STEERING THE SEAS OF REFORM: EDUCATION, EMPIRICAL SCIENCE, AND ROYAL NAVAL MEDICINE, 1815-1860

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Submitted to the Graduate Faculty of

the Dietrich School of Arts and Sciences in partial fulfillment

of the requirements for the degree of

Doctor of Philosophy

University of Pittsburgh

2016

UNIVERSITY OF PITTSBURGH

THE DIETRICH SCHOOL OF ARTS AND SCIENCES

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August 2, 2016

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ABSTRACT

As medical and imperial actors, early-nineteenth-century British naval surgeons navigated the sweeping changes that occurred within the Royal Navy, the medical profession, and British society. They embraced and applied empirical natural and medical scientific approaches between the 1810s and 1850s. Their attempts to employ science as they negotiated naval service's realities and experiences, pursued their scientific and medical interests and duties, and confronted tropical fevers transformed the naval service. Scottish and Scottish-trained medical officers and leaders, who dominated the service through mid-century, spearheaded these efforts. In the process, surgeons' practical utility to the Navy's global-imperial duties became an increasingly important consideration, and their professional status and respectability rose. This dissertation culminates with a case study of surgeons' efforts to confront tropical fevers encountered off the West African coast. These later chapters analyze the changes in medical and strategic thought, approaches, and practices that led to a shift in practices related to fevers and the widespread use of quinine.

This account builds on efforts to integrate military and colonial medicine and science into narratives of British history, and the histories of empire, medicine, and science. It draws from medical course and student records, naval papers, reports and correspondence, university and parliamentary committees, and medical and scientific manuscripts and journals. This approach

sheds analytical, statistical, and demographic light on naval medicine's place in broader imperial and professional contexts, highlighting the convergence of educational, professional, institutional, and practical reforms with the necessities of service at sea. It portrays the early nineteenth century as a period of turmoil and transition in medicine and science— often labeled the Age of Reform. Professionalization and the rise of science within the medical profession led to educational, professional, and practical upheaval, as well as rising qualifications, authority, and ambitions. Bringing multiple literatures on medical and scientific education, professionalization, and practice into dialogue, this project presents an inclusive but focused view of these developments, and their relations to naval medicine. Naval surgeons emerge as an important group that had to negotiate the myriad professional and societal changes that shaped British science, medicine, and society during this formative period.

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LIST OF ABBREVIATIONS

Archives:

ADM— Admiralty Papers, British National Archives

BLM— British Library, Manuscripts Section

EUL CRC, GA — University of Edinburgh Library, Centre for Research Collection, General Archives

EUL CRC, UA— University of Edinburgh Library, Centre for Research Collection, University Archives

FO— Foreign Office Papers, British National Archives

GUL SC— University of Glasgow Special Collections

NA— British National Archives

NMM— National Maritime Museum

NLS— National Library of Scotland

RCPEdL— Royal College of Physicians of Edinburgh Library

RCSEdL— Royal College of Surgeons of Edinburgh Library

RNML/AL— Royal Naval Museum, Portsmouth Library, Admiralty Library

WL RBM— Wellcome Library, Rare Books & Manuscripts

WSRO— West Sussex Records Office

Journals, Proceedings & Transactions:

AMJ— Association Medical Journal

AJMS— The American Journal of Medical Science

BFMCR— British and Foreign Medico-Chirurgical Review

BMFR— British Medical and Foreign Review

BMJ— British Medical Journal

EMJ— Edinburgh Medical Journal

EMSJ— Edinburgh Medical and Surgical Journal

ENPJ— Edinburgh New Philosophical Journal

IJMH— International Journal of Maritime History

JESL— Journal of the Ethnological Society of London

JHMAS— Journal of the History of Medicine and Allied Sciences

JMR— Journal for Maritime Research

JRGS— Journal of the Royal Geographical Society of London

JRSM— Journal of the Royal Society of Medicine

JRNMS— Journal of the Royal Naval Medical Service

JSSL— Journal of the Statistical Society of London

Lancet— The Lancet

LJM— London Journal of Medicine

LMG— London Medical Gazette

M-CR— Medico-Chirurgical Review

M-CT— Medico-Chirurgical Transactions

MM— The Mariner's Mirror

MT— Medical Times

MTG— Medical Times and Gazette

PMSJ— Provincial Medical and Surgical Journal

PMSJRMS— Provincial Medical Journal and Retrospect of the Medical Sciences

PRSE— Proceedings of the Royal Society of Edinburgh

PZSL— Proceedings of the Zoological Society of London

TESL— Transactions of the Epidemiological Society of London

TFA— The Friend of Africa

TPBSE— Transactions and Proceedings of the Botanical Society of Edinburgh

USJ— The United Service Journal

USJNMM— The United Service Journal and Naval and Maritime Magazine

Parliamentary Papers:

"Expedition Papers"— House of Commons, "Papers Relative to the Expedition to the River Niger," *Parliamentary Papers*, 1843(472), xlviii, 39.

PP— Parliamentary Papers (ProQuest House of Commons Parliamentary Papers, http://parlipapers.proquest.com/parlipapers, cited in footnotes and bibliography with publication details as follows: Session Year (Paper Number): Volume Number, Starting Page Number in Bound Volume)

University Presses:

CUP— Cambridge University Press

EUP— Edinburgh University Press

HUP— Harvard University Press

JHP— Johns Hopkins University Press

LUP— Liverpool University Press

MUP— Manchester University Press

NUP— Northwestern University Press

OUP— Oxford University Press

PUP— Princeton University Press

UCP— University of Chicago Press

UCaP— University of California Press

UNDP— University of Notre Dame Press

UPP— University of Pennsylvania Press

UWP— University of Wisconsin Press

UTP— University of Toronto Press

YUP— Yale University Press

Societies & Titles:

ACS— Society for the Extinction of the Slave Trade and the Civilization of Africa (African Civilization Society)

CMS— Church Missionary Society

Director-General— Medical Director-General of the Medical Department of the Navy (Post was titled Physician of the Navy (1832-35), Physician-General of the Navy (1835-41), and Inspector-General of Naval Hospitals and Fleets (1841-44))

MB— Medical Bachelors

MD— Medical Doctorate

Historical Individuals:

Alison— William Pulteney Alison, M.D., Professor, University of Edinburgh

A. Thomson— Allen Thomson, M.D., Professor, University of Edinburgh

Baikie— William Balfour Baikie, M.D., Surgeon R.N.

Ballingall— Sir George Ballingall, M.D., Surgeon 33rd Foot, Professor, University of Edinburgh

Barrow— Sir John Barrow, Baronet, Second Secretary of the Admiralty

Bennett— John Hughes Bennett, M.D., Professor, University of Edinburgh

Berkley— Lord Maurice Berkeley, Admiral R.N., First Sea Lord

Boyle— James Boyle, Surgeon R.N.

Bruce— Sir Henry William Bruce, Admiral R.N.

Bryson— Alexander Bryson, M.D., Director-General of the Medical Department R.N.

Burnett— Sir William Burnett, M.D., Director-General of the Medical Department R.N.

Buxton— Sir Thomas Fowell Buxton, Baronet, M.P.

Christison— Sir Robert Christison, M.D., Baronet, Professor, University of Edinburgh

Cree— Edward Hodges Cree, M.D., Surgeon R.N.

Daniell— John Frederic Daniell, Professor, King's College, London

Denman— Joseph Denman, Rear Admiral R.N.

Duncan Sr.— Andrew Duncan Senior, M.D., Professor, University of Edinburgh

Duncan Jr.— Andrew Duncan Junior, M.D., Professor, University of Edinburgh

Forbes— Edward Forbes, Professor, University of Edinburgh

Fossett— Benjamin Fossett, Lead Clerk, Naval Medical Department

Goodsir— John Goodsir, Professor, University of Edinburgh

Hamilton— James Hamilton Junior, M.D., Professor, University of Edinburgh

Henderson— William Henderson, M.D., Professor, University of Edinburgh

Herschel— Sir John Frederick William Herschel, Baronet

Home— James Home, M.D., Professor, University of Edinburgh

Hope— Thomas Charles Hope, M.D., Professor, University of Edinburgh

Hotham— Charles Hotham, Captain R.N.

Hutt— William Hutt, M.P.

Huxley— Thomas Henry Huxley, Assistant Surgeon, R.N.

Jameson— Robert Jameson, Professor, University of Edinburgh

Jamieson— Robert Jamieson, Glasgow merchant

Ja. Russell— James Russell, Professor, University of Edinburgh

J. Graham— Sir James Graham, Baronet, M.P., First Lord of the Admiralty

J. Gregory— James Gregory, M.D., Professor, University of Edinburgh

Johnson— James Johnson, M.D., Assistant Surgeon R.N., East India Company

J. Thomson— John Thomson, M.D., Professor, University of Edinburgh

King— Gilbert King, M.D., Inspector of Fleets and Hospitals R.N.

Laird— Macgregor Laird, Liverpool and Glasgow merchant

Leyson— William Leyson, Surgeon R.N.

Madden— Richard Robert Madden, M.D.

Marshall— William Barrett Marshall, Surgeon R.N.

McCormick— Robert McCormick, Deputy Inspector of Hospitals and Fleets R.N.

McKechnie— Alexander McKechnie, M.D., Inspector of Hospitals and Fleets, R.N.

McKinnal— Robert McKinnal, M.D., Surgeon R.N.

McWilliam— James Ormiston McWilliam, M.D., Surgeon R.N.

Miller— James Miller, Professor, University of Edinburgh

Monro III— Alexander Monro tertius, M.D., Professor, University of Edinburgh

Murchison— Sir Roderick Murchison, Baronet

Playfair— Lyon Playfair, M.D., Baronet, M.P., University of Edinburgh

Prayer— John Prayer, Clerk, Victualling Board

Pritchett— Morris Pritchett, M.D., Surgeon R.N.

Pym— William Pym, Surgeons' Mate R.N., Inspector-General of Army Hospitals

Reid— David Boswell Reid, M.D., Lecturer, University of Edinburgh

Rbt. Hamilton— Robert Hamilton, Secretary of the Admiralty

Richardson— Sir John Richardson, Inspector of Hospitals and Fleets R.N.

Simpson— James Young Simpson, M.D., Baronet, Professor, University of Edinburgh

Syme— James Syme, Professor, University of Edinburgh

Thomson— Thomas Richard Heywood Thomson, M.D., Surgeon R.N.

Traill— Thomas Steward Traill, M.D., Professor, University of Edinburgh

Trotter— Henry Dundas Trotter, Captain R.N.

Wakley— Thomas Wakley, surgeon, founding editor of *The Lancet*, M.P.

Ward— W.P. Ward, Secretary of the Admiralty

Weir— John Weir, M.D., Medical Commissioner, Physician R.N.

W. Gregory— William Gregory, M.D., Professor, University of Edinburgh

PREFACE

Without the assistance and support of many mentors, colleagues, friends, and family, I could never have completed this ambitious project and intellectual journey. There are many people who I would like to thank for their encouragement, help, and guidance during the course of designing, researching for, writing, and revising this dissertation. I would first like to express my gratitude to my advisor Seymour Drescher, co-chair Bill Chase, and dissertation committee members Melanie Hughes, Patrick Manning, and Marcus Rediker for their guidance, support, and patience, which have thoughtfully guided and challenged me, and greatly improved my dissertation over the past four years. The History Department at the University of Pittsburgh has enthusiastically and warmly supported me through this process. I want to especially thank Molly Estes, Kathy Gibson, Bernie Hagerty, Leslie Hammond, Tony Novosel, and David Luesink for their assistance, open ears, and encouragement, as well as Rob Ruck and Ted Muller for their helpful and reassuring feedback on earlier versions of my proposals and research. The comradery, inspiration, and advice that I have drawn from my fellow graduate students, most especially from Katie Parker, Ahmet Izmirlioglu, Andrew Berhendt, Kelly Urban, Jesse Horst, and Aura Jirau Arroyo, has also been invaluable.

A number of scholars beyond the University of Pittsburgh have generously assisted me during the research and writing phases of this project, and eagerly embraced my work. I would like to acknowledge Professors Richard Drayton and Toby Green of King's College, London and

the Imperial and World History Seminar at the Institute for Historical Research, as well as Professor Nuala Zahedieh and the University of Edinburgh's Economic & Social History Seminar for welcoming me, and providing stimulating and insightful discussion and advice during my research trip to the United Kingdom in 2013-14. The advice, readings, and unpublished research graciously provided by Drs. Paul Laxton, John Cardwell, Andrew Cook, and Wendell McConnaha related to their respective fields of expertise have also greatly enriched this project.

A number of institutions and individuals provided assistance during the archival research trip that allowed me to write this dissertation. The staffs of the University of Edinburgh's Centre for Research Collection, the British National Archives, the Royal College of Surgeons of Edinburgh's Library, the Royal College of Physicians of Edinburgh's Library, the Royal Naval Museum, Portsmouth's Library, and the Wellcome Library's Rare Books and Manuscripts Collection all eagerly helped to guide me through their collections. I would also like to thank Joseph Marshall and Stephen Kerr for respectively taking the time to point me toward new materials of which I had been unaware at the University of Edinburgh's Centre for Research Collection and the Royal College of Surgeons of Edinburgh's Library. This project has also received generous funding over the years from multiple institutions. The University of Pittsburgh's Department of History, Dietrich School of Arts & Science, and European Studies Center provided substantial research grants and fellowships supporting my work. The Andrew W. Mellon Fellowship awarded by the University of Pittsburgh and funded by the Mellon Foundation, as well as a project grant from the History Project of the Harvard-Cambridge Joint Centre for Social & Economic History and the Institute for New Economic Thinking funded the research year that made this project possible.

1.0 INTRODUCTION: NAVAL MEDICINE, SCIENCE, EMPIRE AND REFORM

In March 1855, Scottish naval Assistant Surgeon Dr. William Balfour Baikie reported the success of precautions implemented during an expedition up the Niger River to the Royal Navy's Medical Director-General. In stark contrast to the medically disastrous 1841-42 Niger Expedition, the 1854 Expedition did not lose a man to fever thanks to the use of quinine.[1] A University of Edinburgh graduate, and a committed humanitarian and naturalist, Baikie embraced quinine's scientific and strategic implications. He asserted that it "enabled Europeans boldly to face what was once looked on as almost certain death, and to return unscathed." Baikie also positivistically claimed that the drug ensured the success of efforts to reach the interior of Africa and introduce "commerce and civilization." In doing so, he foreshadowed the later rise of the New Imperialism.[2] This story of scientific and imperial success raises questions that have preoccupied historians of medicine and science since the rise of social constructivism. While historians long saw acts of scientific discovery as the fruits of heroic genius, recognition that social, material and practical circumstances shaped the development, professionalization, and institutionalization of nineteenth-century science and medicine has grown in recent decades.[3]

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[1] For this and quinine's effectiveness: Philip D. Curtin, *The Image of Africa: British Ideas and Action, 1780-1850* (Madison: UWP, 1964), ch. 14; Daniel R. Headrick, *The Tools of Empire: Technology and European Imperialism in the Nineteenth Century* (New York: OUP, 1981), ch. 3.

[2] Baikie to Burnett, Mar. 23, 1855, NA, ADM 97/218/8088, f. 32-33. See also W. McConnaha, "William Balfour Baikie and the Prevention of Malaria," *JRNMS* 93, no. 1 (2007): 27–32.

[3] For medical history since the social turn, see Frank Huisman and John Harley Warner, eds., *Locating Medical History: The Stories and Their Meanings* (Baltimore: JHP, 2006), part III.

The rationale for this dissertation is that the professional and practical changes that occurred in early-nineteenth-century British science, medicine, and society reshaped surgeons' social, material and intellectual world. Naval medicine went through a period of far-reaching transition in the post-Napoleonic era as an empirical scientific worldview, mindset and set of approaches proliferated, and became professionally systematized within the Royal Navy. The overarching argument is that surgeons employed these analytical observational practices to help navigate their working experience, as well as sweeping changes within and beyond the Navy between 1815 and 1860. Leading surgeons increased the medical service's required qualifications, pushed for improved working conditions, instituted systematized reporting practices, and supported individual and collective scientific inquiry.[4] An increasingly diverse but still heavily Scottish-educated cohort of surgeons laboring at sea also implemented this transition as surgeon-scientists. At both levels, this process was tied to the practical necessities that arose from the Navy's imperial reorientation. As a prominent force of nineteenth-century imperialism, the Royal Navy committed itself to global operations that helped assert Britain's antislavery, free trade, and liberal policies. The harsh environments to which this exposed sailors made surgeons a vital group of professional experts within the naval establishment.[5]

This project argues that educational reforms, scientific professionalization, and societal developments together shaped naval medicine and the rise of science. It elucidates the multi-factorial processes that drove interacting changes in medical and scientific thinking and practices

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[4] See generally, N.A.M. Rodger, "Navies and the Enlightenment," in *Science and the French and British Navies, 1700-1850*, ed. Pieter Van der Merwe (London: NMM, 2003), 13-14; Mark Harrison, *Medicine in an Age of Commerce and Empire: Britain and Its Tropical Colonies, 1660-1830* (New York: OUP, 2010).

[5] For seapower and empire: David Cannadine, ed., *Empire, The Sea and Global History: Britain's Maritime World, c. 1763-c. 1840* (New York: Palgrave Macmillan, 2007); Miles Taylor, ed., *The Victorian Empire and Britain's Maritime World, 1837-1901: The Sea and Global History* (London: Palgrave Macmillan, 2013); Barry Gough, *Pax Britannica: Ruling the Waves and Keeping the Peace Before Armageddon* (New York: Palgrave Macmillan, 2014). For medicine, see Harrison, *Medicine in an Age*; David McLean, *Surgeons of the Fleet: The Royal Navy and Its Medics from Trafalgar to Jutland* (London: I. B. Tauris, 2010).

within the British Navy. As medical students and practitioners, naval surgeons traversed the medical profession's gradual opening, its increasing oversaturation, and its continuing hierarchies. The accompanying transformations in medical education and practice presented ever greater challenges and opportunities.[6] As systematized science developed during the early nineteenth century, naval surgeons gradually became respectable members of the Victorian medical and natural scientific communities. This process of reform was part of the dramatic social, political, economic, and intellectual changes occurring throughout British society. The rise of science can thus be seen as one of the formative developments of this Age of Reform.[7]

1.1 LITERATURE REVIEW AND SIGNIFICANCE: NAVAL SURGEONS IN MULTIVALENT CONTEXTS

Due to the multiple contexts in which this dissertation places naval medicine, this project engages with a variety of medical, scientific, imperial and British historical historiographies. This section addresses them individually, moving outward from naval, military and colonial medicine to the connected literatures related to British medicine and science. It concludes by addressing the ways in which this dissertation intersects with the broad literatures on British

[6] For the profession: Irvine Loudon, *Medical Care and the General Practitioner, 1750-1850* (Oxford: CUP, 1986); M. Jeanne Peterson, *The Medical Profession in Mid-Victorian London* (Berkeley: UCaP, 1978). For education: Thomas Neville Bonner, *Becoming a Physician: Medical Education in Britain, France, Germany, and the United States, 1750-1945* (Baltimore: JHP, 2000). For medical science: W. F. Bynum, *Science and the Practice of Medicine in the Nineteenth Century* (New York: CUP, 1994).

[7] Llewellyn Woodward, *The Age of Reform, 1815-1870,* 2nd ed. (1938; Oxford: OUP, 1962); Asa Briggs, *The Age of Improvement, 1783-1867,* 2nd ed. (New York: Longman, 2000). For a more recent analysis, see Arthur Burns and Joanna Innes, eds., *Rethinking the Age of Reform* (New York: CUP, 2003). For two influential surveys on the changes in British society, see Boyd Hilton, *A Mad, Bad, and Dangerous People?: England, 1783-1846* (New York: OUP, 2006); Eric J. Evans, *The Forging of the Modern State: Early Industrial Britain, 1783-1870,* 3rd ed. (New York: Routledge, 2001). For medicine in the Age of Reform, see multiple chapters in Roger French and Andrew Wear, eds., *British Medicine in an Age of Reform* (New York: Routledge, 2005); Ian A. Burney, "Medicine in the Age of Reform," in *Rethinking the Age of Reform*, 163–81.

imperial activity and issues related to the Age of Reform. The project contributes most directly to the connected literatures on naval, military and colonial medicine and science. Nonetheless, analyzing naval surgeons as actors within broader professional, imperial, and societal frameworks enriches our understanding of their lives. Building on recent scholarship, it decenters and broadens our understandings of the places of medicine and science in the Age of Reform.

Maritime and naval medicine have received renewed attention in the last fifteen years as a vibrant historiography focusing on military and colonial medicine's connections to themes in British imperial history has emerged.[8] Prior to this, scholarship emphasized surgeons' practical role in warfare, and secondarily in imperial operations. The campaign to combat scurvy and naval medicine's often romanticized role during the French and Napoleonic Wars have dominated the field. The seminal overview of British naval medicine written in the early 1960s had the broadest narrative, temporal and thematic scope. Recently, histories of naval medicine have started to integrate social, institutional, practical, imperial and societal contexts into cohesive analytical narratives.[9]

David McLean has spearheaded the analytical framing of naval medicine through a broader society lens in two histories of nineteenth-century naval medicine. His works investigated naval institutions and actors' roles in the institutionalization and professionalization of the naval medical service, as well as British medical and hygienic efforts to combat cholera. McLean's portrayal of science in these narratives emphasized the public health movement, and preventative and hospital medicine within the Navy. His more focused approach to medical

[8] For a selection on British maritime health: David Boyd Haycock and Sally Archer, eds., *Health and Medicine at Sea, 1700-1900* (Woodbridge: Boydell Press, 2009); Kevin Brown, *Poxed and Scurvied: The Story of Sickness & Health at Sea* (Barnsley: Seaforth Publishing, 2011). See Appendix C.1 for further literature on maritime health.
[9] For the seminal overview: Christopher Lloyd, and Jack L.S. Coulter *Medicine and the Navy, 1200-1900: Volume III: 1714-1815*, and *Medicine and the Navy: 1200-1900: Volume IV: 1815-1900* (London: E. and S. Livingstone, 1963). See also Appendix C.1 for more of the literature on British naval medicine.

practice as part of a social history of naval surgeons and medicine only began to capture science's institutional, professional, and practical impact on naval medicine.[10] Mark Harrison's work on colonial and military medical practice during the eighteenth and early-nineteenth centuries, which focused on the West Indies, demonstrated the origins of the empirical scientific approaches that proliferated among colonial, army and navy practitioners. This emerging scientific mindset became integral to the practical culture and debates among military surgeons that continued to develop through the Napoleonic Wars and into the age of Pax Britannica.[11]

Military and colonial medicine have also seen sustained efforts to more broadly frame their social, institutional, practical and political histories in interconnected narratives. During the past fifteen years, parallel literatures have analyzed military medicine's institutional and practical development in the eighteenth and early nineteenth centuries. Medicine's importance to the state imperial warfare apparatus has remained the overarching theme. Several works have also framed military medicine within the broader changes in the British medical profession, including claims related to authority and expertise.[12] The literature on colonial medicine has also become wider in scope. Recent works have analyzed practitioners' social and practical experiences in the context of imperial institutions, necessities, policies, concerns and practices. Harrison's analysis of the transformation of military and colonial medical practice and theory based on empirical science has served as a thematic and temporal starting point for this project.[13]

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[10] McLean, *Surgeons of the Fleet*; David Mclean, *Public Health and Politics in the Age of Reform: Cholera, the State and the Royal Navy in Victorian Britain* (London: I.B. Tauris, 2006).
[11] Harrison, *Medicine in an Age*.
[12] For a selection focused on British army medicine, see Marcus Ackroyd, Laurence Brockliss, Michael Moss, Kate Retford, and John Stevenson, *Advancing with the Army: Medicine, the Professions and Social Mobility in the British Isles 1790-1850* (New York: OUP, 2006); Catherine Kelly, *War and the Militarization of British Army Medicine, 1793–1830* (London: Pickering & Chatto, 2011), esp. 7-10
[13] Pratik Chakrabarti, *Medicine and Empire: 1600-1960* (New York: Palgrave Macmillan, 2013), esp. ix. For Atlantic colonial medicine: Harrison, *Medicine in an Age*; John Rankin, *Healing the African Body: British Medicine*

This dissertation expands on this recent scholarship on naval, military and colonial medicine by analyzing the relationships between practice, professionalization, and broader educational, professional, imperial, and societal contexts. Naval surgeons serve as the analytical strand that allows for a variety of multilevel connections. This extends the professional and scientific transitions of naval medicine noted in McLean and Harrison's works further into the period of science's systematized institutionalization in the mid-nineteenth century. It highlights the effects of ongoing professional, practical, and institutional debates on the development of naval medicine. In doing so, it emphasizes connections between the backgrounds of surgeons, the service's policies, individual and collective practical approaches, and the larger currents of social change.

The history of tropical medicine in the early-to-mid nineteenth century has developed into its own subfield focused on quinine's adoption by British colonial and military practitioners and actors in the tropics and especially in West Africa. Quinine's future implications as an imperial tool cast a long shadow over the extensive scholarship on tropical medicine. This literature struggles to engender nuance into the narrative of scientific triumph over tropical fevers, which paved the way for further European colonial expansion. Previous works have fruitfully begun to frame the rise of quinine within broader imperial, institutional and medical developments and contexts.[14] While this scholarship recognizes that naval surgeons undertook much of the clinical scientific work leading to the rise of quinine, scholars only recently placed their role and history at the center of the narrative. A recent chapter by Mark Harrison has begun

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in West Africa, 1800-1860 (Columbia: University of Missouri, 2015). See Appendix C.2 for a selection of literature on military and colonial medicine going beyond the Navy.

[14] Curtin, *Image*, esp. ch. 14; Headrick, *Tools*, ch. 3; Dennis G. Carlson, *African Fever: A Study of British Science, Technology, and Politics in West Africa, 1787-1864* (Canton, MA: Science History Publications, 1984); Philip D. Curtin, *Disease and Empire: The Health of European Troops in the Conquest of Africa* (New York: CUP, 1998). See Appendix C.3 for further literature on quinine, tropical medicine, and imperialism.

to fill this gap by examining the connections between surgeons' practical efforts off of West Africa, and institutional and professional debates within the Navy, the medical profession, and British society.[15]

Following up on this analysis, this dissertation presents a two-chapter case study of naval surgeons' practical and scientific efforts to make sense of and confront tropical fevers in and off of West Africa. This focused example connects surgeons' desperate attempts to confront a medical problem with professional, strategic and material implications to institutional, imperial, and societal developments. It demonstrates the contingent nature of surgeons' applications of empirical scientific approaches. The shifting broader environment during the 1830s and 1840s allowed surgeons to make gradual if incomplete progress in developing empirical methods that yielded a solution to malarial fevers. The rise of quinine is thus portrayed as emerging from the multivalent intersections of individual, naval, colonial, and metropolitan developments.

At another level, this dissertation engages with the historiography on the rise of science in early-nineteenth-century Britain. Previous scholarship has seen this period as formative for the professionalization of science, as well as for its proliferation within British society. The fields of natural and social science increasingly took the shape of modern intellectual disciplines in the post-Enlightenment age between the 1800s and the 1850s.[16] The scientific ethos, tied to a mindset of improvement, underpinned the Industrial Revolution and informed many societal issues. The economic, political, social and intellectual implications of the rise of science were

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[15] Mark Harrison, "An 'Important and Truly National Subject': The West Africa Service and the Health of the Royal Navy in the Mid Nineteenth Century," in *Health and Medicine at* Sea, 108–27. For the problem and quinine as a solution, see also John C. Mitcham, "Patrolling the White Man's Grave: Disease and the Anglo-American Anti-Slavery Squadrons, 1841-1862," *The Northern Mariner* 20 (Jan. 2010): 37–56.

[16] Jon Klancher, *Transfiguring the Arts and Sciences: Knowledge and Cultural Institutions in the Romantic Age* (Cambridge: CUP, 2013); Martin J. Daunton, ed., *The Organisation of Knowledge in Victorian Britain* (Oxford: OUP, 2005). See Appendix C.4 for more of the literature on the professionalization of science, and Appendix C.5 for further readings on the emergence of new scientific fields and applications.

far-reaching, affecting the development of industrial capitalism, positivism, liberalism, imperialism, and Marxism.[17]

The empirical scientific practices internalized as the conceptual foundations for the sciences are most relevant for this dissertation. Recent historiography has examined how this approach and mindset held together the sciences as political, professional and practical infighting increased.[18] The legitimacy of expanding applications of scientific approaches became a significant point of debate, particularly in relation to marginalized sciences, such as phrenology. The reassertion of science's conceptual unity and authority through the creation of a more unified professional scientific identity and community during this period was a response to this growing infighting.[19] The prominence of empirical science has become particularly clear in relation to colonial science.[20] This subfield has emphasized colonial institutions and scientists' responses to imperial goals and problems, their role in imperial expansion, and the intersections of domestic and colonial institutions through imperial networks. The contributions of natural history and colonial expeditions often linked to the Admiralty have also received emphasis.[21]

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[17] Donald Cardwell, *The Development of Science and Technology in Nineteenth-Century Britain: The Importance of Manchester*, ed. Richard L. Hills (Burlington: Ashgate/Variorum, 2003); Christine MacLeod, *Heroes of Invention: Technology, Liberalism and British Identity, 1750-1914* (New York: CUP, 2007). For improvement: Briggs, esp. introduction. For broader societal impact: Richard G. Olsen, *Science and Scientism in Nineteenth-Century Europe* (Urbana: University of Illinois Press, 2008).

[18] For an argument for this broad framing of science: John V. Pickstone, *Ways of Knowing: A New History of Science, Technology and Medicine* (Manchester: MUP, 2000).

[19] For scientific expansion, legitimacy and marginal sciences: Adrian Desmond, *The Politics of Evolution: Morphology, Medicine, and Reform in Radical London* (Chicago: UCP, 1989); David Clifford, Elisabeth Wadge, Alex Warwick, and Martin Willis, eds, *Repositioning Victorian Sciences: Shifting Centres in Nineteenth-Century Scientific Thinking* (New York: Anthem Press, 2006). For unity: Trevor H. Levere, *Poetry Realized in Nature: Samuel Taylor Coleridge and Early Nineteenth-Century Science* (New York: CUP, 1987). See Appendix C.5 for further literature on the development of nineteenth-century scientific fields, and Appendix C.6 for readings on the role of Scottish science in many of these developments.

[20] For empirical science, see also Harrison, *Medicine in an Age*, 113-14; Dane Kennedy, *The Last Blank Spaces* (Cambridge: HUP, 2013), 29-34; Daniel R. Headrick, *Power Over Peoples: Technology, Environments, and Western Imperialism, 1400 to the Present* (Princeton: PUP, 2010), 237.

[21] Brett M. Bennett and Joseph M. Hodge, eds., *Science and Empire: Knowledge and Networks of Science Across the British Empire, 1800-1970* (New York: Palgrave Macmillan, 2011). For natural history, see Richard Drayton,

Meanwhile, the history of medical science during the nineteenth century has produced a prolific literature rooted in the history of medicine. While this has led to a distinctive, insular narrative, this literature is also historically connected to the broader rise of science. Clinical hospital practice, germ theory, and experimental laboratory medicine have dominated the narrative of the development of nineteenth-century medical science. French anatomical pathology and German laboratory science's influences on European and British medicine have been the principal focuses.[22] The rise of surgery, the influence of the public health movement, and the importance of anatomical training within British medicine have received increasing attention in recent decades.[23]

This dissertation illustrates a particular example of science's proliferation and influence. It decenters the rise of science from industry and professional natural science. At the same time, by drawing out connections to domestic and colonial natural science, it expands the framing of scientific medicine. It also challenges narratives that have privileged experimental and laboratory medicine, and the emergence of germ theory as the point for departure for "modern" medicine.[24] This thesis argues that the development of empirical scientific medicine was a multivalent process that also occurred in centers well beyond hospitals, medical schools, and learned societies. Extending narratives on colonial and military medicine both in scope and time into the

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Nature's Government: Science, Imperial Britain, and the "Improvement" of the World (New Haven: YUP, 2000). See Appendix C.7 for more of the literature on colonial science, as well as the role of the Royal Navy.

[22] Bynum, *Science and the Practice of Medicine*; Andrew Cunningham and Perry Williams, eds., *The Laboratory Revolution in Medicine* (New York: CUP, 2002); Michael Worboys, *Spreading Germs: Disease Theories and Medical Practice in Britain, 1865-1900* (New York: CUP Press, 2000).

[23] Beyond Bynum, A.J. Youngson, *The Scientific Revolution in Victorian Medicine* (New York: Holmes & Meier, 1979). For surgery: Peter Stanley, *For Fear of Pain, British Surgery, 1790-1850* (New York: Rodopi, 2003). For public health: Anthony S. Wohl, *Endangered Lives: Public Health in Victorian Britain* (Cambridge: HUP, 1983). For anatomy: Russell C. Maulitz, *Morbid Appearances: The Anatomy of Pathology in the Early Nineteenth Century* (New York: CUP, 1987). See Appendix C.8 for an overview of the literature on the rise of medical science.

[24] Bynum, *Science and the Practice of Medicine*; Pickstone, *Ways of Knowing*. For the privileging of "modern" scientific medicine, see David Wootton, *Bad Medicine: Doctors Doing Harm Since Hippocrates* (New York: OUP, 2006).

Victorian era, this study allows for a more integrated approach to analyzing clinical medicine's emergence. In particular, this dissertation offers evidence that the scientific development of natural historical approaches in both domestic and colonial contexts underlay the empirical changes that proliferated throughout the natural, medical, and social sciences.

This analysis treats the emergence of medical science as a process tied to the professionalization of science and medicine, rather than an abstract methodological development. The broader literature on the Age of Reform has largely discussed the age's impact on the medical profession through the accepted narrative of a rising professional political movement. Competition between groups of practitioners, including physicians, surgeons, and general practitioners, as well as the Royal Colleges of Physicians and Surgeons, medical schools, and the government, characterized this process. The profession underwent fundamental changes in regard to the provisioning of medical care, professional organization, educational content and goals, and practitioners' working lives. The rise of general practitioners and surgeons, and their challenges to the profession's established learned and corporate physician-dominated system has received significant attention in this historiography.[25] Related works addressing the shifts in hospital care and medical training have reflexively begun to fit these institutional and practical developments into this period's atmosphere of political professional reform.[26]

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[25] For medical reform, see Burney, "Medicine in the Age of Reform," 163-81; French, and Wear, *British Medicine in an Age of Reform*; Irvine Loudon, "Medical Education and Medical Reform," in *The History of Medical Education in Britain*, ed. Vivian Nutton and Roy Porter (Atlanta: Rodopi, 1995), 229–50. For the profession and competition: Peterson, *Medical Profession*; Loudon, *Medical Care*; Ivan Waddington, *The Medical Profession in the Industrial Revolution* (Atlantic Highlands: Humanities Press, 1984); Anne Digby, *The Evolution of British General Practice 1850-1948* (New York: OUP, 1999); Anne Digby, *Making a Medical Living: Doctors and Patients in the English Market for Medicine, 1720-1911* (1994, repr.; New York: CUP, 2002). See also Appendix C.9 for an overview of the literature discussing the transformation and reform of the British medical profession.

[26] Bonner, *Becoming a Physician*; Keir Waddington, *Medical Education at St. Bartholomew's Hospital, 1123-1995* (Woodbridge: Royal Historical Society/Boydell Press, 2003); Fiona Hutton, *The Study of Anatomy in Britain, 1700–1900* (New York: Pickering & Chatto, 2015).

This dissertation employs naval medical officers as an analytical lens through which the experience of a group that initially occupied an ambivalent place within the medical profession, military apparatus, and shifting British Empire can be examined. Due to their supposedly peripheral and lowly position within that profession, naval surgeons offer a fresh way to view practitioners' attempts to take advantage of the changes occurring during this period. The narrative highlights the impact of rising professional ambitions, a competitive labor market, and increasingly scientific practical training on surgeons' careers. Army and navy surgeons occupied a similar position in the profession to general practitioners with whom they often shared similar concerns. The particular circumstances in the Navy also demonstrate the diversity of experiences of medical practitioners educated at Britain's leading medical schools.

The role of Scottish and Edinburgh medicine in early-nineteenth-century professional reforms emerges as a central development. Despite an abundance of focused literature on Scottish medicine in the Enlightenment and post-Enlightenment periods, scholarship has not sufficiently linked this theme to British imperial and naval medicine.[27] By focusing on Scottish-educated surgeons' domination of the naval medical ranks through the 1840s, this project helps to elucidate Scottish medical education's role in British professional, practical, and scientific reform. During the early nineteenth century, empirical observation, clinical experience, pathological anatomical dissection, and practical science became increasingly prominent in Scottish medicine. This transformation spurred and influenced reforms in London and English medicine through their ongoing rivalry. Scottish medical schools also prolifically trained students who spread throughout Britain, the military services, and the Empire.

[27] Lisa M. Rosner, *Medical Education in the Age of Improvement: Edinburgh Students and Apprentices, 1760-1826* (Edinburgh: EUP, 1991); Stephen Jacyna, *Philosophic Whigs: Medicine, Science and Citizenship in Edinburgh, 1789-1848* (London: Routledge, 1994); Helen M. Dingswall, *A History of Scottish Medicine: Themes and Influences* (Edinburgh: EUP, 2003). See the later part of Appendix C.9 for more on Scottish medicine and its broader influence.

At a still broader level, this dissertation discusses an era in which British imperial and global activity underwent a far-reaching transition. While it is not feasible to engage comprehensively with the extensive literature on Britain in the world, naval surgeons' place within British society, the military apparatus, and overseas expansion connects to several subthemes. Late-eighteenth and early-nineteenth-century British imperialism went through a crisis of identity and mission. Its focus shifted from the Americas and West Indies to India and the world stage. New forms of informal imperialism oriented toward "legitimate commerce" emerged, which were crucially reliant on British maritime supremacy, and diverse coalitions of private and governmental institutions and actors. The Royal Navy's centrality in the pursuit of these evolving imperial conceptions and interests forms the background of this dissertation.[28] Surgeons played an important supporting role in the Navy's rapidly expanding global reach.

This dissertation's case study of naval surgeons' practical scientific efforts to combat tropical fevers encountered during increased naval operations off of West Africa engages with several specific themes related to imperialism, including antislavery, colonial commerce, and exploration. They served as catalysts for British activity in West Africa, and shaped imperial policy and strategy more broadly. The ways in which gentlemanly capitalism and humanitarianism shaped British imperial activity have received particular emphasis in recent historiography. In analyzing surgeons' efforts supporting the Navy's extensive naval slave-trade-suppression operations off West Africa, this dissertation highlights the wide range of institutions,

[28] For British imperialism: C.A. Bayly, *Imperial Meridian: The British Empire and the World, 1780-1830* (New York: Longman, 1989); Ronald Hyam, *Britain's Imperial Century, 1815-1914: A Study of Empire and Expansion*, 3rd Ed. (Basingstoke: Palgrave Macmillan, 2002). For naval supremacy: C.J. Bartlett, *Great Britain and Sea Power, 1815-1853* (Oxford: Clarendon Press, 1963). For the Navy and Empire: Cannadine, ed., *Empire, The Sea and Global History*; Taylor, *The Victorian Empire and Britain's Maritime World*; Gough, *Pax Britannica*. See Appendix C.10 for further literature on both British imperialism and the connected theme of British seapower.

actors, practical concerns, and competing interests involved in British imperialism.[29] Naval surgeons' practical efforts became more important as increasing costs in lives and resources brought Britain's strategy into question.

A connected literature addressed in this dissertation is the role of Scottish actors in British and British imperial history. The various threads of this extensive work emphasize Scots' importance in Britain, the Atlantic, and the Empire, as well as their prolific migration throughout the world. While scholarship has emphasized their roles as state, imperial, and professional actors for decades, the recent literature has expanded the focus to "ordinary" Scots. This work has also emphasized the development of British national and Scottish multivalent identities.[30] This dissertation extends the previous focus on Scots' governmental, colonial, and professional roles that has hitherto emphasized the long-eighteenth century. While Scots developed an institutional power base in naval medicine, Scottish naval surgeons as a group do not easily fit into current analytical divisions. They were a mixture of state-employed professionals, labor migrants, and individuals with their own ambitions and interests that went beyond their Scottish and professional backgrounds.

The broadest historiographical theme considered in this dissertation is the Age of Reform throughout British society. This literature has long emphasized the political reform movement that culminated in parliamentary electoral reform. Political narratives have also highlighted the rise of Whig-Tory party-faction politics with secondary groupings of Radicals and Humanitarians. A related literature has focused on the social-political movements emerging from

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[29] For broad considerations of these different impulses, see Raymond E. Dumett, *Gentlemanly Capitalism and British Imperialism: The New Debate on Empire* (New York: Longman, 1999); Bronwen Everill, *Abolition and Empire in Sierra Leone and Liberia* (Houndmills: Palgrave Macmillan, 2012). See also Appendix C.10 for more literature on imperialism, and the sub-themes of economic activity, exploration, antislavery, and humanitarianism.

[30] For examples of this literature, see John M. MacKenzie and T.M. Devine, eds., *Scotland and the British Empire* (New York: OUP, 2011). See Appendix C.11 for an overview of the literature on the influence of Scots within Britain, the Empire, and throughout the world.

Whig, evangelical and humanitarian conceptions of reform.[31] In the past fifteen years, there have been a few attempts to stretch the concept's thematic and temporal scope by adopting an expanded definition of reform.[32] Building on this work, this dissertation adopts a very broad framing of the Age of Reform, conceiving it as encompassing the totality of the societal changes during the period. It views the political, economic, social and cultural transformation of British society in the early-to-mid nineteenth century as interconnected, and thus integrates developments usually analyzed in several separate but parallel literatures.[33] By analyzing naval surgeons' careers and lives holistically, this analysis illustrates that the scope and impact of the changes that occurred during the Age of Reform are even broader than often acknowledged.

This dissertation cannot, of course, engage with the full range of themes included in this sweeping view of British society. It acknowledges that naval, medical, and scientific developments most directly affected naval surgeons. Nonetheless, they grappled with the age in which they lived based on their experiences and interests. Their professional identity and duties shaped their relationship with the changes that occurred during their active lives. By analyzing surgeons' careers and their relationship with the broader societal context, this project illustrates how the Age of Reform affected a particular range of institutions and individuals, and how they in turn affected their Age. Surgeons' experiences particularly highlight the often underappreciated impact of the rise of science as an ethos, a mindset and an epistemological

[31] Michael J. Turner, *British Politics in An Age of Reform* (Manchester: MUP, 1999); Eric J. Evans, *Parliamentary Reform in Britain, c. 1770-1918* (New York: Longman, 2000); Ian Newbould, *Whiggery and Reform, 1830-41: The Politics of Government* (Stanford: SUP, 1990).

[32] Surveys works have also taken a broader view of the changes in the early nineteenth century. Burns and Innes, *Rethinking the Age of Reform*; Norman McCord and Bill Purdue, *British History 1815-1914*, 2nd Ed. (Oxford: OUP, 2007); Chris Williams, *A Companion to 19th-Century Britain* (Malden, M.A.: Blackwell Publishing, 2004).

[33] The areas that saw fundamental changes included industrialization, class formation, urbanization, poverty and social reform, and religious and moral thought. New societal, professional and governmental institutions began to emerge, including organized medicine, science, education, and policing. Shifts in national identity, gender roles, and sexual norms also took place. See Appendix C.12 for an overview of the literatures on many of the themes and developments related to this broad conception of the Age of Reform.

approach toward many of the fundamental political, economic, social and cultural transformations of the nineteenth century. This study seeks to correct that oversight.

1.2 CONCEPTUAL ISSUES AND ORGANIZATION: PROFESSIONALIZATION AND THE RISE OF SCIENCE

This dissertation offers an integrated social history of early-nineteenth-century naval surgeons, which tries to embrace the multilayered breadth of their educational, working and practical lives. Many previous narratives have chosen a social, practical, institutional, professional, or imperial emphasis as their focus. However, such an approach tends to miss some of the dynamic connections between larger practical, institutional, professional, and societal developments, and their effects. I hypothesize that considerations related to science fundamentally shaped surgeons' medical educations, the institutional dynamics within the medical service, and scientific and medical practice at sea. The proliferation, systematization, and professionalization of science thus affected surgeons' experiences more broadly than scholars have previously acknowledged. By employing science as a thread to integrate surgeons into the broader age, this dissertation follows them across their entire working lives.

This approach to surgeons' experiences emerged primarily from the theoretical conceptualizations of science and education that underlay this project. Questions of causation became unavoidable when considering science's multiple impacts on naval surgeons. Lawrence Dritsas' conception of the construction of scientific knowledge offers a helpful model. In regard to expeditionary science, he argues that scientific knowledge is the product of a socially shaped process of applying concepts and practices to material spaces. He emphasizes that the field-metropole distinction commonly made in the history of colonial science is arbitrary, as "No matter where our Victorian man of science may go he is still part of that community in terms of the scientific concepts he is applying."[34] Combining this conception with the stages of surgeons' careers yields a nuanced temporal view of the advancements of and impediments to scientific knowledge. The methods, conceptions, and mindset instilled by medical and scientific training provided surgeons with the intellectual and practical foundation that they carried into their careers. In the Navy, they relied on, applied, refined and reshaped these approaches. Nonetheless, personal inclinations, differences in educational background, and changing institutional, societal, and material circumstances led to differences and debates regarding scientific approaches and practices.

This conception of naval surgeons' experience and the importance of education led to this study's incorporation of prosopography and collective biography as methodological approaches. By detailing surgeons' institutional, ethnic, and educational backgrounds between 1815 and 1870, this project emphasizes the rise and ramifications of Scottish-trained surgeons' domination of naval medicine through the 1850s. This approach takes advantage of several previous imperial biographical studies, including a detailed prosopography of army surgeons during the early nineteenth century. Due to fragmented and disparate naval and medical professional records, previous efforts to quantify naval surgeons' ethnic, class, and educational backgrounds have proved only partially successful.[35] Despite facing similar limitations in identifying surgeons, prosopography proved a potent analytical method. This study employs it to describe the general trends of naval surgeons' ethnic and educational backgrounds. Medical and imperial collective

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[34] Lawrence Dritsas, *Zambesi: David Livingstone and Expeditionary Science in Africa* (London: I.B. Tauris, 2010), 40-41. See also Barry Barnes, David Bloor, and John Henry, *Scientific Knowledge: A Sociological Analysis* (Chicago: UCP, 1996).
[35] M. John Cardwell, "Royal Navy Surgeons, 1793-1815: A Collective Biography," in *Health and Medicine at Sea*, 38–62; Kaufmann, *Regius Chair*, 79-82, 143, and 225-6. For the study on army surgeons: Ackroyd, *et al*.

biographies have inspired a mixed-method approach that contextualizes naval surgeons' demography within a broader professional, national, and imperial framework than previous works. This project specifically links surgeons' demography to broader dynamics related to medical training, the professional labor market, and the Navy's practical conditions and needs.[36]

Defining the approaches to professionalization and science that have guided this project's analysis has proven to be quite challenging. In terms of professionalization, historical studies have provided a flexible framework for understanding the transition and changes occurring during the early nineteenth century. Penelope Corfield's *Power and the Professions in Britain* provided the most pertinent starting point for understanding the dynamic roles of institutions, individuals, and conceptions of power and identity. The particularities of circumstances, individuals and institutions in different cases are quite apparent, even as rising ambitions, expertise and status remain common characteristics.[37] From a theoretical perspective, the related works discussing the conceptions of and claims to competence that played a formative role in professionalization have proven most relevant. The rise of professionalized scientific competence in the nineteenth century may have been a socially and politically constructed process, but it had profound economic, material, and practical roots and implications.[38]

This dissertation also adopts a broad-ranging conceptual definition of nineteenth-century science. Science had a variety of fluid meanings depending on the circumstances, actors, and institutions involved. While a set of evolving practical approaches from which accepted

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[36] M. Anne Crowther and Marguerite W. Dupree, *Medical Lives in the Age of Surgical Revolution* (New York: CUP, 2007); David Lambert and Alan Lester, *Colonial Lives Across the British Empire: Imperial Careering in the Long Nineteenth Century* (New York: CUP, 2006). See Appendix C.13 for examples of prosopography and collective biography, as well as readings on their methodology and applications.
[37] Penelope J. Corfield, *Power and the Professions in Britain, 1700-1850* (New York: Routledge, 1995). See Appendix C.14 for an overview of the literature on the theory and history of professions and professionalization.
[38] Michael Eraut, *Developing Professional Knowledge And Competence* (Philadelphia: Falmer Press, 1994), esp. 1-3, and ch. 8; Magali Sarfatti Larson, *The Rise of Professionalism: Monopolies of Competence and Sheltered Markets*, New Ed. (New Brunswick: Transaction Publishers, 2013), 222-25, and 230-32.

standards gradually emerged, science also became a mindset and ethos for approaching one's practical work and ordering the world. As science became increasingly professionalized, specialized, and respectable, debate over its practical, philosophical, social, and political essence and meanings reinforced these developments. Given this breadth and complexity, it is helpful to consider how different theoretical and conceptual approaches to science fit into the working understanding that this project employs.

