom 1945-1950." (1991).