Since the rise of social history in the 1970s, recognition that the development of science was not a straightforward process of philosophical or practical application has increased. It was rather socially and politically mediated by the individuals, institutions and environments in which practitioners applied, refined, and produced scientific knowledge and approaches.[39] This constructionist conception emerged in the wake of a sustained critique of narratives focused on scientific progress and innovation. The twentieth-century "crisis of science" led to the rejection by some of a positivist narrative privileging rationality, objectivity, and factual information. Nonetheless, this can be misleading for historical analyses, as many nineteenth-century practitioners viewed science in positivist terms. They truly believed that practical scientific efforts would eventually lead to discoveries and progress in relation to a variety of practical and social issues.[40]

The conception of empirical science allows for a historical synthesis of social construction and positivist outlook. A strand of scholarship in the history of science has argued that a commitment to rigorous observation of the natural, human, and social world characterized

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[39] For the classical texts on the social construction of science, see Bruno Latour and Steve Woolgar, *Laboratory Life: The Construction of Scientific Facts* (1979, repr.; Princeton: PUP, 1986); Bruno Latour, *Science in Action: How to Follow Scientists and Engineers Through Society* (Cambridge: HUP, 1987).

[40] For the attack on positivism, see Edmund Husserl, *The Crisis of European Sciences and Transcendental Phenomenology: An Introduction to Phenomenological Philosophy*, trans. David Carr (Evanston: NUP, 1970), xxvi, and 5-11. For the positivist mindset, see Jacalyn Duffin, *History of Medicine: A Scandalously Short Introduction* (Toronto: UTP, 1999), 51-61. See Appendix C.15 for more on science, social constructivism, and positivism to.

"modern" science. The point has been that empirical scientific approaches and mindsets proliferated and held together the sciences during the nineteenth century, even as specialization rapidly increased. Furthermore, scientific meanings, interpretations and results evolved as they emerged from ongoing professional, practical, philosophical, and social debates.[41] Thomas Kuhn's theory of scientific paradigm shifts has become a leading if often criticized conception of the process that guides transitions in dominant scientific theories and conceptual systems. But when expanded in scope, it offers a way of understanding the relationships between scientific practices, evidence and knowledge, professional culture and politics, and conception and mentality.[42] In a similar vein, John Pickstone's "age of analytical science," which emphasizes observational analysis, captures the changing mentality, approaches, and practices of nineteenth-century science.[43] In terms of broader significance, empirical-analytical science served as one of the foundations for the scientific paradigm shift that culminated in the rise of laboratory experimental science from the late-nineteenth century onward.

This dissertation draws upon two ambitious approaches. First, it examines the three stages and sites that dominated naval surgeons' careers and working lives. It devotes three chapters respectively to Edinburgh and British medical education and training, the naval medical service's institutionalization and professionalization, and natural and medical scientific practice at sea during the early-to-mid nineteenth century. Chapter two examines the increasing importance of clinical, surgical, anatomical, and practical science within Edinburgh medical

[41] Efram Sera-Shriar, *The Making of British Anthropology, 1813–1871* (London: Pickering & Chatto, 2013), 12-14; Mark W. Weatherall, "Making Medicine Scientific: Empiricism, Rationality, and Quackery in Mid-Victorian Britain," *Social History of Medicine* 9, no. 2 (Aug. 1996): 175–94. See also Appendix C.15 for literature discussing empirical and observational science and medicine.
[42] Thomas S. Kuhn, *The Structure of Scientific Revolutions*, 4th Ed. (Chicago: UCP, 2012).
[43] Pickstone, *Ways of Knowing*, 10-14, and chs. 4-5; John V. Pickstone, "Museological Science? The Place of the Analytical/ Comparative in Nineteenth-Century Science, Technology and Medicine," *History of Science* 32, no. 2 (1994): 111–38. See also Appendix C.15 for considerations of scientific change and transitions.

education from 1800 through 1860. Describing the mindset and approaches instilled in those naval surgeons who received their training at Edinburgh, this approach allows later chapters to follow their scientific training and thinking into the Navy, and connect it to the rise of science. This chapter also demonstrates that the early nineteenth century was a dynamic and contentious period of change for British medical education rather than one of stagnation and decline.[44] As this chapter makes clear, factions of medical institutions, professors, students, and practitioners debated, at times resisted, and gradually embraced the increasingly empirical, practical, and scientific reorientation of medical education. The empirical scientific model that emerged at Edinburgh also proliferated throughout leading British medical schools that increasingly competed with each other. This ultimately led to a convergence of British medical education in terms of approach and quality.

The third chapter analyzes the institutionalization and professionalization of medicine within the Navy from 1815 through 1860, emphasizing the connections of these developments to broader medical professional and scientific contexts. During this period, medical officers gained increasing control over institutional policy. They implemented scientifically oriented reforms of the medical service concerned with surgeons' competence and qualifications, and surgeons' increasing professional authority. Scottish-educated surgeons' domination of the medical ranks through the early 1840s and leadership through the early 1860s illustrate the impact of medical professional dynamics on the institutional changes occurring in the service. Despite naval service's unfavorable working conditions, status, and pay, oversaturation of the domestic medical labor market ensured that the Navy received an adequate supply of qualified practitioners. Through the 1840s and 1850s, however, the Navy increasingly encountered

[44] Jacyna, *Philosophic*, 1-2; Christopher Lawrence, "The Edinburgh Medical School and the End of the 'Old Thing,' 1790-1830," in vol. 7 of *History of Universities* (New York: OUP, 1988), 259-260, and 278.

recruiting difficulties as medical students' professional ambitions generally rose. During that period, the medical service faced a surgeon and student-led reform movement that forced improvements to service conditions.

The fourth chapter analyzes naval surgeons' approach to natural scientific and medical practice at sea from 1815 through 1860.[45] It argues that surgeons applied empirical analytical scientific practices to the diverse natural, medical, and social phenomena that they encountered during service at sea. The extension of empirical scientific approaches throughout the natural, medical, and social sciences during the early nineteenth century shaped surgeons' approach to their professional duties, as well as the medical service's practical policies that reinforced and drove surgeons' efforts. Along with increasing skepticism of previous medical theory, the detailed medical journals, statistical reports, and clinical trials that developed during this period demonstrate empirical science's impact on naval medical practices. These practical developments, as well as surgeons' medical and natural scientific contributions also illustrate science's continued methodological and conceptual unity, even as practical and therapeutic results lagged behind this shift in approach.

The second part of this dissertation is a two-chapter case study that brings together the educational, institutional, and practical contexts discussed in the first three chapters by analyzing a specific medical issue with broader strategic implications that occupied naval surgeons' attention during the nineteenth century. It describes surgeons' encounters with tropical fevers due to increasing activity in and off the coast of West Africa. This analysis emphasizes their efforts to employ empirical science to address the material, practical, and intellectual problems

[45] This dissertation does not analytically emphasize scientific and medical practice in naval hospitals, dockyards and port cities due to the overwhelming source base that exists in naval medical reports, correspondence and records in the British National Archives. McLean, *Surgeons*, chs. 4-6 has presented an analysis of naval hospitals at home and abroad.

that arose during these naval operations. These chapters argue that the Navy's widespread adoption of quinine as a prophylaxis in the late 1840s and 1850s was the culmination of a contingent and often-desperate process of applying empirical scientific approaches.

These two chapters analyze the importance of these applications of empirical analytical scientific practices as the naval presence off of West Africa increased from the early-1800s onward due to the impetus of antislavery, economic and imperial policies. The seemingly continuous death and fever epidemics that befell the Navy and British colonies magnified West Africa's deadly reputation through its widespread depiction as the White Man's Grave. Surgeons increasingly became the backbone of the Navy's efforts in this inhospitable environment. The Navy's mission pressed medical officers into action to treat seamen and liberated slaves, and to respond to epidemic crises. The fifth chapter demonstrates that rather than adopting the increasing pessimism and fatalism of the White Man's Grave, surgeons gradually turned to empirical scientific practices. The sixth chapter analyzes the consequences of the more interventionist British strategy in West Africa from the late 1830s, as well as the crisis that emerged during the 1840s. During this period of conflicting humanitarian, free trade, and liberal motivations, as well as questioning of the slave trade suppression mission, empirical science reshaped tropical medical practice. Surgeons increasingly applied empirical scientific approaches of anecdotal, clinical, and statistical analysis to the fever problem. Their efforts to better understand and combat tropical fevers culminated in systematized quinine trials in the late 1840s and early 1850s. Put simply, chapters five and six offer one example of the ways in which competing political, economic, and professional interests interacted to underscore the importance of an empirical, scientific approach to each and all of these motives.

Given this thematic organization, a temporal description of the important developments that transformed the naval medical service during the early-to-mid nineteenth century will help orient readers to the transitions and processes of change running through the coming chapters. During the French and Napoleonic Wars, Scottish and Scottish-educated medical officers came to dominate the medical ranks. As naval surgeons accumulated years of service and their competence increased, their status and service conditions also began to improve. Beyond the Navy, the wars led to a boom in medical education that spurred attempts at practical and scientific reforms to curricula and training, particularly at the University of Edinburgh.

Naval medicine underwent more far-sweeping transformations after the end of the Napoleonic Wars. From 1815 through the 1820s, the naval medical service struggled to address the structural and financial burdens that accompanied demobilization. After the Admiralty placed the service under the Victualling Board in 1817, Drs. John Weir and William Burnett gained unprecedented institutional power, and instituted reforms to improve the service's structural situation and reputation within the medical profession. During the 1820s, they introduced appointment regulations that laid out rigorous, scientifically oriented educational requirements for candidates. The Navy embraced the transformation that had begun within British medical education in the 1810s and 1820s, and took advantage of the high number of practitioners educated at Scottish medical schools. The case of the University of Edinburgh illustrates that a new set of practical, anatomical, surgical, and scientific classes rose in importance, sparking debate and infighting as they challenged the existing educational model. As the Navy embraced a peacetime role that expanded its global reach, the medical service and its surgeons also faced a new set of pressures. The Navy's new operations, particularly its anti-slave-trade patrol off West

Africa, exposed its forces to trying environments. Surgeons thus increasingly confronted and desperately fought epidemic and tropical diseases.

During the 1830s and into the 1840s, the formation of the Naval Medical Department under the command of Sir William Burnett further transformed naval medicine. Burnett led the service through a period of professionalization centered around institutional, bureaucratic, and practical reforms that embraced empirical scientific standards and practices. He increased the service's practical, clinical, anatomical, and scientific requirements, instituted clinical reporting practices grounded in empirical approaches, and encouraged contributions to natural and medical scientific research. While the Navy continued to recruit many Scottish-educated surgeons, as Edinburgh and other leading medical schools fundamentally reformed their curricula and approach, practical, clinical, anatomical, surgical, and scientific training became increasingly professional expected. Meanwhile, surgeons played a prominent role in supporting the Navy's expanded commitments to slave trade suppression off West Africa, convict voyages to Australia, and exploration around the world. As they gained more experience in these environments, the practical reliance that medical officers had placed on existing medical theory, as well as bleeding and mercury treatments came into question.

During the 1840s, medical students and naval surgeons' rising professional ambitions highlighted a series of tensions and developments that reshaped naval medicine. The excess number of practitioners educated in London's hospital schools reshaped the Navy's recruitment pattern; they gained ground as Scottish representation began to decline. Medical officers' demands for improvements in their service conditions also increased, giving rise to a surgeon-led reform movement that took advantage of professional and public interest in the health of the Navy's sailors. As the Admiralty continued to resist granting concessions that would equate surgeons' status and conditions with other officers, the medical service faced increasing recruitment difficulties. Nonetheless, Burnett maintained his rigorous requirements and expectations, and expanded the scientific projects undertaken by the medical service. During this period in which the natural and medical sciences developed rapidly within Britain, he ordered and sponsored an increasing number of clinical trials and statistical reports. As public and parliamentary questioning of naval suppression of the slave trade increased, surgeons' continued scientific efforts to better understand and combat tropical fevers yielded practical shifts. Bloodletting and mercury began to fall out of favor, and quinine rose in practical prominence.

From the late 1840s through the 1850s, the ongoing transformations of the naval medical service yielded both professional and practical successes. Surgeons' demands for improved service conditions converged with the interests and rising ambitions of British medical students, leading to a partial student boycott of naval service. Facing increasing pressure from Parliament and the public, and within the medical profession during this period, the Admiralty acceded to surgeons' demands related to pay, status, and working conditions following the Navy's struggles to mobilize medical manpower during the Crimean Wars. The 1850s also saw another transition in the Navy's recruitment dynamics, as more surgeons educated at rapidly improving Irish medical schools joined the medical service and gained representation in the lower ranks. Beyond these institutional developments, surgeons' ongoing practical and scientific efforts climaxed with a clinical trial of quinine prophylaxis. Along with quinine's successful application during the 1854-55 Niger Expedition, this gave the necessary scientific backing for the widespread adoption of quinine as a prophylactic within the Royal Navy. It represented the culmination of decades of practical, institutional, and professional developments that had driven surgeons and the medical service to embrace empirical science as an ethos, mindset, and practical approach.

2.0 A CRADLE OF SCIENTIFIC SURGEONS: MEDICAL EDUCATION IN NINETEENTH CENTURY EDINBURGH, 1800-1860

Late one evening in November 1847, University of Edinburgh Professor of Midwifery and obstetrician Dr. James Young Simpson, his two assistants, sisters, and brother-in-law gathered around his dining table discussing his latest experiments. Simpson and his assistants had been searching for an alternative anesthetic to ether. They had tried various ethers, oils and gases, including acetone, benzene and iodoform without success. Simpson apparently thought of chloroform as a possibility. He retrieved a bottle from his stores, prepared three saucers, and led his assistants in the ritual of holding it over hot water and inhaling the vapors. The three became “bright-eyed, very happy and very loquacious,” then suddenly there came several successive crashes. The rest of the group saw that the three men had fallen unconscious. After a few nervous minutes, Simpson was the first to rouse. Sitting up, he saw his assistants collapsed on the floor, one snoring and the other rolling over. It was based on this shocking display of empirical self-experimentation that Simpson popularized chloroform as a surgical anesthetic in Britain.[1]

This discovery is one of the more well-known successes attributable to the empirical scientific approaches that overtook the British medical profession in the early-to-mid nineteenth century. The bold and inquisitive scientific approach that Simpson followed also reflects the fundamental scientific changes occurring in British medical education and practice. This chapter

[1] Miller, *Surgical Experience of Chloroform* (Edinburgh: Sutherland & Knox, 1848), 9-11; Walter Radcliffe, *Milestones in Midwifery and the Secret Instruments (The Birth of the Midwifery Forceps)* (San Francisco, Norman Publishing, 1989), 81.

argues that the University of Edinburgh, along with other leading British medical schools, increasingly taught its students a practical scientific mindset grounded in empirical, observational approaches. During the early-to-mid nineteenth century, Edinburgh's existing medical courses became more skill-driven at the expense of theoretical formulations, new practical courses rose in importance, and expected qualifications increased. As the preeminent British medical school at the beginning of the century, Edinburgh at times led other medical schools in making the transition to more scientific training, but also struggled to maintain its top position as leading British schools embraced empirical scientific approaches. This transition in British medical training in turn shaped the medical profession, and colonial and military medicine.[2] For naval medicine, this was significant because the large number of naval medical officers educated at Edinburgh, and many surgeons trained at other British medical schools brought scientific practical views, skills, and training into the Navy.[3] The development of Edinburgh education, and the reforms that occurred during the first half of the nineteenth century thus helps to frame this dissertation's analysis of naval medicine.

The broader changes that occurred throughout nineteenth-century British medical education, especially its increasing professionalization and rigor, exemplified and in part drove the transition that occurred at Edinburgh. Growing generational divides, as well as factional ones between physicians, surgeons, and general practitioners, made the existing model of gentlemanly liberal and theoretical education increasingly untenable. A new generation of doctors pushed for

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[2] Harrison, *Medicine in an Age*, esp. 6-7, 62-63, 120, and 290; Chakrabarti, *Medicine and Empire*, esp. ix, and 50-51; Headrick, *Power*, 226-28.

[3] For this trend: Cardwell, "Royal Navy," 40-44, and 47-50; McLean, *Surgeons*, 25; Matthew H. Kaufman, *The Regius Chair of Military Surgery in the University of Edinburgh, 1806-55* (New York: Rodopi, 2003), 79-82, and 143; The next chapter explores and situates the institutional demography of naval medicine in more detail. For preliminary analysis: Christopher H. Myers, "The Demography of Royal Navy Surgeons: Some Views on the Process of Prosopography," *Journal of World Historical Information* 2-3, no. 1 (2014-2015): 46-49, doi: http://dx.doi.org/10.5195/jwhi.2015.13.

reforms to revitalize medical education. Through intra and inter-institutional competition, British medical schools developed more extensive clinical, anatomical, surgical, and scientific training. The London hospital schools began to challenge the Scottish universities that had been dominant during the late-eighteenth century. Leading Scottish university and London hospital schools at first jockeyed, but over time converged in adopting the new model of training. By mid-century, British medical education increasingly emphasized pathological anatomy, practical medical science, and the blending of medicine and surgery.[4]

The prevailing interpretation of nineteenth-century Edinburgh medical education is that the University's medical school slowly declined from its late-eighteenth-century "golden age." This argument emphasizes the scientific innovativeness, speculation and skepticism of Scottish Enlightenment medicine.[5] Emphasizing the increasing internal turmoil in the early nineteenth century, several authors argue that Edinburgh lost its place as the preeminent British medical school.[6] When analyzed at a profession-wide scale, this argument appears to oversimplify the situation. Edinburgh's sole preeminence did disappear, but more because other medical schools modeled each other's successes. As other schools adopted new and more rigorous approaches to medical education, increasing parity emerged. Edinburgh remained a leading institution, but also gradually reformed its medical training in response to changes throughout British medicine.[7]

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[4] Peterson, *Medical Profession*, 60-66; Digby, *Making a Living*, 52-56, and 92-95. For the 1820s and 1830s, see Digby, *Making a Living*, 12-13; Waddington, *Medical Education*, 45-57, and 72-74; Derek Dow and Michael Moss, "The Medical Curriculum at Glasgow in the Early Nineteenth Century," in vol. 7 of *History of Universities*, ed. Lawrence Brockliss (Oxford: OUP, 1988), 239. For the 1840s and 1850s, see Waddington, *Medical Education*, 75-78, and 84-100. For Edinburgh: Rosner, *Medical Education*; Jacyna, *Philosophic*, chs. 3-5. See also Carin Berkowitz, *Charles Bell and the Anatomy of Reform* (Chicago: UCP, 2015).
[5] Lawrence, "'Old Thing," 260; Helen Dingwall, "The Importance of Being Edinburgh: The Rise and Fall of the Edinburgh Medical School in the Eighteenth Century," in *Centres of Medical Excellence? Medical Travel and Education in Europe, 1500*-1789, eds. Ole Peter Grell, Andrew Cunningham, and Jon Arrizabalaga (Burlington, VT: Ashgate, 2010), esp. 305.
[6] For this argument, among others, see Lawrence, "Old Thing," 259-260, and 278; Jacyna, *Philosophic Whigs*, 1-2.
[7] For a broader view: Bonner, 114-16, 132-33, 145-48, 218-19, and 244-45.

A growing historiography analyzing Edinburgh medical education's transition has already begun to qualify the "decline" thesis. Political, intellectual, and professional conflicts and infighting forced and defined the contested reform, expansion, and standardization of Edinburgh and British medical education. In Edinburgh and elsewhere, new courses, extra-mural teachers, and University professors emerged. The place and importance of surgery, anatomy, physiology, and pathology within the curriculum consequently shifted.[8] The most recent scholarship discussing innovation and reform at Edinburgh during this period has focused on military surgery and anatomy. Among these works are histories of Edinburgh as an educational center for British army surgeons, and its grisly history of anatomy, bodysnatching, and murder.[9]

To appreciate and illustrate the transition, this chapter emphasizes the rise and impact of clinical, anatomical, surgical, observational, and scientific training. By portraying Edinburgh as one of several leading schools during a period of profound change, it presents a broader connective view than many previous works. Throughout the medical profession, the importance of existing theoretical systems came into question, and skepticism regarding accepted approaches to both teaching and practice gradually increased. Empirical practical approaches gained favor. The multifaceted interaction between students' changing educational choices and demands, conservative established interests, generational replacement, and Edinburgh's position relative to the shifts in British and European medicine can shed new light on the rise of medical science. As this thesis more broadly explores in later chapters, many Edinburgh and over time more British medical students who entered the Navy embraced these empirical scientific approaches, and

[8] Jacyna, *Philosophic*, 3, and ch. 4; Rosner, *Medical Education*, part 2. See Stephen Jacyna, "Theory of Medicine, Science of Life: The Place of Physiology Teaching in the Edinburgh Medical Curriculum, 1790-1870," in *The History of Medical Education in Britain*, eds. Vivian Nutton, and Roy Porter (New York: Rodopi, 1995), 141-152.

[9] Kaufman, *Regius Chair*; Lisa M. Rosner, *The Anatomy Murders: Being the True and Spectacular History of Edinburgh's Notorious Burke and Hare* (Philadelphia: UPP, 2010); Alan Bates, *The Anatomy of Robert Knox: Murder, Mad Science and Medical Regulation in Nineteenth-Century Edinburgh* (Brighton: Sussex Academic Press, 2010).

brought them to bear on their naval work. Before analyzing these new approaches, this chapter begins by examining the gradual change that occurred in Edinburgh's established curriculum.

2.1 EMPIRICAL SCIENCE AND THE CORE CURRICULUM, 1800-1860

In 1800, British university medical education's traditional goal of producing liberally educated gentlemanly physicians lingered. Curricula continued in their traditional form despite the ongoing break down of the distinction between physicians and surgeons.[10] Cambridge and Oxford relied on their classical and liberal education, forcing many of their students to take extra-curricular medical classes at other medical schools. While five established London's hospital schools offered new and expanding opportunities for clinical experience, the Universities of Edinburgh, Glasgow and Dublin offered the most extensive medical training. Among these leading British medical schools, Edinburgh remained the largest and most prestigious, even as its old theory-based classes remained in place.

The University of Edinburgh's curriculum was still centered around a group of existing core classes: Practice of Medicine, Institutes of Medicine, Chemistry, Materia Medica, Anatomy & Surgery, and Clinical Lectures. Those students pursuing Edinburgh's medical degree had to attend six months of lectures in each of these classes before writing their dissertations in Latin.[11] In 1800, however, the medical degree was still far from required to practice medicine in Britain. As Lisa Rosner has found, many students chose to attend these Edinburgh courses but did not pursue the medical degree, instead qualifying for professional licensure. Another group of

[10] Charles Newman, *Evolution of Medical Education in the Nineteenth Century* (New York: OUP, 1957), esp. 77.
[11] Rosner, Medical Education, esp. 63; Alexander Morgan, ed., University of Edinburgh, Charters, Statutes, and Acts of the Town Council and Senatus Academics (Edinburgh: Oliver and Boyd, 1937), 253.

students took a few classes at Edinburgh, and completed their training at other schools. Despite this variation, the core classes remained the most institutionally powerful, as their professors alone held the rights accorded to full members of the Medical Faculty. These included lifetime tenure, as well as the power to examine candidates for the medical degree, and to vote in Medical Faculty and Academic Senate meetings. During the first half of the nineteenth century, the power that the established, core professors held became a subject of contention and target for reform.

In the first decade of the century, the University kept several existing and added new elective classes within the medical school, including Natural History, Midwifery, Clinical Surgery, Military Surgery, and Medical Jurisprudence. General Surgery, Pathology, and Practical Anatomy courses followed in the coming decades. The core professors ensured that these classes remained secondary electives, and that their teachers did not gain full faculty rights. While the existing classes faced growing skepticism regarding the applicability of medical theory, the secondary classes offered more practical and clinical teaching, increasingly incorporating dissection, anatomical pathology, and practical surgery. These new approaches faced resistance from professors, practitioners, and institutions invested in the existing system, and only gradually began to shape the established fields. In response to the limited changes in Edinburgh medical training, surgeons and anatomists began to teach medical classes outside the University. From the 1810s onward, many medical students chose to take more highly regarded and practically oriented anatomy and surgery classes from these extra-mural lecturers. Some students also travelled to Glasgow, London, and, after 1815, Paris for additional training.[12]

By the 1840s and 1850s, the tensions present in Edinburgh medical education had sparked an era of reform that led to a scientific transformation and reorganization of Edinburgh's

[12] Rosner, *Medical Education*, 12-19; Lawrence, "Old Thing," 263; Loudon, *Medical Care*, 51-52. See also Newman, 1-25; Bonner, 39-42, and 48-52.

curriculum and requirements. Clinical, surgical, and anatomical approaches first developed and refined in Continental clinical medicine reshaped Edinburgh's curriculum, as the secondary practical, clinical, and scientific medical classes that taught empirical skills became required for the medical degree and expected across the profession. As a result, the secondary medical classes' professors became full faculty members. The rising importance of empirical scientific methods also gradually led to modest changes in the Practice and Institutes of Medicine, Chemistry, and Materia Medica classes. Although individual professors began to embrace the coming rise of experimental approaches from the 1840s onward, the new practical, clinical, and scientific system that had emerged held significant staying power.

The endogenous and exogenous forces that drove the transformation of Edinburgh and British medical education recur throughout this chapter. As tensions between the established professors, and a younger generation of medical students, general practitioners, and surgeons grew, students' educational choices and generational turnover among the professors were the most significant endogenous factors. Students decided which classes and teachers to attend based on their varying quality, rigor, and approaches, as well as broader professional expectations.[13] While Edinburgh's culture welcoming dissenting students, lack of entrance requirements, and practical and scientific offerings drew students from across the British world, some professors defended the primacy of the existing classes taught "altogether by Lectures."[14] Since professors' salaries came from student fees, however, they depended on the ability to convince students to take their courses. Due largely to this economic reality, the intellectual conservatism and institutional self-interest of the older generation of core professors was unsustainable. The

[13] Rosner, *Medical Education*, esp. 61, 176, and 185.
[14] Rosner, *Medical Education*, 23-24; Bonner, 64; Alexander Morgan, "Matriculates in the Faculty of Medicine Prior to 1858," *University of Edinburgh Journal* 8, no 2 (1936-37): 125; Francis Darwin, ed., *The Life and Letters of Charles Darwin: Including an Autobiographical Chapter*, vol. 1, (London: John Murray, 1887), 32-33.

shifting views of students and practitioners regarding medical training and practice thus forced professors to consider rising demands for more clinical, practical, and scientific training, as well as both modest and extensive changes to the curriculum and their teaching.[15]

Meanwhile, Edinburgh and British medical professors, practitioners, and students also had to respond to a series of broader exogenous factors that pushed for scientific reform of medical training. Continental medicine, British surgery, and natural science, each of which embraced new practical, clinical, anatomical, and scientific approaches, drove changes in British medical education. This resulted in increasing demands, gradual institutional reforms, and rising competition between medical schools.[16] As the leading institutions followed each other in introducing reforms so as to avoid falling behind, students' and the profession's expectations continued to increase. Aberdeen and St. Andrew's Universities and more hospital schools in London and Dublin all adopted the new model. As a supplier of professors who taught in many British medical schools, Edinburgh's influence and ideas spread throughout the profession.[17]

The fruits of this complex web of factors only emerged gradually and turbulently over several decades. Analyzing Edinburgh's classes, and the changes in what and how they taught students elucidates the transition that occurred in Edinburgh and British medical training. Later chapters investigate how the rise of scientific approaches in medical education shaped naval medicine. Before that, the first section of this chapter analyzes the modest changes in the established, core medical classes from the 1800s through the 1820s, and then investigates the more significant reforms that occurred from the 1830s onward. It demonstrates that increasing skepticism of rigid applications of medical theory led to a rising emphasis on empirical practical

[15] Rosner, *Medical Education*, 45-46; Lawrence, "Old Thing," 261-63.
[16] Waddington, *Medical Education*, 69-74, and 76-78; Maulitz, chs. 1, 6, and 9.
[17] Anand C. Chitnis, "Medical Education in Edinburgh, 1790-1826, and Some Victorian Social Consequences.," *Medical History* 17, no. 2 (Apr. 1973): 180-84.

knowledge and skills in these core classes. By the 1830s, the new approaches to anatomy and pathology, discussed extensively in later sections, also began to reshape the content and approaches of these existing classes.

The heart of Edinburgh's traditional medical curriculum was Practice of Medicine and Institutes of Medicine, which remained the most prestigious classes due to their importance as practical foundations. Practice of Medicine still analyzed the application of the dominant theoretical system for understanding disease pathology, including causes, symptoms, prognosis, and cures. It dissected competing neo-humoral explanations, as well as schemes for classifying diseases into classes, orders and genera. Professor Dr. John Gregory structured the course by grouping diseases based on symptoms and causes. According to one student, the approach "left us with the impression that we were to be masters over nature in all such diseases— that they must of necessity give way before the physician who is early enough and bold enough in encountering" them.[18] Embracing skepticism regarding the rigid use of theoretical systems, this approach helped develop students' clinical observational and analytical comparison skills.[19]

This skepticism regarding theory, however, threatened to undermine Practice of Medicine's position as the foundational class. Given the pressure from shifts occurring throughout Europe, by the 1820s, Professor Dr. James Home felt that there was "no work under the name of a system which it would be safe to recommend in an unqualified manner." He instead taught major diseases separately, covering "all the well authenticated facts… which

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[18] Gregory: Professor (pre-1800-21). For Edinburgh professors, see Appendix B, and John D. Comrie, *History of Scottish Medicine*, vol. 2 (London: Baillière, Tindall & Cox for the Wellcome Historical Medical Museum, 1932), 628-31. Rosner, *Medical Education*, 52; William Forbes, "Notes from Lectures on the Practice of Physic Delivered by James Gregory," 1812-13, EUL CRC, GA, Gen.691D-693D, Vol. 1, f. i-vii; John Desmond, "Dr. Gregory's Lectures on the Practice of Physic," 1818-19, NLS, MS. 9736, f. 1-8. For the quote: Christison, *The Life of Sir Robert Christison*, ed. His Sons, vol. 1 (Edinburgh: William Blackwood & Sons, 1885), 79.

[19] Christison, *Life*, vol. 1, 81; Christison, "Notes from the Lectures on the Practice of Physic of Dr. James Gregory," 1816-17, RCPEdL, DEP/CHR/1/1, f. 4; Forbes, EUL CRC, GA, Gen.691D-693D, vol. 1, f. 2-3.

appears to be approved of by experience." This approach was at best a compromise. While it put emphasis on the new balance between observation, diagnosis, and experience, the practical focus remained on external symptoms. Home still did not follow Continental teachers who began to emphasize internal pathological changes based on dissection.[20] Those professors who looked to Continental medicine for inspiration, including Home's successor Dr. William P. Alison, cautiously embraced the practical necessity of a working knowledge of physiology and pathology beyond general anatomy. Beyond this, Alison also adopted the Continental approach of combining lecture classes and clinical attendance to develop observational skills and practical expertise.[21] The shift that occurred in the teaching of anatomy and pathology, discussed later in this chapter, helped to inspire these changes in Alison's approach to teaching medicine.

By the turn of the nineteenth century, the Institutes of Medicine class that taught the theories of life and disease from a neo-humoral perspective was also in flux and crisis. Although several new pathological theories emerged between the 1780s and early 1800s, they too remained grounded in humoral theory. The most significant and exemplary was the nervous theory, which attributed disease to disruptions in the balance of nervous energy arising from excesses and deficiencies in external stimuli. Like humoral theory, which focused on bodily functions, doctors saw these imbalances as impairing the nervous system.[22] After taking over the class in the early 1820s, Dr. Alison's outlook reflected the scientific transition occurring in

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[20] Home: Professor (1821-42). Rosner, *Medical Education*, 56; Christison, *Life*, vol. 1, 76-77; Alexander Bower, *The Edinburgh Student's Guide, or an Account of the Classes of the University* (Edinburgh: Waugh and Innes, 1822), 65-67. For the broader shift: Bonner, 146.

[21] Alison: Professor of Medical Practice (1842-55). Alison, *Dissertation on the State of Medical Science From the Termination of the Eighteenth Century to the Present Time* (London: Marchant, 1834), 2; Alison, "Introductory Lecture on the Institutes or Theory of Medicine," c. 1840s, ed. 1861, RCPEdL, DEP/AWP/5/3/10, f. 1-4.

[22] The focus on nervous energy emphasized concepts of debility and excitement. Examples include the Brownian system that emerged in Edinburgh in the 1780s and 1790s, and more generalized nervous theories that emerged in the nineteenth century. Guenter B. Risse, "The Brownian System of Medicine: Its Theoretical and Practical Implications," *Clio Medica*, 5 (1970): 45-51; Michael Barfoot, "Brunonianism Under the Bed: An Alternative to University Medicine in Edinburgh in the 1780s," *Medical History*, supplement no. 8 (1988): 22–45.

pathology and British medicine. He believed that theory was a means of arranging and making sense of experience, and setting guidelines for the material and social practice of medicine.[23] Alison's class thus embraced experience, observation and reasoning alongside the new French anatomical approach to pathology. By the late 1820s, Alison and two extra-mural lecturers had redesigned Institutes courses around this approach.[24] Rejecting a neo-humoral tack, these classes now emphasized physiological understandings of life based on textures, tissues, and systems. They also viewed pathological changes rather than theory as the ideal basis for practice.[25]

Despite the change to these two core classes, which laid the foundation for medical practice, many of the medical professors continued to resist adapting their classes to the Continental physiological and pathological approach. Nonetheless, the Institutes class underwent a significant change from 1831, when Pathology became a separate class. From that point, Alison restricted his Institutes class to an in-depth investigation of physiology and the scientific basis of life. He then embraced and focused on expanding understandings of the conditions of life, the nervous system, and the functions of bodily fluids and solids. Alison saw physiology as the leading edge of medical science, developing and testing new ideas and theories grounded in relationships of scale between textures, organs, and systems.[26] By the 1840s, his successor, Dr. Allen Thomson, further emphasized applied anatomy as the basis of physiology. His course thus

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[23] Alison: Professor of Institutes of Medicine (1821-42). Alison, "Reasons for Doubting the Doctrine of Nervous Energy in Relation to Involuntary Muscles," c. 1813, RCPEdL, DEP/AWP 5/1/102; Alison, "Introductory Lecture on the Institutes of the Theory of Medicine," c. 1820s, ed. 1860, RCPEdL, DEP/AWP/5/3/1. See also Christopher Hamlin, "William Pulteney Alison, the Scottish Philosophy, and the Making of a Political Medicine," *Journal of the History of Medicine & the Allied Sciences* 61, no. 2 (Apr. 2006): 144-86.

[24] Alison, "Heads of Physiology and Heads of Pathology," c. Late 1820s, RCPEdL, DEP/AWP 5/1/118. For the spread of "French" physiology and pathology, see Maulitz, esp. 113-14; W.R. Albury, "Experiment and Explanation in the Physiology of Bichat and Magendie," *Studies in the History of Biology*, no. 1 (1977): 47-131. For extra-mural courses, see Lawrence, "Old Thing," 272; David Ellis, ed., *Memoir of the Life and Writings of John Gordon, M.D. F.R.S.E.* (Edinburgh: Archibald Constable & Co., 1823), 104.

[25] Lawrence, "Old Thing," 272; Jacyna, *Philosophic*, 137-39; Bonner, 145-46, and 154.

[26] See Alison, "Heads of Physiology and Heads of Pathology"; Alison, *Dissertation on Medical Science*, esp. 1. For the old guard that resisted the new approach to physiology and pathology: Bower, 55-56, 59, and 63; Christison, *Life*, vol. 1, 76; Rosner, *Medical Education*, 52-53; Lawrence, "Old Thing," 271.

highlighted even more clearly the roles of bodily systems and textures in physiological functions.[27] The Institutes class and its teaching of physiology thus followed a clear evolution, as knowledge based on practical anatomy overtook the theory-driven humoral approach.

During the 1850s, Professor Dr. John Bennett presided over another shift in Edinburgh's teaching of physiology by incorporating laboratory and experimental approaches. Beyond presenting theories and definitions of life, his course dissected bodily structures and traced their functions based on minute anatomy and histology. Building outward from the cellular level, Bennett connected the roles of tissues, organs, and systems to processes such as nutrition, innervation, and reproduction.[28] He also introduced an elective laboratory class in practical histology to investigate the structure of vegetable and animal tissues. This was presumably based on the belief that histological processes underlay bodily operations. His was Britain's first practical class in histology, clinical microscopy, and laboratory teaching. Furthermore, by the 1860s, Bennett had transformed this class on laboratory experimental physiology into one that blended together practical physiology and histology.[29] He was the one of the Edinburgh professors who most enthusiastically and successfully embraced experimentalism in his teaching.

While scientific medical education gradually embraced physiology, there was less change in the approach to the Materia Medica class, which focused on the practical uses of drugs and other healing agents. The course took a more theoretical schematic approach to teaching therapeutics, ignoring the practical act of mixing and preparing drugs, known as compounding.

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[27] Thomson: Professor (1842-48). Jacyna, *Philosophic*, 168-71; A. Thomson, "Handwritten Introductory Lecture Regarding the Institutes of Medicine," 1842-43, GUL SC, MS Gen 1476/A/2857, f. 1-2; and "Manuscript Lectures on Physiology," 1832, MS Gen.170, vol. 1, f. 10, and f. 38-40.
[28] Bennett: Professor (1848-post-1870). William Stirling, "Notes of Lectures on Physiology by John Hughes Bennett," 1869-1870, NLS, MS.9165, f. 1-2.
[29] Bennett was a pioneer in histology, giving the first cellular description of leukemia. Bonner, 148, 244-45, and 262; Anon, *BMJ* (Oct. 9, 1875): 373-78; Bennett, "Histology Lecture Notice," 1842, EUL CRC, GA, Gen.2007/1; and, "Outline of a Course of Lectures on Histology," 1842, Gen.2007/4, 1-8.

During the early decades of the century, it slowly transitioned from schematically analyzing the uses of the various classes of therapeutic agents to focusing more on common practices related to treatments. By the 1820s, Professor Dr. Andrew Duncan Jr. also incorporated case descriptions and specimen exhibitions into his materia medica lectures.[30] Through mid-century, Dr. Robert Christison took an even more holistic approach, addressing the factors affecting treatments, including diet, lifestyle, drugs, and operations. While discussing how remedies operated, he reminded students that knowledge of therapeutics was still largely empirical. The teaching of Materia Medica thus made a similar transition to that of medical practice, physiology and pathology, emphasizing experience and skills over theoretical dogma.

In 1800, the Chemistry class also struggled to strike a new proper balance between theory, judgment, observation, and experiment. Nonetheless, the field's scientific expansion throughout Europe made it popular among British students.[31] Professor Dr. Thomas C. Hope emphasized his course's practical utility in understanding natural and physiological phenomena. His lectures on pneumatic chemistry investigated the properties and chemical actions of elements, molecules, and compounds based on reactions. Hope also performed "the most splendid and beautiful experiments upon the different gases… [to] impress the audience with a love to the science."[32] By the 1830s, he further emphasized experimental demonstrations, arguing that chemistry was most successfully practiced based on observable phenomena and

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[30] Duncan Jr.: Professor (1821-32). For Home's tenure: Rosner, *Medical Education*, 56; Christison, *Life*, vol. 1, 76-77; Bower, 52. For Duncan: Desmond, 27; Archibald John Primrose, and Royal Commissioners for Visiting the Universities of Scotland, "Evidence, Oral and Documentary, Taken and Received by the Commissioners Appointed by His Majesty George IV. July 23rd, 1826; And Re-Appointed by His Majesty William IV, October 12th 1830; For Visiting the Universities of Scotland. Volume 1. University of Edinburgh," *PP*, 1837(92): xxxv, 1, p. 220.

[31] Rosner, *Medical Education*, 49; Bower, 41; Jack B. Morrell, "Practical Chemistry in the University of Edinburgh, 1799-1843," Ambix 16, no. 1-2 (July 1969): 66-80; Todd Timmons, *Makers of Western Science: The Works and Words of 24 Visionaries from Copernicus to Watson and Crick* (Jefferson, SC: McFarland, 2012), 107-21.

[32] Hope: Professor (pre-1800-44). Bower, 43; Anon, "Notes on Lectures on Chemistry Delivered by Dr. Hope," 1810-1811, NLS, MS.2768, f. 4-6. For quote: Bower, 43-44. See also Traill, *TRSE* 16 (1849): 433; George Wilson, and Archibald Greikie, *Memoirs of Edward Forbes, F.R.S.* (Edinburgh: Edmonston & Douglas, 1861), 98-99.

facts. He increased the number and range of demonstrations that he performed, and gave more time to discussing practical applications than he had at the turn of the century.[33]

Because Hope declined to teach a separate practical chemistry elective class, students demanded that he and his assistants provide more hands-on opportunities. In 1815, twelve students met weekly on their own to carry out the experiments demonstrated in Hope's lectures.[34] By the late 1820s, one of Hope's assistants, Dr. David B. Reid, offered a practical chemistry course that capitalized on growing student demand. His classes allowed students to recreate Hope's demonstrations, while he explained the principles and processes behind them.[35] Furthermore, Reid broadened the horizons of those students who chose to take his class, emphasizing practical chemistry's broader applications to agriculture, geology, the practice of medicine, and pharmacy.[36] His classes represented the earliest successful formal laboratory teaching in Edinburgh, and were crucial in popularizing the empirical and experimental scientific mindset among students. For decades, however, innovation in the established classes, including Chemistry, continued to depend too much on extraordinary teachers rather than epistemological or pedagogical changes to their approaches. Chemistry at Edinburgh began to fall behind the classes offered at the leading Scottish universities and London hospital schools during the 1840s, since it remained reliant on lectures and demonstrations. While Hope's successors synthesized

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[33] Hope, "Introductory Lecture in Chemistry," c. 1825, EUL CRC, GA, Gen.271/120, f. 6; and 1829, Gen.271/123. f. 2; Anon, "Notes on Lectures on Chemistry," NLS, MS.2768, f. 3-4; E.H. Bennett. "Outlines on a Course of Lectures on Chemistry Delivered by Dr. Hope," 1822-1823, Gen.746D, f. i-viii, and 1.

[34] Christison, *Life*, vol. 1, 57-59; W.P. Doyle, "Thomas Charles Hope," University of Edinburgh, last modified 2014, accessed Dec. 5, 2014, http://www.chem.ed.ac.uk/about-us/history-school/professors/thomas-charles-hope.

[35] Reid taught the class from 1828-47. In 1833, he unsuccessfully petitioned for the creation of a Chair of Practical Chemistry. Wilson, and Greikie, 101; Hope, "Introductory lectures in Practical Chemistry," c. 1830, EUL CRC, GA, Gen.271/118, f. 1-4. See Morrell, "Practical Chemistry," 66-80; David Boswell Reid, *A Memorial to the Patrons of the University on the Present State of Practical Chemistry* (Edinburgh: Neill & Co., 1833).

[36] Reid was a well-known applied chemist known for his charcoal and lime chlorate ventilation systems. Hope, EUL CRC, GA, Gen.271/118, f. 4. See Henrik Schoenefeldt, "The Temporary Houses of Parliament and David Boswell Reid's Architecture of Experimentation," *Architectural History* 57 (2014): 175-215.

research from across Europe, particularly the work related to organic chemistry, their efforts lobbying the university for resources to start a practical chemistry class were unsuccessful.[37]

One of the principle weakness of Edinburgh's core courses at the start of the century was that only the Clinical Lectures employed clinical teaching based on observing patients. Although professors began to emphasize empirical approaches and incorporate more practical teaching, lectures remained the dominant pedagogical method. Nonetheless, the Clinical Lectures also had significant limitations. Eighteenth-century Edinburgh had been the first British school to introduce a clinical class that offered the opportunity to observe practicing physicians and patients in the Royal Infirmary. But success had bred complacency. By the mid-1820s, many French and Germanic hospitals and clinics had moved toward clinical teaching that relied more heavily on bedside training and examining living patients. The clinical teaching at London hospitals had also become slightly more clinical. In comparison, Edinburgh's Clinical Lectures remained comparatively overcrowded and dominated by expository commentary.[38] By the early 1830s, an informal change had occurred, as some Edinburgh professors allowed students to stay after class to walk the wards.[39] This helped to slightly increase the scope of students' knowledge beyond the classroom, and began to fill gaps in the practical curriculum. That many Edinburgh

[37] William Gregory: Professor (1843-58) and Dr. Lyon Playfair: Professor (1858-68). W.P. Doyle, "Lyon Playfair," University of Edinburgh, last modified 2014, accessed Dec. 7, 2014, http://www.chem.ed.ac.uk/about-us/history-school/professors/lyon-playfair; and "William Gregory," http://www.chem.ed.ac.uk/about-us/history-school/professors/william-gregory. For Gregory: Alison, *PRSE* 4 (1862): 121-22. For Playfair: Wemyss Reid, ed., *Memoirs and Correspondence of Lyon Playfair* (London: Cassell, 1899), 12-28, and 183-85.

[38] For the 18th century: Rosner, *Medical Education*, 54, and 228; David Hamilton, *The Healers: A History of Medicine in Scotland* (Edinburgh: Canongate, 1981), 125; Guenter B. Risse, *Hospital Life in Enlightenment Scotland: Care and Teaching at the Royal Infirmary of Edinburgh* (New York: CUP, 1986), 240-78. For the 19th century: Bower, 74; Rosner, *Medical Education*, 53. For London: Bonner, 114-16, and 132-33; Loudon, *Medical Care*, 51-52; Adrian Desmond, and James Moore, *Darwin: The Life of a Tormented Evolutionist* (1991; repr., New York: Warner Books, 1991), 27.

[39] For rising attendance: Rosner, *Medical Education*, 53; Bonner, 115. For increasing hospital attendance requirements: Anon, *Lancet* 72, no. 1830 (1858): 334; Anon, *Lancet* 84, no. 2142 (1864): 339-40.

students also pursued further clinical experience by walking the wards in London and European hospitals suggests that such modest opportunities did not meet student demand or expectations.[40]

The education that those students who took the core medical classes at Edinburgh in the mid-nineteenth century received was quite different from their predecessors who attended at the turn of the century. By 1800, the more schematic and theory oriented approach of Edinburgh's core medical courses had begun to break down. They slowly underwent a transition toward emphasizing observational and rational empirical skills, and practical experience. This shift resulted primarily from changes in teaching introduced by the classes' individual professors. Despite the University's and professors' long-standing institutional and intellectual conservatism, a new generation of professors spearheaded conceptual and practical changes. The spread of empirical scientific medicine and the shift in the teaching of anatomy, pathology, and physiology in Continental and British medicine convinced these professors to adopt new approaches in their classes, gradually transforming the core subjects. This led to a definitive shift in which theory gave way to practical skills as the focus of the core classes.[41] Nonetheless, there were limits to the reforms that occurred in Edinburgh's existing medical curriculum. Lecture-based teaching maintained a prominent role even as practical and clinical teaching increasingly overtook the existing pedagogical approach. The remainder of this chapter investigates the rising importance of new classes in and approaches to anatomy, surgery, and practical science, emphasizing the role that they played in the scientific transition within Edinburgh's curriculum.

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[40] Rosner, *Medical Education,* 54; Bonner, 116; Christison, "Notes and Lectures on Clinical Ward: Concluding Lecture," 1835-36, EUL CRC, GA, Dk.4.56/1, f. 1. See also J. Thomson, "Diary of John Thomson's Travels to His Wife," 1814, NLS, MS.9235, f. 1-40; J. Thomson to Thomas Thomson, Aug.-Sept. 1814, NLS, MS.9236, ff. 24-51; James Surrage, *Walking the Paris Hospitals: Diary of an Edinburgh Medical Student, 1834–1835,* ed. Diana E. Manuel (London: Wellcome Trust Centre for the History of Medicine at UCL, 2004).
[41] Rosner, *Medical Education*, 162-64.

2.2 ANATOMY, SURGERY, AND PRACTICAL SCIENCE, 1800-1825

The early nineteenth century was fraught with conflicts related to training in anatomy, surgery, and practical science. Between 1800 and 1830, anatomy and surgery transitioned from peripheral to central subjects within Edinburgh's curriculum, and specialized practical classes rose in importance. A younger generation of professors with surgical backgrounds reformed existing courses and introduced new practical ones. These new university electives and extra-mural classes made Edinburgh medical education more practical and scientific. They often led the way in bringing scientific approaches into Edinburgh and British medical training. Whereas medical and surgical students had previously received separate educations, they now took a similar course of training. Consequently, surgeons capitalized on the success of their efforts to reform the curriculum, pushing for increased professional status within the University and medical community.[42] By the mid-1830s, anatomical, surgical, and practical training had become required for the Edinburgh degree, and henceforth became expected throughout the profession.[43]

This transformation, however, was the result of several decades of upheaval, infighting and transition. The Medical Faculty had incorporated surgery as an "add-on" to the Anatomy course to forestall the Royal College of Surgeons' calls for the foundation of a University surgery chair in the 1770s. By the early nineteenth century, the University's approach to anatomy and surgery had become unsustainable. The Anatomy & Surgery class was one of the most unpopular at Edinburgh. According to a former student, its longstanding instructor, Professor Dr. Alexander Monro III, "betrayed an unimpassioned indifference" toward teaching, which turned

[42] The Royal College of Surgeons introduced its own classes, and began requiring university courses to raise surgeons' status. Rosner, *Medical* Education, 93, 96-97, 102, and 142-48; Jacyna, *Philosophic*, 82. For anatomy and surgery, see also Lawrence, "Old Thing," 263-70; Dingwall, 315-21.

[43] For one view of Edinburgh science, see Stephen Shapin, "'Nibbling at the Teats of Science': Edinburgh and the Diffusion of Science in the 1830s'," in *Metropolis and Province: Science in British Culture, 1780-1850*, eds. Ian Inkster, and Jack Morrell, (Philadelphia: UPP, 1983), 151–78.

students off anatomy. Former pupil Charles Darwin concurred: Monro "made his lectures on human anatomy as dull as he was himself."[44] Monro's lectures provided hyper-detailed presentations of general anatomy that emphasized function, spatial relations, and pathological changes. His cursory treatment of practical anatomy and surgical operations, most likely due to his lack of surgical expertise, however, drew increasing student criticism. As the profession inexorably moved toward a closer linkage between anatomy, pathology, and medical and surgical practice, Monro's shortcomings became glaringly evident.[45]

The increasing demand for surgical education during the Napoleonic Wars enabled several extra-mural teachers to compete with Monro beyond the University. With the Royal College of Surgeons' support, James Russell taught clinical surgery from the late 1780s onward, and John Thomson started teaching general and military surgery in 1803-04. Beyond national utility, Russell and Thomson's classes appealed to surgeons' desire to challenge the University's monopoly over the formal teaching of surgery.[46] Russell's class focused on practical skills, emphasizing rational observation, diagnosis, and decisions regarding when to employ operations.[47] Thomson focused in greater detail on the pathology underlying surgical practice, diseases, and operations. From the 1810s onward, his emphasis on inflammation as a pathological concept resulted in a lifelong project of synthesizing pathological ideas from British

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[44] Alexander Monro III: Professor of Anatomy & Surgery (1800-31), and Anatomy (1831-46). Rosner, *Medical Education*, 47-49, and 149; Darwin, 46-47; Christison, *Life*, vol. 1, 69.

[45] Rosner, *Medical Education*, 149-50; Lawrence, "Old Thing," 265-66; B. Lindsay, "A Course of Lectures Upon Surgery Delivered by Alexr Monro," c. 1774-1775, RCPEdL, DEP/LIB/1, f. 21; Anon, "Surgical Notes Taken from the Lectures of Dr. Monro During Spring 1808," RCSEdL, BS.03, f. 13-17.

[46] Rosner, *Medical Education*, 59, 137, and 151; Jacyna, *Philosophic*, 85-88; Kaufman, *Regius Chair*, 10, and 58-60; Monro III to Hugh Scott, c. 1800, RCSEdL, GD/100/27; Hamilton, "Case of the University in Relation to the Institution of a Professorship of Surgery by the Royal College of Surgeons," 1804, EUL CRC, GA, Dc.1.5, f. 4.

[47] Rosner, *Medical* Education, 149-150; Jacyna, *Philosophic*, 85-86; Christison, *Life*, vol. 1, 89; Hamilton, "Case," Dc.1.5, f. 6; Ja. Russell, "Surgical Casebook," 1787-90, RCPEdL, DEP/RUJ/1/2, f. 3-4, and DEP/RUJ/1/5, f. 3; Anon, *The Medical Calendar or, Student's Guide to the Medical Schools in Edinburgh, London, Dublin, Paris, Oxford, Cambridge, Glasgow, Aberdeen, and St. Andrews* (Edinburgh: MacLachan and Stewart, 1828), 44.

surgical and French tissue-based pathology.[48] By comparison, Monro clung to an outdated gentlemanly and scholarly approach to an increasingly dynamic and changing field.

Russell and Thomson ultimately convinced the Crown to create two surgery chairs at the University. In 1803, Russell gained a commission as Professor of Clinical Surgery. His success spurred Midwifery Professor Dr. James Hamilton, who was unhappy with the secondary place of his course, to recommend that the Royal College sponsor a competing general surgery course.[49] Hamilton's campaign caught the Medical Faculty off guard. Stunned by their colleague's personal attacks, the professors could not decide how best to respond to Russell and Hamilton's criticisms and proposals. The Royal College took advantage of the University's indecision, sponsoring Thomson's surgery classes as a counter to the danger of Monro's monopoly. This allowed his surgical teaching to become more holistic, and challenge the boundaries between medicine and surgery based on their practical interconnections.[50] When the Whig government came to power in 1806, Thomson convinced it to commission a Chair of Military Surgery.[51] His military surgery lectures covered material that received limited coverage in other surgery classes, including the pathology, treatments and operations of violent wounds, hygiene, and accommodation and hospital design. This specialized approach helped to cement Edinburgh

[48] Jacyna, *Philosophic*, 87-88, and 98; Kaufman, *Regius Chair*, 61-63; Anon, "Notice of Some of the Leading Events in the Life of the Late Dr. John Thomson," in *An Account of the Life, Lectures, and Writing of William Cullen*, ed. J. Thomson (Edinburgh: Blackwood & Sons, 1859), Vol. 1, 39-43. For inflammation: J. Thomson, *Lectures on Inflammation* (Edinburgh: William Blackwood, 1813), esp. 31.

[49] Russell: Professor (1803-33). Jacyna, *Philosophic*, 85-86, and 93-95; Rosner, *Medical Education*, 137, and 150; Kaufman, *Regius Chair*, 10; Bower, 73-76; Ja. Russell, "Memorial in Favour of the Erection of a Clinical & Pathological Professor of Surgery at the University of Edinburgh," c. 1802, EUL CRC, UA, La II 500, f. 1-3. For Hamilton's proposal: Hamilton, Dc.1.5, 17-18.

[50] Rosner, *Medical Education*, 151-152; Jacyna, *Philosophic*, 89; Kaufman, *Regius Chair*, 58-60; J. Thomson, "Lectures on Practice of Surgery," 1809-10, RCPEdL, DEP/THO/1/3, Lecture 4, Nov. 1.

[51] Jacyna, *Philosophic*, 91, and 93-95; J. Thomson to the Army Medical Board, "Concerning Proposal to Give Lectures at the Royal College," 1804, GUL, SC, MS Gen 1476/C/3/25; Royal College of Surgeons of Edinburgh, "Extract from the Records of the Royal College of Surgeons," 1805, MS Gen 1476/C/3/43.

students' domination of the military medical services' ranks during and in the decades following the Napoleonic Wars.[52]

At the same time, a similar shift occurred in anatomical teaching. During the early 1800s, a comparative anatomical approach centered on demonstration, classification, and spatial relations gave way to approaches emphasizing general organization and function. Morbid anatomy shifted toward dissection, and to findings applicable in pathology, diagnosis, and practice. The new morbid anatomy originated in late-eighteenth century Paris. While the long conflict with France was initially an impediment to its spread, some London and Edinburgh anatomists and surgeons pursued teaching and research through dissection.[53] Here again, Monro faced criticism. His reliance on demonstrations came under scrutiny, as critics emphasized the inadequacy of the limited number of low-quality cadavers that he dissected at the front of an enormous lecture hall. As students searched for alternative training, Monro's poor teaching justified the existence of extra-mural anatomy teachers outside the University.[54] Among them was surgeon-anatomist John Barclay who taught the most popular practical class based on dissection.[55] By the 1810s, Barclay also taught comparative anatomy using a large collection of zoological and human specimens, including his prized elephant skeleton.[56] As most students found extra-mural classes superior, enrollment in Monro's university course declined.

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[52] Jacyna, *Philosophic*, 117; Kaufman, *Regius Chair*, 65-68; J. Thomson, "Notice for Lectures on Military Surgery," 1805, GUL SC, MS Gen 1476/C/5/15; J. Thomson, "Unbound Lecture Notes," c. 1805, GUL SC, MS Gen 1476/C/5/1, f. 1-3; J. Thomson, "Lectures on Military Surgery," c. 1810, RCSEdL, BS.03.

[53] See Bonner, 145; Maulitz, chs. 1-2; Toby Gelfand, "The 'Paris Manner' of Dissection: Student Anatomical Dissection in Early Eighteenth Century Paris," *Bulletin of the History of Medicine* 46 (1972): 99-130.

[54] Lawrence, "Old Thing," 265-266; Bower, 38-39; John Bell, *Letters of the Professional Character and Manners on the Education of a Surgeon, and the Duties and Qualifications of a Physician* (Edinburgh: John Moir, 1810), 579.

[55] Lawrence, "Old Thing," 266; Rosner, *Medical Education*, 49; Matthew H. Kaufman, "John Barclay (1758-1826): Extra-Mural Teacher of Anatomy in Edinburgh," *The Surgeons: Journal of the Royal Colleges of Surgeons of Edinburgh and Ireland* 4, no. 2 (Apr. 2006): 93-100; Christison, *Life,* vol. 1, 70; William Jardine, ed., "Memoir of John Barclay M.D.," in *The Naturalists Library: Mammalia, vol. 24* (Edinburgh: W.H. Lizars, 1846), 14-44.

[56] For specimens: Christison, *Life*, vol. 1, 73; Ballingall, *Memoir of the Skeleton of an Elephant, Dissected at Bangalore in 1813, and Now Deposited in Dr. Barclay's Museum* (Edinburgh: G. Ramsay, 1820). For teaching:

The end of the Napoleonic Wars threatened to reverse the gains derived from the proliferation of extra-mural anatomy training in Edinburgh. After 1815, the need for competent medical officers, which had overridden pre-existing moral and legal objections against dissection, disappeared. Furthermore, rising competition for cadavers made pilfering of graves and mortuaries so blatant that city authorities and the public could no longer ignore the situation.[57] Despite a citywide crackdown, a thriving illicit body trade continued into the 1820s. While middlemen and resurrectionists sold bodies of dubious provenance, the University and Royal College used tunnels to smuggle bodies from the city's catacombs into their anatomy theaters. Some teachers bypassed the trade altogether, taking their students to the graveyard to dig up subjects for class.[58]

These open secrets turned public opinion against anatomy, and led to a backlash that further threatened the growth of anatomy teaching. These conditions hampered efforts to make practical anatomy a more important part of Edinburgh and British training during the 1820s. One professor recalled a "student lying under charge of police… with a gunshot wound received in a resurrectionary expedition to Musselburgh churchyard. He was looked upon as a martyr by the students, and as little better than a murderer by the people."[59] Despite these obstacles, medical students continued to flock to extra-mural practical anatomy and surgery classes.[60] Many students and professors also journeyed to Paris after the peace in 1815 to study in an

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Bonner, 146; Kaufman, "John Barclay," 93-100.

[57] For the body trade: Christison, *Life,* vol. 1, 176; Rosner, *Medical* Education, 49; R. Michael Gordon, *The Infamous Burke and Hare: Serial Killers and Resurrectionists of Nineteenth Century Edinburgh* (Jefferson, NC: McFarland, 2009); 5-18.

[58] Wilson, and Greikie, 93; R. Michael Gordon, 12-14; Bates, ch. 5; Ruth Richardson, *Death, Dissection and the Destitute* (1987; Chicago: Chicago University Press, 2000), ch.3; Robert D. Anderson, Michael Lynch, and Nicholas Phillipson, *University of Edinburgh: An Illustrated History* (Edinburgh: EUP, 2003), 108.

[59] For poems and broadsides related to anatomy: EUL CRC, GA, P.46/17-23. Charles M. Adair, *Letter to the Right Honourable the Lord Advocate Proposing a Means of Procuring (by Act of Parliament) Subjects for the Instruction of Medical Students* (Edinburgh: A. Aikman for J. Carfrae, 1822). For the gunshot story: Wilson, and Greikie, 92.

[60] Rosner, *Medical Education*, 96-97, and 137-38.

environment friendlier to dissection. The knowledge that they brought back helped to drive Edinburgh and British anatomy forward despite the civic burdens that it faced.[61]

While practically oriented anatomy and surgery classes had already increased in number, they only became fully connected to the teaching of medical theory and practice in Edinburgh after the Napoleonic Wars. This process began with the scientific reorientation of Edinburgh's teaching of pathology led by Dr. John Thomson. His experience observing French and Germanic practices during travels in the 1814-15 led him to believe that Continental pathology was the new foundation for practice. As a lecturer and later University professor, Thomson focused on surgical pathology related to diseases, and texture-based organic pathology. In his classes, students learned that diseases arose from pathological changes in tissues, that past causal theories should be treated skeptically, and that precision was integral to medical practice and diagnosis.[62] As this approach grounded in anatomical pathology became increasingly accepted by the 1830s, it also reshaped Edinburgh's existing courses on medical practice and theory.

Beyond anatomical and surgical teaching, student demand for practical and scientific training also allowed Edinburgh's other secondary courses to prosper. While the core professors ensured that the degree did not require attendance and examination in these classes, their enrollments, status, and importance continued to increase.[63] The Midwifery class serves as an exemplar. The course rose in stature during the Napoleonic Wars, as Professor Dr. James Hamilton Jr. marketed it by promising students opportunities to see patients and assist during a delivery. The prospects for practical training and Hamilton's practical lectures describing

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[61] Rosner, *Medical* Education, 164; Bonner, 147; Bates, ch. 5; Maulitz, ch. 5-6; Anon, *Medical* Calendar, 53-113, and 150-60; Thomson, NLS, MS.9235, f. 1-40, and NLS, MS.9236, ff. 24-25, 28-30, and 50-51.
[62] John Thomson: University Professor of Pathology (1831-42). This section is reliant on Stephen Jacyna's skillful analysis of Thomson's teaching of pathology. Jacyna, *Philosophic*, 105-6, and 117-23.
[63] Bower, 26; Rosner, *Medical Education*, 55, 93, and 161-64; Jacyna, *Philosophic*, 99.

generation, development, and different types of labor drew an increasing number of students.[64] Despite demonstrating his course's utility, Hamilton's requests for full recognition of his course failed. The issue went beyond one of subject matter, as the core professors were wary of the precedent of elevating a secondary colleague.[65]

Natural History and Botany, the other existing secondary medical classes, held similarly unstable places in the curriculum in the early 1800s. While Botany had been a required course during the mid-eighteenth century, the class focused on description and classification rather than botanical therapeutics. It thus became less relevant as Materia Medica expanded to address botanical cures, and the Faculty ultimately dropped it as a required course.[66] Meanwhile, when Robert Jameson took over as professor in 1807, the Natural History class moved from the Arts to the Medical Faculty. It had developed as a grab-bag course of physical scientific fields, such as geology and meteorology. In order to make sense of such diverse material, it emphasized collection and classification.[67] The class became increasingly popular during the 1810s, when Jameson began to emphasize zoology to better connect his class with the other courses. He taught through lectures and "in the field the mode of carrying out investigations in Natural History." Students thus learned scientific skills transferable to medical practice, especially collection and analysis of evidence and theories.[68]

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[64] Hamilton Jr.: Professor (1800-39). For the history of physicians taking over childbirth, see among many works Radcliffe, ch. 6. For his class: Rosner, *Medical Education*, 55; Anon, "Heads of Lectures on the Theory and Practice of Midwifery by James Hamilton Junior," vols. 1-2, 1793-94, RCPEdL, DEP/HJA/1/1, f. i, and HJA/1/2, f. i-ii.

[65] Medical Jurisprudence occupied a similar role as a practical scientific secondary course. Its ties to anatomical pathology reinforced changes throughout the curriculum. For Hamilton's request: Rosner, *Medical Education*, 59; Bower, 70; Hamilton, *Memorial for Dr. Hamilton, Professor of Midwifery in the College of Edinburgh* (Edinburgh: J. Shaw and Co., 1824), Appendices 2-3. For Medical Jurisprudence: Rosner, *Medical Education*, 53, and 163; Bower, 72. See Alison, "Heads of Medical Jurisprudence," c. 1821, RCPEdL, DEP/AWP/5*/1/40; Christison, Syllabus of the University Course of Lectures on Medical Jurisprudence* (Edinburgh: A. Balfour, 1826), esp. 4.

[66] Dr. Daniel Rutherford: Professor of Botany (1786-1820). Rosner, *Medical Education*, 56-57.

[67] Jameson: Professor (1807-54). M.D. Eddy, "The University of Edinburgh Natural History Class Lists, 1782–1800," *Archive of Natural History* 30, no. 1 (Apr. 2003): 97-117.

[68] Christison, *Life*, vol. 1, 89-90; Royal Commissioners, "Evidence, Edinburgh," 141.

Military Surgery, the last secondary class, also remained a specialized and increasingly practical course following the Napoleonic Wars. Former army Surgeon Dr. George Ballingall, who took over the class in 1823, occupied an awkward place as a military surgeon turned doctor. Looked down upon by his fellow professors, Ballingall believed that surgical and medical practice were closely related. He argued that military surgeons needed broad knowledge beyond wounds since they often served as general practitioners on isolated stations. Ballingall expanded the course to include all elements of medicine and surgery that military surgeons were likely to encounter.[69] His class was thus more practical, comprehensive and relevant than Thomson's earlier offerings. Ballingall described the surgical diseases common among soldiers and sailors, demonstrated treatments and operations using specimens and cadavers, and discussed preventive medicine. Topics in the later area included examinations of fitness, accommodation and hospital planning, and physical, mental and feigned disabilities. He ended the course with an analysis of epidemic and contagious diseases, including those in tropical and arctic climates. The breadth of material that Ballingall covered based on his experience as an army surgeon made his class a significant addition to surgical and practical teaching.[70] Like Military Surgery, the secondary classes took highly practical approaches that helped students develop clinical, observational, and scientific skills that could be applied to medical practice. Due to institutional politics, however, they remained elective classes until a broader series of reforms occurred from the 1830s onward.

[69] Kaufman, *Regius Chair*, 109-11, 127-29, and 212; Ballingall, *Introductory Lectures to a Course of Military Surgery Delivered in the University of Edinburgh* (Edinburgh: Adam Black, 1830), Lecture I; Ballingall, *Speech Delivered at the Meeting of the Senatus Academicus of the University of Edinburgh on the 13th October 1824 on the Subject of the Proposed Regulations for Granting Medical Degrees* (Edinburgh, 1824), EUL CRC, GA, P.468/1, 10.
[70] Kaufman, *Regius Chair*, 131, and 214; Ballingall, *Prospectus of the Course of Lectures on Military Surgery* (Edinburgh, 1824), EUL CRC, GA, QP.470.14; Ballingall, *Syllabus on the Course of Lectures on Military Surgery* (Edinburgh, 1827), EUL CRC, GA, P.385/18. For praise: Kaufman, *Regius Chair*, 111, 176-77, and 213; Bower, 76.

2.3 REFORM AND SCIENTIFIC TEACHING IN EDINBURGH, 1825-1865

During the 1820s, Edinburgh's surgical, anatomical, and scientific medical classes became increasingly popular. British medical schools and the profession gradually accepted these new practical scientific fields and approaches as student and professional demand and expectations steadily rose. The influx of new professors, who had been Edinburgh students during the 1810s and early 1820s, reinforced the idea that physicians, surgeons, and general practitioners alike should be trained in anatomy, physiology, pathology, medicine, and surgery.[71] Claims in favor of the utility and rise of the new views of science throughout British schools presented challenges for those committed to the existing system. In Edinburgh, from the mid-1820s through the 1830s, several factions of professors engaged in fraught debates regarding whether and how medical training should be fundamentally reformed. Beyond their differing thoughts on medical reform and science, professors' desire to protect their own personal positions also shaped their views. These conflicts over reform shaped the reorientation of Edinburgh's medical curriculum from the 1830s, which made anatomical, surgical, and practical classes vital to a new model of medical training.

Despite the empirical and practical scientific trajectory of individual courses, by the 1820s, overarching reforms of Edinburgh's curriculum remained limited. The core professors continued to resist challenges to their authority and clung to the existing system.[72] Nonetheless, Edinburgh's increasing emphasis on scientific approaches influenced other British medical

[71] Gregory had proposed the unity of physic and surgery to assert that physicians should learn and oversee both (Lawrence, "Old Thing," 269-270). See Lawrence, "Old Thing," 267, and 270; J. Thomson, "Lectures on Practice of Surgery," RCPEdL, DEP/THO/1/3, Lecture 4; Struthers, 40-41; J. Thomson, *Lectures on Inflammation*, 4.

[72] In 1822, three months of Botany became compulsory again. Senatus Academicus, "Statuta Solemnica," 1822, in Bower, 107; Duncan Sr., *Speech Delivered at a Meeting of the Senatus Academicus of the University of Edinburgh, on the 20th Nov. 1824, Respecting a Proposal for New Regulations in Granting the Degree of Doctor of Medicine* (Edinburgh, 1824), EUL CRC, UA, JA 3207/2, 15-16.

schools. Glasgow, Dublin, and the London hospitals all hired Edinburgh graduates during this period.[73] By the early 1820s, these institutions offered rigorous medical training, and had caught up to Edinburgh. Critics simultaneously portrayed Edinburgh as an education mill with lax requirements.[74] These dynamics produced to a mounting crisis and louder calls for reforms.

By 1824, many of Edinburgh's professors felt that they needed to implement reforms to ensure that its graduates maintained their reputations as broadly trained, liberal physicians. As many professors argued that their fields should be required due to their practical value, the situation descended into institutional anarchy.[75] When the Academic Senate asked the Medical Faculty to consider changing the medical regulations, a minority of the professors lobbied for extensive reforms in response to the recent practical and scientific changes made in Glasgow's degree requirements.[76] The Faculty, however, disagreed over whether Midwifery, Clinical and Military Surgery, Natural History, and Medical Jurisprudence should become required classes for the medical degree.[77]

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[73] Chitnis, "Medical Education in Edinburgh," 180-84; James Coutts, *A History of the University of Glasgow from to Foundation in 1451 to* 1909 (Glasgow: James Maclehose, 1909), 511-520; Anon, *A Comparative View of the Schools of Physic of Dublin and Edinburgh* (Dublin: Graisberry and Campbell for Hodges and M'arthur, 1818), 63.

[74] Rosner, *Medical Education*, 164-69, and 170-71; Jack B. Morrell, "Science and Scottish University Reform: Edinburgh in 1826," *British Journal for the History of Science* 6, no. 1 (June 1972), 39-40; T.C. Speer, *Thoughts on the Present Character and Constitution of the Medical Profession* (Cambridge: J. Smith, 1823), 92.

[75] Hamilton's attempts to lobby for his Midwifery course went the furthest. He appealed to the Lord Provost, emphasizing his class's practical importance. Hamilton, *Memorial*, 4, 6, and 10-13. For similar arguments: Christison, *A Short View of the Extent and Importance of Medical Jurisprudence, Considered as a Branch of Education* (Edinburgh, 1821), EUL CRC, GA, P.46/14; Ja. Russell, *Remarks on the Utility and Importance of Clinical Lectures on Surgery* (Edinburgh: J. & C. Muirhead, 1824).

[76] The professors only agreed that English written exams should replace the Latin *viva voce* examination system. Lawrence, "Old Thing," 275; Duncan Sr., EUL CRC, GA, JA 3207/2, 22; Hamilton, *Hints from Dr. Hamilton to the Senatus Academicus on the Subject of Medical Degrees* (Edinburgh, 1824), EUL CRC, GA, QP 470/5, 2-4.

[77] Duncan Jr. argued for requiring Midwifery, Clinical and Military Surgery, Natural History, and Medical Jurisprudence for the degree. Ballingall also argued for preliminary standards in Latin, Greek, natural philosophy, math, and natural history. John Thomson first proposed pathology and general surgery courses. Duncan Jr., *Regulations Proposed by Dr. Duncan (but Not Agreed to) in the Senatus Academicus* (Edinburgh, 1824), EUL CRC, GA, QP.470/19; Ballingall, *Speech, 13th October 1824*, EUL CRC, GA, P.468/1, 8-11; Ballingall, *Speech Delivered at the Meeting of the Senatus Academicus of the University of Edinburgh on the 15th October 1824 on the Proposed Regulations for Granting Medical Degrees* (Edinburgh, 1824), EUL CRC, GA, P.468/1, 1-2, and 4-5; J. Thomson, *Hints Respecting the Improvement of the Literary & Scientific Education of Candidates for the Degree of Doctor of*

Given that the Edinburgh degree's seven required courses had fallen behind the twelve classes required by Glasgow and the Royal College of Surgeons, the medical professors reached a compromise.[78] The core professors expanded the degree to four years of study, including two of the secondary courses and six more months of hospital attendance. This confirmed their courses' superiority, and recognized the other classes' contributions.[79] The Faculty only added midwifery to the degree after Hamilton threatened to sue the University for charter violations.[80] Several of the older core professors, however, bitterly resented the compromise and public infighting, and were not willing to accept the new reality.[81]

When the Academic Senate and Medical Faculty consequently requested a royal visitation, the state of the medical curriculum was one of the most prominent issues. Based on reports of paralyzing infighting, King George IV appointed a Royal Commission to broadly investigate the Scottish universities. In 1826 and 1827, the Commissioners visited Scotland's university towns, and took evidence from professors, extra-mural teachers, and practitioners. They came away convinced that Edinburgh's medical training needed to become even more

Medicine in the University of Edinburgh, Humbly Submitted to the Consideration of the Patrons and Professors of That Institution (Edinburgh: David Brown, 1824), 15-20, and 80.

[78] Edinburgh Medical Faculty. *Statement of the Principal Questions Regarding Medical Graduations, to Be Finally Decided by the Senatus Academicus on 20th November 1824* (Edinburgh, 1824), EUL CRC, GA, G.15/1.5/11, 3-6.

[79] Rosner, *Medical Education*, 171-74; Senatus Academicus, "Statuta Solemnica," 1825, in Anon, *Medical* Calendar, 38-42; and *Regulations to Ascertain Regular Attendance of Medical Students* (Edinburgh, Oct. 13, 1824), EUL CRC, GA, QP.470/7; Edinburgh Medical Faculty, EUL CRC, GA, G.15/1.5/11, 27-29, and 31-33.

[80] Rosner, *Medical Education*, 174; Hamilton, *Letter from Dr. Hamilton to the Members of the Senatus Academicus Giving Reasons for Adding His Class to the Curriculum* (Edinburgh, 1824), EUL CRC, GA, QP.470/8.

[81] Duncan Sr. felt that only those practical courses that needed to be studied in the university should be included. The Duncans also unsuccessfully sued Hamilton for libel. Duncan Sr., EUL CRC, GA, JA 3207/2, 17-20; Duncan Jr., *Reasons for Protesting Against the New Code of Regulations in the Study of Medicine* (Edinburgh, 1824), EUL CRC, GA, QP.470/21. For the lawsuit: Duncan Jr., *A Speech Delivered at a Quarterly Statutory Meeting of the Senatus Academicus of the University of Edinburgh, on the 15th of January 1825* (Edinburgh, 1825), EUL CRC, UA, JA 3207/3; Duncan Jr., *Petition of Dr. Duncan Against Dr. Hamilton at the Commissary Court* (Edinburgh, 1825), EUL CRC, GA, QP.470/17.

rigorous and practical. Their report ultimately focused on the positions of the secondary classes, the question of separating Anatomy & Surgery, and students' qualifications for practice.[82]

In their testimony, the professors expressed a variety of views regarding the secondary and practical classes. Some felt that they should be required, because they helped students develop clinical, practical, and scientific abilities.[83] Others passionately disagreed, arguing that these courses' connection to clinical practice was not close enough to justify making them compulsory. Chemistry Professor Thomas Hope had one of the more unique takes, arguing that rigorous surgical teaching would make it unnecessary to require all of the secondary classes.[84] The point on which most of the professors agreed was that the University should split the Anatomy & Surgery course into two classes. William Alison stated: "It is the general opinion of my colleagues that there be two separate courses, one of Anatomy only, and one full six months' course, upon the principles and practice of Surgery."[85] Facing this consensus and student demands, Monro conceded that a course on the higher surgical operations would be beneficial to students, but perhaps more importantly, it would help save his Anatomy position.[86]

Despite the consensus on the need for a General Surgery course and a few smaller issues, Edinburgh's professors did not take action until after the Royal Commission completed its 1830

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[82] Rosner, *Medical Education*, 174-76; Archibald John Primrose, and Royal Commissioners for Visiting the Universities of Scotland, "Report Made to His Majesty by a Royal Commission of Inquiry into the State of the Universities of Scotland," *PP*, 1831(310): xii, 111, p. 5, and 59.

[83] Russell felt that additional hospital attendance, Practical Anatomy, Practical Chemistry, and Clinical Surgery were imperative. Ballingall wanted to also add Medical Jurisprudence and Practical Anatomy. Royal Commissioners, "Evidence, Edinburgh," 285, and 302.

[84] Hamilton and Graham supported adding Clinical Surgery for more hospital teaching. Duncan Jr. objected that students could choose to take these classes regardless. Duncan Jr. and Christison also argued that Medical Jurisprudence helped develop scientific abilities. Jameson made the same argument for Natural History, but most professors felt that its subject matter was peripheral. Clinical Surgery: *Ibid.*, 308, 333, 225, and 277. Medical Jurisprudence: *Ibid*., 243, 307, and 318. Natural History: *Ibid*., 141, and 252. Military Surgery: *Ibid.*, 244, and 302.

[85] Five professors agreed that there was "too little attention paid to the Surgical part of education," and backed splitting Anatomy & Surgery. Hope argued that a separate Surgery course would complement Clinical Surgery. For quote: *Ibid.*, 200. For Hope: *Ibid.*, 270, and 277-78. For others: *Ibid.*, 291, 243, 302, 307, and 464-65.

[86] Alison and Graham went furthest with their proposals that Edinburgh should award a separate master's in Surgery if another surgery professor was added. For Alison and Graham: *Ibid.*, 200, and 333. For Monro: *Ibid.*, 274.

report. The Commissioners presented their plans for reform aimed at helping Edinburgh produce competent practitioners who still met older gentlemanly expectations. They recommended the plan followed by many students who began with a liberal preliminary education, and moved from the basic sciences to the core medical courses before taking extensive practical and clinical coursework.[87] They encouraged the professors to increase Edinburgh's course requirements, as well as the degree's the liberal, scientific, and medical rigor. Their recommendations included separating Anatomy & Surgery into two courses, making most of the secondary courses compulsory, and instituting classical and individual class examinations.[88]

Edinburgh's medical professors vacillated in the face of these clear recommendations, objecting that the Commissioners had not considered the feasibility of requiring students to demonstrate competence in literature, science, medicine, and surgery. A group of professors argued that gradual reforms would be more "effectual for the good of the public." While supporting increased hospital attendance and improved examinations, they resisted making the secondary classes degree requirements. They felt that so greatly increasing the length and cost of Edinburgh medical studies would be "a hazardous experiment."[89] The younger generation of professors instead pushed through another compromise, which added three-month courses of Clinical Surgery and Medical Jurisprudence to the medical degree.[90]

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[87] Rosner, *Medical Education*, 176-78, and 188-89; Robert D. Anderson, *Education and Opportunity in Victorian Scotland: Schools and Universities* (Oxford: Clarendon Press, 1983), 48; Royal Commissioners, *Report*, 56; "Evidence, Edinburgh," 199; and "Evidence, Oral and Documentary, Taken and Received by the Commissioners Appointed by His Majesty George I. July 23rd, 1826; and Re-Appointed by His Majesty William IV, October 12th, 1830; for Visiting the Universities of Scotland. Volume II, University of Glasgow," *PP*, 1837(93): xxxvi, 1, p. 564.
[88] Rosner, *Medical Education*, 176-178, 184-185, and 188-190; Ballingall, *Speech, 13th October 1824*, EUL CRC, GA, P.468/1., 3-4; Royal Commissioners, *Report*, 38, 56, 63, and 190; and "Evidence, Edinburgh," 193, and 455-64.
[89] The higher cost of an Edinburgh education affected student enrollment and professors' salaries. For the lack of action: Rosner, *Medical Education*, 176-77; Hope, Home, Monro III, Duncan Jr., Graham, and Alison, "Petition to the Commissioners," Jan. 12, 1832, GUL SC, Ms Gen 1476/C/1/17. For objections: Royal Commissioners, "Evidence, Vol. 1," Appendix, "Report of the Medical and Surgical Professors," 1831, 260, and 264.
[90] Royal Commissioners, "Evidence, Edinburgh," Appendix, "Dissent by Andrew Duncan Junior, Robert Graham, William Pulteney Alison, and Robert Christison," 1832, 266.

As part of the modest changes implemented from 1831 to 1833, the Medical Faculty also separated Anatomy and Surgery. By this time, the class had reached its nadir in reputation. The increasingly influential Royal College of Surgeons had withdrawn its recognition of Monro's class as meeting the surgical requirement for its diploma, judging his lectures practically and scientifically insufficient.[91] Additionally, in late 1828, animosity regarding the practice of anatomy boiled over when police accused William Burke and William Hare of murdering sixteen people, and selling their bodies to anatomist Robert Knox. A mob then attacked Knox's home intent on hanging him.[92] This public uproar gave the Whig government the momentum needed to create the Chairs of Surgery and Pathology in 1831, which in turn forced Edinburgh's professors to accede to a more rigorous curriculum. After 1833, beyond the core classes, students had to attend six months of Pathology, Practical Anatomy, and Surgery, as well as three months of Clinical Surgery, Medical Jurisprudence, and Natural History to qualify for the medical degree. The Medical Faculty also granted full faculty rights to all of the existing medical professors.[93]

This prolonged period of infighting over the future of Edinburgh's medical training contributed to the narrative of decline discussed in this chapter's introduction. What is often not understood is the substantial reforms that followed this fractious period. In fact, the reforms transformed Edinburgh into one of a handful of leading schools that widely embraced clinical, anatomical, and scientific approaches. In the decades that followed, Edinburgh's practical, anatomical, surgical, and medical classes flourished as their status continued to increase. By the early 1830s, many students recognized scientific approaches' growing influence on medicine and

[91] Rosner, *Medical Education*, 155-56; Court of Royal College of Surgeons, Edinburgh, Nov. 25, 1823, RCSEdL, "Minute Books," Vol. 9, f. 131-32.
[92] R. Michael Gordon, parts II, and III; Rosner, *Anatomy Murders*, chs. 3-10; Bates, chs. 6-8; Lonsdale, 79; Sir Robert Grenville to Sir William Jardine, Feb. 12, 1829, EUL CRC, UA, Dk.6.20/123, f. 2.
[93] Rosner, *Medical Education*, 189-190, and 194-195; Royal Commissioners, "Evidence, Edinburgh," Appendix, "Report of the Medical and Surgical Professors," 1831, 265; "Statutes Relative to the Medical Degree, 1833," *Lancet* 40, no. 1048 (Sept. 30, 1843): 918-919.

surgery, and eagerly pursued the newly compulsory courses.[94] The protracted breakdown of the old order thus allowed for the emergence of a new approach to medical education.

Surgery and anatomy underwent particularly far-reaching transformations, becoming vital parts of the new curriculum. During the late 1820s and 1830s, a new generation of leading British surgeons began teaching extra-mural classes in Edinburgh. Famed Edinburgh surgeons James Syme and John Lizars were the most successful surgery teachers. They started as anatomy demonstrators, in the late 1810s and became accomplished experimental surgeons in the 1820s.[95] While Lizars' class covered more theory and Syme's emphasized amputations, they both discussed inflammation as surgery's general principle. They also described disorders' pathologies, symptoms, operations, and post-operational protocols using morbid demonstrations and drawings.[96] This observational approach appealed to students increasingly committed to learning medical and surgical science.

This competition from extra-mural surgeons forced Monro to propose a separate surgery class. In a last-ditch effort to keep that part of his position, he vowed to teach surgical diseases using the same innovative pedagogical approaches as Syme and Lizars. Despite Monro's willingness to change his approach, the professors voted to split the Anatomy and Surgery classes in 1831.[97] Syme became the University Professor of Clinical Surgery in 1833. He was the most dynamic university surgery professor during this period, continuing with his demonstrative

[94] This reorientation propelled Edinburgh through the 1850s when experimentalism emerged. Bonner, 218-219.
[95] Syme invented operations for excision of the lower jaw, and amputation at the ankle. Lizars performed Britain's first ovariotomy. Harold Ellis, *A History of Surgery* (London: Greenwich Medical Media, 2001), 77-78. Ornella Moscucci, *The Science of Woman: Gynecology and Gender in England*, 1800-1929 (London: CUP, 1990), 137.
[96] Syme, *Syllabus of Lectures on the Principles and Practice of Surgery* (Edinburgh: James Walker, 1827), esp. 11; and (Edinburgh: James Walker, 1829); John Lizars, *Syllabus of the Course of Lectures on the Principles and Practice of Surgery Instituted by the Royal College of Surgeons of Edinburgh* (Edinburgh: Andrew Shortrede, 1832), RCPEdL, DEP/OWW/1, 17-9. For Knox: Bates, chs. 5-6; "The Lecturer," c. 1830, L0041640, Wellcome Images.
[97] Monro III, *Syllabus of Lectures on Surgery* (Edinburgh, c. 1827), EUL CRC, GA, P.123/4, 1.

clinical approach.[98] The emphasis that he placed on pathology and practice also ensured a close link with James Miller's General Surgery course, which gave a systematic analysis of surgical diseases.[99] From the 1830s onward, most Edinburgh students thus learned surgical principles and skills in a practical manner reliant on both general principles and pathological observation.

Similarly, the teaching of anatomy changed significantly, forcing students to engage with these new practical and scientific approaches. Facing increased competition from extra-mural teachers during the 1820s, Monro began to incorporate more morbid demonstrations in addition to museum specimens. A turning point came in 1831 with the split of Anatomy & Surgery, introduction of Pathology, and legalization of a regulated body trade. From that point, licensed anatomy and surgery teachers could purchase bodies from regulated sources, such as infirmaries, workhouses, and coroners.[100] Despite Monro' willingness to perform more dissections, students continued to avoid his course due to his demeanor and lack of hands-on practical dissection opportunities. In response, Monro attempted to undermine extra-mural classes, cornering the body market through intimidation and excess purchases. While authorities remained reluctant to intervene given the public prejudice against dissection, Edinburgh's anatomy teachers formed an association to defend their interests in 1833. They reached an agreement with the University on a rotating distribution of bodies based on a strict order of turns in early 1840.[101]

Despite Monro's intransigence, the 1832 Anatomy Act, which legalized and regulated the body trade, led to the zenith of Edinburgh extra-mural anatomy teaching during the 1830s and

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98 Syme: Professor 1833-69). John Storer Balenidge, "Brief Notes of '999' Cases in the Lectures on Clinical Surgery," 1856-1857, EUL CRC, UA, Dc.7.60, f. 1-3; Alexander Russell Simpson, "Notes of a Course of Lectures in Clinical Surgery," 1853, RCPEdL, DEP/SIA/1.

99 Miller: Professor (1842-64). Miller, *Syllabus for the Course of Systematic Surgery* (Edinburgh: Andrew Shortrede, 1844).

100 Jacyna, *Philosophic*, 162-164; Richardson, *Death and the Destitute*, part II. For Monro's teaching: Bower, 35. For the trade: Lizars, 5.

101 Monro was left out of the negotiations with the University in late 1839. Jacyna, *Philosophic*, 162-64.

1840s. Edinburgh's anatomists zealously argued for their field's applicability to pathology, therapeutics, and medical practice. Their classes typical began with descriptive anatomy focused on tissues, organs and systems, and then covered topographical anatomy where student conducting dissection in small groups.[102] As anatomy began to diversify and specialize, additional approaches varying in scale and focus also emerged.[103] Edinburgh teachers gravitated toward different forms based on their expertise and judgment.[104] Regardless, anatomical, pathological, and physiological teaching at Edinburgh became increasingly scientific.

The University finally forced Monro to resign in 1846, sealing the victory of anatomy teaching in Edinburgh. He had become an unbearable colleague and teacher. Monro had lost control of his classroom, and refused to allow recognition of any extra-mural classes despite the logistical burden that this placed on students.[105] In late 1845, at behest of the Town Council, the professors discussed the status of outside universities' and extra-mural teachers' classes. After a proposal that would have kept extra-mural teachers disenfranchised, the Faculty conceded that some classes could be taken at recognized institutions.[106] By early 1846, a still intransigent Monro had resigned. The extra-mural teachers rejoiced, feeling that his resignation would "raise the College [of Surgeons] in the eyes of the profession." Beyond this, Monro's departure also led

[102] Jacyna, *Philosophic*, 164-65; A. Thomson, "Introductory Lecture on Anatomy, Edinburgh and Aberdeen," 1838-1839, GUL SC, MS Gen 1476/A/2849, f. 1-2, and 25-26, and 28.
[103] Comparative anatomy looked at animal structures and functions; descriptive focused on the textures and tissues; general examined their relations to structure and function; and minute investigated structures at a microscopic level.
[104] Thomson, GUL SC, MS Gen 1476/A/2849, f. 22-26, and 28-30. For minute anatomy, see Bennett, EUL CRC, GA, Gen.2007/1; and EUL CRC, GA, Gen.2007/4, 1-8.
[105] For Monro's classroom: John Lee to Monro III, Jan. 24, 1845, NLS, MS.3445, ff. 5-6; Monro III to John Lee, Jan. 28, 1845, MS.3445, f.8. For outside lectures: Edinburgh Medical Faculty, *Report on Proposed Changes in the Statuta Solemna: Altered in November 1839* (Edinburgh, 1839), EUL CRC, GA, P.551/14, 1-3, and 6*; Resolutions by the Medical Faculty Founded on the Report of the 22nd July 1839* (Edinburgh, 1839), EUL CRC, GA, P.551/13; and *Report on Proposed Changes in the Statuta Solemna: To Be Submitted by the Medical Faculty to the Senatus* (Edinburgh, July 22, 1839), EUL CRC, GA, P.551/12, 6.
[106] College Committee, *Report by the College Committee of the Town-Council of Edinburgh, Patrons of the University, Regarding the Statutes of the University Relative to the Degree of M.D.* (Edinburgh, 1846), EUL CRC, GA, QP.455/13, 4, and 6-7; Senatus, "Statutes Relative to the Medical Degree" *Lancet* 72, no. 1830 (1858): 334.

to rapid increases in the reputations of both the University and its medical students.[107] Most importantly, it allowed for a practical shift in the university anatomy class' organization and approach, which finally caught up to the practical transition building over several decades.

Extra-mural anatomy teacher John Goodsir, who replaced Monro in 1846, revolutionized the University course. While practical anatomy worked well in smaller classes, it could not be directly translated to Edinburgh's large lecture course. Goodsir took a new approach to teaching the lectures, at first teaching multiple smaller sections before shifting to a mixed lecture-tutorial format. Through the early 1850s, Goodsir's lectures began with anatomical scales, moving outward from cells to textures, tissues, organs, and systems. He argued that these levels applied to all animals. He then examined human textures and organic systems, emphasizing their arrangement, mechanics, and relations to pathological symptoms. In addition, Goodsir's assistants taught practical tutorials utilizing demonstrative dissections, as well as Practical Anatomy in which students performed their own dissections.[108] Furthermore, after Jameson's retirement, Goodsir taught the zoology and comparative anatomy portions of Natural History. He emphasized the distinctions between organized and unorganized animals, as well as the cellular, organic, and systematic differences between plants, animals, and humans. By the early 1860s, Goodsir focused his class on the human body's physiological organization "as an organism" based on current research. This approach emphasized organic chemistry as the building block for structures and functions.[109] The conceptual and empirical breadth of the reformed approach to

[107] John Salisbury to John Struthers, "Letter on Professorship of Anatomy," Apr. 11, 1846, RCSEdL, GD3/379.
[108] Goodsir: Professor (1846-66). He was known for his research in minute cellular anatomy, and the comparative anatomy of apes. Anon, "Retrospective: The Researches of John Goodsir," *Nature 26,* no. 669 (Aug. 24, 1882): 409–10; Goodsir, "Goodsir's Anatomical Notices," 1855-1856, EUL CRC, UA, Gen.291; and "Outline of a Course on Institutes of Human Anatomy," c. 1852-1854, EUL CRC, UA, Gen.291/(1.60c), f. 2.
[109] Alexander Russell Simpson, "Synopsis of the Course of Lectures on Zoology and Comparative Anatomy Delivered by John Goodsir, in the University to the Natural History Class," 1853, RCPEdL, DEP/SIA/2, f. 1-10; Goodsir, "Introductory Lecture on Anatomy," Nov. 3, 1863, EUL CRC, UA, Gen.289, f. 1-4.

these anatomy classes contributed to a broader expansion of scientific education throughout Edinburgh's medical curriculum.

Goodsir and Jameson were thus more representative of the direction of Edinburgh and British medical training than Monro after the reforms of the early 1830s. John Thomson's teaching of pathology, meanwhile, embraced many of the developments occurring in practical anatomy during the 1830s. His successor Dr. William Henderson further incorporated organic pathology, and reintroduced questions related to disease causation. He presented an overview of historical and contemporary theoretical and scientific conceptions of disease, including neo-humoral theory, contagion, the constitutional theories of temperaments and homeostasis, organic tissue-based pathology, and concepts of susceptibility and immunity. Henderson also emphasized predisposing and exciting causes, and encouraged the use of pathological concepts alongside experience and observations. Such ideas were the seeds of an empirical and material pathological theory, which developed into germ theory.[110]

Beyond anatomy, pathology and surgery, Edinburgh's practical and specialized courses devoted to the physical and biological sciences also became more positivist from the 1830s onward. One commentator reflected that "every subject of academic prelection [sic] admitting of public experimental illustration had come to receive it."[111] Medical Jurisprudence led the way, as Drs. Christison and Thomas S. Traill used dissections, demonstrations and applied knowledge as means to discuss legal and social questions. Christison's research and teaching focused on toxicology, in which he "improved the method for detecting poisons." He also debated methods

[110] Henderson: Professor (1842-69). Alexander Russell, Simpson, "Notes Taken from Course on Pathology Given by Professor Henderson," 1854-1855, RCPEdL, DEP/SIA/4, f. 1-3. For this transition more broadly: Worboys, *Spreading Germs*.
[111] Wilson, and Greikie, 91, and 100

for preserving public health through policing of ill-health factors.[112] Meanwhile, Traill further embraced forensic medicine's applications to societal, legal, and policing issues. The precision required to address such questions forced students to consider the nature of medical evidence and scientific ideas.[113]

The specialized scientific classes that attracted the most students, as well as many who went on to become naval surgeons were Natural History and Midwifery. Professor Jameson's Natural History class increasingly focused on geology, mineralogy, meteorology, hydrology and zoology in an attempt to further develop students' scientific skills. Beyond precise description and classification, he increasingly emphasized the "laws of nature, and the mode of conducting investigations," geological and zoological preparations, and field teaching.[114] Dr. James Young Simpson offered a surgical and practical Midwifery class designed to provide practical training and opportunities. Beyond reinforcing students' clinical skills, he felt that this practical approach reliant on patient demonstrations would teach them how to identify cases encountered in their practice for which they needed to call in specialist assistance. As naval surgeons and some general practitioners often practiced in relative isolation, such training would help them realize the limits of their knowledge and experience.[115]

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[112] Medical Police focused on hygiene, diet, public services, and work safety. Wilson, and Greikie, 126; Christison, "Introductory Lecture on Medical Jurisprudence," 1831, EUL CRC, UA, Dk.4.57, f. 3-4.

[113] Trail, Christison and Syme developed systematized post-mortem examination procedures. Traill: Professor (1832-62). Traill, *Outlines of a Course of Lectures on Medical Jurisprudence* (2nd ed.; Edinburgh: A. & C. Black, 1840), iii-xi; Traill, Christison, and Syme, *Suggestions for the Medico-Legal Examination of Dead Bodies* (Edinburgh, 1839), NLS, APS.1.78.223. For precision: Alison, "Retrospective Essay on Medical Jurisprudence," 1861, RCPEdL, DEP/AWP/5/3/2, f. 2.

[114] His successors followed similar courses. Jameson, *Syllabus of Lectures on Natural History* (Edinburgh: Neill, 1830), 2-4, and 10-14. For scientific teaching: Edinburgh Medical Faculty, EUL CRC, GA, G.15/1.5/11, 29; Anon, "Notes of Natural History Lectures by Robert Jameson," 1831-1832, NLS, MS.3936, f. 5-7.

[115] Simpson: Professor (1840-post-1870). Simpson, "Introductory Lecture on Midwifery," 1838-39, RCPEdL, DEP/SYJ/1/1/2, f. 1; Simpson, *Clinical Lectures on Midwifery and the Diseases of Women and Infants During the Session 1845-6* (Edinburgh: Hugh Paton, 1846), 3. For his views on knowing when to call for specialists: Simpson, RCPEdL, DEP/SYJ/1/1/2, f. 2-3.

Given this dissertation's focus on students who became naval surgeons, it is significant that Military Surgery was the only long-standing subject that Edinburgh eliminated during the mid-nineteenth century. Through the 1830s and 1840s, however, it provided important training for these students. Professor George Ballingall had further extended the scope of his military surgical teaching, arguing that military surgeons were responsible for all aspects of soldiers' and sailors' health. He also gave more consideration to diseases common among soldiers and sailors, and preventive hygienic practices.[116] Ballingall's crossing of field boundaries between physic and surgery, however, provoked a backlash from some of his colleagues. By the time that the University eliminated the class in 1856, as we shall see, shifts in British medical education and naval service conditions had made Edinburgh's contribution of naval surgeons less essential.[117]

The increasing importance of scientific approaches and methods within Edinburgh's practical, surgical, and anatomical courses coincided with the emergence of increasing pressure for professional reform. From the mid-1820s onward, Edinburgh, other leading medical schools, and newer competitors reformed their training, emphasizing these new fields, and practical and pedagogical approaches. After decades of transition, these interconnected developments culminated in the 1858 Medical Act, in which the government for the first time set and regulated practitioners' qualifications. This more formally institutionalized the more rigorous and scientific professional expectations that had emerged in regard to medical education and training.[118] The

[116] Kaufman, *Regius Chair*, 212-14; Ballingall, "Notes from Lectures on Military Surgery," 1837, EUL CRC, UA, Dc.3.20, f. 1-4.

[117] Syme especially attacked his clinical experience and teaching competence, succeeding in his push to eliminate Military Surgery following Ballingall's death. Kaufman, *Regius Chair*, esp. 176-79, and 186-87; Ballingall, *Review of Some of the Surgical Cases Which Have Lately Occurred in the Royal Infirmary of Edinburgh- A Clinical Lecture Delivered to the Student of Surgery in That Institution, on Thursday, 26th July 1827* (Edinburgh, 1827), WL RBM, T.1212/3; Syme, *Lancet* 67, no. 1692 (Feb. 2, 1856): 133.

[118] In response to intermediate degrees at the University of London, Edinburgh offered medical bachelor's and chirurgical master's degrees from 1861. Bonner, 193; Helen M. Dingwall, *A Famous and Flourishing Society: The History of the Royal College of Surgeons, 1505-2005* (Edinburgh: Royal College of Surgeons, 2005), 157-158;

prevalence and importance of science only continued to rise within British and European medical education. Nonetheless, as Germanic and then Continental schools adopted laboratory teaching during the 1860s, British medical schools lagged behind. Edinburgh offered several early laboratory courses in practical chemistry, practical anatomy, microscopy, and histology, but struggled to keep up with the shift to experimental approaches and pedagogical methods.[119] Another period of crisis and adaptation beyond the purview of this chapter thus awaited Edinburgh's medical school in the late-nineteenth century.

2.4 THE RISING TIDE OF SCIENCE IN BRITISH MEDICAL EDUCATION

During the early-to-mid nineteenth century, British medical education underwent a profound transition as empirical science transformed both medical training and the medical profession. The prestigious medical school at the University of Edinburgh gradually embraced this rise of science. The breadth of its curriculum and practical scientific offerings, and the empirical reorientation of its surgical and pathological training led British medical schools. Particularly in the core classes and anatomy, however, it responded to competition from other leading institutions, and broader changes occurring throughout medical training and the profession. While reforms helped Edinburgh maintain its reputation as one of several leading medical schools in the United Kingdom, it lost the dominance that it had built during the eighteenth century. By mid-century, the new practical model of medical training had proliferated

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Senatus Academics, "Statutes Relative to the Medical Degrees, 1861, *Lancet* 84, no. 2142 (1864): 339-340.

[119] Bonner 244-45, and 262. For scientific and laboratory medicine, see also Bynum, *Science and the Practice of Medicine*, chs. 2-4; William Coleman, and Frederic L. Holmes, "Introduction," in *The Investigative Enterprise: Experimental Physiology in Nineteenth-Century Medicine*, eds. William Coleman, and Frederic L. Holmes (Berkley: UCaP, 1988), 1-14.

throughout British medical schools. Edinburgh's training therefore offers a lens for analyzing some of the most significant changes occurring throughout British medical education.

At Edinburgh and other British medical schools, the core fields of medical education underwent a gradual transformation characterized by an increasing skepticism of the practical applicability of theory and an increasing emphasis on empirical and scientific skills. The introduction of elective practical courses devoted to clinical, surgical, anatomical, pathological, and scientific approaches played a key role in this development. Throughout British and European medicine, anatomical, pathological and surgical dissection, bedside-based clinical teaching, and practical courses rapidly rose in status and importance. At Edinburgh, the courses that focused on these approaches remained largely subject to student choice until the early 1830s. By mid-century, however, they had become integral and required parts of Edinburgh training. In the process, they transformed medical teaching and training at Edinburgh and other British medical schools.[120] As laboratory teaching and experimentation overtook European medicine from the 1850s onward, however, Edinburgh faced another existential crisis. It struggled to incorporate laboratory classes as more than a practical add-on to the lecture-based, practical, and clinical classes that made up the mid-century curriculum.

Significant internal and intra-professional conflict characterized the process that led to the scientific reshaping of Edinburgh and British medical training. Professors, practitioners, and institutions entrenched in the existing system that separated physicians and surgeons' training, and valued learned, theoretical, and gentlemanly education resisted fundamental reforms. Edinburgh's older generation of professors vacillated in implementing reforms that would cede some of their power to clinical, surgical, anatomical, and scientific professors and approaches. A

[120] See Hutton, esp. 10-11, 17-21, 111-112, and 127.

younger generation of lecturers and professors, who had taken advantage of emerging opportunities in these new fields as students, reshaped Edinburgh education from the 1820s onward.[121] Competition and professionalization within British medicine and surgery, the turn of Continental medicine toward practical anatomy and pathology, and the rise of science throughout British society also helped to drive the formative reforms that began in the late 1820s.

The transition and approaches laid out in this chapter had a practical impact on both British medical practice and naval medicine. In British medicine, despite surgery's gruesome reputation, surgeons developed "speed surgery," a variety of new operations, and chloroform as an anesthetic. The shifts in medical training also helped to give rise to the interconnected public health and sanitation movements.[122] Nonetheless, empirical science had limited immediate impact on disease theories and practices. Germ theory only began to transform medical education and practice from the 1860s onward. It can be argued, however, that germ theory's development could not have occurred without the earlier empirical practical scientific transformation of medicine.[123] The remainder of this dissertation explores the impact that this transition had on naval medicine. Just as Edinburgh and British students had helped to transform medical training, the new tools that they brought into the Navy allowed them to reshape the medical service. The next chapter examines how this process shaped naval medicine's institutional professionalization and reform. The remaining chapters posit that naval surgeons applied the practical, anatomical, and observational scientific mindset and approaches with profound ramifications, including the broader adoption of quinine to combat tropical fevers.

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[121] John Struthers, "List of classes attended by John Struthers," late 1844, RCSEdL, GD4/437.
[122] For surgery: Stanley, *For Fear of Pain*. For public health: Wohl, *Endangered Lives*; Christopher Hamlin, *Public Health and Social Justice in the Age of Chadwick: Britain, 1800-1854* (New York: CUP, 1998).
[123] For the period of germ theory beyond Worboys and Wootton, see John Waller, *The Discovery of the Germ: Twenty Years That Transformed the Way We Think about Disease* (New York: University of Columbia Press, 2002).

3.0 EXPERTISE AND THE FORTUNES OF OVERCROWDING: PROFESSIONALIZING REFORM IN NAVAL MEDICINE, 1815-1860

In 1800, Edinburgh surgeon-anatomist and medical reformer John Bell denounced the poor state of naval medicine in regard to surgeons' status, education and qualifications. He reflected that "to the life of a navy surgeon there are, God knows, no seductions! Nothing as it now stands, can drive a man into such a service, but want of education and want of friends; nothing can support him… but a love of his profession, and a sense of duty above all obstacles."[1] The stereotype of naval medical officers as marginally qualified practitioners working in unfavorable conditions has perpetuated this judgment. Nonetheless, surgeons' status, position and competence within the Navy and the profession rose substantially from the Napoleonic Wars through the 1850s.[2] This chapter examines how the naval medical service struggled but largely succeeded in attracting highly qualified students as it underwent rapid professionalization.

Naval surgeons gained institutional control over the medical service during this period, shaping its organization and direction. In the decades following the Napoleonic Wars, a small group of experienced medical officers gained increasing administrative and professional authority as commissioners on the Admiralty Boards responsible for naval medicine. Cape St. Vincent, Nile and Trafalgar veteran Sir Dr. William Burnett emerged as the most significant

[1] John Bell, *Memorial Concerning the Present State of Military and Naval Surgery Addressed Several Years Ago to the Right Honourable Earl Spencer, First Lord of the Admiralty* (Edinburgh: Mundell & Son for Mesrs. Longman & Rees, and Messrs. Cadell & Davies, 1800), 9; Brian Vale and Griffith Edwards, *Physician to the Fleet: The Life and Times of Thomas Trotter, 1760-1832* (Woodbridge: Boydell & Brewer, 2011), 24.

[2] McLean, *Surgeons*, esp. xii-xiii. For Napoleonic era: Cardwell, "Royal Navy," 65, and 71-72; Patricia Kathleen Crimmin, "The Sick and Hurt Board: Fit for Purpose?," in *Health and Medicine at Sea*, 104-05.

figure after his appointment to the Victualling Board in the early 1820s. He had substantial influence over naval medicine's professional and institutional development, serving as the first head of the Medical Department from 1832 to 1855. Recent work has highlighted the connections between the Naval Medical Department, the reform campaign among surgeons pushing for improved service conditions, nascent public opinion, and profession-level developments through the 1850s. This chapter explores how naval surgeons, and especially Burnett as their leader shaped the service's institutionalization and professionalization during the early nineteenth century. In response to broader professional changes and challenges, Burnett and the surgeons under his command pursued strategies and implemented reforms grounded in empirical scientific conceptions of competence, expertise and professional status.[3] As these ideas and approaches became increasingly prominent in medical training and throughout the profession, surgeons brought them into and applied them in the Navy.

These developments occurred within the broader "Age of Reform," which led to increasing professionalization, efficiency, and scientific authority throughout British society. This turbulent age of social and political transition saw significant internal and external crises within the medical profession, as well as the rise of science more generally.[4] As changes in medical training and approaches gained momentum, factional and generational conflicts among physicians, surgeons and general practitioners, and London and Scottish medical institutions increased.[5] Students, surgeons, and naval medical leaders negotiated these professional and

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[3] Lloyd, and Coulter, vol. 3, 29-36, and vol. 4, chs. 1-2; McLean, *Surgeons*, 12-15, and chs. 2-3; Harrison, "Important Service", 109-13, and 124-25; Christopher Robert Howard Penn, "Sir William Burnett and the Medical Staffing of the Royal Navy," (MA Thesis, University of Exeter, 2001), WSRO, Add. Mss. 52638. For an analysis of military medicine, see Kelly, 7-10. For a broader scope on professionalization and authority, see Corfield, esp. 1-8.
[4] Dingwall, *Famous and Flourishing Society*, 84-85; Michael J. Lacey and Mary O. Furner, *The State and Social Investigation in Britain and the United States* (New York: CUP, 1993), 23-25. See also Corfield, ch. 7.
[5] Bonner, 193-95**;** Irvine Loudon, "Medical Practitioners 1750-1850 and the Period of Medical Reform in Britain," in *Medicine in Society: Historical Essays*, ed. Andrew Wear (New York: CUP, 1992), 219–48; Ivan Waddington,

educational changes, a shifting labor market, and the rising requirements, qualifications, and expectations that came with ongoing professional reform. New scientific conceptions of practical competence and overcrowding in the labor market underpinned the naval medical service's and surgeons' responses to the changes occurring both within the Navy and the profession.[6] While these dynamics fundamentally shaped naval medicine's institutional, demographic, and professional development, the broader professional context also underlay the Navy's struggle to attract and keep competent surgeons. A range of institutional and medical professional factors thus shaped naval surgeons' ethnic and educational backgrounds and professional outlook.

This approach introduces the relative dynamics of British medical training, employment, and professionalization during the Age of Reform as analytical factors for understanding naval medicine's institutional development. Scholarship on Edinburgh medical education, especially Matthew Kaufman's work on the teaching of military surgery, has most fruitfully employed this multi-focal social-political approach.[7] This chapter expands on this work by considering the Navy's place within the British medical profession. Students, surgeons, and Director-General Burnett appear as complex actors. They shaped naval policies, reforms, and demography as they traversed this period, pursued their material interests, and embraced empirical scientific professional principles. To investigate the dynamics that transformed the medical service, this chapter begins by examining naval medicine's institutional development during and after the Napoleonic Wars. Naval surgeons' rising authority, ambitions, and scientific competence amid arduous working and professional conditions emerges as one of the principal themes.

"The Movement Towards the Professionalization of Medicine," *BMJ* 301, no. 6754 (Oct. 3, 1990): 688–90. See Appendix C.9 for an overview of the literature on developments in the British medical profession.

[6] For overcrowding: Loudon, *Medical Care*, 208-11; Peterson, *Medical Profession*, 29; Waddington, *Medical Profession*, 139-42; Digby, *Making a Medical Living*, 7, 12, and 20-24; Myers, "Demography," 47-48; Irvine Loudon, "A Doctor's Cashbook: The Economy of General Practice in the 1830s," *Medical History* 27 (1983): 257-8.

[7] Kaufman, *Regius Chair*, passim; Rosner, *Medical Education*, 20-21, and 137-38.

3.1 INSTITUTIONAL REFORM AND GROWING PAINS TO 1832

From the Seven Years' War onward, an increasing number of surgeons from the Celtic Fringe entered naval service. Many left Scotland and Ireland to find employment and pursue their ambitions following apprenticeship and formal educations.[8] The Admiralty, however, continued to see surgeons as craftsmen rather than as officer-gentlemen. It tried to limit the institutional influence of medical officers even as recognition of their expertise and necessity rose. Some critics argued that poor conditions and pay led to a "lamentable want of properly qualified" surgeons, forcing increased reliance on Scottish-educated medical officers. By the 1790s, five Scottish-educated physicians with limited bureaucratic experience oversaw the medical service as commissioners on the Sick and Hurt Board.[9] As the Navy expanded during the French and Napoleonic Wars, increasing demands magnified these conflicting interests related to authority and the place of surgeons within the Navy.[10]

Increasing criticism linking the service's problems to the lack of incentives for students to join the Navy emerged during the early 1790s. Naval surgeons and some practitioners began to lobby for improved working conditions but with little success. The Admiralty largely resisted enacting changes recommended by the medical commissioners, including measures intended to address some of the logistical and financial burdens inherent in a London-centered examination

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[8] Lloyd, and Coulter, vol. 3, 4-5, and 13; Rosner, *Medical Education*, 20; Kaufman, *Regius Chair*, 79-82, and 143; Laurence Brockliss, M. John Cardwell, and Michael Moss, *Nelson's Surgeon: William Beatty, Naval Medicine, and the Battle of Trafalgar* (Oxford: OUP, 2005), 23; N.A.M. Rodgers, *The Command of the Ocean: A Naval History of Britain, 1649-1815*, vol. 2 (New York: W.W. Norton, 2005), 487.

[9] During the Napoleonic Wars, Scots were overrepresented by 274% given the British population. For the Board: Lloyd, and Coulter, vol. 3, 4-5, and 10-13; vol. 4, 20; Janet MacDonald, *The British Navy's Victualling Board, 1793-1815: Management Competence and Incompetence* (Woodbridge: Boydell Press, 2010), 111-12. For Scots: Cardwell, "Royal Navy," 38, and 40-41. For naval health: Michael Crumplin, "Surgery in the Royal Navy During the Republican and Napoleonic Wars (1793-1815)," in *Health and Medicine at Sea*, 88. Gilbert Blane, "Statements of the Comparative Health of the British Navy, from the Year 1779 to the Year 1814," *M-CT* 6 (1815): 490–573.

[10] For the Napoleonic Wars and manpower: Briggs, 143; Rosner, *Medical Education*, 21, and 137.

and appointment process. Reformers, such as John Bell, continued to argue that improved status, pay, and conditions would help attract well-educated young surgeons and ensure the Navy's readiness. The response of the Lords Commissioners of the Admiralty was half-hearted at best and ensured that the Navy continued to rely on Celtic candidates coming forward for service. While the naval establishment objected to Scots' growing ethnic domination of the medical service, reformers worried that only those poor students with no other options joined the Navy.[11]

The Lords Commissioners finally responded to reformers' complaints when many surgeons refused to return to service in the midst of the 1803 invasion scare following the Peace of Amiens. In 1805, they increased surgeons' pay, nominally placed their status on par with commissioned officers and Army surgeons, and introduced the rank of Assistant Surgeon in place of surgeon's mate. These concessions began the long-term process of addressing issues related to service conditions, manpower and competence.[12] Yet the road of reform was not linear. In early 1806, following parliamentary findings that its accounts were £2.5 million in arrears, the Lords Commissioners amalgamated the Sick and Hurt Board into the Transport Board. They also reduced medical representation on the Transport Board to one doctor responsible for everyday administration under strict supervision. This targeting of the medical commissioners' power and influence was in part a bitter reaction to their weak response to surgeons' collective action.[13]

Meanwhile, years of war led to an increase in surgeons' experience, competence and practical importance. The demands of service during the Napoleonic Wars weeded out the least

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[11] Crimmin, "Sick," 103-4; Rosner, *Medical Education*, 21, 137-38; and 155. For critiques of the service: Brockliss, *et al.*, 15, and 25; Crumplin, "Surgery," 71-72; Gilbert Blane, *Observations on the Diseases of Seamen*, 3rd ed. (London: Murray & Highley, 1799), esp. ix. For Admiralty reform: Rodgers, *Command*, 487.

[12] Crimmin, "Sick," 104; Lloyd, and Coulter, vol. 3, 29-32; Brockliss, *et al.*, 15-17. For reformers: Bell, *Memorial*, 8-11; Blane, *Observations*, ix. For the Order in Council: see; Burnett, memo, Apr. 4, 1829, RNML/AL, Mss.242/3/f. 252; preliminaries to Order in Council, in Christopher Lloyd, ed., *The Keith Papers: Selected from the Papers of Admiral Viscount Keith, 1803-1815*, vol. 3 (London: Navy Records Society, 1955), 178.

[13] Lloyd, and Coulter, vol. 3, 5-7; Crimmin, "Sick," 105-6; Rodgers, *Command*, 487; Jedediah Stephens Tucker, ed., *Memoirs of Admiral the Right Hon. the Earl of St. Vincent*, vol. 2 (London: Richard Bentley, 1844), 147, and 157.

able medical officers, and those that remained became increasingly experienced.[14] Nonetheless, the Navy was ill prepared to confront the upheaval accompanying demobilization after the wars ended. By 1815, significant discord had emerged between the Navy's leading medical officers, including the former Sick and Hurt Board members. While one of them continued to serve Transport Board, the others held competing posts as naval hospital administrators and inspectors.[15] An additional crisis emerged as invalid, recently retired, and out-of-work medical officers fell back on half pay following rapid demobilization in 1815-16. Surgeons' only responsibility to the Navy while on half pay was to return to service when called. This provided them with the opportunity to supplement their naval income by developing a civilian practice. Half pay thus was one of surgeons' few perks, but substantially increased the Navy's financial liabilities. The overwhelmed Transport Board struggled to address rising half-pay obligations. There was no easy solution, as cutting back or eliminating half pay would have risked a wave of resignations, and made it difficult to mobilize surgeons for future conflicts.[16]

Facing a mounting structural and fiscal crisis, the Admiralty again reorganized its bureaucracy in 1817, and transferred responsibility for the medical service to the Victualling Board. The purpose of this reform was to increase peacetime efficiency and reduce costs as the Navy and British government entered a period of retrenchment. Edinburgh graduate and Scottish

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[14] Medical officers' increasing qualifications and skills reflect the continued importance of on-the-job and apprenticeship training. Crumplin, "Surgery," 88-89; Cardwell, "Royal Navy," 56; Bonner, 9, and 44-46. For practical advances: McLean, *Surgeons*, 6-7, and 10; Lloyd, and Coulter, vol. 3, 70-93. See also Appendix C.1 for a comprehensive view of works on the history of naval medicine.

[15] Lloyd, and Coulter, vol. 3, 6; Brockliss, *et al.*, 12; Vale, and Edwards, 123, and 128; Anon, *Authentic Memoirs, Biographical, Critical, and Literary, of the Most Eminent Physicians and Surgeons of Great Britain*, 3rd ed. (London: Sherwood, Neely, and Jones, 1822), 542.

[16] Lloyd, and Coulter, vol. 3, 32-34, and 158. For demobilization; Andrew D. Lambert, "Preparing for the Long Peace: The Reconstruction of the Royal Navy 1815–1830," *MM* 82, no. 1 (Jan. 1, 1996): 41–54; Lord Melville to Lord Liverpool, "Navy Estimates," July 28, 1818, in John Hattendorf *et al*., eds., *British Naval Documents, 1204-1960* (Brookfield, VT: Scolar Press, 1993), 570-74. For half pay, see Weir, and Burnett, memo, Nov. 3, 1825, NA, ADM 105/5/no.44, f. 4.

naval surgeon Dr. John Weir joined the Board as the medical commissioner.[17] Weir had some early success as an administrator. He led the Navy's response to an attempt by the Royal College of Surgeons, London to force demobilized army and naval surgeons to obtain corporate licenses in order to practice in the civilian market. The 1815 Apothecaries Act, which placed general practitioners under apothecaries' corporate authority, had opened debate regarding regulation within the medical profession and brought the Royal College's power and rights into question. The College attempted to reassert its influence at the expense of military medical officers. On Weir's advice, the Victualling Board responded that surgeons' customary right to practice without license ensured that the Navy retained its best surgeons. The Victualling Commissioners emphasized that many surgeons lived off of wages from private practice. A compromise emerged that restricted practice without a license to those surgeons with two or more years of service.[18]

Despite this victory, the Board had less success cutting expenditures as half-pay burdens and obligations rose after 1815. There was no mechanism for forcing any of the 830 of 1029 Surgeons receiving half pay in early 1817 to retire due to the rights granted during the wars in 1805. Nor was there any incentive for them to leave the Navy.[19] Through the 1820s, the commissioners regularly surveyed the service, requiring surgeons to report their addresses and fitness under threat of having their wages cut off. As the Admiralty had been unsuccessful in purging those too old to serve, it targeted Assistant Surgeons, those who failed to report, and

[17] Lloyd, and Coulter, Vol. 4, 2, and 11; MacDonald, *British Navy*, 90, and 111-112. For Weir: McLean, *Surgeons*, 11; Anon, *Authentic Memoirs*, 541-542; Prayer, memo, Mar. 1817, NA, ADM 105/1/10-11.
[18] Lloyd, and Coulter, vol. 4, 3, 11, 14-15, and 21-22; James Hamilton, "A Letter to Sir William Garrow, His Majesty's Attorney-General on his Proposed Bill for Regulating the Practice of Surgery Throughout the United Kingdom of Great Britain and Ireland" in *The Pamphleteer*, vol. 12 (London: A.J. Valpy, 1818), 137; House of Commons, "Sess. 1818. A Bill for Regulating the Practice of Surgery Throughout the United Kingdom of Great Britain and Ireland," Feb. 13, 1818, *PP*, 1818(22): i, 77, p. 2. More generally, see Bonner, 167-68.
[19] Brockliss, *et al.*, 25-26; William Corker, and Weir, memo, Apr. 3, 1827, NA, ADM 105/15/145-47.

those who had not drawn half pay in over a year.[20] Attrition from promotions, deaths, erasures, and resignations gradually reduced the ranks of unassigned Assistant Surgeons over the course of the late 1810s and 1820s. Nonetheless, there remained a substantial excess in ranks of Full Surgeons, as they had better service conditions and limited promotion opportunities.[21]

Such fiscal problems were the source of much frustration. Displeased by this slow progress, the Admiralty assigned a second medical commissioner and ten clerks to the Victualling Board in 1822. The new commissioner, Dr. William Burnett, was a Scottish doctor and Napoleonic veteran with nearly two decades of active service. His education included a Scottish apprenticeship, Edinburgh and London lectures, and St. Andrews and Aberdeen degrees, which he earned after the wars. His extended tenure on the Board and commanding the Medical Department through his retirement in 1855 allowed him to shape naval medical policy and reforms.[22] Soon after joining the Victualling Board, Burnett ordered a new personnel survey to determine the dimensions of the fiscal and personnel problems. His 1822 report highlighted the attrition of 407 medical officers since 1814 through resignations, deaths and dismissals, leaving 158 Assistant Surgeons employed.[23] This study revealed a shortage of junior surgeons, forcing the Admiralty to reopen appointments several times during the 1820s.[24] Progress at reducing the

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[20] Prayer, memos, Mar. 1817, NA, ADM 105/1/10-11; Apr. 29, 1817, ADM 105/1/21-23; Jan. 26, 1818, ADM 105/1/156-61; Jan. 27, 1818, ADM 105/1/162-63; Jan. 21, 1823, ADM 105/11/44-52. Fossett, memo, Jan. 24, 1825, ADM 105/13/12-16.

[21] A mid-1818 report had found 38 of 83 Assistant Surgeons unfit, 8 unaccounted for, and 4 deceased. For Assistant Surgeons: Prayer, memo, May 1, 1818, NA, ADM 105/1/273-74; Prayer, memo, June 18, 1818, ADM 105/1/311-13. For Surgeons: Prayer, memo, Apr. 22, 1822, ADM 105/10/69-75; Weir, and Burnett, memo, Jan. 19, 1824, ADM 105/4/no.21; Burnett, memo, Jan. 23, 1835, RNML/AL, Mss.242/3/f. 364.

[22] McLean, *Surgeons*, 11-13; Lloyd, and Coulter, vol. 4, 2-4; Anon, *Lancet* 56, no. 1420 (Nov. 16, 1850): 559-62.

[23] There were 39 Assistant Surgeons ruled unfit, 12 on extended leave, and 43 erased. Lloyd, and Coulter, vol. 4, 2-4; Prayer, memo, Apr. 22, 1822, NA, ADM 105/10/69-75; Burnett, memo, Apr. 4, 1829, RNML/AL, Mss.242/3/f. 254, and 258; Anon, "Review of Portrait of Sir William Burnett," *M-CR*, 47 (July 1, 1845): 255.

[24] In early 1824, 208 of 275 Assistant Surgeons were employed. Only 18 Assistant Surgeons available for assignment. Hattendorf, *et al.*, 624; Weir, and Burnett, memos, Jan. 19, 1824, NA, ADM 105/4/no.21; and Nov. 3, 1825, ADM 105/5/no.44; Barrow, memo, Sept. 23, 1822, ADM 105/10/233-34; Burnett, and Weir, memos, Jan. 15,

number of medical officers among the higher ranks who received half pay still remained slow, as 644 of 856 Surgeons remained on half pay in 1827.[25]

The structural situation and resulting personnel dynamics adversely affected many naval surgeons' career prospects. Promotion bottlenecks due to the abundance of Surgeons and dearth of Physician posts frustrated many younger and veteran medical officers. They understood quite clearly that there was limited mobility within the medical service, which remained clogged in the middle ranks. Multi-year waits after becoming eligible for promotion forced many medical officers to fall back on private practice and half pay, making them unavailable for continued service. Due in large part to the limited prospects, nearly 300 surgeons resigned between 1814 and 1820. Although this allowed for a wave of Assistant Surgeons promotions during the late 1810s, the bottleneck remained as many Surgeons still refused to resign and continued to draw half pay. The Navy consequently continued to lose experienced surgeons.[26]

During the 1820s, Weir and Burnett used these crises to secure greater administrative authority to reduce the ranks of Assistant Surgeons, and to set new standards for Surgeons' fitness. Such reforms gradually enabled them to reopen appointments. By the late 1820s, they also introduced systematized appointment regulations, which are analyzed later in this chapter.[27]

1825, ADM 105/13/Doc. 1; and Jan. 15, 1825, ADM 105/5/no.28; Burnett, memos, Apr. 4, 1829, RNML/AL, Mss.242/3/f. 256-57; and Jan. 23, 1835, Mss.242/3/f. 360-61.

[25] The proportion of Surgeons on half pay had decreased since 1817 (80.6% on half pay). In early 1829, 47 Assistant Surgeons were purged, 45 appointed, 2 unemployed, and 50 deemed "wholly ineffective." Brockliss, *et al.*, 25; Prayer, memo, Apr. 22, 1822, NA, ADM 105/10/77; Weir, memo, Apr. 3, 1827, ADM 105/15/145-149; Burnett, memo, Apr. 4, 1829, RNML/AL, Mss.242/3/f. 259, 263, and 265; Fossett, memo, Mar. 11, 1829, ADM 105/7; Weir, and Burnett, memos, Mar. 18, 1829, ADM 105/7; and June 19, 1830, ADM 105/8/156.

[26] McLean, *Surgeons*, 30-31; Prayer, memo, Apr. 22, 1822, NA, ADM 105/10/69; Weir, and Burnett, memo, Jan. 19, 1824, ADM 105/4/no.21; Fossett, memo, Mar. 11, 1829, ADM 105/7; Burnett, memos, June 19, 1830, ADM 105/8/156, Jan. 23, 1835, RNML/AL, Mss.242/3/f. 362-363, and Apr. 4, 1829, Mss.242/3/f. 253. See also Christopher H. Myers, "A Most Disagreeable Service": Scots, Shipboard Experimentation, Statistics, and Royal Naval Medicine, 1803-1864," (M.A. Thesis, University of Pittsburgh, 2011), 18-19.

[27] McLean, *Surgeons*, 11; Anon, *Authentic Memoirs*, 542-43. See also Weir and Burnett, Feb. 20, 1826, NA, ADM 105/6/no.47; Weir and Burnett, Feb. 20, 1826, RNML/AL, Mss.242/2/f. 252-261; Admiralty, *Regulations and Instructions for the Medical Officers of His Majesty's Fleet* (London: W. Clowes, 1825).

But other realities also affected the medical service as surgeons confronted increasing pressures to perform a new set of shifting duties after the wars. Battle medicine became less crucial, and their ability to address the diseases encountered during peacetime operations came into question. These new realities forced surgeons themselves to consider their professional qualifications, and decide which prospects offered the best chance for professional advancement.

The creation of the Naval Medical Department in 1832 proved the most significant reform of naval medicine during the nineteenth century. It was one of the results of the drive for efficiency following the Whigs' return to power in 1830. First Lord of the Admiralty Sir James Graham oversaw the elimination of the existing system of Admiralty boards, which divided authority among competing groups of admirals and politicians. He argued that the old system spawned "clashing interest and rival powers… inattention to the public welfare, [and] gross neglect of important duties." Based on the principles of efficiency and individual responsibility, he tried to centralize authority, by replacing the boards with singular departments overseen by professional experts.[28] As part of these efforts, Graham eliminated the Victualling Board and founded the Naval Medical Department. He appointed Burnett as the Department's head in June 1832, and granted him broad responsibilities, including supervising surgeons and hospitals, and recommending medical officers for assignments and promotions.[29]

After more than ten years of experience and frustration, Burnett moved to take full advantage of his new institutional powers, which were unprecedented for a naval medical officer. Burnett reshaped the medical service by institutionalizing policies based on empirical scientific

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[28] McLean, *Surgeons*, 12; Penn, "Burnett," 13-14; Jones, 548-552; Roger Morriss, *Naval Power and British Culture, 1760-1850: Public Trust and Government Ideology* (Aldershot, UK: Ashgate, 2004), 150, and 249; Oswyn A.R. Murray, "The Admiralty Part V," *MM* 24 (1938): 350-352; William Jones, *Biographical Sketches of the Reform Ministers* (London: H. Fisher, R. Fisher, and P. Jackson, 1832), 548-550; Graham, "Memorandum of the First Lord of the Admiralty," Dec. 6, 1831, reproduced in Hattendorf, *et al.*, 646-50.

[29] See also Lloyd, and Coulter, vol. 4, 3-6; Graham, Dec. 6, 1831, reproduced in Hattendorf, *et al.*, 649; Anon, "Review of Portrait of Sir William Burnett," 265.

standards and conceptions of competence, and by responding to the pressures that shifting medical educational and professional contexts placed on the service between the 1830s and 1850s. Before analyzing how this process of naval medical institutionalization occurred and the role that surgeons played in it, the next section investigates how changing broader British medical contexts shaped the naval medical service's ethnic and educational composition.

3.2 THE PROFESSIONAL DEMOGRAPHY OF NAVAL SURGEONS, 1815-1870

Scottish and Scottish-educated surgeons' representation among naval medical staff had increased during the Napoleonic Wars as the Navy needed more surgeons to aid the war effort. In a sample of Napoleonic-era surgeons based on the 1851 census, John Cardwell has found that 37.4% were Scottish while only 25.2% were English. By the first decade of the nineteenth century, naval surgeons received extensive educations via grammar schools, apprenticeships, and medical instruction at universities, teaching hospitals, and private lectures.[30] Those students who went on to become naval surgeons increasingly gravitated to hospitals and schools that offered practical and clinical instruction. Edinburgh's extensive curriculum and Royal Infirmary were particularly enticing. While the core courses drew the largest numbers, the practical and clinical sciences, including anatomy, surgery, midwifery, medical jurisprudence, and even natural history, became increasingly popular classes. The leading London hospital schools, including St. Bartholomew's, St. Thomas' and Guy's, also drew many future naval surgeons.[31] As

[30] Scots were overrepresented by 274% given their population within Britain. Bell, *Memorial*, 8; Cardwell, "Royal Navy," 40-44, and 47-50; Brockliss, *et al.*, 19-23; Ackroyd, *et al.*, 128-32.
[31] Cardwell, "Royal Navy," 47-50; Brockliss, *et al.*, 21-22; Guenter B. Risse, "Britannia Rules the Seas: The Health of Seamen, Edinburgh, 1791-1800," *Journal of the History of Medicine and Allied Sciences*, 43 (1988), 426-46. For

professional expectations continued to rise, the core classes and hospital attendance became “an almost universal prerequisite” throughout the profession, and practical and clinical training became increasingly expected. By 1810, meeting the anatomy, surgery, and hospital requirements needed to pass the naval examinations for appointment cost the equivalent of an Oxford education.[32] In this atmosphere of rapidly rising qualifications, some active surgeons also returned to school for training and degrees to increase their chances of advancement.[33]

Despite this clear understanding of the Napoleonic era, the possibility of changes in naval medical officers’ ethnic and educational backgrounds from 1815 through the 1860s has remained largely unexplored.[34] This dissertation’s prosopographical analysis extends the investigation of medical officers’ demography past 1815 and through 1870. It asserts that the dramatic shifts that occurred throughout the British medical profession and in medical training during this period shaped the medical service’s recruitment patterns, and its ethnic and educational composition. Some of the structural issues within the Navy, discussed in the previous section, guided the process for defining the study population for this analysis. The database focuses on medical officers who joined the Navy or received promotion after 1815, excluding surgeons who left the Navy or drew half pay without service. In compiling the dossier, it thus likely omits some who carried over for a short time after the Napoleonic Wars, but had limited service.[35] Those medical

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individuals, see J.C. Goddard, "An Insight into the Life of Royal Navy Surgeons during the Napoleonic War. Part 2" *JRNMS*, 78 (1992): 30; J. McIlraith, *The Life of Sir John Richardson* (London: Longman, and Green, 1868), 4-6.

[32] Cardwell, “Royal Navy,” 51-53. See also Court of Royal College of Surgeons, Edinburgh, Nov. 1, 1803, “Minute Books,” Vol. 7, f. 471; and May 15, 1805, Vol. 7, f. 577.

[33] Roughly 15% of surgeons received Scottish medical degrees. Harrison, *Medicine in an Age*, 51-52, 71, 150, 184, and 191; Cardwell, “Royal Navy,” 50-52; Rosner, *Medical Education*, 138, 165, and 169; McIlraith, 41-42; Speer, 92; Burnett, memo, Apr. 4, 1829, RNML/AL, Mss.242/3/f. 253.

[34] Previous analyses have emphasized that Scottish-educated surgeons’ high level of representation within the naval medical ranks continued during the decades following the Napoleonic Wars. For one analysis of Edinburgh and Scottish students’ representation, see Kaufman, *Regius Chair*, 79-82, and 143-44.

[35] A significant issue for analysis is that the percentage of surgeons whose background could not be identified is larger in the study’s initial decades, and declines over time. This is primarily due to improved record keeping, as professionalization and regulation increased, print culture expanded, and drives for efficiency intensified during the

officers who made their careers in the Navy, however, had a greater institutional and practical impact on the medical service.

Based on analysis of medical officers' ethnic backgrounds after the Napoleonic Wars, Scottish surgeons predominated within the naval medical ranks through the 1820s. During that period, Scottish surgeons constituted the largest ethnic group in the lower and upper medical ranks, but did not comprise a majority at the lower level. Nonetheless, they remained overrepresented relative to the proportion of Scots in the British population (see Figure 1 and Figure 2).[36] Despite missing data issues at both rank levels, the general trends and magnitude of Scottish surgeons' domination shown in these figures reinforce Caldwell's findings for the preceding period.[37] As we will see, the significant Scottish presence during this post-war period had a continuing impact beyond mid-century, as surgeons who entered the Navy during these years dominated the upper ranks through the 1840s and into the 1850s.

In terms of the service's educational composition through the 1820s, Scottish-trained medical officers also dominated the naval ranks. Scottish universities, and especially the University of Edinburgh, were the leading educators of medical officers, training a majority of the students who entered the Navy in the period prior the 1830s (see Figure 3).[38] As illustrated in Figure 4, the Scottish universities educated an even larger proportion of medical officers in the

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early nineteenth century. The resulting data gaps must be supplemented by Cardwell's earlier findings, and the assumption that Scots are slightly overrepresented. See Appendix A.1 for further discussion of methodology and data issues. See also Myers, "Demography," 46-49.

[36] For those identifiable surgeons who entered prior to the 1830s, Scotsmen comprised 43.6% of those in the lower ranks, and 46.9% of those who reached the upper ones. For this analysis, the lower ranks are Assistant Surgeons and Full Surgeons. The upper ranks are Physicians, Staff Surgeons, Medical Inspectors, and the Director-Generals. Myers, "Demography," 46. See Appendix A.2, Table 3 for surgeons' ethnicity by multi-decadal groupings of entry into the Navy, and Figures 5-6 for graphs showing the numbers of surgeons by ethnicity and rank.

[37] The small number of surgeons represented, and significant proportion of unidentifiable surgeons through the mid-1820s make statistical tests unreliable, particularly for the upper ranks.

[38] Of those lower-ranking surgeons who entered before 1830, 49.8% received some or all of their training at Edinburgh, and a further 16.2% attended other Scottish universities. See Appendix A.2, Table 4.

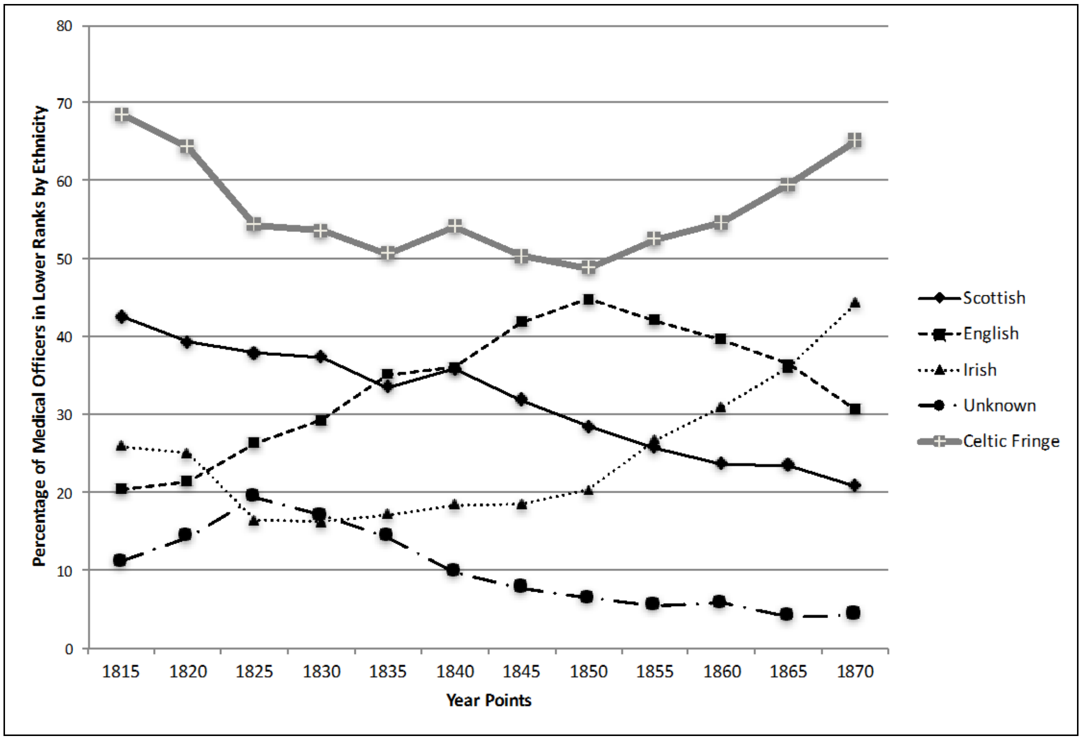

Figure 1. Percentage of Medical Officers in the Lower Ranks by Ethnicity with Unknowns and Celtic Fringe, 1810-1870. Colonial and Welsh surgeons were dropped from the graph.

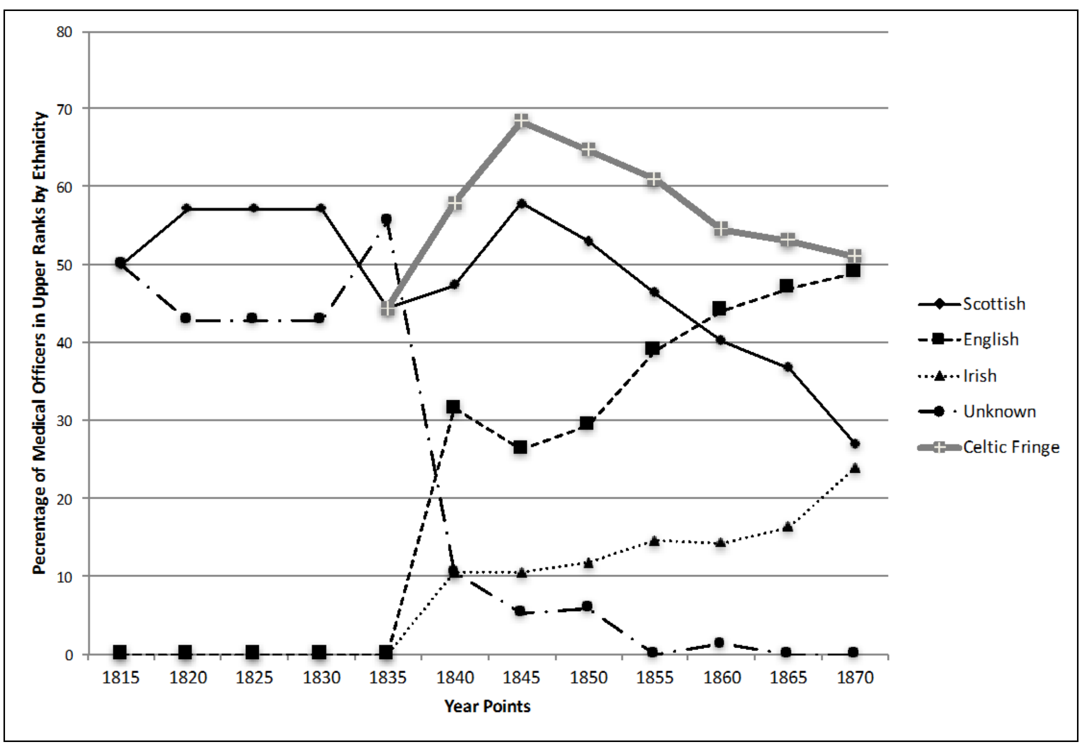

Figure 2. Percentage of Medical Officers in the Upper Ranks by Ethnicity with Unknowns and Celtic Fringe, 1810-1870. Colonial and Welsh surgeons were dropped from the graph.

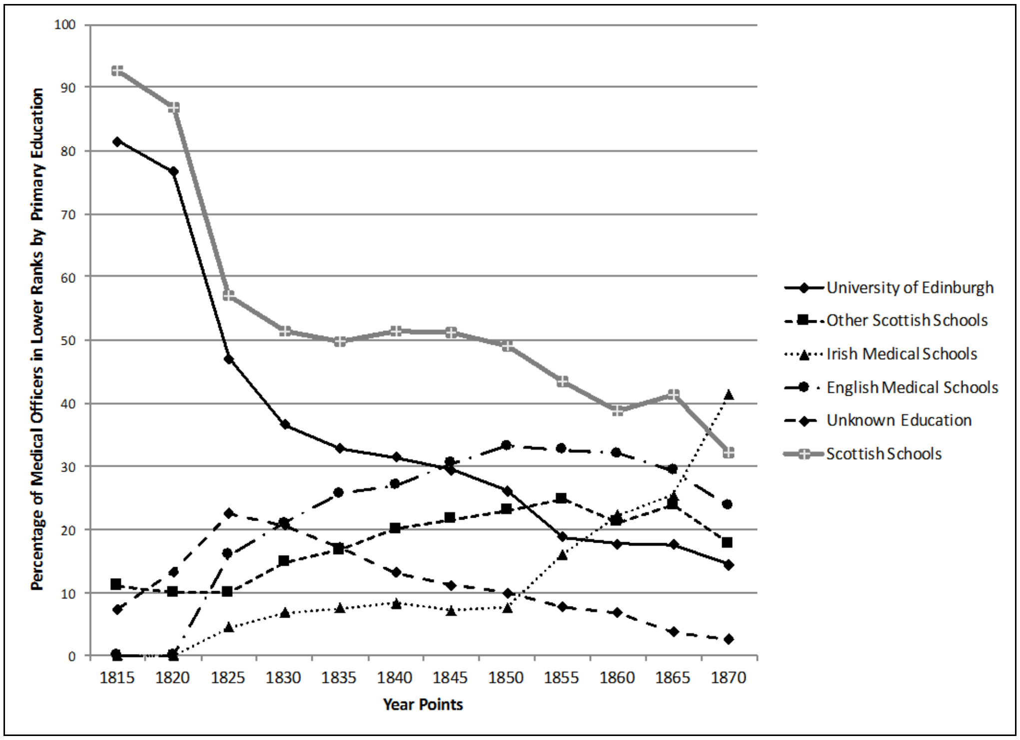

Figure 3. Percentage of Medical Officers in the Lower Ranks by Primary Place of Medical Education with University of Edinburgh Disaggregated from Scottish Medical Schools.

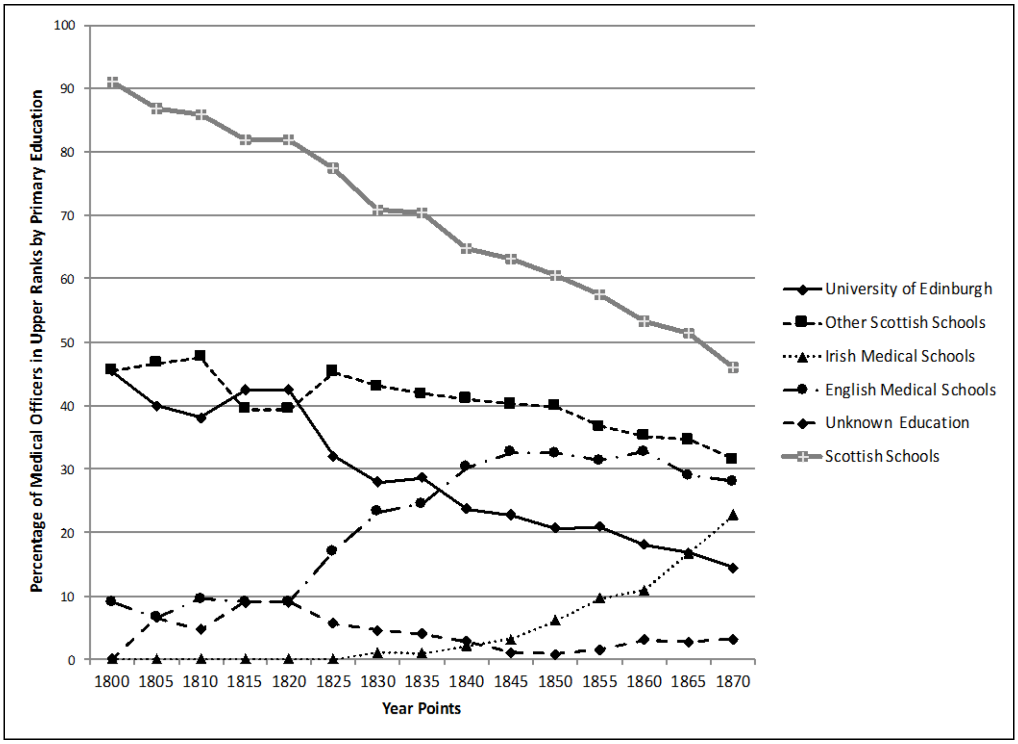

Figure 4. Percentage of Medical Officers in the Upper Ranks by Primary Place of Medical Education with University of Edinburgh Disaggregated from Scottish Medical Schools.

upper ranks. However, a higher percentage of those at these ranks attended Scottish medical schools beyond Edinburgh.[39] The career longevity of these Scottish-educated surgeons ensured their continued if declining presence in the upper ranks through mid-century.

Several endogenous and exogenous factors related to surgeons' motives for joining and staying in the Navy underpinned Scottish and Scottish-educated surgeons' high level of representation within the naval medical service. Shifts in educational opportunities and the medical labor market were the most significant factors. From the 1780s, medical students flocked to Edinburgh and Glasgow to take advantage of the relatively cheap, and increasingly practical and scientific educations that they offered. The rising demand for military doctors during the French and Napoleonic Wars ensured an expanded labor market.[40] After the wars, the London hospital schools began to offer more comprehensive training, and many surgeons returned to Scottish and London schools in the hope of advancing their careers. But by the mid-1820s, the employment bubble had burst, as continued educational overproduction at near-wartime levels oversaturated the labor market. This forced many students to look to Ireland, the Empire, and military service for work. Steady employment in the armed forces remained the best option for many students, particularly middling ones, assuming that they were accepted.[41]

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[39] For Scottish-educated surgeons' dominance, see McLean, *Surgeons*, 25; Kaufman, *Regius Chair*, 79-82, and 143; Anon, *Lancet* 55, no. 1378 (Jan. 26, 1850): 133; Robert McCormick, *Voyages of Discovery in the Arctic and Antarctic Seas: And Round the World*, vol. 2 (London: Sampson Low, Marston, Searle, and Rivington, 1884), 214. See also Myers, Demography," 47, and Appendix A.2, Table 4 for distribution and Figures 7-8 for the number of surgeons in the lower and upper ranks by primary place of education.

[40] In the early 1820s, 60% of medical students went to Scottish universities. Myers, "Demography," 47; Digby, *Making a Medical Living*, 12-13; Morgan, "Matriculates," 125; Rosner, *Medical Education*, 20-21, and 28-30; Kaufman, *Regius Chair*, 225; Dow, and Moss, 239; Carolyn Pennington, *The Modernisation of Medical Teaching at Aberdeen in the Nineteenth Century* (Aberdeen: Aberdeen University Press, 1994), 7; Christopher H. Myers, "Explaining the Socio-Economic Demographics of Victorian Naval Medicine," report, Joint Centre for History and Economics, and Institute for New Economic Thinking, http://www.histproj.org/completed/MYERS.pdf, 2-4.

[41] Myers, "Demography," 48; Myers, "Explaining," 5-8; Digby, *Making a Medical Living*, 15, and 20; Cardwell, "Royal Navy," 41, and 54; Ackroyd, *et al.*, 106, 119, and 130-34.

Several push and pull factors also affected individual surgeons' decisions to join the Navy. Desire to aid Britain, and curiosity to sail the seas and see the world drew many surgeons to the Navy during and after the wars.[42] Financial perks beyond poor base compensation, such as half pay, invalid allowances and prize money also proved attractive. Due to poor service conditions, and structural issues that limited surgeons' promotion potential and opportunities for advancement, however, the Navy struggled with high attrition and resignation in the medical ranks. Those career medical officers who achieved promotion felt that their higher pay and status outweighed civilian opportunities and the harsh rigors of naval life, but their junior colleagues often felt differently. In the post-war period, the Navy thus attracted many Scottish and Scottish-educated students searching for employment, as well as practitioners who wanted to establish their credentials, and accumulate the experience and capital needed to move into private civilian practice. The combination of these broader educational and professional dynamics shaped the medical service's recruitment abilities and patterns.[43]

Further investigation of the medical service's ethnic and educational composition during the 1830s and 1840s illustrates a significant shift in the backgrounds of naval surgeons', which began after the Napoleonic Wars. The number and proportion of Scottish surgeons within the naval ranks began to decline in the late-1810s and 1820s, and this trend accelerated through the 1840s. By 1835, while Scottish surgeons maintained a substantial presence within the Navy's lower ranks, they had lost their place as the predominant ethnicity. English surgeons'

[42] Cardwell, "Royal Navy," 53-54; Howard J. Fuller, *Empire, Technology and Seapower: Royal Navy Crisis in the Age of Palmerston* (New York: Routledge, 2013), part I; Anon, "Extracts from the Diary of a Naval Surgeon," *Colburn's United Service Journal* 3 (1843): 505. For a brief discussion, see also McLean, *Surgeons*, 32.

[43] These factors also lay behind several of the structural issues within the medical service, including the Assistant Surgeon shortage during the 1820s and the continuing Surgeon-level promotion bottleneck. For some of these factors: Cardwell, "Royal Navy," 54-55; McIlraith, 48-49; J.R. Hill, *The Prizes of War: The Naval Prize System in the Napoleonic Wars, 1793-1815* (Stroud: Sutton/Royal Naval Museum Publications, 1998); Christopher Lloyd, *The Navy and the Slave Trade* (1949, repr.; London: Frank Cass, 1968), xi, and 79-85.

representation increased substantially from the 1820s onward (see Figure 1).[44] Meanwhile, while Scots continued to predominate in the upper ranks, from the mid-1830s, the proportion of English medical officers also rose (see Figure 2).[45] As a result of these shifts, between 1830 and 1850, ethnic diversity rose substantially but Scots remained a sizable minority within the ranks.

During the 1830s and 1840s, the educational diversity of the Navy's medical officers also increased, as English medical schools and Scottish universities beyond Edinburgh contributed more practitioners in the lower ranks. While English-trained surgeons' representation at these ranks rose rapidly, Scottish-educated surgeons collectively remained predominant. The proportion of surgeons in the lower ranks educated at the University of Edinburgh, however, fell. Nonetheless, while its dominance as a single institution began to decline, Edinburgh remained a prominent educator of naval surgeons compared to other individual schools (see Figure 3).[46] Meanwhile, in the upper ranks, the other Scottish universities still contributed the majority of medical officers, and English medical schools' contribution again rose most substantially (see Figure 4). Just as in the preceding period, it was broader educational and professional dynamics that shaped the medical service's ethnic and educational composition, and particularly underlay the influx of English-educated surgeons overtaking the naval service.

From the 1830s through 1850s, the turbulent medical educational landscape created by the political and social transitions occurring within the medical profession shaped the naval service's institutional and demographic dynamics. While students had flocked to the Scottish

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[44] Of the medical officers in the lower ranks who entered between 1830 and 1849, 44.9% were English. See Appendix A.2, Table 3.

[45] Since it generally took ten or more years of service for medical officers to reach to the upper ranks, the English surgeons who joined the Navy during this period only dominated the upper ranks after 1855. Myers, "Demography," 46. See also Appendix A.2, Table 3.

[46] Scottish-educated surgeons comprised 53.8% of those who joined the Navy between 1830 and 1849. But Edinburgh contributed 27.3% of those in the lower ranks who entered between 1830 and 1850, and only 18.2% of those who made it to the upper ones. English schools also trained 36.9% of lower-ranking surgeons who entered between 1830 and 1850. See Appendix A.2, Table 4, and Myers, "Demography," 48.

universities between the 1790s and the 1820s, as Edinburgh and Glasgow significantly increased their medical requirements and restricted their enrollments from the mid-1820s, the number and nature of British medical students changed. Leading medical schools also adopted educational reforms aimed at revitalizing the breadth, content, and method of training. The London hospital schools rapidly reformed their curricula, modeling new classes, approaches and other elements from Edinburgh, Glasgow, and Continental medical training as they tried to become more competitive. They adopted the practical scientific educational model described in the preceding chapter, extending their medical curricula and teaching.[47]

The increasing standardization of and parity within British medical education were the most significant factors leading to the shifts seen in naval medical officers' educational demography during the 1830s and 1840s. Due to their rapid expansion from the 1820s, the London teaching hospital schools contributed to an already oversaturated labor market. The armed forces and emigration were thus viable options during this period as many students had limited civilian prospects. An adequate number of students well trained in the clinical and practical approaches expected throughout much of the profession continued to join the Navy. But this generation of medical officers came from a broader range of medical schools than their predecessors. They also brought practical scientific training, and greater professional and practical ambitions into the Navy.[48] These educational and professional dynamics also converged with Burnett's attempts to introduce rising standards related to practical scientific, anatomical, and surgical training within the Navy, which we will see in the coming section. These broader

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[47] Myers, "Demography," 48; Myers, "Explaining," 3-5; Morgan, "Matriculates," 125; Digby, *Making a Medical Living*, 12-13; Dow and Moss, 239; Pennington, 7. For hospitals, see also Waddington, *Medical Education*, 45-49, and 50-52.

[48] As the number of Scottish doctors gradually fell, the labor market began to open. Furthermore, during this period, many Scottish and Scottish-educated practitioners emigrated beyond Britain. Myers, Demography," 48; Myers, "Explaining,"7-8, Digby, *Making a Medical Living*, 12-13, and 20; Loudon, *Medical Care*, 208-209; Kaufman, *Regius Chair*, 226.

medical contexts thus contributed at multiple levels to the shifts in the naval medical service's educational and ethnic composition.

During the 1850s and 1860s, the shifts in the naval service's ethnic and educational composition continued in a new direction. Rising Irish, and declining English and Scottish ethnic and educational representation within the Navy transformed the medical ranks. Irish surgeons' became the predominant ethnicity in the lower ranks after 1865 (see Figure 1).[49] From the 1850s, Irish medical schools similarly educated an increasing number of surgeons in the lower ranks, and became the most prominent contributors. Regardless, Scottish-educated surgeons remained a significant minority group (see Figure 3). These shifts were more gradually felt in the upper ranks. English medical officers came to ethnically dominate at those ranks due to the large number of them who had entered the Navy from the 1830s onward (see Figure 2). Following a different pattern, however, Scottish-educated medical officers continued to dominate the upper ranks in terms of education (see Figure 4). The rise of Irish and Irish-educated medical officers during this period ultimately set the stage for them to take over the medical service's ranks in the later decades of the century beyond the scope of this analysis.

British medical education's continued diversification from the mid-nineteenth century onward underlay the changes in naval medical demography during the 1850s and 1860s. New civic universities and provincial schools offering medical training emerged throughout Britain, and Irish medical education especially became more rigorous. While the rise of Irish and Irish-educated surgeons in the Navy from 1850 reflects this trend, Ireland's internal situation also underpinned it. As Ireland underwent social, political and economic reform after the Great Famine, Irish medical education expanded and underwent reform. More Irish students entered

[49] Irish surgeons comprised 41.0% of those in the lower ranks who joined after 1850. Myers, "Demography," 46. See Appendix A.2, Table 3.

medical school as a route to potential financial and social mobility and advancement.[50] The rapid increase in the number of Irish and Irish-educated medical students, however, quickly oversaturated the Irish labor market. Furthermore, discrimination and lingering questions about the quality of Irish students' training limited their prospects. These factors contributed to many Irish-educated students' decisions to emigrate or volunteer for the armed forces. From the early 1850s, more Irish and Irish-educated surgeons came forward and joined the Navy.[51]

As a later section further explores in the context of surgeons' campaign pushing for reforms to improve their service conditions and status, there was disagreement within the Admiralty regarding how to respond to the changes that occurred in the Navy's ability to recruit surgeons from different ethnic and educational backgrounds. The debates became increasingly contentious as Burnett and the Admiralty recognized the impact that broader medical educational and professional developments, as well as the medical service's institutional structure and working conditions had on recruitment. When discussing the service's declining reputation among increasingly ambitious Scottish and London-educated students, Burnett resisted relaxing the Navy's educational, age, and fitness requirements. He instead advocated for improvements to service conditions so as to regain and maintain the service's reputation.[52] The rest of this chapter investigates the medical service's institutional policies and reforms from the 1830s onward, considering throughout how dynamics and debates related to the service's working conditions, recruitment patterns, and practical competence shaped the Medical Department's professionalization through the 1850s.

[50] Digby, *Making a Medical Living*, 12-13; S. Karly Kehoe, "Accessing Empire: Irish Surgeons and the Royal Navy, 1840–1880," *Social History of Medicine* 26, no. 2 (2013): 204.
[51] Kehoe, 204-205; Greta Jones, "Strike out Boldly for the Prizes that are Available to You": Medical Emigration from Ireland 1860–1905," *Medical History* 54, no. 1 (2010): 55.
[52] McLean, *Surgeons*, 26, and 29-30; Brown, *Poxed*, 168; Burnett, memo, Feb. 23, 1846, NA, ADM 105/38/f. 383-84. See also Burnett to Earl Grey, Jan. 23, 1835, RNML/AL Mss.242/3/f. 360-362; Burnett to Earl Grey, Jan. 23, 1835, ADM 97/137/3525/B; Burnett to Graham, June 14, 1831, NMM, ELL/245, f. 10-11.

3.3 MEDICAL REFORM AND SCIENTIFIC COMPETENCE, 1832-1865

The founding of the Medical Department transformed the balance of naval medical authority. Naval surgeons, particularly a small cadre of senior, largely Scottish-educated medical officers led by Burnett, gained increasing control of medical administration and policy. Although under the supervision of the Lords Commissioners, as head of the service Burnett had considerable liberty to confront long-standing structural and practical issues, lobby for his department, and respond to routine administrative and personnel matters. However, he had limited resources to meet growing commitments as the Navy's global reach expanded, service conditions remained poor, and the gap relative to the medical profession appeared to be widening. As he confronted large-scale problems related to manpower, recruitment and competence, Burnett ultimately institutionalized and professionalized the service based on empirical scientific conceptions of competence.[53]

During the late 1820s, and early 1830s, as medical commissioner and Physician of the Navy, Burnett prepared a series of reports on the service's personnel and expenditures. They highlighted the ongoing and seemingly intractable structural issues facing the service. By 1831, the Navy employed 29.9% of 720 Surgeons on active assignments. Furthermore, only 55.6% the 322 Surgeons younger than fifty declared themselves fit for sea duty. One of the significant problems facing the service was that aging and invalided surgeons from the Napoleonic Wars continued to collect half pay as an informal pension. While the majority of Assistant Surgeons were employed and only 92 were on half pay, most of the progress in the reduction of the ranks

[53] For analysis of Burnett's tenure and the Medical Department, see Lloyd, and Coulter, vol. 4, 3-6, and ch. 1; McLean, *Surgeons*, 12-21, and 197; Penn, "Burnett," ch. 2; Anon, "Review of Portrait of Sir William Burnett," 265. See also *inter alia*, Appendix D.1 for contemporary medical journal articles on Burnett's leadership of the service.

had come from surgeons dying in service and of old age. Burnett had less success in his attempts to purge unfit Surgeons and those on half pay.[54]

An even more significant internal issue affecting the service throughout Burnett's tenure was the poor service conditions that surgeons faced. Their treatment within the Navy remained unfavorable relative to most of the medical profession, and shaped the service's demographics and bureaucratic policies. Surgeons continued to complain that their pay was far less than that of Army medical officers. While prize money offered some relief, Assistant Surgeons received smaller shares of such money than other officers. Poor compensation ensured that doctors from middling backgrounds entered the service, led to numerous resignations, and forced aging Surgeons who could not afford to retire to continue drawing half pay.[55] Burnett pushed for progressive increases in pay for every five years of service so as to convince more surgeons to volunteer for assignment and to be able to retire. Despite his recommendations, the Admiralty only grudgingly introduced meager increases in surgeons' pay rates through the mid-1850s.[56]

When the Admiralty refused to acknowledge their complaints, many aging surgeons felt no compunction about avoiding service while drawing half pay. Burnett thus argued that low half pay was the root cause of rising half-pay obligations, the bloating of the service list, and

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[54] From 1817-31, 345 Surgeons and 266 Assistant Surgeons died in service. Burnett to Graham, June 14, 1831, NMM, ELL/245, f. 2-10; Burnett, memo, Apr. 4, 1829, RNML/AL, Mss.242/3/f. 263. For an analysis of this same report, see McLean, *Surgeons*, 26-27.

[55] Naval pay was 20% lower. McLean, *Surgeons*, 27-28, and 66; Penn, "Burnett," 58-61, and 78-79; Burnett to Graham, June 14, 1831, NMM, ELL/245, f. 10-26, and 28-30; Pritchett to Burnett, May 23, 1837, NA, ADM 97/142/1281.

[56] Arthur Wellesley, and the Commissioners of Naval and Military Promotion and Retirement, "Report of Commissioners for Inquiring into Naval and Military Promotion and Retirement," *PP* 1840(235): xlii, 1, p. lxvi, and 189. Regarding pay: William Corker, and Weir, memo, Apr. 3, 1827, NA, ADM 105/15/145-49; Burnett to Graham, June 14, 1831, NMM, ELL/245, f. 10-14; Burnett to Capt. Berkley, May 27, 1833, ADM 105/70/116-17; Burnett to Earl Grey, Jan. 23, 1835, RNML/AL, Mss.242/3/f. 367-72; Burnett to Thomas Troubridge, June 5, 1835, ADM 105/70/f.365-68; Barrow to Burnett, Sept. 22, 1840, ADM 97/26/2014; Burnett, memos, Jan. 25, 1836, ADM 105/71/f.33-42; June 5, 1837, ADM 105/71/f.223-31; Nov. 14, 1837, ADM 105/71/f.326, and 332-33; Dec. 19, 1837, ADM 105/71/f.338-40; July 17, 1839, ADM 105/72/f.144-51; May 17, 1847, Mss.242/4/f. 602-10; Jan. 16, 1855, ADM 105/39/f.376-84; and Mar. 16, 1855, ADM 97/218/7786.

difficulties recalling surgeons for assignment. The retrenchment occurring throughout the Navy and within the Admiralty forced Burnett to consider more cost-effective ways of reducing half pay obligations.[57] These included proposals to call more surgeons back into active service, to examine unfit or malingering individuals, and to institute mandatory retirement ages during the 1820s and 1830s. The Admiralty also debated forcing Surgeons who had not recently completed service to serve in junior and secondary posts on larger ships, but did not enact this measure due to Burnett's objections.[58] While the Admiralty attempted to call forth Surgeons from the half-pay list based on when they had last served, it had little success forcing aging officers not fit for duty to retire. A commutation scheme proposed in late 1833, offering Surgeons promoted before 1820 release from service, one-quarter pay, and the right to remain in private practice had modest success. While it failed to fully relieve the increasing burden of scrutinizing medical officers' fitness, it did create some room to promote more surgeons.[59]

Based on these circumstances, naval surgeons' best hope for increasing their wealth and social status was to earn promotions. Their promotion prospects, however, were limited. The ranks had become clogged with inactive and unfit surgeons, creating a promotion bottleneck during the 1830s and 1840s that allowed fewer than half of Assistant Surgeons to make it to

[57] Beyond the previous footnote's sources, see also Barrow to Burnett, Dec. 31, 1833, NA, ADM 97/19/3893; Capt. Richards to Burnett, July 21, 1854, ADM 97/214/3722; Burnett, memos, Dec. 5, 1833, ADM 1/3530; Dec. 24, 1833, ADM 1/3530; July 17, 1838, ADM 105/38/f.84; July 19-21, 1838, ADM 105/72/f.1-13; June 12, 1839, ADM 1/3532/380-81; and Feb. 23, 1839, ADM 1/3532, f.284.

[58] Penn, "Burnett," 80-82; Victualling Board, memo, July 5, 1822, NA, ADM 105/10/127-29; Burnett to Capt. Berkley, May 15, 1834, ADM 105/70/f.243-45; Burnett, memos, Apr. 4, 1829, RNML/AL, Mss.242/3/f. 247, and 267-68; Dec. 24, 1833, ADM 105/70/f.208; Jan. 6, 1834, ADM 105/70/f.217; Jan. 2, 1835, ADM 105/70/f.317-18; May 2, 1839, ADM 105/72/f.105-06; June 12, 1839, ADM 105/72/f.124-25.

[59] In mid-1838, 54 Surgeons accepted commutations. McLean, *Surgeons*, 27; Penn, "Burnett," 82; Burnett to the House of Commons, July 17, 1838, NA, ADM 105/38/f.84; July 19, 1838, ADM 105/72/f.1-4; and July 21, 1838, ADM 105/72/f.6-12; Burnett, memos, Dec. 26, 1834, RNML/AL, Mss.242/3/f. 353-54; Nov. 14, 1837, ADM 105/71/f.327; June 12, 1839, ADM 1/3532/380-81. For commutation, see also Burnett, memos, Dec. 24, 1833, ADM 105/70/f.208-10; Dec. 20, 1834, Mss.242/3/f. 354-56; Jan. 2, 1835, ADM 105/70/f.318-23; Jan. 23, 1835, Mss.242/3/f. 372-73, 377, and 379-81; Jan. 25, 1836, ADM 105/71/f.27-30; June 5, 1837, ADM 105/71/f.232-35; Nov. 14, 1837, ADM 105/71/f. 325-27; Dec. 19, 1837, ADM 1/3531; June 18, 1838, ADM 1/3532/74-75; and Mar. 20, 1839, ADM 105/72/f.83-84.

Surgeon.[60] Because that bottleneck had ramifications for recruitment and retention, Burnett explored measures to create more room for advancement. In the early 1840s, he reduced the seniority needed to take examinations in the hope of reducing the wait between passing the exam and receiving promotion. Although new gradations of higher rank would have increased prospects, Burnett expressed concerns that changing the rank system could lead to increased resentment among those passed over for promotion, and would not address the wider causes of the bottleneck. Nonetheless, the Admiralty created the Medical Inspector ranks in 1841, and Staff Surgeon in 1847. While this began to slowly increase surgeons' chances of ascending in rank, all of these structural and institutional issues, and the conflicting interests of the Admiralty and its surgeon thus continued to plague the medical service through the 1830s and 1840s.[61]

Beyond confronting the state of the service's surgeon corps, Burnett remained especially concerned with the qualifications, education, and quality of medical officers throughout his career. Soon after joining the Victualling Board, Burnett spearheaded a shift in the service's approach to education as appointments resumed in the early 1820s. This led to increasing systemization of appointment requirements, which both reflected and encouraged the rising educational expectations after the Napoleonic Wars. While the naval service had implemented formal education requirements and examination procedures during the mid-to-late 1820s, these became increasingly more demanding from then into the 1840s. Burnett's reforms were also both a response to and an embrace of changing professional dynamics, and the rise of scientific

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[60] McLean, *Surgeons*, 30-31; Christopher Penn, "The Medical Staffing of the Royal Navy in the Russian War, 1854–6," *MM* 89, no. 1 (Jan. 2003): 51. See among others, A Navy Surgeon, *Lancet* 29, no. 749 (Jan. 6, 1838): 530; Anon, *Lancet* 54, no. 1362 (Oct. 6, 1849): 381–82.

[61] Admiralty, "Regulations," 1842, NA, ADM 97/156/2523; Burnett, memo, Nov. 14, 1837, ADM 105/71/f.328, and 332-33. For new ranks and promotions: Penn, "Burnett," 85; Wellesley, and the Commissioners of Naval and Military Promotion and Retirement, lxvii, and lxvi; Burnett to the Commission of Naval and Military Enquiry, June 26, 1838, ADM 97/144/1110; Barrow to Burnett, Sept. 22, 1840, ADM 97/26/2014; Burnett, memos, Jan. 23, 1835, RNML/AL, Mss.242/3/f. 369-370, and 374; and Mar. 1, 1847, Mss.242/4/f. 519-22. See *inter alia*, Appendix D.2.

principles and approaches. This was especially the case after he gained control of appointments as head of the Medical Department.[62]

Before that, however, when examinations resumed in 1822, Burnett lobbied for clearer guidelines to demonstrate the service's professional nature and rigor. Future examinations would be conducted based on the order in which the Board received applications rather than personal and professional connections. Although age, education, and an oral examination would be the principal criteria, the Board's educational expectations were not yet explicitly stated.[63] More precise regulations emerged in 1824, as the Admiralty attempted to clear up confusion regarding the authority of the different Boards. According to these clarifications, candidates had to submit certificates that they had completed six months of apothecary placement and eighteen months of hospital attendance. Only then could they sit for an examination before the medical commissioners. The exam focused on their competence in medical practice, theory, anatomy, surgery, materia medica, and chemistry. In 1826, the required educational demands increased further. Candidates then had to master Latin, and complete two years of apothecary service and twelve months of hospital attendance, in addition to: eighteen months of Anatomy and Surgery lectures; twelve months of Practice & Theory of Medicine; and six months of Practical Anatomy, Chemistry, Materia Medica, and Midwifery. Preference was also given to those who had also attended classes on Diseases of the Eye, Botany, Medical Jurisprudence, or Natural Philosophy.[64]

These changing standards reflected the Navy's embrace of the empirical practical scientific mindset, principles and practices emerging in Scottish and London medical schools.

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[62] Penn, "Burnett," 45; McLean, *Surgeons*, xiii; Rosner, *Medical Education*, 138, 165, and 169; Kaufman, *Regius Chair*, 19; Newman, 17-18; Burnett, memo, Apr. 4, 1829, RNML/AL, Mss.242/3/f. 266.

[63] Burnett, and Weir to Barrow, Oct. 31, 1822, NA, ADM 105/10/235-237; Fossett, and C.H. Locker, memo, Apr. 11, 1826, ADM 105/14/108-09.

[64] Weir and Burnett, Feb. 20, 1826, NA, ADM 105/6/no.47; Weir, and Burnett, memo, Feb. 20, 1826, RNML/AL, Mss.242/2/f. 252-53.

They were ambitious and compared favorably with most British medical training. In 1827, the attendance at Practice and Theory of Medicine, Anatomy, Surgery, Chemistry, Materia Medica, and hospital wards demanded by the Navy matched or exceeded the requirements of most British medical degrees and licentiates. The Universities of Edinburgh and Glasgow, and the London Royal College's regulations came closest to the Navy's requirements. The principal difference was that the Navy required more study of the core medical courses.[65] Surgeons' broad responsibilities as general practitioners, physicians, surgeons, and apothecaries while at sea in large part drove the Navy's demanding standards. But they also indicate that the competitive labor market allowed the medical service to adopt the profession's rising expectations in relation to physic, surgery, and empirical science.[66]

The importance of Scottish medical education and Scottish-educated surgeons to the naval service, especially in the 1820s and 1830s, was readily apparent to Admiralty officials and medical professors. In June 1827, when Burnett testified before the Royal Commission on Scottish Universities, he stated that "many of the Medical Officers admitted into the Navy are educated in Edinburgh." In addition, several Edinburgh professors argued that Edinburgh's importance to the military emerged during the wars and continued after them as "multitudes of medical men returned to their studies."[67] Burnett also stressed that the Navy preferred Edinburgh-educated candidates, particularly degree graduates, precisely because of their superior

[65] The standards of Edinburgh and Glasgow degree students were even more ambitious; they had to write a dissertation and attend more specialized, elective classes.
[66] For other institutions' requirements: Anon, *Medical Calendar*, 38-42, 44-48, 118-20, 141-45, 164, 166-68, 173-75, and 179-80; Anon, *EMSJ*, 26, no. 88 (July 1826), 209-10; Royal College of Surgeons of Edinburgh, *Regulations to Be Observed by Candidates: Previous to Their Being Taken Upon Trials for Obtaining Diplomas from the Royal College of Surgeons of Edinburgh* (Edinburgh: Walker & Greig, 1822), 7-8.
[67] Ninety-one London students from at least five hospital schools, as well as ninety-one Edinburgh and fifty-nine Glasgow students admitted between 1821 and June 1827. Royal Commissioners, "Evidence, Edinburgh," 531-33. For the professors: Hope, Home, Monro III, Duncan Jr., Graham, and Alison, GUL SC, MS Gen 1476/C/1/17, 2-3; Royal Commissioners, "Evidence, Edinburgh," 192, and 248.

education and competence. He also stated that the students most sought after by the Army and Navy were those who "acquired certain scientific knowledge in addition to that required of their medical men." Thus, he implied that Edinburgh offered the breath, rigor and scientific skills desired by the Navy as long as students took advantage of the University's full range of offerings.[68]

While Burnett's reforms embraced the scientific principles and approaches gaining momentum and influence at Edinburgh and other British medical schools, his testimony and policies also reinforced and gave impetus to continued reforms in medical training. In his testimony, Burnett discussed his views regarding how medical students should pursue their education, and what reforms should occur at Edinburgh. He encouraged students to gain clinical and practical knowledge of surgery and physic, or as he put it, by paying "great attention to the cultivation of Clinical Medicine and Surgery." He thus agreed that the Surgery class should be separated from Anatomy, and praised the Military Surgery class.[69] Burnett also recommended Practical Anatomy, Natural History, and Medical Jurisprudence, which he felt helped ensure students learned the proper practical and scientific mindset and approaches. He considered Practical Anatomy vital in making "a thoroughly good surgeon," and encouraged attending Medical Jurisprudence and Natural History for additional anatomical and scientific training. Linking his general advice back to the naval medical service and its policies, Burnett stated that the Victualling Board endeavored "to give [medical officers] every facility of improving their knowledge" through continued education, particularly in the sciences.[70] His belief in the value of empirical scientific training thus shaped his approach to issues of education and competence.

[68] Royal Commissioners, "Evidence, Edinburgh," 531.
[69] *Ibid.*, 531-32; Ballingall, EUL CRC, UA, Dc.3.20, f. 4, and 8; Anon, *Lancet* 40, no. 1048 (Sept. 30, 1843): 918-9.
[70] Royal Commissioners, "Evidence, Edinburgh," 531-33.

Beyond these views, Burnett was attuned to the ways in which the service's requirements shaped its personnel composition. During the 1830s, he instituted requirements for appointment within the Naval Medical Department geared toward surgeons who attended Scottish medical schools, and secondarily to the London hospitals. The advantage held by Edinburgh and Glasgow disappeared though, as the scientific classes emphasized in Burnett's naval regulations proliferating throughout medical schools. While Burnett and the Lords Commissioners had reduced the requirement for Theory of Medicine to six months by 1835, they added six months of Clinical Medicine, Clinical Surgery, and Botany. Candidates also had to attend twelve months of Practical Anatomy including dissection. Burnett and the Lords Commissioners also publicly stated their preference for University of Edinburgh, Glasgow, Dublin, and Oxbridge graduates.[71] As British medical training shifted toward the new practical approach, Edinburgh, Glasgow, and the London hospital schools became the preferred recruiting grounds, educating the majority of candidates for naval service through the 1860s. Despite this picture of stability, and the rising requirements for entry into the medical service, Burnett faced other recruiting problems. By 1837, he had begun to worry that poor service conditions jeopardized the recruitment of "Individuals of that superior grade of education."[72]

Before discussing service conditions and the emerging reform movement, analysis of the education of naval surgeons who attended Edinburgh between 1800 and 1850 sheds light on the material effects of Burnett's reforms and rigorous requirements. It clearly illustrates the increasing importance of practical and scientific training, skills and competence within the early-

[71] In 1835, the Army, and Royal College of Surgeons, Edinburgh also issued more stringent regulations. Wellesley, and the Commissioners of Naval and Military Promotion and Retirement, 198; Anon, *M-CR* (Jan. 1834): 188–189; Burnett, memo, Apr. 3, 1833, NA, ADM 105/70/f.107-114; Burnett, "Regulations," 1835, ADM 105/71/f.452. For a discussion of the 1830s and 1840s regulations, see McLean, *Surgeons*, 23.

[72] McLean, *Surgeons*, 25-26; Commissioners, *Evidence, Edinburgh*, 531-33; Burnett, memos, Apr. 3, 1833, NA, ADM 105/70/f.107; Mar. 6, 1834, ADM 1/3530, returns nos. 5-8; Nov. 14, 1837, ADM 105/71/f.330-331; Dec. 19, 1837, ADM 105/71/f.337; Nov. 29, 1849, RNML/AL, Mss.242/6/f. 251. See also *inter alia*, Appendix D.2.

to-mid nineteenth century medical service, which contributed to and reinforced an empirical practical mindset. Based on analysis of Edinburgh's matriculation and course records conducted as part of the broader examination of surgeons' backgrounds, their studies at Edinburgh closely aligned with the rising emphasis on the clinical core subjects within the medical profession, and increasingly the Navy's regulations.[73] As shown in Table 1, Chemistry, Practice and Institutes of Medicine, and Materia Medica were the most widely attended courses because of their core status, and their professional reputation. Due to their practical importance, and the Navy's preference for those with "scientific knowledge," however, Clinical Medicine and Midwifery were also highly attended.[74] While students spent much of their time mastering the courses needed to enter the Navy, they increasingly added more of the practical, clinical and scientific

Table 1. Number of Medical Officers Who Attended Medical Courses at the University of Edinburgh by Course and Ethnicity, 1800-1850.

Course	Scottish	English	Irish	Total
Chemistry	156	28	33	224
Practice of Medicine	141	27	32	209
Materia Medica	126	23	30	186
Institutes of Medicine	116	25	31	182
Clinical Medicine	86	19	25	137
Midwifery	71	16	19	110
Clinical Surgery	66	12	14	97
Anatomy & Surgery	43	12	16	73
Botany	49	6	15	73
Surgery	40	11	10	64
Military Surgery	38	75	8	58
Pathology	22	5	9	41
Medical Jurisprudence	25	5	9	41
Natural History	16	6	6	31
Total Classes	995	270	257	1526

[73] University of Edinburgh, "General and Medical Class Lists," 1806-1851, EUL CRC, UA, EUA/IN1/STA/3, vols. 1806-1851; University of Edinburgh, "Matriculation Indices," 1852-1867, EUL, EUA/IN1/STA/3, vols. 1852-1867.
[74] The introduction of the Surgery, Pathology, Medical Jurisprudence, and Military Surgery classes during this period makes these courses appear less significant. Royal Commissioners, "Evidence, Edinburgh," 531. For courses' effects on the total number of courses surgeons attended at Edinburgh, see the regression in Appendix A.3, Table 9.

classes to their course load.[75] The dissertation topics of those students who graduated from Edinburgh followed similar patterns. Although they focused initially on theoretical topics related to disease, over time, dissertations increasingly adopted practical, clinical, and scientific approaches to topics related to disease and a broader range of the medical sciences.[76]

Although English students' course attendance was slightly higher than Scots, there was no significant variation in the relative popularity of medical courses or the number of Edinburgh courses that students attended based on ethnicity. While the majority of English students attended six to ten Edinburgh courses, and the Irish tended to enroll in one to five classes, those students who reached the Navy's upper ranks attended more Edinburgh courses than those who remained in the lower ones.[77] The number of courses attended thus serves as an index for surgeons' educations; they also partially determined the naval rank that they achieved.

Based on the individual and aggregated course attendance data, those Edinburgh students who entered the Navy generally had extensive medical educations that were broad, rigorous, and increasingly expansive. This was especially the case after the reform to both the University curriculum and the Navy's educational requirements. From the 1830s onward, students increasingly pursued specialized and scientific classes to improve their chances of advancing in the service.[78] Nonetheless, while oversaturation of the labor market with Scottish-trained practitioners had allowed Burnett's strategy to prosper early on, the professional conditions that the Navy faced became increasingly difficult in the 1830s. Edinburgh and Glasgow cut down

[75] See Appendix A.3, Table 5 for data on those naval medical officers who repeated courses at the University of Edinburgh. Weir and Burnett, Feb. 20, 1826, NA, ADM 105/6/no.47.
[76] For Edinburgh medical dissertations, see Appendix A.3, Table 6. University of Edinburgh, ed., *List of Graduates in Medicine in the University 1705-1866* (Edinburgh, University of Edinburgh, 1867).
[77] While a majority of 43.1% in the upper ranks attended six to ten courses, 26.5% took eleven to 23 classes. Of those in the lower ranks, 47.1% took less than 6 classes. See Appendix A.3, Tables 7-8.
[78] Even after the reforms of the 1830s, there were still many naval surgeons who had attended only a few courses while at Edinburgh, but likely also took classes at other schools. See Appendix A.3, Tables 7-8.

their student bodies and made their degrees more selective, reducing the number of practitioners that they trained, and consequently the number who considered naval service. Burnett also claimed that recruiting difficulties had increased as the Army medical service's reputation continued to rise above that of the Navy.[79] He first attempted to counteract this decline by communicating more directly and clearly with the Royal Colleges and medical schools, and updating the newspapers in which the service advertised to draw candidates.[80] These were at best stopgap measures, as they did not affect the shifting educational reality.

Meanwhile, during the 1830s, tensions had also begun to emerge regarding the opportunities for continuing education. Burnett fought a number of Admiralty proposals that would have required candidates to apprentice in naval hospitals before their formal appointment. Worried about growing but still sporadic recruiting difficulties due to the shifting medical professional situation, he instead proposed a one-year probationary period for Assistant Surgeons in 1841.[81] Burnett preferred to rely on surgeons' initial medical education, and encourage course-based and other forms of continuing education. He advocated for the creation of libraries and museums at naval hospitals, coordinating book donations from retired surgeons. He also encouraged surgeons to return to school while on leave. Given that 104 officers earned degrees after entering the Navy, medical officers welcomed this largely successful policy.[82]

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[79] Penn, "Burnett," 43; Myers, Demography," 48; Anon, *Lancet* 40, no. 1048 (1843): 918-919; Burnett, memos, Dec. 19, 1837, NA, ADM 105/71, f. 337-339; and Dec. 14, 1837, ADM 97/143/3101. See *inter alia*, Appendix D.2.

[80] Edmund Belfour to Burnett, June 29, 1833, NA, ADM 97/134/2043; Ballingall to Burnett, Oct. 12, 1835, ADM 97/139/2164; and Nov. 24, 1837, ADM 97/143/2852; Dr. Howison to Burnett, Nov. 1837, ADM 97/143/3508; and Feb. 1, 1838, NA, ADM 97/143/3600. For adverts, see Barrow to Burnett, Nov. 26, 1832, ADM 97/18/2329; Admiralty to Burnett, Mar. 14, 1835, ADM 97/21/412; Charles Wood to Burnett, May 2, 1835, ADM 97/21/519; Burnett, memo, Dec. 19, 1837, ADM 105/71/f.337; W.P. Ward to Burnett, July 24, 1846, ADM 97/32/1049; and Rbt. Hamilton to Burnett, July 17, 1847, ADM 97/33/5360.

[81] Burnett, memos, Dec. 8, 1832, NA, ADM 105/70/f.76-80; Nov. 14, 1837, NA, ADM 105/71/f.318-320; Jan. 17, 1840, ADM 97/149/3761; and May 31, 1845, RNML/AL, Mss.242/4/f. 45-49. See also *inter alia*, Appendix D.2.

[82] Lloyd, and Coulter, vol. 4, 25-29; Commissioners, *Evidence, Edinburgh*, 532; Weir, and Burnett, memos, Feb. 25, 1825, RNML/AL, Mss.242/2/f. 98-108; and Feb. 26, 1825, NA, ADM 105/5/no.30; Burnett, memos, Nov. 28, 1832, ADM 105/70/f.62-69; and, Feb. 6, 1839, ADM 105/72/f. 73.

As professional qualifications rose across the profession in the late 1830s and early 1840s, Burnett still pursued his demand for increasing professional rigor. He first continued to define the amount of attendance needed as schools increasingly taught subjects in a mixture of general, comparative, and practical forms. In 1842, he reduced the maximum age for entering the service to 24 years old, required candidates to attend three years of classes, and increased the required amount of hospital attendance to two years. By 1845, candidates also had to present a certificate from a reputable teacher that they had satisfactorily performed the "capital operations of surgery" on corpses. The regulations that Burnett instituted in the 1840s were thus the most demanding and ambitious. During the 1840s, educational requirements for the core classes exceeded other institutions' regulations, while those in the specialized courses matched them.[83] Due to the reforms occurring throughout leading medical schools, however, more London hospital schools and Scottish universities educated student who could meet these requirements.

Despite the ongoing diversification in naval surgeons' backgrounds, the ever-increasing qualifications needed to enter the Navy and apparent continued dominance of Scottish-educated surgeons led to accusations of ethnic and national favoritism and discrimination. As the quality of medical schools converged during the 1840s and Irish schools became more competitive, the limited number of Irish and Irish-educated naval surgeons became particularly glaring. Thomas Huxley recalled his interview with Burnett, stating that the second question asked was "whether I was an Irishman… I satisfied the Director General that I was English to the backbone." There were also complaints that Scottish surgeons were more likely to receive plum assignments and promotions. Surgeon-naturalist Robert McCormick best expressed this sentiment, complaining

[83] McLean, *Surgeons*, 23; Admiralty, "Regulations," 1839, NA, ADM 105/72/f.107-8; 1842, ADM 97/156/2523; and 1845, ADM 97/163/850; Burnett, memo Jan. 25, 1845, RNML/AL, Mss.242/4/f. 6-7. See also, Anon, *Lancet* 40, no. 1048 (1843): 913-14, 918-20, and 935-36; Anon, *M-CR* 31, no. 77 (Oct. 1843): 571-72.

that "only Scotchmen have any chance" of advancing in the service. While some of Burnett's actions could indicate either a belief in Scottish education's superiority or ethnic discrimination, his increasing acceptance of well-qualified English and Irish candidates rather than relaxing qualifications for Scottish applicants belies these allegations.[84]

Through the 1840s and early 1850s, the cornerstone of Burnett's tenure remained his continued advocacy for the most stringent of professional requirements. Despite pressures, he refused to bend the course requirements, but he was very sympathetic to students who struggled through a rigorous and costly course of study. He resisted proposals to reduce the entry requirements even when he reported shortages of candidates, arguing in 1848 that it was more important to "maintain the respectability of the profession."[85] By 1850, however, it had become clear that students could only have qualified for naval service if they had planned their course of study well in advance. This was because the repeated course attendance required by the Navy had become excessive as specialized classes' importance increased throughout the profession.

By the 1850s, however, the viability of some of Burnett's institutional policies had come into question. In the years prior to the Crimean War, certain factions within the medical service, the medical profession, and the Admiralty felt that the Medical Department's policies had created severe manpower shortages, and exacerbated growing recruiting difficulties. While the severity of the situation is debatable, over Burnett's objections, the Admiralty nonetheless reduced hospital attendance to eighteen months, and allowed married and older men to volunteer during the war. Despite attacks by surgeons on the diluting of requirements, there is a persuasive

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[84] Penn, "Burnett," 30, and 41-42; McCormick, *Voyages of Discovery,* 214; Leonard Huxley, ed., *Life and Letters of Thomas Henry Huxley*, vol. 1, (New York: D. Appleton, 1900), 25; Burnett, memo, Mar. 6, 1834, NA, ADM 105/70, f. 229; Richard Southwell Bourke, and Commissioners to Enquire into the Dublin Hospitals, "Report of the Select Committee to Enquire into the Dublin Hospitals," *PP*, 1854(338): xii, 1, appendix 13, 340-43. For articles on Burnett and recruitment, see *inter alia*, Appendices D.1, and D.2.

[85] Burnett, memo, Dec. 2, 1852, NA, ADM 105/68; Burnett to William J Baird, Aug. 1, 1850, NMM, BGY/B/5.

argument that changes to the naval medical regulations did not go far enough. The perceptions of personnel shortages during the Crimean War precipitated the decisions to strip control of recruitment from Burnett. Ultimately, they cost him his position.[86] Perhaps most significantly, the changing internal and medical professional environments sparked a movement for reforms to naval medical service conditions, which the next section analyzes.

3.4 THE SURGEONS' REFORM MOVEMENT AND THE MEDICAL SERVICE

The movement for naval medical reform that grew in the 1840s and 1850s illustrates the relationship between Burnett's institutional reforms of the medical service, surgeons' reformist efforts, and the shifts occurring in the medical profession. Concerns about service conditions, status and treatment occupied Burnett's attention and galvanized medical officers. While Burnett worked within the Admiralty establishment, naval surgeons organized and agitated for themselves. Medical students, and the medical profession and press increasingly supported naval surgeons' cause, and helped build governmental and public support. As we will see, by the 1850s, this growing movement forced the Admiralty to grant concessions to its medical officers.

The emergence of the reform movement traces back to naval surgeons' growing dissatisfactions from the 1830s onward. Surgeons increasing saw their relatively poor position as indicative of the stinginess, lack of regard, and contempt that pervaded the Admiralty. This reinforced the view that the Navy had reneged on the concessions given in the 1805 Order in

[86] Penn, "Burnett," 46-47, and 103-04; Admiralty, "Regulations," 1850, NA, ADM 97/189/3415; Burnett, memo, Apr. 22, 1854, RNML/AL, Mss.242/7, f. 129; House of Commons, Hansard, 3rd series, vol. 130, Feb. 17, 1854, 821. For the debate over manpower and competence during the Crimean War: Penn, "Medical Staffing of the Royal Navy in the Russian War," 51–57. See also *inter alia*, Appendices D.1 and D.2.

Council that promised naval surgeons improved rights and status. Surgeons' designation as warrant officers, however, grouped them with "an inferior Class of Society" in terms of skill and education, and gave only Physicians and Surgeons wardroom status. Assistant Surgeons' low rank restricted the rights that they received onboard ship.[87] They were not guaranteed their own cabin or the right to mess with the officers, but lived with the midshipmen. By the 1830s, despite Burnett's efforts to raise standards, increasing awareness of this low social position meant that the students volunteering for naval service were largely those without better options.[88]

The naval medical reform campaign that began to emerge within the ranks in the 1830s was a manifestation of surgeons' increasing grievances about their degraded position. *Lancet* founder and Radical MP Thomas Wakley gave surgeons substantial page space to express and publicize their case. He also personally backed their demands for improved pay, and for raising their status and privileges to the level of commissioned officers. Wakley's championing of the "Assistant Surgeons' case" in part brought these issues to the attention of the parliamentary Commission on Military and Naval Retirement and Promotion. While their 1840 report recommended that naval surgeons be placed on equal footing with other officers, the Admiralty resisted implementing such a measure, which would have met many of the surgeons' demands.[89] Medical officers' reform efforts increasingly focused on the poor place of Assistant Surgeons in

[87] Assistant Surgeons were grouped with Midshipmen, Gunners, and Boatswains. For these issues and surgeons' responses, see McLean, *Surgeons*, 28-30; Harrison, "Important Service," 109-110; Burnett to Graham, June 14, 1831, NMM, ELL/245, f. 15-16; Burnett, memos, June 14, 1831, RNML/AL, Mss. 242/3, f. 300; and Nov. 14, 1837, NA, ADM 105/71/f.328. For the Admiralty, see Barrow to Burnett, Sept. 22, 1840, ADM 97/26/2014; and. 7, 1841, ADM 97/27/114; Burnet, memos, Aug. 9, 1841, ADM 105/73/f.11-12; May 17, 1847, Mss.242/4/f. 602-610; May 17, 1847, ADM 105/39/f.71-78; Mar. 1, 1847, Mss.242/4/f. 512-22; and Apr. 12, 1852, ADM 105/68/f.252-62.

[88] See John Strang, *Letters to a Student of Medicine on His Commencing Practice* (London: J. Mawman, 1812), 28; [McWilliam], Naval Medical Officer, *An Exposition of the Case of the Assistant Surgeons of the Royal Navy by a Naval Medical Officer* (London: J. Churchill, 1849), 25; Burnett to Graham, June 14, 1831, NMM, ELL/245, f. 16-17; Burnett, memo, Nov. 14, 1837, NA, ADM 105/71/f.331.

[89] Harrison, "Important Subject", 109-10; Brown, *Poxed*, 168; Wellesley, and the Commissioners of Naval and Military Promotion and Retirement, lxvi-lxviii; Anon, *Lancet* 30, no. 772 (June 16, 1838): 403–08; A Naval Surgeon, *Lancet* 28, no. 724 (July 15, 1837): 592. For Wakley: Burney, 163-81; Peter Froggatt, "The Lancet: Wakley's Instrument for Medical Education Reform," *Occupational Medicine* 29, no. 2 (Apr. 1979): 45–53.

terms of pay, promotion, rank, and status. Their desire for social and professional advancement, however, led to accusations that their demands were self-interested, which in turn allowed the Admiralty to reject their complaints about the disregard for medical officers within the Navy. When combined with other sources of discontent among medical officers, the burdens of naval life and poor conditions required widespread reforms and cultural change within the Navy.[90]

In the late 1830s and early 1840s, Burnett became increasingly concerned about the effects of surgeons' unaddressed grievances on recruitment and the service's overall functioning. He thus began to devote behind-the-scenes attention to presenting the Assistant Surgeons' case within the Admiralty. While reluctant to publicly criticize the Admiralty, Burnett privately put significant pressure on the Lords Commissioners, and carefully chose his moments of public intervention. He emphasized that the situation harmed the service's professional reputation. As part of this argument, in 1837, Burnett questioned the service's ability to mobilize in the event of war, arguing that "unless some better encouragement is held out… we shall fail in obtaining the services of Individuals of that superior grade of education, which it has been my current ambition to acquire."[91]

Burnett's assessment was on point. The convergence of these internal dynamics with the medical profession's rising requirements and status made naval service increasingly unattractive to medical students. They learned of them because naval surgeons communicated their growing dissatisfactions to professors, students, and medical reformers back in Britain. The burdens and

[90] For an alternative analysis of surgeons' reform efforts, see Harrison, "Important Subject," 110-113, and 123-125. For a broader perspective: M. Jeanne Peterson, 'Gentlemen and Medical Men: The Problem of Professional Recruitment', *Bulletin of the History of Medicine*, 58, no. 4 (1984): 457–73.

[91] McLean, *Surgeons*, 27-28; Penn, "Burnett," 48-49, and 53; Wellesley, and the Commissioners of Naval and Military Promotion and Retirement, 187; Burnett, memo, Dec. 14, 1837, NA, ADM 1/3531; Burnett to Earl Grey, Jan. 23, 1835, RNML/AL Mss.242/3/f. 359-60; Burnett, memos, Feb. 23, 1836, Mss.242/4/f. 189-90; Nov. 14, 1837, ADM 105/71/f.330-31; and Feb. 23, 1846, ADM 105/38/f. 382-84. See also *inter alia*, Appendix D.2.

challenges presented by naval service thus became public knowledge.[92] Burnett felt that improving Assistant Surgeons' situation would be especially beneficial to the service's reputation within the medical profession and its efficacy. Given their superior education and gentlemanly character, Burnett argued that it would be advantageous to appoint all surgeons as commissioned officers with respectable uniforms, wardroom rights, and individual cabins.[93]

As Mark Harrison has argued, the growing public recognition of surgeons' importance to naval operations gave the reform campaign increased momentum. During the mid-1840s, surgeons had begun to link their service conditions to the welfare of Navy's sailors. They argued that adverse conditions limited their practical success, and lambasted the Admiralty for failing to spend a modest amount of money to protect sailors' health and to better meet its mission.[94] These efforts netted some success in 1846. As the torrent of public complaints by naval surgeons grew and Burnett reported his Department would not be able to mobilize in the event of war, the Admiralty granted Assistant Surgeons the right to a cabin as study space and accommodation on ships that had enough cabin space.[95]

Since this represented only a modest gain given surgeons' broader complaints, their campaign intensified during the late 1840s and early 1850s. Surgeons leveraged the attention from several cases of heroism, which also gained publicity. By the late 1840s, in addition to

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[92] Beyond previous footnote's sources, see Burnett, memos, Dec. 14, 1837, NA, ADM 97/143/3101; May 24, 1848, RNML/AL, Mss.242/5, f. 350, and May 24, 1848, ADM 105/39.

[93] Burnett to Graham, June 14, 1831, NMM, ELL/245, f. 17-19, and 21-25; Burnett, memo, June 14, 1831, RNML/AL, Mss. 242/3/f. 300. See also Burnett to Earl Grey, Jan. 23, 1835, Mss.242/3/f. 383-84; Burnett, memos, Sept. 14, 1837, NA, ADM 105/71/f. 331-32; Nov. 14, 1837, ADM 105/71/f. 328; and Feb. 23, 1846, ADM 105/38/f.384-85.

[94] Harrison, "Important Service," esp. 112-13, and 124-25. See also Anon, *Lancet* 30, no. 764 (Apr. 21, 1838): 121; Ninian Hill, *Lancet* 30, no. 785 (Sept. 15, 1838): 865–68; F. N**s, *Lancet* 44, no. 1109 (Sept. 30, 1844): 302; Anon, *Lancet* 30, no. 766 (May 5, 1838): 193–97.

[95] Surgeons soon realized that the small vessels to which many Assistant Surgeons were assigned did not have enough cabins accommodate the command. Penn, "Burnett," 53; Burnett, memo, Feb. 23, 1846, RNML/AL, Mss.242/4, f. 189-190; Frederick James Brown, *Lancet* 56, no. 1417 (Oct. 26, 1850): 487–88; *Lancet* 58, no. 1457 (Aug. 2, 1851): 119; *Lancet* 55, no. 1399 (June 22, 1850): 763.

numerous medical journals, newspapers and periodicals, including *The Times*, *Spectator, Punch, and Morning Chronicle*, had published articles on surgeons and naval medical reform. Scottish Surgeon Dr. James McWilliam, a public hero from his service on the 1841-42 Niger Expedition, championed the Assistant Surgeons' cause. In early 1849, he anonymously published a pamphlet that presented the case for reform of Assistant Surgeons' situation. The pamphlet, which reads like one of Burnett's reports, was well received and helped to galvanize the medical profession and the public into action when it became publicly known that McWilliam had authored it.[96]

The pivotal point for the naval reform campaign came in the Spring of 1849 when the medical students at Middlesex Hospital and in Scotland through the Royal College of Surgeons, Edinburgh considered petitions in support of naval Assistant Surgeons. By the end of 1849, the Royal Colleges Physicians in Edinburgh, and Surgeons in London, Edinburgh, Glasgow, and Dublin had all submitted petitions on behalf of students and naval surgeons. The Royal College of Surgeons, Edinburgh had also refused to examine candidates for naval service until the Admiralty enacted significant reforms.[97] The Royal Colleges, naval surgeons, and several medical professors also began coordinated efforts warning medical students what awaited them if they entered the Navy. Such actions caught the attention of the Admiralty as these forewarnings threatened to further undercut the Navy's recruiting abilities.[98] While the severity of the

96 Harrison, "Important Service," 124; McWilliam, *Exposition*, passim; McWilliam, "Album of Letters and Memorabilia," 1839-1852, WL, MS.6830, ff. 1-14; Robert Peabody to McWilliam, Mar. 14, 1850, WL, MS.6829/3. See also, An Assistant-Surgeon R.N., *Lancet* 51, no. 1294 (June 17, 1848): 677–78; Anon, *MT* 19 (Apr. 23, 1849): 514 Anon, *BFMCR* 4 (Oct. 1849): 537-538; Anon, *LJM* 1, no. 8 (Aug. 1849): 744; Anon, *PMSJ* 1 (1850): 136; Anon, *MTG* 1 (Feb. 28, 1857): 217-18.

97 Professors James Syme and George Ballingall, who had risen from middling origins and taught many students who entered the Navy, spearheaded the Edinburgh petition. Harrison, "Important Service," 123; An Assistant-Surgeon R.N., *Lancet* 51, no. 1291 (May 27, 1848): 586; M.R.C.S.; R.N., *Lancet* 52, no. 1319 (Dec. 9, 1848): 647; Anon, *Lancet* 53, no. 1330 (Feb. 24, 1849): 216; Anon, *Lancet* 65, no. 1643 (Feb. 24, 1855): 225. For petitions from the medical schools and Royal Colleges, Edinburgh, and the student boycott, see *inter alia*, Appendix D.3.

98 Anon, *Lancet* 53, no. 1330 (Feb. 24, 1849): 216; John Argyll Robertson, *Lancet* 53, no. 1333 (Mar. 17, 1849): 297–98; M.R.C.S., R.N., *Lancet* 53, no. 1336 (Apr. 7, 1849): 384; Anon, *Lancet* 53, no. 1338 (Apr. 21, 1849): 436. For more such warnings, see *inter alia*, Appendix D.4. For the emergence of a student boycott, see Appendix D.3.

recruiting difficulties during the Crimean War is subject to debate, they were in no small part due to the convergence of this devastating negative campaign targeting the naval service's reputation, and ongoing professionalization more generally.

This organized professional activity yielded the first successful parliamentary efforts related to the issue of naval surgeons. After the House of Commons passed a resolution in April 1850 denouncing Assistant Surgeons' treatment, conditions began to slowly improve.[99] The Admiralty first granted limited reforms, guaranteeing wardroom mess and a cabin to Assistant Surgeons who had completed three years' service and passed their examination for Surgeon. The number and quality of candidates coming forward, however, continued to decline due to the warnings circulating in medical schools. The Admiralty's continued resistance to widespread reforms likely confirmed these admonitions in many students' minds. Compounding this situation, Burnett had reached over fifty years of active service and was slowly ceding bureaucratic responsibilities to the Department's clerks. When he reported in 1853 that the situation had deteriorated further, he received the brunt of the Lords Commissioners' ire. The Admiralty transferred the right to examine candidates to an examination board of senior medical officers, implying that it had given Burnett too much deference.[100]

The supposed medical manpower crisis during Crimean War and an intensification of the student campaign against the Navy pushed reform forward. The existing recruitment crisis made it difficult to mobilize for the war and to adequately staff ships with medical officers, which

[99] Harrison, "Important Service," 124-25. For failed parliamentary efforts before 1850, see *inter alia*, Appendix D.5. For 1850 debate: Hansard, 3rd Series, vol. 110, Apr. 8, 1850, 7-14; Anon, *Lancet* 55, no. 1389 (Apr. 13, 1850): 465; Frederick James Brown, *Lancet* 56, no. 1403 (July 20, 1850): 97–98; Michael Healy, *Lancet* 56, no. 1404 (July 27, 1850): 131–32. On slow, gradual reform, see Frederick James Brown, *Lancet* 56, no. 1419 (Sept. 9, 1850): 538–39; Anon, *Lancet* 62, no. 1560 (July 23, 1853): 85–86.
[100] Anon, *Lancet* 60, no. 1512 (Aug. 21, 1852): 182; Frederick James Brown, *Lancet* 56, no. 1409 (Aug. 31, 1850): 276; House of Commons, Hansard, 3rd series, vol. 130, Feb. 17, 1854, 821; Burnett to Graham, Jan. 14, 1853, NA, ADM 97/201/4635; Robert Osbourne, memo, "Regulations," 1853, ADM 97/211/905; Burnett, memos, Sept. 24, 1851, ADM 105/39/f.283; and Apr. 22, 1854, RNML/AL, Mss.242/7, f. 129. See again, Appendices D.2-D.4.

forced the Admiralty to decrease the number of surgeons assigned to each vessel. Although vacancies exceeded available candidates by April 1854, Burnett resisted the Admiralty's plan to pull aging Surgeons off of the half pay list for these positions.[101] He transferred over 100 surgeons to the Crimean front at the expense of other stations; growing shortages across naval stations thus appeared in early 1855. Burnett also proposed admitting forty advanced medical students as hospital dressers in order to fill the gap. Although he professed that generous terms would overcome students' inimical views and he did manage to procure 73 student dressers, his efforts underscored the significant desperation of the crisis.[102]

Furthermore, when the Navy called on students to volunteer, it led to a backlash among students and surgeons who saw it was an attempt to impress students into service and to undermine ongoing reform efforts. The uproar led to the creation of the Naval Medical Reform Association, a national association of students centered in London and Scotland. During 1855, it organized a boycott of the dresser positions and discussed shunning the Navy. While it did not succeed in implementing a total boycott, the Association gained public and professional attention, and organized further petitions from the Royal Colleges and medical schools.[103]

The mounting reputation crisis, and growing professional and public attention forced the Admiralty to more seriously consider the issue of surgeons' treatment. Surgeons effectively

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[101] McLean, *Surgeons*, 154-57; Penn, "Burnett," 97-98; Penn, "Medical Staffing of the Navy in the Russian War," 51-53; Burnett, memos, Apr. 22, 1854, NA, ADM 105/39; June 17, 1854, ADM 105/39; and July 31, 1854, ADM 105/39.

[102] Penn concluded that modest shortages occurred on stations beyond the Crimean fleets. McLean, *Surgeons*, 170-76, and 196; Penn, "Burnett," 99-100, and 106. For the dresser scheme, see also Penn, "Medical Staffing of the Navy in the Russian War," 54. Burnett, memos, Jan. 3, 1855, NA, ADM 105/39/f. 370-76; and Apr. 22, 1854, RNML/AL, Mss.242/7/f. 177; Burnett to McKechnie, Mar. 14, 1855, ADM 97/218/7782; Admiralty, "Assistant Surgeons (Navy)," Apr. 7 1854, *PP*, 1854(223): xlii, 511, p. 1; Admiralty, "Surgeons, &c. (Baltic and Black Sea)," July 17,1854, *PP*, 1854(437): xlii, 509, p. 1. See also *inter alia*, Appendix D.2.

[103] Random Roderick, *Lancet* 63, no. 1603 (May 20, 1854): 548; Anon, *Lancet* 65, no. 1643 (Feb. 24, 1855): 225; Anon, *AMJ* 3, no. 115 (Mar. 16, 1855): 246–47; Anon, *AMJ* 3, no. 116 (Mar. 23, 1855): 269; Anon, *Lancet* 65, no. 1652 (Apr. 28, 1855): 440; W., *Lancet* 65, no. 1654 (May 12, 1855): 498. See also *inter alia*, Appendices D.3-D.4.

attacked the Admiralty and top officials, criticizing their failure to follow through on previous concessions. After a series of parliamentary debates, which linked surgeons' service conditions and morale to the war effort, Parliament forced the Admiralty to grant wide-ranging concessions. In July 1855, the Navy issued a circular that granted most of surgeons' demand, including equal relative rank to their Army brethren and naval Lieutenants, the right to mess in the wardroom, a cabin when available, and gentlemanly status. But the Admiralty exacted its revenge when it forced Burnett to retire after 33 years as head of the Medical Department in April 1855.[104]

Although medical officers remained wary of whether the Admiralty would enforce their newly won rights if it came to confronting commanders' decisions, a royal warrant backed the reforms. While grievances about spotty enforcement and agitation continued through the 1860s, the reforms technically guaranteed all surgeons increased pay, "their mess, their wine, their gentlemanly treatment, [and] their respected position wherever they go." The Admiralty quickly granted most of these rights and privileges. Naval surgeons had thus won key victories through organized professional action. While the Navy's Assistant Surgeons benefited greatly from these reforms, the service still struggled to keep up with the rapid changes occurring throughout the medical profession due to the hazards, burdens and long terms of naval service.[105]

Even as the medical service underwent its first leadership transition in over two decades after the Crimean War due to Burnett's forced retirement, the concessions gained in 1855 reshaped it. The reforms within the Navy, i.e. those granting favorable status, privileges and service conditions to surgeons, continued to improve the service's reputation and recruiting

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[104] Penn, "Burnett," 56-57; Anon, *Lancet* 55, no. 1375 (Jan. 5, 1850): 33. For the failure of previous guarantees: Frederick James Brown, *Lancet* 59, no. 1494 (Apr. 17, 1852): 383; Amicus Justitae, *Lancet* 60, no. 1511 (Aug. 14, 1852): 161–62. For the 1853-54 debates: Random Roderick, *Lancet* 63, no. 1593 (Mar. 11, 1854): 290–91; Michael Healy, "*Lancet* 61, no. 1542 (Mar. 19, 1853): 279–80; Z., *Lancet* 63, no. 1597 (Apr. 8, 1854): 404–06; Michael Healy, *Lancet* 63, no. 1599 (Apr. 22, 1854): 455–56. For debates and concessions, see Appendices D.5-D.6.
[105] Anon, *Lancet* 55, no. 1375 (Jan. 5, 1850): 33. For the warrant and grievances, see *inter alia*, Appendix D.6.

capabilities. Naval medicine's position relative to the profession changed significantly in the mid-1850s, as the more general medical reform campaign gained momentum. Burnett's successors had to devote more attention to issues related to recruitment and the broader profession. The beginnings of educational standardization and professional registration mandated by the 1858 Medical Act also benefited the Navy in the long run. The consequent revision of the naval regulations in 1859, which remained in place for nearly a decade, granted recognized Irish medical schools the same status and preference as their Scottish and English counterparts. Perhaps more importantly, it brought the Navy's requirements in line with those shared by the General Medical Council and British medical schools. By that point, practical, clinical and empirical science had become the educational and practical standard throughout the profession and within the Navy.[106] As a result of these developments and the service's broader professionalization, naval surgeons' scientific competence had increased over the course of several decades, and looked assured by mid-century.

3.5 THE DIVERGING PRESSURES AND INTERESTS OF NAVAL MEDICINE

In the early-to-mid nineteenth century, like the broader medical profession, naval medicine underwent fundamental institutional changes. Naval surgeons, medical students, leading figures such as William Burnett, and the Admiralty pursued their own interests as they navigated the professional changes occurring between the 1810s and 1860s. Medical officers and students tried to make a living and to enhance their economic and social mobility, and

[106] Anon, *Lancet* 72, no. 1837 (Nov. 13, 1858): 508–10. For a reflection on Burnett's importance, see McLean, *Surgeons*, ch. 8, esp. 197-200.

professional prestige. Before and after they entered the Navy, they performed calculations regarding their prospects in private practice, taking into account their connections, the relative competitiveness of regional and urban labor markets, and their relative qualifications. They balanced these considerations against naval service's remuneration, status and conditions, the possibilities of advancing through the ranks or transitioning to private practice, and as the next chapter explores, the practical and scientific opportunities that the Navy offered. This meant that the surgeons who joined and stayed in the Navy were often those who saw it as their best professional option.[107]

Naval medicine's professionalization improved naval surgeons' status and situation, and led to rising medical educational expectations within the Navy. Medical Director-General Sir William Burnett played a key role in this shift, designing institutional policies and appointment requirements that emphasized practical training and reflected the rising importance of empirical scientific approaches. One of his principal goals had been to maintain and improve the competence of the Navy's surgeons relative to the rest of the profession. This was a difficult goal to achieve. Poor service conditions ensured that naval service remained a relatively unfavorable option through the reforms that occurred in the early 1850s, especially as prestige, ambitions and scientific competence rose across the profession. Furthermore, institutional inefficiency and bottlenecks related to half pay, promotion and retirement dynamics resulted in continuing structural and fiscal issues. Burnett's ambition to raise competence became entwined with the Admiralty's drive for bureaucratic efficiency and retrenchment.

As the Navy faced these challenges, it benefited greatly from the labor oversaturation that resulted from the expansion and profusion of medical education at Scottish universities through

[107] For some of surgeons' motivations related to career choices, see McLean, *Surgeons*, 32.

the 1830s, at the London hospital schools during the 1830s and 1840s, and at Irish schools from the 1850s onward. As this chapter's quantitative analysis illustrates, Scottish and Scottish-educated surgeons dominated the ranks of the Navy's medical service through the 1830s, and maintained significant representation through the 1850s and 1860s. While Scottish-educated surgeons continued to predominate at the upper and leadership ranks, English and English-educated surgeons' representation in both the lower and upper ranks rose from the mid-1830s onward.[108] By that point, there was greater diversity in naval surgeons' ethnic and educational backgrounds. Analysis of Edinburgh-educated naval surgeons also demonstrates that they became increasingly qualified in clinical and practical scientific fields. The ambitious and demanding regulations instituted by Burnett within the medical service, which underlay this trend, reflected the rising scientific qualifications across the profession, as well as the Navy's professional and personnel realities. Until the mid-1830s, Scottish-educated students could most easily meet the naval requirements. As British medical schools and the medical profession converged in adopting rising scientific qualifications and the model of medical training discussed in the last chapter, a rising number of English and then Irish-educated naval surgeons also received rigorous practical and scientific medical educations.

By the 1840s, these rising qualifications and ambitions throughout the profession and within the naval service gave rise to an organized movement for naval medical reform. Naval surgeons and increasingly medical students and institutions lobbied for improved naval service conditions. The Admiralty remained resistant to these efforts until increasing public organization and material ramifications became apparent. As Scottish and London medical schools restricted their enrollment and the labor market opened again, the service's recruitment strategy came

[108] From the 1860s onward, however, Irish and Irish-educated medical officers came to dominate the naval medical ranks.

under stress. A new generation of ambitious Scottish and London students turned away from and began to boycott naval service. As questions emerged regarding the service's readiness and implications for naval operations during the Crimean era, the public campaign, student boycott, and parliamentary efforts forced concessions.[109] Building on the findings that the reforms that occurred in British medical education and in the institutional and professional transformation of naval medicine emphasized empirical scientific conceptions and competence, the next chapter analyzes how they affected and shaped the medical service's and naval surgeons' approaches to medical practice.

[109] For an alternative consideration, see Harrison, "Important Service," 112-14, and 123-25.

4.0 A SERVICE OF SCIENTIFIC OPPORTUNITIES: NAVAL SURGEONS, NATURAL SCIENCE, AND MEDICAL PRACTICE, 1815-1865

Applying to the Naval Medical Department in late 1849, Englishman Charles Prentice stated: "I cannot contemplate without disgust the probability of being a mere provincial practitioner all my life, devoted to the comparatively trivial duties which such a position requires." An accomplished student in medical and natural science at University College, London, Prentice exemplified many surgeons who entered the Navy from the end of the Napoleonic Wars through the mid-nineteenth century.[1] Many of these young medical officers saw naval service as offering distinctive cosmopolitan opportunities for exploring the natural world, and contributing to medical and scientific discovery.[2] This chapter analyzes surgeons' practical experience, especially the relations between individuals' actions, the social and material realities of naval service, the development of institutionalized practices, and the rise of science throughout British society. Understanding the relationship between these distinct but connected contexts elucidates the forces driving the rise of practical empirical science within naval medicine, and some of the scientific and societal changes occurring during the Age of Reform.

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[1] Prentice had won medals in Practice of Medicine, Botany, and Chemistry at University College, as well as the Society of Apothecaries' top prize in Botany. He did not join the Navy, and remained in private practice in Cheltenham through the late 1850s, publishing on phrenology and botany. McLean, *Surgeons*, 51; Charles Prentice to Burnett, Oct. 28, 1849, NA, ADM 97/184/3815; Anon, *Gardeners' Chronicle & New Horticulturist* (1843): 309; Anon, *The Gardeners' Chronicle and Agricultural Gazette*, no. 2 (1844), 4; Anon, *MT* 8, no. 190 (May 13, 1843): 112; Anon, *Lancet* 41, no. 1050 (Oct. 14, 1843): 65. For Prentice's later publications see *Lancet* 53, no. 1339 (Apr. 28, 1849): 461; *LMG* 8 (Apr. 6, 1849): 611; *The Phrenological Journal and Magazine of Moral Science* 19, no. 96 (Jan. 1846), 88; *The Annals and Magazine of Natural History* 17, no. 101 (May 1856): 446.

[2] Kennedy, *Last Blank Spaces*, 29-31, and 34.

Scholarship on naval medicine has analyzed the Navy's surgeon-naturalist tradition, and the scientific development of medical practice during the nineteenth century. The literature on naturalists has tended to analyze natural scientific activities independent of surgeons' medical work. In regard to naval medicine, Lloyd and Coulter's seminal work analyzed medical and natural science in thematic and geographical contexts. David McLean's studies have presented overviews of surgeons' practical and scientific efforts, and the Navy's connections to Victorian science through the public health movement.[3] Beyond this, a recent literature investigating the development of empirical colonial science and medicine has emerged. Beyond Daniel Headrick's general work, Mark Harrison and Dane Kennedy have analyzed the forces that shaped colonial scientific practices through studies of specific professional groups.[4] When applied to naval surgeons, this approach sheds further light on the relationship between science's increasing authority and sophistication, and naval and colonial medical and natural scientific practices.

In relation to the process unfolding within the Navy, this chapter contends that naval surgeons' individual and collective efforts developed, legitimized, and systematized medical and natural scientific practices within the Medical Department. Surgeons' roles supporting the extension of the Royal Navy's operations as part of a broader imperial and global reorientation was the principal internal factor underlying this transformation.[5] Since this process began in the late-eighteenth century, the seeds of institutionalized naval science can be traced back to that period and the Napoleonic Wars. Within the contexts of late-eighteenth and early-nineteenth

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[3] For works mentioned above: Lloyd, and Coulter, vol. 4, 69-80; McLean, *Surgeons*, 51-56; McLean, *Public Health*, esp. chs. 1, and 3. For the surgeon-naturalist tradition, see Drayton, *Nature's Government*, 175-84; Glyn Williams, *Naturalists at Seas: Scientific Travelers from Dampier to Darwin* (New Haven: YUP, 2013), chs. 1, 4, and 6.

[4] For this literature, see among others Harrison, *Medicine in an Age*, esp. 2-10, 27-28; Kennedy, *Last Blank Spaces*, esp. 29-34; Chakrabarti, *Medicine and Empire*, esp. 50-51, and ch. 2; Headrick, *Power*, 237-238.

[5] For imperial science, among many works, see Drayton, *Nature's Government*; Jim Endersby, *Imperial Nature: Joseph Hooker and the Practices of Victorian Science* (Chicago: UCP, 2008). For seapower, empire, and global power: Gough, *Pax Britannica*; Cannadine, *Empire, The Sea and Global History*; Bartlett, *Great Britain and Sea Power*.

century warfare and empire, historians have noted the importance of practical necessity to the development of colonial and military science. This continued through the peacetime transition from the 1810s through the early 1850s, as scientific medical practices became vital to the operational effectiveness of the Navy.[6] As the Admiralty committed a plurality of its forces to harsh environments around the world, surgeons had greater opportunities to pursue scientific activities. In the process, their efforts to meet personal, professional and strategic goals received institutional support within the Navy, albeit largely for utilitarian motivations.

Beyond highlighting the increasing importance of empirical science within the medical service, this chapter argues that naval surgeons' individual and collective efforts operationalized analytical scientific approaches. While the clinical and anatomical-pathological medical revolutions remain in the background, this chapter emphasizes the requisite observational analytical approaches refined in natural history, and extended across the natural, medical and social sciences.[7] Naval medicine's professionalization ensured that surgeons increasingly entered the Navy with rigorous clinical, practical, and natural scientific educations, and applied and refined them based on the contingent circumstances of naval life and practice. As they encountered and analyzed medical, natural and social phenomena around the world, surgeons gradually systematized scientific practices. The Admiralty supported such endeavors, as

[6] For necessity driving science, see Harrison, *Medicine in an Age*, 3, 17, and 23; Headrick, *Power*, 226; Kelly, *War and the Militarization*, esp. 1-2; J. D. Alsop, "Warfare and the Creation of British Imperial Medicine, 1600-1800," in *British Military and Naval Medicine, 1600-1830*, ed. Geoffrey L. Hudson (New York: Rodopi, 2007), 23–50. See also Bart Schultz and Georgios Varouxakis, *Utilitarianism and Empire* (Oxford: Lexington Books, 2005).

[7] Michel Foucault, *The Birth of the Clinic: An Archaeology of Medical Perception*, trans. A.M. Sheriden (London: Tavistock Publications, 1973), esp. xii, xv, and xix; José A. López Cerezo, "Dimensions of Clinical Observation in the Origins of Scientific Medicine," in *New Methodological Perspectives on Observation and Experimentation in Science*, ed. Wenceslao J. González (Oleiros, Spain: Netbiblio, 2010), 117-34. For the influence of natural history on colonial medical practices: Harrison, *Medicine in an Age*, 113; Chakrabarti, *Medicine and Empire*, ch. 2. For the development of the sciences: Pickstone, *Ways of Knowing*, 7-13, and chs. 4-5; I. Bernard Cohen, *Revolution in Science* (Cambridge: HUP, 1985), chs. 18-22; David Cahan, ed., *From Natural Philosophy to the Sciences: Writing the History of Nineteenth-Century Science* (Chicago: UCP, 2003).

expectations regarding science's positivist and utilitarian potential rose. Led by Burnett, it developed institutional policies that promoted surgeons' efforts, and attempted to systematize scientific practices within the service. This chapter begins by describing the medical practical environment in the Navy after the Napoleonic Wars, and setting the stage for an examination of this scientific shift in naval medical practice through the 1850s. It then examines the processes that underlay this transition, linking it to the Navy's operational environment, and the changes occurring in medical training, the medical profession, and British science.

4.1 MEDICAL OFFICERS AND SCIENCE IN NAVAL AND PROFESSIONAL CONTEXTS

While battle-wound medicine has dominated many depictions of naval medicine, during the Napoleonic Wars, naval practice extended beyond wounds and amputations. Medical officers expanded their efforts to address a wide range of preventative medical issues due to wartime exigencies. By the end of the wars, hygiene and provisioning had advanced, mortality and morbidity had declined significantly, and the Navy had become a more effective fighting force thanks to surgeons' practical efforts. As the Navy made the transition to peacetime operations after 1815, surgeons' responsibilities for sailors' health became increasingly important. Hence, their practical efforts focused increasingly on treating and preventing disease.[8]

This shift in surgeons' practical focus was due in large part to increased exposure to hostile disease environments. By the 1820s, the Navy had added stations off West Africa and South America to its five existing fleets, and expanded its global reach. It took a supporting role

[8] McLean, *Surgeons*, xii-xiii, 1, 6-7, and 10; Harrison, *Medicine in an Age*, 8, and 23; Under Attack," in *Master and Commander: The Far Side of the World*, directed by Peter Weir (Beverley Hills: 20th Century Fox Home Entertainment, 2003), DVD.

in convict transportation to Australia, and recommitted itself to its role as a leading force in exploration.[9] While confrontations with disease became strategically important, surgeons' practical duties remained burdensome. The small vessels that made up much of the fleet often carried only one medical officer. The Navy thus expected surgeons to perform their medical duties with limited or no professional practical support, and to address the ailments that arose as best they could.[10] Surgeons struggled to effectively meet their mandate. Their efforts to fight disease showed less success than the surgical practices refined over the course of the Napoleonic Wars. Furthermore, the most easily implementable measures had been put in place, and further improvement largely depended on more interventionist or costly approaches.[11]

Surgeons' limited practical success in confronting the diseases encountered during peacetime service, and advocacy of interventionist preventative measures adversely affected their authority within the Navy. Doubts about the utility of medical officers' work increased among sailors and officers. Line officers' skepticism and even contempt for surgeons carried over into disputes over medical practices, since surgeons needed the assent of their commanders to carry out many of their duties. David McLean has recounted several cases of officers forcing surgeons to employ certain therapeutic measures.[12] One example is that the 1838 case of Surgeon R.J.C. Scott whose Lieutenant ordered him to pump a sailor's stomach as punishment. While he objected based on his professional ethics, judgment, and authority, the captain threatened to court

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[9] The five existing fleets were the Channel, North American, West Indian, East Indian, and Mediterranean Fleets. McLean, *Surgeons,* 10-11; Hattendorf, *et al.*, 624. For the changes following the Napoleonic Wars: Lambert, "Preparing for the Long Peace," 41-54.

[10] Penn, "Burnett," 17; McLean, *Surgeons,* 1, and 68; Bryson, *A Report on the Climate and Principal Diseases of the African Station* (London: William Clowes and Sons, 1847), 256; Burnett, memo, RNML, AL, Mss.242/2/f. 361.

[11] Throughout British medicine, surgical and hygienic practices advanced beyond internal medical aimed at diseases. For surgery: McLean, *Surgeons*, 10; Crumplin, "Surgery," 83-86, and 88. For therapeutics' limited effectiveness, see Wootton, *Bad Medicine*, esp. 283; Hutton, 9; Harrison, *Medicine in an Age*, 119; K. Coddell Carter, *The Decline of Therapeutic Bloodletting* (New Brunswick, NJ: Transaction Publishers, 2012), esp. 1-2.

[12] McLean, *Surgeons,* 37, and 47-48. See the case of an Assistant Surgeon abused and flogged by midshipmen: Medicus, *Lancet* 55, no. 1378 (Jan. 26, 1850): 133; Attis, *Lancet* 55, no. 1397 (June 8, 1850): 706.

martial him for not displaying more “regard to the good of the ship than to have made a quibble on medical grounds against that which seemed an effectual mode of punishment.”[13]

These shifting post-war dynamics, and the status and pay issues described in chapter three represented only some of the burdens that adversely affected surgeons’ practice efforts. As David McLean has noted, the surgeons’ cockpit was ill adapted for medical practice or scientific activity. The most successful practitioners quickly learned that their work required significant flexibility.[14] Furthermore, McLean has also found that many assignments were both arduous and unpopular. Service on the African, West Indian, South American and Pacific Stations, and Australian convict voyages entailed months on the open seas and often in harsh tropical climates. While surgeons’ daily lives often alternated between routine boredom and natural curiosity, they faced a deluge of patients when epidemics struck their ships.[15] Unsurprisingly, some young surgeons could not handle the pressures of naval service. The suicide of Assistant Surgeon Thomas Hart in 1847 is one of the most serious examples. Next to his body, authorities found positive testimonials from two captains, and a note stating that "I should have been recommended for promotion."[16]

At first glance, it does not appear that the medical service was favorably positioned for a scientific transition to occur. Given the conditions and pressures, however, surgeons’ high levels

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[13] R.J.C. Scott, *Lancet* 30, no. 771 (June 9, 1838): 371; Myers, "Most Disagreeable Service,” 28-29.
[14] McLean, *Surgeons*, 45-46; “Batteries and Biology,” “The Fighting Naturalist,” and “Dentistry” in *Master and Commander*, DVD; Michael Levien, ed., *Naval Surgeon: The Voyages of Dr. Edward H. Cree, Royal Navy, as Related in his Private Journals, 1837-1856* (New York: E.P. Dutton, 1982), 166.
[15] For the West African Station: McLean, *Surgeons*, 66-70; John Rankin, “British and African Health in the Anti-Slave-Trade Squadron,” in *The Suppression of the Atlantic Slave Trade: British Policies, Practices and Representations of Naval Coercion*, ed. Robert Burroughs and Richard Huzzey (Manchester: MUP, 2015), 95–121. For Australian convict voyages: Katherine Foxhall, *Health, Medicine, and the Sea: Australian Voyages, c. 1815-1860* (Manchester, MUP, 2012).
[16] Incidents of negligent and careless practice, lack of discipline, desertion, absconding, and drunkenness demonstrate the adverse effects of surgeons’ poor working conditions. For more examples, see McLean, *Surgeons*, 33-36. For the case of suicide, see *The Times*, no. 19605 (July 19, 1847): 8; Peter Davis, “The Suicide of Assistant Surgeon Thomas Hart,” accessed Mar. 10, 2016, http://www.pdavis.nl/ThomasHart.php.

of clinical proficiency and commitment are striking. Senior doctors and Admiralty officials recognized this at the time. In the late 1820, in the midst of his efforts to set rigorous standards within the service, Burnett touted medical officers' "zealous and ardent devotion to their professional vocations." In particular, surgeons humanely and professionally risked their lives and often paid the ultimate price.[17] In these regards, the Navy benefited from the contrast between naval service and civilian practice, and the competitive British labor market, which allowed for an ambitious and selective approach to evaluating candidates for service.

While chapter three examined the Navy's ability to attract comparatively well-qualified candidates in the context of the broader labor market and professional dynamics, that analysis only reflects one side of surgeons' motivations. Despite the conditions that they faced, many medical officers also saw naval service as personally rewarding. They drew happiness from their work caring for sailors, satiating their professional and scientific curiosity, and aiding Britannia in meeting its providential, humanitarian and imperial missions.[18] Most importantly, the service offered cosmopolitan intellectual, scientific and practical opportunities, and romantic and utilitarian scientific appeals not possible in civilian practice.[19] In terms of the ongoing scientific transition, naval vessels increasingly served as mobile platforms, exposing surgeons to the world's natural laboratory. Surgeons encountered distinctive environments and natural phenomena, which could be observed and analyzed alongside their medical duties.[20]

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[17] Penn, "Burnett," 76, and 106-07; Burnett, memo, Apr. 4, 1829, RNML, AL, Mss.242/3, f. 259.
[18] Penn, "Burnett," 77-78; Levien, 119; Louise King-Hall, ed., *Sea Saga: Being the Naval Diaries of Four Generations of the King-Hall Family* (London: Victor Gollancz, 1935), 85.
[19] For examples of these points: McLean, *Surgeons*, 51-52. See candidate Meredith Gairdner, who ultimately joined the Hudson's Bay Company's expedition to Fort Vancouver, and became a prolific naturalist. Meredith Gairdner to Burnett, Apr. 22, 1832, NA, ADM 97/132; David Igler, *The Great Ocean: Pacific Worlds from Captain Cook to the Gold Rush* (New York: OUP, 2013), 15. See Gairdner, *ENPJ* 16 (Apr., 1834): 290-302; *ENPJ* 19 (1835): 1-14; *ENPJ* 20 (1836): 67; and *Journal of the Royal Geographic Society of London* 11 (1841): 250-57.
[20] Foxhall, *Health, Medicine, and the Sea*, 70-71, and 142. For ship and world as a laboratory: Roy M. MacLeod and Philip F. Rehbock, eds., *Darwin's Laboratory: Evolutionary Theory and Natural History in the Pacific* (Honolulu:

In order to understand why practitioners with a high level of practical scientific training and competence entered the Navy, it is critical to explore the opportunities that naval practice offered, and its contrast with civilian practice. After the enlightening experience of training in large cities, many students found that their best prospect was to set up a general practice near where they had grown up. In an oversaturated labor market, competition increased in urban centers, and prosperous areas of southern England and central Scotland. Even as state employment expanded in workhouses and colonial posts from the 1830s, most doctors still entered general practice. They remained tied to their practices for patient fees, and had limited time to engage in scientific pursuits.[21] In several key ways, naval service was general practice's antithesis. The Navy paid its medical officers a salary per diem, alleviating many concerns related to professional competition, building a client base, and maintaining a practice.[22] On the other hand, naval surgeons faced the fickle needs of the service, including arduous assignments and uncomfortable periods on half pay. Despite the drawbacks, they could count on several years of steady employment, and time to pursue their intellectual, scientific and practical interests.

The backgrounds of the surgeons most committed to medical and natural scientific activities demonstrate the continued relationship between the medical labor market, civilian practice, and the naval medical service's relative success.[23] Based on a sample of forty-eight naval surgeon-naturalists and scientists, they came from a mix of ethnic and educational backgrounds that reflected the broader recruitment dynamics analyzed in chapter three. Within

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University of Hawaii Press, 1994), esp. ix-x, and 4-6; Harry W. Dickinson, *Educating the Royal Navy: 18th and 19th Century Education for Officers* (New York: Routledge, 2007), 66, and 84-85.

[21] Digby, *Making a Living*, 108-17; Peterson, *Medical Profession*, 91-98. For overcrowding and its consequences, see Loudon, *Medical Care*, ch. 10. For public employment, see Digby, *Making a Living*, 118-22. For poor law workhouses: Kim Price, *Medical Negligence in Victorian Britain: The Crisis of Care under the English Poor Law, c. 1834-1900* (New York: Bloomsbury Academic, 2015), esp. 10-14.

[22] Penn, "Burnett," 81; Burnett, memo, Mar. 16, 1855, NA, ADM 97/218/7786.

[23] I constructed a sub-database of scientific surgeons by combining twenty naval surgeon-naturalists and scientists cited in David McLean's *Surgeons* with twenty-eight surgeons that I identified from Medical Department records.

Table 2. The Ethnic and Educational Backgrounds of a Sample of Naval Surgeon-Naturalists and Scientists who Entered Service Between 1794 and 1864.

	Combined	Pre-1830	Post-1830
English	22	6	16
Scottish	17	8	9
Irish	8	1	7
Unknown Ethnicity	1	1	-
University of Edinburgh	13	6	7
London Hospitals	12	3	9
University of Glasgow	8	3	5
University of London	5	-	5
University of Aberdeen	5	2	3
University of St. Andrews	2	1	1
Dublin Hospitals	2	0	2
Unknown Education	1	1	-

the sample, those surgeons who entered the Navy before 1830 were largely Edinburgh-educated, and predominantly Scottish and English. Eleven of the sixteen surgeons in this period also earned their medical degrees, exceeding the percentage of medical officers throughout the service who achieved that qualification. As the naval medical service became increasingly English and London-educated during the 1830s and 1840s, surgeon-scientists' backgrounds shifted. English and London-educated surgeons became a majority in this group, and greater diversity in their ethnic and educational backgrounds emerged. By the 1850s and 1860s, the initial impact of the rise of Irish medical education can also be seen.

Beyond the Navy's shifting recruitment pattern, science's increasing prominence within British and especially Scottish medical education also underlay these dynamics. For example, the University of Edinburgh's offerings in natural history and the medical sciences played a key role in preparing and shaping medical students; other Scottish schools also provided early opportunities for gaining scientific expertise. As London medical schools began to compete with

Scottish universities, they too offered additional opportunities to study natural history and the sciences.[24] The proliferation and diversification of natural scientific and practical medical education generally reflected a growing awareness of their practical utility. Even as the natural and medical sciences began to specialize, professional science and medicine continued to develop in close connection with education and practice.[25] The next section discusses the existing scholarly approaches to the development of empirical science and medicine, allowing the remaining sections to analyze the rise of natural and medical science within naval medicine.

4.2 ANALYTICAL SCIENCE, NATURAL HISTORY, AND MEDICAL PRACTICE

As they sailed around the world between the Napoleonic and Crimean Wars, surgeons took advantage of the opportunities to increase the scope of their scientific practice. Medical officers made contributions in medical and surgical practice, therapeutics, pathology, comparative anatomy, zoology, botany, geology, meteorology, geography and ethnography. They recorded observations, collected specimens, and conducted experiments in places as diverse as Alaska, the Arctic, Antarctica, Australia, British Canada, Brazil, the Cape Verdes, China, Chile, Central America, Egypt, the Falklands, the Galapagos, the Mediterranean, Polynesia and West Africa. The breadth of their activities across the medical, natural and social sciences, and of their geographic focus illustrates a profound commitment to understanding the

[24] Eddy, 97-98; Morrell, "Science and Scottish University Reform," 39-56; Bernard E. Leake, *The Life and Work of Professor J.W. Gregory F.R.S. (1864-1932): Geologist, Writer, and Explorer* (London: Geology Society of London, 2011), 100; Adrian Desmond, and James Moore, *Darwin's Sacred Cause: How a Hatred of Slavery Shaped Darwin's View on Human Evolution* (New York: Houghton, Mifflin, Harcourt, 2009), 28-30. For London: Desmond, *Politics*, esp. 17-21, and 25-26; David Elliston Allen, *The Naturalist in Britain: A Social History* (London: Allen Lane, 1976), 162-63.

[25] For specialization: Cahan, esp. 8; George Weisz, *Divide and Conquer: A Comparative History of Medical Specialization* (New York: OUP, 2005), ch. 2, esp. p. 27-34.

natural world.[26] Nonetheless, surgeons' efforts were part of a series of converging institutional, professional, imperial, and societal developments that allowed them to conduct sophisticated and increasingly organized scientific practice. Like scientific practice more broadly, naval medical and natural science were material, methodological, social and ideological endeavors.[27]

During the early nineteenth century, naval surgeons, Burnett and Admiralty officials transformed the surgeon-naturalist tradition into institutionalized naval science. While similar developments occurred in British and colonial science and medicine, these are often portrayed as distinct developments. This chapter adds to the existing literature by emphasizing the continued methodological unity between natural and medical scientific practices, processes, and approaches. Even as scientific specialization increased, professional science maintained a common focus on nature and analytical observation. Practitioners generally saw this scientific mindset and set of approaches as applicable across most fields, institutions and geographical settings. Nonetheless, they engaged in lively debates over how to apply these principles and practices under varying circumstances.[28]

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[26] For post-Napoleonic scientific activity see Foxhall, *Health, Medicine, and the Sea*, 70-71; Lloyd, and Coulter, vol. 4, 70-79; Drayton, *Nature's Government*, 175-84; Williams, *Naturalists at Sea*, 232-33, and 260-61. For tradition of surgeon-naturalist see Lloyd, and Coulter, vol. 4, 69-70; Williams, *Naturalists at Sea*, chs. 1, 4, and 6; "The Galapagos," and "Deleted Scene: Galapagos," in *Master and Commander*, DVD. McLean, *Surgeons*, 51-55, and Lloyd, and Coulter, vol. 4, 69-80 gives an overview of the types of scientific activities pursued by naval surgeons.

[27] For scientific professionalization and institutionalization: Roy M MacLeod and Peter Collins, *The Parliament of Science: The British Association for the Advancement of Science 1831-1981* (Northwood, UK: Science Reviews, 1981); Jack Morrell and Arnold Thackray, *Gentlemen of Science: Early Years of the British Association for the Advancement of Science* (Oxford: Clarendon Press, 1981); Roy M. MacLeod, ed., *Public Science and Public Policy in Victorian England* (Aldershot, UK: Variorum, 1996).

[28] For observation and natural science: Loraine Daston, and Elizabeth Lunbeck, "Introduction: Observation Observed," in *Histories of Scientific Observation*, eds. Loraine Daston, and Elizabeth Lunbeck (Chicago: UCP, 2011), 1, and 4; Mary Terrall, *Catching Nature in the Act: Réaumur and the Practice of Natural History in the Eighteenth Century* (Chicago: UCP, 2014), 5-6; Nicholaas A. Rupke "Oxford's Scientific Awakening and the Role of Geology," in *The History of the University of Oxford: Volume VII: Nineteenth Century Oxford, Part 2,* eds. M.G. Brock and M.C. Curthoys (Oxford: Clarendon Press, 1984), 543-44. For analytical science: Pickstone, *Ways of Knowing*, chs. 4-5.

Before analyzing naval surgeons' scientific efforts and their practical institutionalization within the Navy, it will be helpful to consider briefly the existing theoretical and historiographical approaches to the emergence of empirical science and medicine. For much of the twentieth century, historians, philosophers, and sociologists of science have debated the logic that guides discourses and conceptions of scientific investigation and theoretical change. There has been significant disagreement over the existence of a normalized scientific rationality, in which scientists regulated and idealized standards of scientific practice.[29] A formative body of scholarship shaped by Thomas Kuhn and Michel Foucault has addressed the continuing concern with the conceptual, discursive and social construction of scientific rationality, especially in relation to theoretical and methodological systems and paradigm shifts.[30] Since the 1980s, but particularly in the past two decades, scholarly considerations have reemphasized the importance of individual and collective practice as a socially, materially and intellectually conditioned process tied to practitioners and scientific fields' idealized epistemologies.[31] While the histories of science and medicine have turned to practice, they have followed parallel but separate paths in analyzing the development of scientific discourses, theories, and practices until recently.[32]

Meanwhile, the distinct and long accepted narrative of the development and extension of scientific medicine throughout Western Europe during the early nineteenth century has focused

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[29] Michael Lynch, *Scientific Practice and Ordinary Action: Ethnomethodology and Social Studies of Science* (New York: CUP, 1997), 134-40; Harold Garfinkel, *Studies in Ethnomethodology* (Englewood Cliffs, NJ: Prentice-Hall, 1967), 280; Karin Knorr-Cetina, *The Manufacture of Knowledge: An Essay on the Constructivist and Contextual Nature of Science* (New York: Pergamon Press, 1981), 21; Latour and Woolgar, 152-53.
[30] Joseph C. Pitt and Marcello Pera, eds., *Rational Changes in Science: Essays on Scientific Reasoning* (Boston: D. Reidel Publishing, 2012), esp. vii-viii; Gary Gutting, "Michel Foucault and the History of Reason," in *Construction and Constraint: The Shaping of Scientific Rationality*, ed. Ernan McMullin (Notre Dame: UNDP, 1988), 186. See also Kuhn, *Structure of Scientific Revolutions*; Ernan McMullin, ed., *Construction and Constraint: The Shaping of Scientific Rationality* (Notre Dame: UNDP, 1988); Gary Gutting, *Michel Foucault's Archaeology of Scientific Reason: Science and the History of Reason* (New York: Cambridge University Press, 1989), esp. chs. 2-5.
[31] Michael Lynch, "From Normative to Descriptive and Back: Science and Technology Studies and the Practice Turn," in *Science After the Practice Turn in the Philosophy, History, and Social Studies of Science*, ed. Léna Soler et al. (New York: Routledge, 2014), 93–113. For one of the pioneering works: Latour and Woolgar, *Laboratory Life*.
[32] For an attempt to build an integrated narrative, see Pickstone, *Ways of Knowing*, passim.

on French clinical medicine. This has emphasized that practitioners in Parisian hospitals developed and systematized clinical scientific principles and approaches during and following the French Revolution. Eighteenth-century medical practice had relied on placing symptoms within existing theory and nosological classification systems to reach a diagnosis. From the late eighteenth century onward, new ways of understanding internal symptoms, pathological changes, and therapeutic responses emerged in France and Britain. Clinical medicine's emphasis on pathological anatomy focused on symptoms, structure and function, and clinical hospital practice emphasizing physical examination reordered both knowledge and practice. While chapter two analyzed the impact of these approaches on medical training, they also shaped medical practice, including prototypical tools such as hospital rounds, postmortem exams, and empirical trials.[33]

In one of the works that has defined the narrative of clinical medicine, Michel Foucault's *Birth of the Clinic* emphasized the medical gaze and institutionalized authoritative discipline that guided the rationalization inherent in early-nineteenth-century clinical medicine. He proposed this discursive argument to counter histories that emphasized "the rediscovery of the absolute values of the visible" through empirical practices. Scholarship has swung back in the other direction, analyzing the anatomical, pathological and clinical practices that were critical to the shift in both doctors' practices and the structure of knowledge that Foucault discussed. Yet, one of his legacies has been to demonstrate that these processes were socially, politically and economically conditioned at the levels of conception, discourse and practice.[34]

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[33] Harrison, *Medicine in an Age*, 2; Duffin, 222-24. See Ulrich Tröhler, *"To Improve the Evidence of Medicine": The 18th Century British Origins of a Critical Approach* (Edinburgh: Royal College of Physicians of Edinburgh, 2000). For France, Foucault, *Birth of the Clinic*, xii, xv, and xix; Erwin Ackerknecht, *Medicine at the Paris Hospital, 1794-1848* (Baltimore: JHP, 1967); Toby Gelfand, *Professionalizing Modern Medicine: Paris Surgeons and Medical Science and Institutions in the Eighteenth Century* (Westport, CT: Greenwood Press, 1980). More generally: López Cerezo, 117-34.

[34] See Foucault, *Birth of the Clinic*, esp. xii-xix. For the broader shift, see also Nicholas D. Jewson, "The Disappearance of the Sick-Man from Medical Cosmology, 1770-1870," *Sociology* 10, no. 2 (May 1976): 225–44.

This approach to science can be extended further. One theme that runs counter to the narrative privileging scientific specialization is that the new clinical medicine reflected methodological developments occurring in the natural sciences. Even as institutionalized fields emerged, common empirical and inductive principles and practices unified nineteenth-century science. Among the theories that has elucidated this in relation to the natural sciences is the concept of Humboldtian science. Susan Cannon argued that natural scientists began to more rigorously investigate natural phenomena in the hope of defining laws and dynamic causes during the late-eighteenth and early-nineteenth centuries. The hallmarks of their approach were insistence on accurate observation, emphasis on measurement, skepticism of past theory, and the use of new conceptual and statistical tools.[35] Humboldtian scientists largely rejected truths and theories as the starting point for scientific inquiry. They instead valued logical and critical analysis driven by the disciplined collection of observations and measurement-based data. From that evidentiary base, they could generalize and hypothesize natural forces, laws and concepts. Existing works have also connected this theory to colonial science due to the emphasis placed on field research through scientific exploration.[36]

Following this extension and cross-fertilization of approaches further, Humboldtian science's concerns with the roles and practices of scientific observation, evidence, and theory were broader considerations throughout nineteenth-century science and medicine. For example, the "age of scientific analysis" proposed by John Pickstone highlights the commonalties between medical and the natural scientific practices. He describes a shift in European natural science's

[35] Susan Cannon, *Science in Culture: The Early Victorian Period* (New York: Science History Publications, 1978), 75-80, 82-83, 87, and 105; Nicolaas A. Rupke, "Humboldtian Medicine," *Medical History* 40 (1996): 294-299, and 304-305; Michael Dettelbach, "Humboldtian Science," in *Cultures of Natural Science*, eds. N. Jardine, J.A. Secord, and E.C. Spary (New York: CUP, 1996), 287, and 290-291

[36] Dettelbach, 287; Cannon, 24, 73, and 93-94. For colonial, see also Andrea Wulf, *The Invention of Nature: Alexander von Humboldt's New World* (New York: Alfred A. Knopf, 2015), ch. 3-8.

dominant approach during the eighteenth and early-nineteenth centuries. Science and medicine increasingly focused on dissecting natural phenomena's elements and functions through observation, description and measurement. Doctors and scientists attempted to posit new conclusions while embracing the likelihood of imprecision and fallacy.[37]

This grand narrative of the "age of scientific analysis" presents one interpretation of the methodological developments that held science and medicine together. A broader literature has continued to elucidate the growing methodological overlap that developed between medicine and the natural sciences as analytical science overtook theory-driven, classification-based approaches. This ongoing process sought to tie together "all the modern sciences, both natural and human," including medicine. Several prominent eighteenth and nineteenth-century scientists, but most famously Alexander von Humboldt, argued for the unity of scientific practice based on shared approaches and principles.[38] Eighteenth-century French naturalist René de Réaumur argued that "the spirit of observation… is equally necessary to progress in every other science. It is the spirit of observation that causes us to perceive what has escaped others." As a case-in-point for the development of scientific practices during the French and Scottish Enlightenments, natural history expanded beyond a science of classification and taxonomy by refining methods of observation, collection, illustration, experimentation, and quantification.[39]

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[37] Pickstone, *Ways of Knowing*, esp. 7-13; Weisz, xix; Bynum, *Science and Practice*, xi-xii. For approaches to observation and analytical medicine: Thomas Laycock, *Lectures on the Principles and Methods of Medical Observation and Research* (Edinburgh: Adam and Charles Black, 1856).
[38] Daston, and Lunbeck, 1-3; Williams, *Naturalists at Sea*, 232-33, and 241; Daston, "Empire of Observation," 91-101; David Aubin, Charlotte Bigg, and H. Otto Sibum, "Introduction," in *The Heavens on Earth: Observatories and Astronomy in Nineteenth-Century,* eds. Aubin, Bigg, and Sibum (Durham: DUP, 2010), 4, and 8.For the unity of nature: Harrison, *Medicine in an Age*, 114; Nancy Stepan, *Picturing Tropical Nature* (Ithaca: Cornell University Press, 2001), 35-43; Shahid Rahman, and John Symons, "Logic, Epistemology, and the Unity of Science: An Encyclopedic Project in the Spirit of Neurath and Diderot," in *Logic, Epistemology, and the Unity of Science* (Dordrecht: Springer Science, 2009), 11-14. For Alexander von Humboldt, see Auguste Comte and Alexander von Humboldt: Mary Pickering, *Auguste Comte: An Intellectual Biography*: *Volume 2* (New York: CUP, 2009), 42.
[39] René A.F. de Réaumur, *Memoires pour servir à l'histoire des insectes: sur les chenilles & sur les papillons* (Paris: Paul Lechevalier, 1734), 49, quoted in Terrall, 6. For natural history more generally, see Daston, 91-93, and 105;

Nineteenth-century science expanded on the idea that observation, measurement, reasoning, and theoretical skepticism were unifying scientific principles, tools and practices, albeit with variations between fields. Considerations related to standards of precision, repetition, synthesis, generalization, and specificity, however, remained contested.[40] As analytical science developed into a disciplined approach with its own training, internal logic, and culture, nineteenth-century English scientist and astronomer Sir John Herschel argued that the ideal scientist was the perfect observer, one who had his eyes open to everything so "they may be struck at once with any occurrence which… ought not to happen."[41] Even as practical standards became systematized and experimentation rose in importance, observation remained an integral scientific tool and approach.[42] Nonetheless, one of the points of this chapter that existing works discussing this scientific transition have not explicitly drawn out is that doctors also transferred and applied these approaches and ideas to medicine in the early nineteenth century. As this dissertation demonstrates, this was especially the case in naval and colonial medicine.

While much of the work on the development of medicine and natural science has focused on the transition in European and British institutional, professional and societal settings, the past

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Terrall, 3-5, 14, 26, 50, 100, 111, and 176; Aubin, Bigg, and Sibum, 4-7. For natural history as observation and classification, see Jacques Rogers, *Les Sciences de la Vie dans La Pensée Française du XVIIIe Siécle* New/3rd. Ed. (Paris: Albin Michel, 1993). For shifts in natural history, see Marie-Noëlle Bourguet, "Landscape with Numbers, Natural History, Travel, and Instrumentation in the Late Eighteenth and Early Nineteenth Centuries," in *Instruments, Travel, and Science: Itineraries of Precision from the Seventeenth to the Twentieth Century*, ed. Marie-Noëlle Bourguet, Christian Licoppe, and H. Otto Sibum (New York: Routledge, 2002), 96-125.

[40] Daston, 93-95, and 99-101; Terrall, 165. See also Cahan, esp. 8-13; Michael Brian Schiffer, *The Archaeology of Science: Studying the Creation of Useful Knowledge* (New York: Springer, 2013), 25-40.

[41] Daston, and Lunbeck, 1-3; Pickstone, chs. 4-5; Aubin, Bigg, and Sibum, 8, and 11; John F.W. Herschel, *A Preliminary Discourse on the Study of Natural Philosophy* (1830, repr.; Chicago: UCP, 1987), 132. For the developed system: Daston, 101-02, and 104-05; Terrall, 3-6, and 14; Loraine Daston, and Elizabeth Lunbeck, "Part 3: Observing in New Ways: Techniques," in *Histories of Scientific Observation*, 181-82.

[42] Daston, and Lunbeck, 3-4, and 6; Mass, 213, and 217; Herschel, *Preliminary Discourse*, 131-34; Ian Hacking, *Representing and Intervening: Introductory Topics in the Philosophy of Natural Science* (New York: CUP, 1983), 149-185. For systematized scientific practices, see Laycock, *Lectures on the Principles and Methods of Medical Observation and Research*; John F.W. Herschel, ed., *A Manual of Scientific Enquiry: Prepared for the Use of Officers in Her Majesty's Navy, and Travellers in General* (London: John Murray, 1849).

two decades have seen an increase in scholarship focused on colonial science and medicine. The British Empire provided opportunities for professional scientists to practice on a disciplined population of colonial and imperial subjects, and develop their expertise and reputations. The prospects and challenges presented by the natural world encountered through colonial service and travel gradually transformed the field-based natural sciences. They provided the diversity of natural observation and specimen collection that drove developments in geology, biology and astronomy.[43] This revisionist narrative has attempted to counter an established view of colonial science as a project geared toward providing data for metropolitan institutions and professional scientists to analyze.[44] Multiple works have recently explored how colonial institutional, material and strategic contexts shaped scientists and officials' approaches to scientific practice. The changes that occurred in the methods and standards of colonial scientific and medical practice in the eighteenth and early-nineteenth centuries have been a point of focus. The argument, reflected best in the work of Dane Kennedy and Mark Harrison, is that colonial scientists adopted an authoritative scientific approach that privileged observational experience and expertise.[45]

The remaining analysis in this chapter builds on this literature emphasizing how analytical science developed and became institutionalized in naval medicine. The intertwined development of domestic and colonial natural science and medicine shaped naval surgeons' individual and collective scientific practices, as well as the Navy's broader efforts. Reflecting the

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[43] Peter Gottschalk, *Religion, Science, and Empire: Classifying Hinduism and Islam in British India* (New York: OUP, 2013), 44-45; Richard Drayton, "Knowledge and Empire," in *The Oxford History of the British Empire: The Eighteenth Century*, ed. P.J. Marshall (Oxford: OUP, 1998), 233-34, 238, and 241-42, and 251; Robert A. Stafford, "Scientific Exploration and Empire," in *The Oxford History of the British Empire: Volume III: The Nineteenth Century*, ed. Andrew Porter (New York: OUP, 1999), 295. For colonial scientific approaches and fields: Kennedy, *Last Blank Spaces*, 29-31, and 34.
[44] Harrison, Medicine in an Age, 10. See also Roy MacLeod, "On Visiting the 'Moving Metropolis': Reflections on the Architecture of Imperial Science," *Historical Records of Australian Science* 5, no. 3 (1982): 1–16.
[45] Gottschalk, 45-46; Chakrabarti, *Medicine and Empire*, esp. ix; Harrison, *Medicine in an Age*, 3-6. For Kennedy, *Last Blank Spaces*, 25-28; Harrison, *Medicine in an Age*, 6-7, 62-63, 120, and 290.

trends discussed above, Mark Harrison has shown that colonial, army and naval surgeons embraced empirical medicine, and observational, descriptive, anatomical, experimental and quantitative methodological approaches over the course of the eighteenth century.[46] Extending his argument further in time and scope, nineteenth-century naval scientific practices, while materially and socially contingent, were also integrally connected to the methodological development of domestic and colonial science. Broader-level and collective processes converged with shared individual practices in British scientific institutions, including the Royal Navy. This leads to a view of the rise of science that emphasizes the multifaceted interactions between practitioners, institutionalizing practices, and professional and societal-level developments.[47]

4.3 NAVAL SURGEONS AND EMPIRICAL SCIENTIFIC PRACTICE, 1815-1860

Given the narrative of nineteenth-century British science and medicine introduced above, we can now investigate the shift that occurred in naval surgeons' medical and natural scientific practices. As previously alluded to, surgeons' interactions with the environments, phenomena, and medical, scientific and social experiences that they encountered shaped their approach toward their work.[48] The career of English Staff Surgeon Edward Cree provides one example.[49]

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[46] Harrison, *Medicine in an Age*, 11, and 27-28. For natural history and colonial medicine: Chakrabarti, *Medicine and Empire*, ch. 2.

[47] For 19th century institutionalization of scientific practices: Harrison, *Medicine in an Age*, 23. For works that fit famous individuals into institutional, professional and societal contexts: Endersby, *Imperial Nature*; Nicolaas A. Rupke, *Richard Owen: Victorian Naturalist* (New Haven: YUP, 1994); Robert A. Stafford, *Scientist of Empire: Sir Roderick Murchison, Scientific Exploration and Victorian Imperialism* (New York: CUP, 1989).

[48] Humboldt acknowledged this dynamic through his emphasis on field research. Cannon, 75-76, 79, and 87.

[49] Cree was educated at Trinity College, Dublin, a London anatomy school, and the University of Edinburgh. He joined the navy in 1837. His professional ambitions led him to return to Edinburgh for his degree in 1846-47, where he excelled in Materia Medica and Clinical Surgery. Cree initially took Institutes of Medicine, Natural History and Military Surgery at Edinburgh. When he returned, he studied Practice of Medicine, Pathology, Materia Medica,

In the space of four days in March 1840, during his first solo run as an Assistant Surgeon to the Pacific, Cree recounted eating a shark that the crew had caught, struggling to treat a case of rheumatism that ended in death by nervous degeneration, performing an autopsy on a marine who died of a ruptured abscess in the spleen, witnessing the fate of a marine who fell overboard and was drowned by a shark, and collecting ornithological specimens in China.[50] This mix of invigorating, curious and disorienting experiences was a common feature of naval service, which broadened surgeons' worldviews. Many surgeons, such as Cree, fell back on the analytical scientific outlook and approaches instilled during their medical training to make sense of these encounters with nature. This in turn drove the systematization of science within the Navy.

Assistant Surgeon William Leyson's natural scientific efforts on the 1824 Northwest Passage Expedition, which explored Arctic Canada, are illustrative of the interactions between surgeons' duties, experiences, and practical applications of natural science. An Edinburgh and London-educated surgeon-apothecary, Leyson had joined the Navy in 1810. His career had stalled following the Napoleonic Wars and the Expedition offered an opportunity to distinguish himself.[51] Leyson's most important scientific contribution ensured the expedition's survival. *HMS Griper* had started losing water stored in its hold following the storm that ultimately forced

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Midwifery, and Clinical Surgery. He got low passes in his examinations for most subjects but received high passes in Practice and Surgery and full marks in Materia Medica and Clinical Surgery. His dissertation was entitled "On the Principal Diseases Affecting Europeans in China." For his career: Levien, 5-6, 9-15. University of Edinburgh, "General and Medical Class Lists," 1806-1851, EUL CRC, UA, EUA/IN1/STA/3, vols. 1836, and 1846-47; University of Edinburgh, "General and Medical Examinations," 1847, EUL CRC, UA, EUA/IN1/STA/8, Vol. 1847.

[50] For the four-day period: Levien, 42-43. For the other cases: Levien, 52, and 60. For more of Cree's cases: Levien, 88-89; McLean, *Surgeons*, 46.

[51] *HMS Griper* encountered bad winter conditions in Hudson's Bay. A storm grounded *Griper*, likely on an iceberg. The ship also lost its anchor, and damaged its masts and riggings in another storm. *Griper* limped back to Spithead, where it crashed into another ship's mooring cables. The official narrative details scientific contributions on botany and magnetic error, and extensive metrological observations. Leyson distinguished himself, earning his promotion for Surgeon in 1825. For Leyson: British Medical Directory Office, *The British Medical Directory: For England, Scotland, and Wales* (London: 1853), 353; Admiralty, *The Navy List* (London: H.M.S.O., 1815, 1825). For the Expedition: George F. Lyons, *A Brief Narrative of An Unsuccessful Attempt To Reach Repulse Bay In His Majesty's Ship Griper* (London: John Murray, 1825), vii-viii, 75-81, and 160-98; John Barrow, *Voyages of Discovery and Research within the Arctic Regions, from the Year 1818 to the Present Time* (London: John Murray, 1846), ch. 7.

it to return to Spithead. The ship was on the verge of rationing water to subsistence levels when Leyson devised an inventive solution. He "contrived an ingenious and simple method of distilling water," whereby he created a rudimentary still using the copper sheathing in the ship's hull.[52] He devised this emergency solution by generalizing and triangulating his knowledge of chemistry and the resources available aboard the ship.

Before devising this invention, Leyson had explored the Arctic environment as part of several excursions ashore. Beyond a surveying mission, he accompanied boats on several walrus hunts. The account in his medical journal is a distinctive mix of rigorous scientific description and Melvillian adventure tale. Leyson gave a chronological description of the hunt. He analytically compared the ineffectiveness of musket balls during the hunt to "snowballs," both of which bounced off walruses' hides. Based on similar observations, Leyson went on to discuss the danger posed by wounded walruses attacking the boats with their tusks. He also reported his observations on their comparative anatomy and behavior:

> These animals are bulky and appear on the ice of the bigness of bullocks of different sizes; they are gregarious and on being disturbed make a bellowing snorting noise, which may be heard at some distance; they use the fore and hind fins as legs and feet, and when on the ice the ends of the hind fins are turned forward under the belly for that purpose; their fins are so small in proportion to their bodies, that their strength or speed in the water is not considerable… They are particularly careful of their young, which cling to their backs during an attack, or else are taken down under the fin of their mother, and pushes on under her protection. They are also mindful of each other.[53]

In presenting this description, Leyson remained open and inclusive, applying an analytical natural historical and physiological approach concerned with structure, function and behavior.[54]

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[52] Lyons, 52.
[53] *Ibid.*; William Leyson, "Medical Journal of HMS Griper," 1824, NA, ADM 101/103/5, f. 11-13. For an earlier example describing a lightning strike, see Thomas Tappen, "Medical Journal of HMS Arab," Oct. 1799, ADM101/85/4, f. 17. For these medical journals in a digitalization project: Bruno Pappalardo, and the NA, "Surgeons at Sea: Royal Navy Medical Officers' Journals: Highlight Guide," Dec. 2010, accessed Apr. 1, 2015, http://www.nationalarchives.gov.uk/documents/surgeons-at-sea-highlights-guide.pdf.
[54] For the anatomical approach: Hutton, 19-20; Jacyna, "Theory of Medicine," esp. 150.

Beyond Leyson's actions, other examples more clearly illustrate surgeons' strategy of scientifically approaching natural, medical and social phenomena as an inclusive whole. Edward Cree's journals incorporated observations of his medical practice, and natural and social experiences. Cree recounted attending a party hosted by the Chinese merchants of Singapore, where he observed a Malay dance and a Chinese song in a setting of moonlight, torches and jungle.[55] Distinctive and shocking experiences received greatest detail, such as his empathetic recounting of the state of the city of Zhenjiang, which had been pillaged during the Battle of Chinkiang in the First Opium War.[56] In these examples, Cree applied scientific approaches and standards to his ethnographic descriptions. Many surgeons brought together their practical, scientific, and social observations in similar ways to present encompassing narratives of their experience. Shared and transferable skills allowed their natural, medical and social observations to transcend disciplinary and subject boundaries that today appear rigid. This was particularly true of skilled naturalists, as seen in the case of Charles Darwin who contributed in practical ways to zoology, botany and geology following his aborted career as a medical student.[57]

Further reinforcing this conclusion that naval surgeons broadly and practically employed empirical scientific practices, they also increasingly applied these approaches to the developing social sciences. By their extension of natural scientific methods to social questions during the

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[55] Levien, 129. See also a more risqué gathering at the home of the leading Portuguese merchant in Singapore, where Cree flirted with several Malay women: Levien, 131-32.

[56] Levien, 104-05. The occasions when he heard an Admiral Thomas Cochrane's yarns at the mess, and attended music parties hosted by Professors Christison and Syme also received mention. See Levien, 153, and 183-85.

[57] Daston, and Lunbeck, 7; Anon, "Darwin's Geology," *Nature Geoscience* 2, no. 2 (Feb. 2009): 81; Sara B. Hoot, "Charles Darwin: Botanist," *Reports of the National Center for Science Education* 29, no. 1 (Jan.-Feb. 2009): 19-21; Anouk Barberousse, and Sarah Samadi, "Species from Darwin Onward," *Integrative Zoology* 5, no. 3 (Sept. 2010): 187-197. See more broadly, Cahan, *From Natural Philosophy to the Sciences*. For prominent figures in multiple natural scientific fields, see Charles Darwin, John Richardson, and Thomas Huxley. Charles Darwin, ed., *The Zoology of the Voyage of H.M.S. Beagle*, 5 vols. (London: Smith, Elder & Co., 1838-43); T.H. Huxley, *Discourses Biological and Geological*, vol. 7 of *Collected Essays* (New York: D. Appleton and Co., 1897); Richardson, William Swainson, and William Kirby, *Fauna Boreali-Americana, or, The Zoology of the Northern Parts of British America*, 4 vols. (London: J. Murray, 1829-37); Richardson, and Edward Forbes, *The Zoology of the Voyage of HMS Herald* (London L. Reeve, 1852); Richardson, *The Polar Regions* (Edinburgh: A. and C. Black, 1861).

early nineteenth century, the contours and practices of ethnography and anthropology took shape. By the 1830s, medical professionals, physiologists, phrenologists, cultural researchers, linguists, and some policy makers focused increasingly on the study of race, humankind and indigenous populations. The expansion of formal and informal empire during the nineteenth century provided the stage for their racially tinged investigations. Naval surgeons were part of a diverse group of practitioners who conceived of ethnographic inquiry as scientific in nature. Although by the 1840s, domestic authorities had asserted their primacy, imperial travelers, including naval surgeons, continued to provide data, perform initial analyses and present their results. Surgeons' scientific approach to these and other emerging fields gave their work considerable credibility.[58]

In regard to ethnographic issues, the case of Surgeon Thomas R.H. Thomson is illustrative of the approach that some naval surgeons took. A Manxman, and a London and Edinburgh-educated surgeon, Thomson is known as one of the 1841-42 Niger Expedition's medical officers. He had served on the Channel Fleet, in Haslar Hospital, and off South America during the late-1830s, completed a tour on the patrol off Brazil in the mid-1840s, and served on a convict voyage to Australia in 1848-49.[59] In 1854, he wrote an article examining purported claims that mixed-race women were increasingly unable to reproduce with aboriginal men in Australia. Based on a scientific approach privileging his observations of the colony in late 1848,

[58] Sera-Shriar, 12-16, 21-26, 33-42, 58-64, 77-79, and 113-14; Richard R. Yeo, "Scientific Method and the Rhetoric of Science in Britain, 1830-1917," in *The Politics and Rhetoric of Scientific Method: Historical Studies*, eds. J. Schuster and R. R. Yeo (Boston: D. Reidel Publishing, 1986), 283; Arne Hessenbruch, *Reader's Guide to the History of Science* (Chicago: Fitzroy Dearborn, 2000), 107; George W. Stocking Jr., *Victorian Anthropology* (New York: Free Press, 1987), ch. 3, esp. 79-80. For racialized science, ethnography and empire: Nancy Stepan, *The Idea of Race in Science: Great Britain, 1800-1960* (Hamden, CT: Archon Books, 1982), esp. xii-xvi, and ch. 1-4; Ishita Pande, *Medicine, Race and Liberalism in British Bengal: Symptoms of Empire* (New York: Routledge, 2009), 29-43.

[59] Leslie Bethell, *The Abolition of the Brazilian Slave Trade: Britain, Brazil and the Slave Trade Question* (1970, repr.; Cambridge: CUP, 2009), 210; Admiralty, NA, ADM/196/8/f.320; Anon, *The Nautical Magazine* 26 (Apr. 1838): 546; Thomson to Burnett, June 17, 1840, ADM 97/150/1680; William Hutt, "Second Report from the Select Committee on Slave Trade," *PP*, 1847-48(366): xxii, 283, p. 106; Thomson, "Medical Journal of the Convict Ship Blenkeum," 1848-49, NA, ADM 101/12/5.

Thomson argued that "it was by the diseases, the altered habits, [sic] the enervating and depraving vices which the white man takes with him when he goes forth to seek a new home in the land of savages" that aboriginal and mixed-race women had adopted behaviors that led to infertility. He rejected arguments based purely on racial miscegenation. While Thomson emphasized the physiological similarities across races based on scientific and humanitarian principles at several points during his career, he should not be held up as a moral paragon. In the name of science, he also brought back from Australia a grave-robbed "baked child" specimen as evidence of infanticide.[60]

Despite their prolific observations and publications on the natural and social world, surgeons' naval duties ensured that medical phenomena attracted much of their attention.[61] In their medical work, unsurprisingly, surgeons also followed the pattern of applying empirical-analytical approaches. Nonetheless, the efforts of medical officers to implement methodological advances within the Navy achieved limited advances in medical therapeutics during the early nineteenth century. Like British medicine more generally, therapeutics lagged behind. Surgeons and practitioners thus applied scientific approaches based on the positivistic potential of delayed practical gains.[62] One illustrative example is Humboldtian science's applications in medical practice. While the enthusiasm for drawing out the ramifications of geographic differences

[60] Thomson, "Observations on the Reported Incompetency of the 'Gins' or Aboriginal Females of New Holland," *JESL* 3 (Jan. 1, 1854): 244-246. For other views and actions: Hutt, *PP*, 1847-48(366): xxii, p. 131; W. Augustus Miles, "How Did the Natives of Australia Become Acquainted with the Demigods and Daemonia, and with the Superstitions of the Ancient Races?" *JESN* 3 (1854): 29; Damon Ieremia Salesa, *Racial Crossings: Race, Intermarriage, and the Victorian British Empire* (New York: OUP, 2011), 134-35; Lynette Russell, "'Dirty Domestics and Worse Cooks': Aboriginal Women's Agency and Domestic Frontiers, Southern Australia, 1800-1850," *Frontiers: A Journal of Women Studies* 28, no. 1 (2007): 32-33, and 45; Marguerita Stephens, *White Without Soap: Philanthropy, Caste and Exclusion in Colonial Victoria 1835-1888 : A Political Economy of Race* (PhD diss.; University of Melbourne, 2003; Melbourne: UoM Custom Book Centre, 2010), 112-13.
[61] One example is surgeons' views on drunkenness' implications. See McLean, *Surgeons*, 39-41; Crumplin, 74-75; William Warner, "Medical Journal of HMS Ville de Paris," 1813, NA, ADM 101/125/3; Thomas Simpson, "Medical Journal of HMS Arethusa," 1805, ADM 101/86/1, f. 5; Daniel McNamara, "Medical Journal of the Convict Ship John Barry," 1821, ADM 101/38/2, f. 2-3, and 5-7; Pappalardo, and the NA, "Surgeons at Sea."
[62] Wootton, *Bad Medicine*, esp. 283; Hutton, 9; Carter, *Decline of Therapeutic Bloodletting*, esp. 1-2.

produced significant advances in the natural sciences and public health, its application in therapeutics yielded less promising results. Furthermore, instrumental measurement also had a less significant impact due to the difficulty of connecting such data to medical practice.[63]

Naval surgeons also faced additional challenges to applying scientific efforts in naval medical practice. As medical officers' practical duties shifted after the Napoleonic Wars, they continued to approach issues related to disease in a similar manner as their civilian colleagues. Because of their medical training, they generally ascribed to the refined version of neo-humoral theory that remained dominant throughout British medicine. This system instilled the belief that external factors, such as poisons, environment, and immoral actions, caused bodily imbalances and dysfunction, local and general inflammation, and disease.[64] The nervous, chemical and constitutional theories refined between the 1790s and 1820s represented attempts to elucidate the pathological processes underlying the neo-humoral system. Despite continued disagreement over specific processes, the lingering poison-based explanation of disease causation represented an incremental move toward germ theory even as it led to many false lines of inquiry.[65]

Despite the existing system's considerable Kuhnian staying power, the early nineteenth century saw substantial upheaval in British and naval medical practice. Neo-humoralism's applicability to therapeutics gradually came into question, driving the search for an alternative that culminated in germ theory. As a requisite development to that advance, the roles of observation, classification, diagnosis and symptomology in medical practice began to shift. While the importance of the combination of the clinical gaze and anatomical pathology to the

[63] Cannon, 77; Rupke, "Humboldtian Medicine," 294-99, and 304-05; Charles W.J. Withers, "Afterword: Putting the Geography of Science in Its Place," in *Geographies of Nineteenth-Century Science*, ed. David N. Livingstone and Charles W.J. Withers (Chicago: UCP, 2011), 441-45; Michael A. Osborne, *The Emergence of Tropical Medicine in France* (Chicago: UCP, 2014), 50-51.
[64] McLean, *Surgeons*, 39-41; Crumplin, 74-75; Carter, 11. For inflammation and naval medicine, see George Ballingall, *Outlines of Military Surgery*, 3rd ed. (Edinburgh: Adam and Charles Black, 1844), 109-32.
[65] For the state of theory c. 1860, and the conception of poisons: Worboys, *Spreading Germs*, 2, and 33-42.

transition in clinical practice in this period has dominated the literature, empirical scientific approaches underpinned these developments. Even as therapeutics focused on combating symptoms and restoring bodily processes, practitioners employed analytical observation to make sense of pathological problems.[66] Mark Harrison has shown that military and naval surgeons both helped to develop and embraced this practical approach in the late-eighteenth and early-nineteenth centuries.[67]

Another more specific but equally significant methodological development was that a more responsive approach to therapeutics became the practical standard. Practitioners increasingly tailored treatments based on their desired and produced effects, used observed symptoms and pathology to evaluate their success, and changed or continued regimens based on patients' responses. This approach gradually supplanted more prescriptive practices driven by nosological classification. Nonetheless, since practitioners saw most diseases as resulting from inflammation, antiphlogistic treatments grounded in humoral pathological theory remained dominant. The favored therapies continued to include bleeding, purgatives, emetics, cathartics, stimulants, depressants, anti-purgatives, and mercurials, which theoretically and supposedly in practice added, removed, stimulated, and depressed fluids, heat and bodily processes.[68] Since failure in experimentation often meant patients' deaths, moving beyond the existing therapeutic system was materially and professionally risky. Until viable alternatives to humoral theory and the antiphlogistic regimen began to emerge in the 1860s, many practitioners and medical officers

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[66] Gutting, *Michel Foucault's Archaeology of Scientific Reason*, ch. 3, esp. 127-33*;* Carter, 20-21, 32, and 90.

[67] Harrison, *Medicine in an Age*, 6-7, 27-28, 62-63, 120, 290; Chakrabarti, *Medicine and Empire*, 50-51.

[68] Crumplin, "Surgery," 75-77; Carter, 11; Alex Berman, "The Heroic Approach in 19th Century Therapeutics," *Bulletin of the American Society of Hospital Pharmacists* 24, no. 11 (1954): 320–27; Guenter B. Risse, "The Renaissance of Bloodletting," *Journal of the History of Medicine* 34, no. 1 (Jan. 1979): 3-5; Curtin, *Image*, 193-94. For antiphlogistics and naval medicine, see Ballingall, *Outlines*, 117, 172-75, 201-03, 217, 269, 279, 299, 312, 229, 428-30, and 439-40; Pappalardo, and the NA, "Surgeons at Sea." For the medicines used in the Navy: Admiralty, *Regulations and Instructions for the Medical Officers of His Majesty's Fleet* (London: W. Clowes, 1835), 56-58.

believed that their greatest chance of success lay in critically applying their knowledge of the existing system and their previous practical experience.[69]

Therefore, like many practitioners, naval surgeons often continued bloodletting, mercury, and other antiphlogistic treatments, but increasingly noted their mixed results and deleterious effects. This process largely reflects Kuhn's portrayal of the gradual breakdown of dominant theoretical and practical systems. Beyond the risks of deviation from accepted practices, surgeons continued to apply the dominant system because analytical observation alone could not provide an adequate alternative practical and therapeutic conception.[70] The difficulty that surgeons had in diagnosing the disparate ailments afflicting their patients further complicated these practical issues. Surgeons often made practical decisions based on symptoms as they lacked a reliable specific diagnosis. In such cases, many surgeons stuck to the antiphlogistic system because decades of cumulative collective experience limited them to selecting from accepted treatments.[71] This helped to ensure that substantial continuity remained in medical practices following the Napoleonic Wars, and that therapeutic change only gradually occurred.

While few therapies gained the same practical acceptance as antiphlogistics, the period during and following the Napoleonic Wars saw the apogee and rapid decline of bloodletting and mercury. From the 1830s, following a Kuhnian process of accumulation, generational struggle, and transition, many practitioners and naval surgeons restricted the circumstances and symptoms for which they employed bloodletting and mercury. Surgeons' less dogmatic approach reduced

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[69] Carter, 58-59, and ch. 1.

[70] For the cases of treatment of a poisonous tropical fruit, and a tarantula bite, see Tappen, ADM 101/85/4A, f. 11, and 23. For treatment of a severe case of pneumonia with severe bloodletting, see John Duke, "Medical Journal of HMS Atlas," Oct. 21, 1819, and Nov. 7, 1819, ADM 101/6/2, f. 16, and 25. For a case involving an ammonia eyewash, see Pierre Mansfield, "Medical Journal of HMS Raccoon," Feb. 12-Mar. 5, 1868, ADM 101/139/2, f. 16-17. For the case of yaws sores treated with caustic scrubbing, see John O'Neill, "Journal of HM Gun Boat Decoy," Dec. 1, 1874, ADM 101/148/48, f. 20; Pappalardo, and the NA, "Surgeons at Sea."

[71] For the case of worms treated with emetic antiphlogistics, see Pierre Power, "Medical Journal of the Convict Ship Elizabeth," June 13-June 29, 1825, NA, ADM 101/76/9, f. 11-13; Pappalardo, and the NA, "Surgeons at Sea."

the overall scale of those methods' use. This practical moderation emerged as theoretical skepticism increased, and responsive therapeutics proliferated within British medicine. K. Coddell Carter has argued that philosophical, professional and social changes within British society and medicine drove the gradual methodological shift and decline of bloodletting.[72] Naval surgeons in particular also began to restrict their use of bleeding and mercury based on their experience with tropical fevers and continued observations of their effects in such cases.[73]

Beyond this moderate shift in therapeutic practices, one of the few direct innovations was the rise of quinine, which is discussed in the next two chapters. This was the case because it was particularly difficult to convince medical practitioners to adopt new practical breakthroughs based on empirical approaches alone unless there was an overwhelming accumulation of positive evidence. As we will see, naval surgeons produced the evidence that justified the extended use of quinine. This begs the question of why and under what circumstances individual surgeons chose to deviate from accepted therapeutic practices. Efforts to employ alternative treatments often occurred in desperate or unfamiliar situations in which practitioners progressed from accepted to empirical treatments as their efforts faltered. Empirical trial was also more likely in cases where surgeons' experience with particular diseases demonstrated a stark gulf between observed results and prescribed practices. Such cases provided surgeons greater practical justification for their deviation from accepted practice.[74]

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[72] For an analysis of the various factors contributing to bloodletting's decline, see Carter, 3-5, and ch. 7.

[73] For tropical fevers, mercury and bloodletting: Bryson, *Report on the Climate and Diseases*, 240-243; Pritchett, *Some Account of the African Remittent Fever Which Occurred on Board Her Majesty's Steam-Ship Wilberforce, in the River Niger* (London: John Churchill, 1843), 172; McWilliam, "Medical Journal of HMS Albert," Jan. 12, 1843, NA, ADM 101/82/2, f. 244; McWilliam *Medical History of the Expedition of the Niger During the Years 1841-42* (London: John Churchill, 1843), 196; Bryson, "Medical Journal of HMS Atholl," 1831-32, ADM 101/88/3, f. 34-35.

[74] For limited areas of advancement: Penn, "Burnett," 18-19. For a case involving the treatment of continued fever first with bleeding, cinchona bark, nitrate mixture, and finally tepid bathes, see James Little, "Medical Journal of HMS London," Feb. 17-Aug. 25, 1800, NA, ADM 101/107/1, f. 15-16, and 23-24. For a case involving near-drowning and hypothermia, see Benjamin Lara, "Medical Journal of HMS Princess Royal," Jan. 19 1802, NA, ADM

While most such empirical trials lacked organized designs, the approach of moving from accepted to unconventional therapies flourished as a broader culture of military experimentation emerged in the post-Napoleonic era.[75] One example is Edward Cree's response to a cholera outbreak in 1845. Early one morning, he was called to the crew's berth, where he found a rapidly deteriorating case of cholera. Several new cases emerged over the course of the day, and it looked like the start of a virulent outbreak. Cree administered opium and mercury at the earliest symptoms. The patients received no benefit from mercury-induced salivation, and their diarrhea worsened. By mid-day, Cree pursued an unconventional course of treatment, administering a zinc sulphate solution. The outbreak disappeared overnight, but Cree resisted the urge to credit zinc sulphate based on this one case.[76] Just as he had limited power to confront cholera, he knew that this empirical evidence could be interpreted in several different ways. Nonetheless, the example illustrates the trial-and-error approach often forced on surgeons by dire circumstances.

Similarly, the approach of Glasgow-graduate and Surgeon Dr. Alexander Bryson to outbreaks of diarrhea, fever, and hemeralopia (day blindness) on the convict ship *Marquis of Hastings* in 1842 also fits this pattern. A scientifically inclined surgeon, and a veteran of the African and West Indian Stations, Bryson was known for his statistical reports on naval health, inquiry into the African Station, advocacy of new approaches to tropical disease, and willingness

101/115/3a, f. 46. For treatment of inflamed tonsils with emetics, and a sulphuric acid gargle, see John Knox, "Medical Journal of HMS Bombay," Dec. 28, 1808-Jan. 16, 1809, NA, ADM 101/91/4, f. 23. For another case of near-drowning involved strychnine, see Belgrave Ninnis, "Medical Journal of HMS Garnet," Nov. 15 1880, ADM 101/293/1, f. 21. For these cases, see also Pappalardo, and the NA, "Surgeons at Sea."

[75] Katherine Foxhall, "From Convicts to Colonists: the Health of Prisoners and the Voyage to Australia, 1823–1853," *Journal of Imperial and Commonwealth History* 39, no. 1 (2011): 8; Geoffrey L. Hudson, "Introduction: British Military and Naval Medicine, 1600-1830," in *British Military and Naval Medicine, 1600-1830*, ed. Geoffrey L. Hudson (New York: Rodopi, 2007), 12-16, and 18; Philip R. Mills, "Privates on Parade: Soldiers, Medicine and the Treatment of Inguinal Hernias in Georgian England," in *British Military and Naval Medicine*, 149–82.

[76] Zinc sulphate proved effective because it acted as a partial anti-purgative, reducing vomiting while replenishing some of lost fluids to diarrhea. The treatment unintentionally addressed dehydration. Levien, 172.

to conduct scientific trials.[77] He first employed soothing, anti-purgative and cathartic agents in diarrhea cases. The intent of these therapies was to address patients' inflamed intestinal systems and to flush their systems of poisons. These therapies had little effect in several diarrhea cases, allowing typhus and exhaustion to appear.[78] As multiple treatments proved ineffective, Bryson suspected that insufficient diet and exposure to noxious air during confinement made the convicts susceptible to disease. While his explanation dovetailed with accepted pathological theory, Bryson's observations on causation and treatment allowed him to justify a more comprehensive practical course. Bryson abandoned antiphlogistics, and convinced the captain to land at the Cape Colony to collect fruit and to air out the hold. This produced immediate results, as the most debilitated diarrhea and typhus patient recovered.[79] The disruptiveness of changing the ship's itinerary makes this case somewhat peculiar. Nonetheless, Bryson followed the trend of employing analytical skills and reasoning to justify deviation from accepted practices.

Although singular empirical trials were the most prevalent attempts at therapeutic innovation, naval surgeons were one of the groups of British practitioners who helped to refine and to organize experimental efforts during the nineteenth century.[80] The Navy's authoritative structure with flexible and immediately unsupervised practice provided the possibility for surgeons to experiment with treatments, and to observe their patients in ways inconceivable in the domestic practice. Surgeons' individual efforts helped to normalize experimental practices,

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[77] For Bryson, see J.V.S. Wickenden, "Watching Over Jack: Alexander Bryson, 1802-1869," *JS* 96, no. 1 (2010): 45-53. Barrow to Burnett, Oct. 23, 1847, NA, ADM 97/169/3153; Burnett, memo, Feb. 25, 1847, RNML/AL, Mss.242/4/f. 508-09.

[78] Alexander Bryson, "Medical Journal of the Convict Ship Marquis of Hastings," 1842, NA, ADM 101/50/6, f. 26. For the same voyage: Foxhall, *Health, Medicine, and the Sea,* 102, and 140-141; Foxhall, "From Convicts," 8-9.

[79] Bryson, ADM 101/50/6, f. 26-27.

[80] Brown, *Poxed*, viii; Harrison, *Medicine in an Age*, 6, and 27-28; Hudson, "Introduction," 12-16, and 18. For Victorian experimentation: Terrie M. Romano, *Making Medicine Scientific: John Burdon Sanderson and the Culture of Victorian Science* (Baltimore: JHP, 2002), 2, and 8. For quantification and experimentation, see Tröhler, *"To Improve the Evidence of Medicine,"* 71-73.

which the next section discusses at an institutional level.[81] As structured experimentation emerged, surgeons continued to reconsider evidentiary and methodological questions. Nonetheless, their experiments were often not repeatable or falsifiable. This constrained surgeons' ability to generalize their findings, and discuss processes and theories.[82] While it also led many to challenge the assumptions that underlay accepted practice, overturning a holistic theory based on case-by-case evidence was a prolonged process. The next section thus considers the ramifications of the medical service's and the Admiralty's changing practical views and policies, especially in relation to the shift occurring in naval medical and scientific practices.

4.4 EMPIRICAL SCIENCE IN THE NAVAL MEDICAL SERVICE, 1815-1860

Beyond the gradual shift in surgeons' individual and collective practical approaches, the Admiralty and the Naval Medical Department institutionalized analytical scientific approaches to naval medicine in the early nineteenth century. They developed a practical environment and institutional policies that supported and encouraged medical and natural scientific research and investigations following the Napoleonic Wars. While some voyages in the eighteenth century had civilian naturalists aboard, it was surgeons who more commonly undertook that role, usually for their own edification and professional ambitions. Broader-scale scientific activities and medical trials received case-by-case backing from the Admiralty based on their potential to aid

[81] Foxhall, *Health, Medicine, and the Sea*, 61, and 70-71; Hudson, 13-14; J.D. Aslop, 31-33. For a case of experimentation involving the transmission of gonorrhea on a convict ship, see David Cowan, "Medical Journal of HMS Gladiator," July 1808, and Apr. 27, 1809, NA, ADM 101/103/2, f. 7-9, and 13; Pappalardo, and the NA, "Surgeons at Sea."

[82] Gilbert Blane was the figure to first call for careful consideration of "the laws of evidence, and the rules of investigation" in naval medicine. Such considerations became increasingly important as experimentation expanded. Hudson, "Introduction," 14; Blane, *Observations*, x. See the Cowan case, ADM 101/103/2, f. 7-9, and 13.

naval operations.[83] Such shifts occurred most frequently during and following the wars. For example, during the 1810s and 1820s, the Victualling Board appointed an increasing number of surgeons to voyages based in part on their knowledge of such fields as zoology, geology and botany. By the 1830s and 1840s, many ships travelling to far-away areas of the world carried surgeons who possessed both medical training, and interests and skills in natural science.[84]

In fact, a symbiotic relationship developed between medical officers and the Admiralty. Most surgeons pursued their interests and duties, while benefiting from naval resources and patronage. Some young surgeons, most notably Thomas Huxley, used naval service as a stepping-stone into domestic scientific careers. Seasoned medical officers, exemplified by Sir Dr. John Richardson, saw scientific investigation as an alternative route to prominence within and beyond the Navy.[85] The Admiralty's support for scientific efforts and activities, meanwhile, was a response to the difficulties involved in its global operations. During this era of rising utilitarian thought and governmental retrenchment, it was efficacy and efficiency that guided many of the Admiralty's policy and resource decisions. Recognizing surgeons' importance to the health of its crews and the knowledge gained of a new world, the Admiralty encouraged their efforts, and gradually embraced scientific practices, particularly those that did not directly compete with naval operations for resources. While the Navy also used scientific prospects as a tool to recruit surgeons that met its rigorous appointment requirements, surgeons maneuvered within this system, invoking their expertise in pleas for resources and practical support.[86]

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[83] Drayton, 178-79; Foxhall, *Health, Medicine, and the Sea*, 70-71; Lloyd, and Coulter, vol. 4, 69; "The Galapagos," and "Deleted Scene: Galapagos," in *Master and Commander*, DVD

[84] Williams, *Naturalists at Sea*, 232; Foxhall, *Health, Medicine, and the Sea*, 55-56.

[85] Lloyd, and Coulter, vol. 4, 70-76; Williams, 232-33; Levien, 42-43, 52, and 60. For T.H. Huxley and Sir John Richardson, see McLean, *Surgeons*, 52-53. Drayton, *Nature's Government*, 179; Williams, *Naturalists at Sea*, 260.

[86] For the Navy and science: Foxhall, *Health, Medicine, and the Sea*, 70-71; Drayton, *Nature's Government*, 172, 176-79, 183, and 201-02; McLean, *Surgeons*, 55-56; John G. T. Anderson, *Deep Things Out of Darkness: A History of Natural History* (Berkley: UCaP, 2012), 119, and 128.

Medical Director-General Burnett set the tone for these converging institutional efforts during the early nineteenth century by encouraging intellectual and practical contributions across the natural and medical sciences. A thorough clinical practitioner with immense intellectual curiosity, Burnett drew on his own experiences in the field. He wrote nearly a dozen reports on fever epidemics during his career, which presented nuanced analyses of marsh miasmatic and contagionist theories, as well as the utility of hygienic measures.[87] More importantly, Burnett embraced the rising importance of medical and natural scientific principles in his administration of the service. As medical commissioner and Director-General, he lobbied for postings and policies that offered scientific opportunities. His fostering of science within the medical service contributed to its growing institutionalization within the highly bureaucratic and political Admiralty system. As David McLean has noted, Burnett's motivations were quite practical and utilitarian, as he invoked science's potential benefits for medicine, agriculture and industry.[88]

In institutional policy, Burnett also helped to formalize and standardize the empirical scientific practices proliferating within the naval ranks. From the 1820s onward, he spearheaded efforts to revise surgeons' instructions and duties. Beyond treating accidents and sickness, and implementing preventative practices, the Navy required surgeons to record increasing details

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[87] McLean, *Surgeons*, 13; Penn, "Burnett," 26; Burnett, *A Practical Account of the Mediterranean Fever, as It Appeared in the Ships and Hospitals of His Majesty's Fleet on That Station: With Cases and Dissections* (London: J. Callow, 1816); Burnett, *Official Report on the Fever Which Appeared on Board His Majesty's Ship Bann, on the Coast of Africa* (London: Burgess and Hill, 1824); Burnett, memos, Dec. 12, 1822, RNML, AL, Mss.242/1/f.154-98; Aug. 17, 1838, NA, ADM 1/3532/140-53; Oct. 7, 1845. Mss.242/4/f. 81-86; Oct. 29, 1845, Mss.242/4/f. 87-93; Nov. 8, 1845, Mss.242/4/f. 103-04; Nov. 14, 1845, Mss.242/4/f. 105-06; Nov. 21, 1845, Mss.242/4/f. 109-17; July 2, 1847, Mss.242/5/f. 30-37; Nov. 27, 1845, Mss.242/4/f. 135-54; Nov. 24, 1847, Mss.242/5/f. 177-86; Dec. 17, 1847, Mss.242/5/f. 210-11.

[88] McLean, *Surgeons*, 51-52; Penn, "Burnett," 27, and 31; Burnett, memo, May 22, 1835, NA, ADM 1/3531, f. 107. For science's bureaucratic politics, see Victualling Board to Thomas Hodgkin, Dec. 30, 1829, WL RBM, Hodgkin Papers, PP/HO/D/A1347; Burnett, memo, Aug. 16, 1847, RNML, AL, Mss.242/5/f. 82-83; W.J. Alexander, Arthur Adams & Baikie to Burnett, Sept. 20, 1852, NA, ADM 97/200/3603; Baikie to Burnett, Feb. 7, 1852, NA, ADM 97/196/4787; Herman Merivale to Burnett, Dec, 2, 1854, ADM 97/215/5397; David Lyall to Burnett, Dec. 5, 1854, ADM 97/216/5461; John Richardson to John Liddell, June 18, 1855, ADM 97/220/1803. For utilitarian benefits: McLean, *Surgeons*, 52; Burnett to Duke of Richmond, Aug. 9, 1843, WSRO, Goodwood Papers, 1651.

about their cases. Although from 1806, the Admiralty expected surgeons to keep a sick list, nosological returns, and practical journals on case histories, as expectations expanded throughout the profession, Burnett pressed to institutionalize such clinical and scientific records. In addition to demanding careful and accurate clinical records, Burnett developed a series of printed nosological forms that attempted to systematize disease classification and reporting within the Navy during the 1820s and 1830s.[89] In 1835, the Navy's instructions codified surgeons' natural scientific efforts, directing them to report on phenomena of medical or scientific use to the service and to "the scientific branches of the Profession." To reinforce these efforts, Burnett supported the creation of the Blane Gold Medal to recognize surgeons whose journals demonstrated clinical and scientific excellence.[90] Summing up, Burnett's institutional practical policies supported, encouraged, and extended empirical scientific practices.

Meanwhile, Burnett's instructions to pursue matters with practical ramifications had an immediate impact, as they spurred a sustained and broader devotion to natural scientific activity among surgeons. Climate and meteorology received emphasis due to their importance in constitutional and humoral medical theory, and the Navy's ongoing encounters with varied environments. While many surgeons had already begun to record temperatures, precipitation and sun position in earlier decades, these practices became more widespread. Burnett's policies and attempts to reward such efforts with promotions and plum postings led to a redoubling of medical officers' commitment to empirical scientific approaches. With his encouragement, surgeons also reported observations related to the geology, climate, natural history, peoples and

[89] McLean, *Surgeons*, 37-38; Lloyd, and Coulter, vol. 4, 43, and 46; Admiralty, *Instructions for Surgeons of the Royal Navy* (London, 1806), EUL CRC, GA, P.468/2, 12, and appendix no. 6; and *Regulations and Instructions* (1835), 35-36, and 73-74. For nosological forms, see also Prayer, memo, Mar. 1817, NA, ADM 105/1/10-11; Granville A.C.Stapylton, Courtenay Boyle, and Weir, memo, Oct. 23, 1822, ADM 105/10/305-08.

[90] Curtin, *Image*, 344; Curtin, "White Man's Grave," 106; Bryson, *Report*, xiii; Admiralty, *Regulations and Instructions* (1835), 40-41; Carlson, *African Fever*, 37. For the Blane Gold Medal: J.L. Coulter, *JRNMS* 46 (1960): 183-91; Anon, *TFA*, no. 27 (Jan. 1843): 12; Anon, *MTG* (May 17, 1862): 520.

goods that they encountered. Scientific remarks ranging across fields found their way into medical journals, portions of official narratives, and separate articles and accounts.[91]

Furthermore, Burnett's efforts to encourage scientific practices went beyond the previously discussed scientifically oriented institutional policies. He provided opportunities for surgeons to pursue continuing medical and scientific training. He advocated for and allowed periods of leave for many surgeons to continue their medical and scientific studies, and to earn degrees. Burnett also supported training within the Navy, including supplemental instruction in naval hospitals. From 1827, he advocated for funding for a library, museum, and lectureship in naval medicine and medical science at Haslar. These efforts helped scientifically inclined and mid-career surgeons stay abreast of changing practices and approaches in medical science.[92] While the lectures ended in the mid-1840s, naval surgeon and naturalist-explorer Sir John Richardson developed an informal school of science at Haslar Hospital. Under his tutelage, promising surgeons pursued their medical duties and scientific passions alongside each other.[93]

Furthermore, beyond the Navy, Burnett supported surgeons' engagement with medical and scientific associations and societies. Naval physician-naturalist John Richardson provides one of the prominent examples of naval surgeons' participation in British scientific life. From 1842, Richardson had assumed a leadership role as a member of the Council of the British

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[91] McLean, *Surgeons*, 38; Lloyd, and Coulter, vol. 4, 69-70; Williams, *Naturalists at Sea*, 241. For an example, see Cree's detailed journals, which served as diary, scientific log and sketchbook. They reported on phenomena of medical and scientific practice, and collected measurements of temperature, wind, weather, and position.

[92] Lloyd, and Coulter, vol. 4, 26-29; Foxhall, *Health, Medicine, and the Sea*, 70; Admiralty, *Instructions for the Royal Naval Hospitals at Haslar and Plymouth* (London: William Clowes, 1834), 68; Dr. Scott, "List of Gentlemen Attending Lectures at Haslar," 1827-40, NA, ADM 305/101. For reports on the library and lectures at Haslar, see Weir, and Burnett, memo, Feb. 25, 1825, RNML, AL, Mss.242/2/f. 98-108; Burnett, memos, Nov. 28, 1832, ADM 105/70/f.62-69; and Feb. 6, 1839, ADM 105/72/f. 73. For proposals regarding training in hospitals, see Weir, and Burnett, memo, Feb. 26, 1825, NA, ADM 105/5/no.30; Burnett, memos, Nov. 14, 1837, ADM 105/71/f.318-20; and May 31, 1845, Mss.242/4/f. 45-49.

[93] Lloyd, and Coulter, vol. 4, 29, and 72-76; McLean, *Surgeons*, 53; McIlraith, 179; Paul White, *Thomas Huxley: Making the "Man of Science"* (New York: CUP, 2003), 6-9, and 24; Baikie to Burnett, Feb. 7, 1852, NA, ADM 97/196/4787. See also Robert E. Johnson, *Sir John Richardson: Arctic Explorer, Natural Historian, Naval Surgeon* (New York: Taylor & Francis, 1976). For Huxley: Williams, *Naturalists at Sea*, 253, and 260-61.

Association for the Advancement of Science, and served as vice-president of its Zoology and Botany Section. At the 1842 meeting, he gave reports on the fish of New Zealand, a new fish species from Australia, and a diving accident resulting in what is known today as decompression sickness; he also co-authored a report on zoological nomenclature.[94] While Richardson's research contributed most significantly to zoology and the natural sciences, there were also a number of medical-related scientific fields in which surgeons became prominent figures.

Beyond Richardson's contributions, a small group of medical officers became active in the public health movement, which emerged as industrial, urban, and colonial social and health issues brought together humanitarian reformers, engineers, scientists, and doctors.[95] Over the course of the 1830s and 1840s, public health, scientific and statistical societies began to campaign for legislative and practical reforms. By the mid-to-late 1840s, they had succeeded in gaining national attention and parliamentary backing for projects that focused on planning, drainage and sewage. During this period of success, however, infighting between factions advocating engineering, medical and statistical approaches increased.[96] Drs. Alexander Bryson and James McWilliam, known for their roles in the Navy's confrontation with tropical fevers and the rise of quinine, found themselves drawn into this debate.[97] Due to their interest in epidemic disease, they both joined the Epidemiological Society of London as founding members in 1850.

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[94] British Association for the Advancement of Science, ed., *Report of the Twelfth Meeting of the BAAS Held at Manchester in June 1842* (London: John Murray, 1843), General Report: Iii, vii, x-xi, xv-xvi, and xxii-xxiii; Reports on Researches: 12-30, and 105-21; Section Reports: vi, 69-70, 84-85, and 36. For the British Association: MacLeod and Collins, *Parliament of Science*; Morrell and Thackray, *Gentlemen of Science*.

[95] For movement's development: Hamlin, *Public Health*, 2-3, 5-7, and 12; Libby Schweber, *Disciplining Statistics: Demography and Vital Statistics in France and England, 1830–1885* (Durham: Duke University Press, 2006, 112.

[96] For the growing power of the public health movement following the 1847-48 London cholera epidemics: Roy Porter, *London: A Social History* (Cambridge: HUP, 1994), 260-62; Dorothy Porter, *Health, Civilization and the State: A History of Public Health from Ancient to Modern Times* (New York: Routledge, 2005), 118-20.

[97] For McWilliam's early clinical work: McWilliam, "Exercise Book," WL, RBM, MS.6831/1; Anon, *MTG,* May 17, 1862, 520; McWilliam, to Burnett, Jan. 30, 1839, NA, ADM 97/147/351; and Feb. 20, 1839, ADM 97/147/770.

Originally organized as a forum to investigate epidemic diseases following the 1848 London cholera epidemic, the Epidemiological Society was at the heart of epidemiology's disciplinary development as it broke away from engineering-dominated public health societies.[98] It was Bryson's work on naval health and medical statistics that had pushed him toward the nascent field. Throughout the 1850s, he continued to produce high-level, clinical-scientific work on subjects ranging from insanity cases to scurvy treatments, sanitary practices and inventions within the Navy, and served as one of the Society's vice-presidents. Bryson also presented a variety of papers before the Society based on military and naval records, including an 1850 one that started a debate with John Snow over the transmission of cholera prior to Snow's famous distribution map of the 1854 cholera outbreak in Soho, London.[99] For his part, McWilliam became one of the Society's most committed members, serving as its secretary for much of the 1850s. But his research publications were also quite influential. He presented papers on yellow fever, produced a number of global panoramic reports on epidemics, and worked to develop ties between the Society, medical schools and the naval service.[100] Like many surgeons, Bryson and

[98] Peter Vinten-Johansen, Howard Brody, Nigel Paneth, Stephen Rachman, and Michael Rip, *Cholera, Chloroform, and the Science of Medicine: A Life of John Snow* (New York: OUP, 2003), 230, and 238-42; Stanley Williamson, *The Vaccination Controversy: The Rise, Reign, and Fall of Compulsory Vaccination for Smallpox* (Liverpool: LUP, 2007), 120

[99] Carlson, *African Fever,* 77-78; Wickenden, 48-51; Vinten-Johansen, *et al*., 240. Bryson, *The Lancet* 51, no. 1272 (Jan. 15, 1848): 81; Anon, *PMSJ* 15, no. 25 (Dec. 10, 1851): 688–90; Anon, *AMJ* 3, no. 135 (Aug. 3, 1855): 728–29. For Society papers: Bryson, *On the Infectious Origin and Propagation of Cholera* (London: William Tyler, 1851), esp. iii-iv; Bryson, "On the Recent Introduction of Yellow Fever into Port Royal, Jamaica," *TESL* 1 (1861): 181–87. For Bryson's Navy work, see Bryson to Burnett, Apr. 30, 1849, ADM 97/182/521; Bryson, *MT* 21 (1850): 212–214, and 435–436; Bryson to Burnett, Mar. 16, 1850, ADM 97/186/6030; Burnett, memo, July 5, 1850, ADM 97/186/5286. For Snow, cholera, and the Society: Vinten-Johansen, *et al*., 302, 318-20, 332, 337, and 346-48.

[100] R.R. Willcox, "James Ormiston McWilliam (1807–1862)," *Transactions of the Royal Society of Tropical Medicine and Hygiene* 44, no. 1 (July 1950): 139-41. For yellow fever: McWilliam, *MT*, no. 42–43 (Apr. 19, 1851): 423–26, and 448–53; Alexander Frampton to McWilliam, June 19, 1851, WL, RBM, MS.6829/3; Anon, *PMSJ* 15, no. 25 (Dec. 10, 1851): 688–90. For work as Society Secretary: McWilliam, *The Assurance Magazine* 2, no. 1 (1852): 54–56; Edward Rigley to McWilliam, May 29, 1852, WL, RBM, MS.6829/3; J.Y. Simpson to McWilliam, Feb. 8, 1853, WL, RBM, MS.6829/3; McWilliam to Burnett, Mar. 21, 1854, ADM 97/209/6096; Anon, *AMJ* 3, no. 135 (Aug. 3, 1855): 728–729; Anon, *BMJ* 1, no. 55 (Jan. 16, 1858): 55; Anon, *BMJ* 1, no. 143 (Sept. 24, 1859): 781–82; Anon, *BMJ* 1, no. 13 (Mar. 30, 1861): 344–46; Anon, *BMJ* 1, no. 15 (Apr. 13, 1861): 400.

McWilliam found that medical and scientific societies offered them forums to consider medical and scientific issues that had emerged from their practical work in the Navy.

While the rise of public health and epidemiology was one result of empirical science's institutionalization in British society and medicine, it was also interlinked with the emergence of the statistical movement. Furthermore, the rise of medical statistics was one of the significant empirical scientific developments within the Navy that fed off of and contributed to this broader environment.[101] Naval surgeons had been at the forefront of efforts to bring together descriptive and quantitative approaches from the late-eighteenth century onward.[102] Nonetheless, many practitioners resisted embracing quantification in medical practice, as the homogeneity and objectification that these methods imposed challenged their claims to liberal gentlemanly status and learned expertise. But as pathological understandings of disease became prominent, statistical approaches gradually gained acceptance within the medical profession and the naval service. The proliferation of statistics within the sciences and British society, and the rising concern with preventative medicine also drove increased quantification.[103]

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[101] For medical statistics: Headrick, *Power*, 228; Daniel Headrick, *When Information Came of Age: Technologies of Knowledge in the Age of Reason and Revolution, 1700-1850* (New York: OUP, 2000), esp. 81-89; Curtin, *Death*, 162-65; Harold Cook, "From the Scientific Revolution to the Germ Theory," in *Western Medicine: An Illustrated History*, ed. Irvine Loudon (New York: OUP, 1997), 94. For the broader movement: Carlson, *African Fevers*, 62-63; Lawrence Goldman, "Statistics and the Science of Society in Early Victorian Britain; an Intellectual Context for the General Register Office," *Social History of Medicine* 4, no. 3 (1991): 415–34; Michael J. Cullen, *The Statistical Movement in Early Victorian Britain: The Foundations of Empirical Social Research* (New York: Barnes and Nobles, 1975); Theodore M. Porter, *The Rise of Statistical Thinking, 1820-1900* (Princeton: PUP, 1986); Theodore M. Porter, *Trust in Numbers: The Pursuit of Objectivity in Science and Public Life* (Princeton: PUP, 1996).

[102] Harrison, *Medicine in an Age*, 27-28; Chakrabati, *Medicine and Empire*, 50-51; F.P. Ellis, "The Health of the Navy: The Changing Pattern," *British Journal of Industrial Medicine* 26 (1969): 190-92; Ulrich Tröhler, "Quantification in British Medicine and Surgery, 1750-1830: With Special Reference to Its Introduction Into Therapeutics," (PhD diss.; University of London, 1978), esp. 40-54, and ch. 4. For early examples, see Gilbert Blane, "Statements of the Comparative Health of the British Navy, from the Year 1779 to the Year 1814," *M-CT* 6 (1815): esp. 539-47; Gilbert Blaine, *A Brief Statement of the Progressive Improvement of the Health of the Royal Navy, at the End of the Eighteenth and Beginning of the Nineteenth Century* (London: W. Nicol, 1830).

[103] For these shifts, see *op cit.* footnote 102, and also Carlson, *African Fever*, 68; Gerd Gigerenzer and Zeno Swijtink, *The Empire of Chance: How Probability Changed Science and Everyday Life* (New York: CUP, 1990); 46.

The relatively early adoption of, and improvements to statistical reporting practices in the form of nosological returns within the Army and Navy beginning in the 1790s served as the foundation for large-scale medical statistical projects from the mid-1830s onward.[104] Captain Alexander Tulloch, a young army officer who had studied mathematics at the Royal Military College, was the leading figure behind these later efforts. In 1835, the Secretary of War and army officials assigned him to conduct an empire-wide analysis of army health and mortality based on his earlier study of mortality among soldiers in India. From 1835 to 1840, Tulloch prepared statistical reports through analysis of Army medical and nosological returns for stations ranging from the West Indies and West Africa to the Mediterranean and Britain.[105] He analyzed each sub-station and class of disease based on the geographic, climatic, social and ethnic/racial factors that might influence health and mortality. While imprecise nosological systems and collection practices partially undermined the precision of his results, his approach yielded generally accurate findings that focused attention on issues tied to hygiene and disease.[106]

The Navy followed the Army's lead in commissioning statistical reports based on surgeons' journals and returns. These efforts came at the behest of Burnett who proposed a similar project after learning of the Army's program. He stated that, "it will require much, and attentive professional research to render it [a naval project], on the same plan as that adopted by the Army" given the large number of separate ships, commands and records. Nonetheless, Burnett argued for the potential importance of such efforts, writing "that neither trouble,

[104] Carlson, *African Fever*, xvii, and 17; Burnett and Weir, memo, Jan. 20, 1823, ADM 105/11/40-43.
[105] Cullen, *Statistical Movement*, 46-47; Carlson, *African Fever*, 64-65; Curtin, *Image*, 344; Lucile H. Brockway, *Science and Colonial Expansion: The Role of the British Royal Botanic Gardens* (New Haven: YUP, 2002), 129; Philip D. Curtin, "Epidemiology and the Slave Trade," *Political Science Quarterly* 83, no. 2 (1968): 203; Anon, *United Service Magazine*, no 2 (July 1864): 405-06.
[106] Cullen, *Statistical Movement*, 47-50; Carlson, *African Fever*, 65. For the earliest report: Henry Marshall, and Alexander M. Tulloch, "Statistical Report on the Sickness, Mortality, & Invaliding among the Troops in the West Indies," *PP*, 1837-38(138): xl, 417, esp. p. iii-v.

attention, or labour, shall be spared to render the Naval Report as full and satisfactory as possible, should they [the Lords Commissioners] think it proper to authorize."[107] After receiving the Admiralty's approval, he appointed experienced naval surgeon-scientist and Edinburgh graduate Dr. John Wilson to prepare statistical station reports for the years 1830-36. It took Wilson five years to prepare two detailed reports that were largely outdated when completed in the early 1840s.[108] Despite his limited progress, Wilson's initial efforts allowed Bryson to more seamlessly and successfully conduct his follow-up statistical studies during the late-1840s.

While Tulloch continued the Army's statistical project through the 1840s, there was a gap of eight years between Wilson's initial reports and the next such efforts within the Navy. As alluded to earlier, Alexander Bryson became the Navy's statistical authority as he prepared an 1847 Admiralty report on the African Squadron's health based on analysis of medical records and practices.[109] After he completed that assignment, Burnett assigned him to resume Wilson's work. Bryson completed his first reports on the health of sailors on the South American, West Indian, and Mediterranean stations from 1837-43 after two years of intense research. His more sophisticated comparative approach, which took advantage of new techniques, systematized compilation-based quantification within the Medical Department. Bryson remained the Navy's medical statistician through the mid-1850s, becoming a respected authority figure.[110]

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[107] Carlson, *African Fever*, 67-68; Harrison, "Important Subject'," 112-13; Burnett, memos, June 28, 1836, NA, ADM 105/71/f.92-95; and July 11, 1836, ADM 105/71/f.97-102; Wilson to Burnett, Apr. 28, 1835, ADM 97/138/357.

[108] Wilson joined the Navy in 1798. He returned to Edinburgh for his degree from 1822-25, taking Medical Practice and Theory, Anatomy & Surgery, Chemistry, Materia Medica, and Botany. He graduated in 1826 with a dissertation "On Syphilis." See Ellis, 192; Cullen, *Statistical Movement*, 50-52; Thomas Troubridge, and Wilson, "Statistical Reports on the Health of the Navy, for the Years 1830-36. Part I." *PP*, 1840(159): xxx, 367; and "Statistical Reports on the Health of the Navy, for the Years 1830-36. Part II." *PP*, 1841 Session 2 (53): vi, 246; Anon, *Lancet* 30, no. 769 (May 26, 1838): 308-09; and 34, no. 885 (Aug. 15, 1840), 755. For training: University of Edinburgh, "General and Medical Class Lists," EUA/IN1/STA/3, vols. 1822-1825; University of Edinburgh, *List of Graduates*, 80.

[109] Carlson, *African Fever*, 69-70, and 75-76; Gelfand, *Rivers*, 57-59; Cullen, *Statistical Movement*, 52.

[110] Wickenden, 48-49; Lloyd, and Coulter, vol. 4, 8-9; Burnett, memo, Nov. 24, 1847, ADM 97/174/4455; Bryson, "Statistical Reports on the Health of the Navy for the Years 1837-1843. Part I." *PP*, 1849(436): xxxii, 281. For

Nonetheless, the Admiralty's recognition of Bryson as an expert after only a few years engaged in statistical work illustrates the nascent nature of these efforts, and the importance of data collection and analysis to the rapid rise of natural and medical science. Beyond the statistical reports, one of the Navy's most significant scientific projects during the 1840s was the preparation of a manual on scientific observation for naval officers. The Admiralty solicited famed scientist and astronomer Sir John Herschel to coordinate the project. Herschel convinced leading scientists to contribute sections; among the contributors were Charles Darwin on geology, William Hooker on botany, Richard Owen on zoology, and James Cowles Pritchard on ethnography. With the Admiralty's input, Bryson also wrote a piece on medical observation, reporting and statistics. The *Manual of Scientific Enquiry* became a mainstay of naval, colonial and British science, going through three editions between 1849 and 1871, which included versions of Bryson's contribution.[111] The Admiralty's efforts to encourage the broader use of empirical scientific practices reflected their proliferation within naval medicine.

Beyond these empirical scientific efforts, the "newly confident naval culture of scientific and medical experimentation" that emerged after the Napoleonic Wars, which Katherine Foxhall has highlighted, represents the fruit of the institutionalization of these approaches. While the Navy had a long tradition of medical and victualling trials, these had relied on the aegis of individual surgeons and officials. The efforts that produced favorable support, such as James

continued statistical work: Burnett, memo, May 15, 1849, ADM 97/182/806; Burnett, memo, May 15, 1849, RNM, AL, Mss.242/6/f. 189; Anon, *MT* 22, no. 2 (July 13, 1850): 38–39; Anon, *BFM-CR* 6 (Oct. 1850): 361–373; Bryson, "Statistical Reports on the Health of the Navy for the Years 1837-1843. Part II," *PP*, 1852-53(555): lxi, 533; Bryson, "Statistical Reports on the Health of the Navy for the Years 1837-1843. Part III," *PP*, 1854(505): lxviii, 9; Anon, *AJMS* 28, no. 55 (1854): 179–184; Anon, *BFM-CR* 16, no. 31 (July 1855): 52–62.

[111] Wickenden, 48; Carlson, *African Fever*, 76-77; Lloyd, and Coulter, vol. 4, 80; Yeo, "Scientific Method," 266; Drayton, *Nature's Government*, 183; Herschel, *Manual of Scientific Enquiry*, iii-xi; Bryson, "Medicine and Medical Statistics," in *Manual*, 445-64. For the 1871 edition: Bryson, "Medicine and Medical Statistics," in *Manual of Scientific Enquiry*, ed. John Frederick William Herschel, 3rd ed. (London: J. Murray, 1871), 445-64.

Lind's lemon juice trials to combat scurvy, did so despite sporadic official support.[112] By the 1820s and 1830s, Burnett and Admiralty officials had begun to develop a system for streamlining and systematizing trials of new inventions and apothecarials on ships and in hospitals. The potential for utilitarian solutions underlay their empirical scientific efforts, which brought some order to the easily abused process whereby inventors, scientists, and surgeons submitted proposals, prototypes, and samples to nearly a dozen Admiralty boards and departments. Through the mid-nineteenth century, the medical service mobilized surgeons in organized trials and experiments that tested preventative medical measures, surgical inventions and therapeutic concoctions.[113]

The testing of machine apparatuses and chemical concoctions designed to ventilate and fumigate ships, and distill water dominated naval medical trials during the early nineteenth century. Many surgeons believed that these efforts would lead to a preventative medical breakthrough since poor air and water were seen as sources of disease. While the dream of turning large amounts of saltwater into fresh remained elusive, naval trials contributed to advances in ventilation, disinfection and fumigation. The rising clinical scientific skills that

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[112] Foxhall, *Health, Medicine, and the Sea*, 70. See the celebration of Lind's efforts in David I. Harvie, *Limeys: The True Story of One Man's War Against Ignorance, the Establishment and the Deadly Scurvy* (Stroud: Sutton, 2002).

[113] McLean, *Surgeons*, 13; Penn, "Burnett," 18-19; Foxhall, *Health, Medicine, and the Sea*, 70-73, and 142. For preventative measures, hygiene and diet: Burnett, memo, July 30, 1832, NA, ADM 105/70/f. 4-6; Robert Armstrong & William Rae to Burnett, Aug. 30, 1836, ADM 97/141/2271. James Henderson to Burnett, Sept. 8, 1836, ADM 97/141/2272; Burnett, memos, Sept. 10, 1836, ADM 105/71/f. 125-26; Oct. 22, 1836, ADM 105/71/f.127-39; Aug.10, 1838, ADM 105/72/f.17-18; Aug. 29, 1839, ADM 105/72/f.169-71; and Mar. 16, 1849, RNML, AL, Mss.242/6/f. 125-27. For surgical inventions: Burnett, memo, Dec. 4, 1835, ADM 105/70/f.435-37; D.J. Werthumber to Burnett, June 5, 1848, ADM 97/176/1066; Charles R. Brien to Burnett, Feb. 4, 1849, ADM 97/175/6949; Burnett to John Drummond, Feb. 18, 1849, ADM 97/181/5655; Owen Evans to Burnett, Mar. 20, 1849, ADM 97/181/6201; John Drummond to Burnett, Aug. 1, 1849, ADM 97/183/2250; John Richardson to Burnett, Feb. 7, 1851, ADM 97/190/4856; Owen Brown to John Liddell, May 7, 1855, ADM 97/219/880; James Scott to John Liddell, Oct. 2, 1855, ADM 97/222/3910. For therapeutic concoctions: Matthew Byers to Burnett, July 4, 1842, ADM 97/156/1625; Byers, and Dr. Warbury to Burnett, July 30, 1842, ADM 97/156/1778; J.E. Goodridge to Burnett, June 15, 1843, ADM 97/159/1693; Bryson to Burnett, Dec. 20, 1843, ADM 97/158/1268; Alexander E. Mackay to Burnett, Mar. 20, 1849, ADM 97/181/6222; S.A. Hayes to Burnett, Oct. 1850, ADM 97/190/3645; William Crawford to Burnett, Dec. 20, 1850, ADM 97/190/4117.

medical officers brought into the Navy due to the reforms that occurred in British medical training made sophisticated and coordinated scientific efforts within the Navy possible. Surgeons' expertise was also vital to these efforts. Their experience and shared skills allowed them to judge the efficacy of inventions, concoctions or practices by comparing them to previous efforts to address these issues.[114] This approach worked best for large-scale trials of practices that showed promise in initial smaller-scale trials. Nonetheless, the personal financial fortune that Burnett amassed by convincing the Admiralty to adopt his proprietary solution of zinc chloride as a disinfectant demonstrates the institutional politics that remained at play.[115]

While the Navy developed this structure for clinical trials based on accepted training and practices, the Medical Department only organized a few experimental trials that can be seen as meeting the treatment-control protocols that later came to dominate laboratory and experimental practice. One exception was Burnett and Bryson's efforts during clinical trials responding to the reemergence of scurvy on Australia-bound convict ships following the government's ideological and economic decision to reduce rations and lemon juice supplies in the early 1830s. Empirical

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[114] Foxhall, *Health, Medicine, and the Sea*, 67-70. For proposals, trials, and reports related to fumigation and ventilation: Frances Stanley to Burnett, Aug. 8, 1833, NA, ADM 97/135/2793; Wilson to Burnett, Apr. 28, 1835, NA ADM 97/138/357; Charles Priaulx to Burnett, Nov. 21, 1839, NA, ADM 97/148/2893; G.E. Trevelyan to Burnett, Feb. 1, 1841, NA, ADM 97/151/3699; John Gorrie to Burnett, July 12, 1842, NA, ADM 97/156/1775; Burnett, memos, Aug. 10, 1842, NA, ADM 105/73/f.140-141; Nov. 29, 1844, ADM 105/73/f.500; Oct. 27, 1845, RNML, AL, Mss.242/4/f. 79; Oct. 30, 1845, Mss.242/4/f. 94; Feb. 19, 1846, ADM 97/166/4719; and Mar. 14, 1851, ADM 97/191/5523; J. McWhinnie to Burnett, Sept. 2, 1851, ADM 97/194/2622. For the distillation of fresh water: Rusty Peyre, Charles Clark, and John Sterling to Burnett, Dec. 21, 1841, ADM 97/151/3178; Charles Clark to Burnett, Sept. 5, 1843, ADM 97/159/2224; Apr. 7, 1845, ADM 97/164/94; and Apr. 23, 1845, ADM 97/163/308; F.A. Collier to Burnett, May 9, 1845, ADM 97/163/540; Burnett, memos, Oct. 26, 1844, ADM 105/73/f.479-81; May 28, 1845, Mss.242/4/f. 38-44; July 19, 1848, Mss.242/5/f. 404-09; and July 5, 1850, ADM 97/186/5286; Alfred Bird to Burnett, July 7, 1850, ADM 97/188/1487; Principal Medical Officers of Haslar Hospital to Burnett, Aug. 25, 1850, ADM 97/188/2283. For tests on water quality: Burnett to William Gardner, Jan. 8, 1840, NA, ADM 97/149/3558; Burnett, memos, Nov. 20, 1840, ADM 97/151/2800; and Feb. 25, 1842, ADM 105/73/f.84-85; Daniell to Burnett, Oct. 21, 1843, ADM 97/159/2827; and May 9, 1844, ADM 97/161/484; Vice Admiral Austen to Burnett, June 10, 1845, ADM 97/163/1573; Archibald Sibbald to Burnett, Mar. 20, 1852, ADM 97/196/5559.

[115] Burnett marketed his own zinc chloride solution for fumigation after he had ordered one of his naval surgeons, Thomas Stratton, to trial it in hospitals in Lower Canada. He became the equivalent of a millionaire off of his concoction. There was bitter distaste in medical and naval circles, as some believed that Burnett had abused his position. See David McLean, "Protecting Wood and Killing Germs: 'Burnett's Liquid' and the Origins of the Preservative and Disinfectant Industries in Early Victorian Britain," *Business History* 52, no. 2 (2010): 285-96.

trials of lime juice, citric acid, and nitrous vinegar began as individual efforts conducted by scientifically skilled surgeons. These trials became more organized and their pace accelerated after 1839, when Burnett ordered official therapeutic trials using convicts as test subjects.

This scurvy treatment trial became one of the largest naval medical experiments of the nineteenth-century. Between 1840 and 1844, sixty convict ship surgeons tested and compared the therapeutic and prophylactic effects of lemon or lime juice, citric acid, and nitrate of potash.[116] Katherine Foxhall, who has analyzed this episode at length, found that Burnett envisioned dividing the convicts into three treatment groups with standardized external conditions. While his orders embraced the newest scientific approaches, they did not materialize in practice. Many of surgeons deviated from the protocol due to a mixture of differing clinical and ethical views, disagreements over scientific protocol, and outright laziness. This breakdown of standardization resulted in trials of varying design and sophistication, but illustrates the detailed debates occurring in regard to scientific practices. Burnett's instructions also contributed to the variation among surgeons, as they did not standardize the dosage or timing for administering the treatments. As Foxhall reported, this made interpreting and comparing the results difficult.[117]

Alexander Bryson conducted one of the most scientifically rigorous scurvy treatment trials during his service on the *Marquis of Hastings*. His journal demonstrates that he expanded on Burnett's instructions related to dividing patients into treatment groups by introducing multiple extra steps into the protocol to address experimental and evidentiary issues. Bryson withheld the standard daily allowance of lemon juice to make sure that the experiment was not "embarrassed by any previous exhibition of either of the proposed treatments" or the possibility

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[116] Foxhall, *Health, Medicine, and the Sea*, 134-138; Foxhall, "From Convicts," 8-9. See Burnett, "Report on Scurvy," c. 1844, NA, ADM 105/36, quoted in Foxhall, *Health, Medicine, and the Sea*, 138.
[117] Foxhall, *Health, Medicine, and the Sea*, 139-140; Foxhall, "From Convicts," 9.

of lemon juice's influence being "lost in some degree from long use." Applying clinical pathological practices, Bryson also attempted to identify scorbutic symptoms as early as possible to militate potential ethnical objections. He recorded his observations on convicts' baseline health during his initial intake examinations, so he could recognize early symptoms of scurvy in convicts' mouths and eyes during daily inspections. Bryson believed that this step would also reduce the effect of variations in the timing of administering treatments.[118]

His most substantial variation on the experimental protocol brought together these considerations of evidence, design, and ethics. Bryson abandoned nitrate of potash once he had observed its deleterious clinical effects, but made sure to provide a convincing scientific justification for his actions. While he knew that this decision could potentially skew the trial's results, Bryson stated that he "persisted until the severity of the symptoms [reactions] compelled me in humanity to resort to a less equivocal plan of treatment." He also justified this decision, stating that he only abandoned potash once he "had already obtained sufficient evidence" of its ineffectiveness and deleteriousness. From that point on, he redesigned the trial, changing over to a two treatment-group design that allowed him to collect new observations and evidence on lemon juice and citric acid. This represented a separate experiment, the results of which could be compared to those from the original trial.[119] As this example begins to illustrate, Bryson critically embraced, applied, and refined the empirical scientific practices that he had learned at Glasgow during his years of naval medical practice. He represents the ideal naval surgeon of this period.

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[118] Bryson, ADM 101/50/6, f. 16-28, esp. 26; Foxhall, *Health, Medicine, and the Sea*, 140, and "From Convicts," 9.
[119] Bryson, ADM 101/50/6, f. 27-28.

4.5 NAVAL MEDICINE AND THE PROLIFERATION OF EMPIRICAL SCIENCE

The Royal Navy was one of several significant British national institutions that developed empirical medical and natural scientific practices into an organized program during the first half of the nineteenth century. Its central role in supporting and operationalizing Britain's commitment to antislavery, penal transportation, free trade, and imperial policies made medical scientific practices and innovation crucial to meeting these missions. Based on utilitarian strategic and practical considerations, the Naval Medical Department and Admiralty developed institutional policies that supported medical and natural scientific activities. From the 1820s through the early 1850s, Medical Director-General Burnett was one of the chief advocates encouraging, supporting, and directing medical and natural scientific efforts within naval medicine. The changes that Burnett and the Lords Commissioners made to surgeons' instructions and duties, and their development of a structured approach to medical and scientific clinical trials especially helped to systematize scientific efforts within naval medicine.

While these institutional developments have been the focus of analyses in their own right, surgeons' individual and collective scientific efforts have been less explored beyond the cases of a handful of well-known individuals. Facing the unfavorable and demanding conditions and practical necessities of nineteenth-century naval service and operations, surgeons employed empirical-analytical approaches that they had learned during their increasingly practical medical and scientific training. While increasingly scientific training provided surgeons with the requisite practical foundation, skills and worldview, naval service's cosmopolitan environment helped to ensure that they applied and refined medical and natural scientific practices. Furthermore, the rapidly professionalizing medical service built part of its recruiting criteria around the scientific opportunities offered by encounters with far-away areas of the world so as to attract surgeons with comparable medical and scientific qualifications to the rest of the profession. One of this chapter's key arguments is thus that surgeons' individual initiative and practices were one of the foundations for the development, legitimization, and systematization of medical and natural science in practice, organization, and culture within the Navy during the early-to-mid nineteenth century. Nonetheless, these developments emerged within the medical ranks at the same time that the Admiralty began to adopt institutional-level scientific policies.

The symbiotic relationship among surgeons' own interests, experiences and practices, the opportunities and challenges that came with naval service, and the Admiralty's material needs played a key role in these individual, collective and institutional developments. Surgeons' efforts coincided with and fed off of the medical service's and Navy's bureaucratic policies and orders, and professional and societal-level scientific developments in a multifactorial process that contributed to the systematization of scientific practices. As various studies have shown, similar processes occurred throughout naval, colonial, and British science during the early-to-mid nineteenth century.[120] While much of the scholarship on scientific activity and practices within the Navy has focused on exploration, hydrography, and steamships, this chapter demonstrates the key role that naval medicine played in the emergence of naval and colonial scientific practices.[121]

This chapter has also argued that shared medical and natural scientific approaches were one of critical but often underemphasized factors underlying early-nineteenth-century science.

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[120] See multiple chapters from Cahan, *From Natural Philosophy to the Sciences*; Drayton, *Nature's Government*. For the underlying philosophy of improvement that emerged, see Roy M. MacLeod, ed., *The "Creed of Science" in Victorian England* (Burlington, VT: Ashgate/Variorum, 2000).

[121] Rodger, "Navies and the Enlightenment," 5–23; Randolph Cock, "Rear-Admiral Sir Francis Beaufort, RN, RFS: 'The Authorized Organ of Scientific Communication in England', 1829-1855," in *Science and the French and British Navies, 1700-1850*, ed. Pieter Van der Merwe (London: NMM, 2003), 99–116; John Gascoigne, "Joseph Banks and the Expansion of Empire," in *Science and Exploration in the Pacific: European Voyages to the Southern Oceans in the Eighteenth Century*, ed. Margarette Lincoln (Woodbridge: Boydell Press, 1998), 39–54; John Gascoigne, *Science in the Service of Empire: Joseph Banks, the British State and the Uses of Science in the Age of Revolution* (New York: CUP, 1998); Don Leggett and Richard Dunn, eds., *Re-Inventing the Ship: Science, Technology and the Maritime World, 1800-1918* (Burlington, VT: Ashgate, 2012).

Scientific fields became increasingly specialized and professionalized, and more sophisticated practices of measurement, experimentation and quantification developed. Nonetheless, empirical-analytical scientific approaches remained common conceptual and methodological foundations across the natural, medical and social sciences. For nineteenth-century British medicine specifically, this process illuminates the empirical foundation of clinical scientific medicine as it developed in both colonial and domestic practice. This resulted in a gradual and uneven Kuhnian breakdown of the neo-humoral system. Beyond advances in preventative medicine, however, these approaches produced few significant therapeutic breakthroughs. Moderation in the use of antiphlogistics and other treatments represented a gradual and incomplete shift. More fundamental changes occurred after germ theory gave rise to a viable alternative theoretical and practical system.

As previously alluded to, the proliferation of quinine within British naval and colonial medicine is perhaps the most notable exception to this trend. This dissertation culminates with a two-chapter case study of naval surgeons' efforts to confront tropical fevers in and off the coast of West Africa. The coming chapters investigate the changes in medical and strategic thought and approaches that allowed surgeons to gradually transform practices related to fevers, and in the end to more widely employ quinine. This focused case study connects these developments to the educational, institutional, demographic, professional, and practical contexts analyzed in the last three chapters, particularly the rise of empirical science.

5.0 NAVIGATING THE “WHITE MAN’S GRAVE”: THE MATERIAL CONTEXTS OF NAVAL MEDICAL PRACTICE IN WEST AFRICA, 1815-1838

By 1800, West Africa had developed a deadly reputation among British and European sailors and captains, as many had faced its tropical climate and virulent fevers as participants in the Atlantic slave trade. The refined representation of West Africa as the “White Man’s Grave,” however, only gained widespread and public acceptance during the 1820s and 1830s. As British colonial and naval activity in and off the coast of West Africa increased in the early nineteenth century, daunting mortality rates continued unabated, and West Africa’s reputation as the “White Man’s Grave” grew.[1] Despite this reality, Britain’s antislavery, commercial, exploratory and civilizing missions ensured that activity in the region continued. In these circumstances, surgeons confronted the “White Man’s Grave” and the Atlantic slave trade’s continuing horrors on the West African Squadron. They embraced the hardened, duty-first approach expected of them, led sustained practical efforts to respond to and make sense of the desperate situations that emerged during fever outbreaks, and adopted a positivist outlook that diverged from the pessimistic views of many lay actors.[2] Although surgeons’ practical efforts culminated in quinine’s proliferation, before that occurred they tried numerous strategies to ameliorate, cure or prevent fevers.

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[1] Philip D. Curtin, “‘The White Man’s Grave:’ Image and Reality, 1780-1850,” *Journal of British Studies* 1, no. 1 (Nov. 1, 1961): 94-110. For the morality of slave trade captains and sailors, see Emma Christopher, *Slave Trade Sailors and Their Captive Cargoes, 1730-1807* (New York: CUP, 2006), 143-44, and 205-07; Marcus Rediker, *The Slave Ship: A Human History* (New York: Viking, 2007), 197-98; Stephen D. Behrendt, “Crew Mortality in the Transatlantic Slave Trade in the Eighteenth Century,” *Slavery & Abolition* 18, no. 1 (1997): 53-58.

[2] Some of the horrors of the slave trade grew as the British attempted to suppress it in the early nineteenth century. David Eltis, *Economic Growth and the Ending of the Transatlantic Slave Trade* (New York: OUP, 1987), 136-38,

While a few works have begun to analyze naval surgeons' personal and practical experiences, most narratives of their medical work on the African Squadron have focused on the rise of quinine, foreshadowing its use as a tool of European imperialism.[3] Scholars' focus on quinine and the decline of European mortality in Africa as a "triumph of empiricism," however, has risked portraying it as inevitable.[4] Works that rely primarily on morality rates have also understated the sheer desperation wrought by tropical fevers, and the relative practical helplessness of practitioners' responses through the 1830s. The following case study contends that the African Squadron's material conditions and experience, its imperial, antislavery and commercial strategies, and practical and theoretical medical developments combined to steer many naval surgeons toward new empirical scientific approaches to this mortal threat. Surgeons adopted such practices as they desperately confronted the grim reality of tropical diseases.

In analyzing surgeons' working and practical experiences, and their convergence with material, imperial and practical contexts through the late 1830s, this chapter sheds new light on the process by which surgeons began to apply observation-based scientific approaches. Over the course of several decades, their efforts gradually transformed tropical medicine. Nonetheless, the course of this development was not inevitable. Both logistical problems and the staying power of existing theoretical explanations limited the practical progress that occurred in the 1820s and 1830s. The contingent process through which surgeons applied empirical practices in the 1820s

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and 265-58. For increased mortality following abolition: Marika Sherwood, *After Abolition: Britain and the Slave Trade Since 1807* (New York: I.B. Taurus, 2007), 114. For the mindset of naval surgeons and African service: Padraic Xavier Scanlan, "'A Bloody War or a Sickly Season': The Remains of a Middling British Imperialist in Early Colonial Sierra Leone," *Essays in History* 45 (2011), http://www.essaysinhistory.com/articles/2011/29.

[3] Curtin, *Image*, 243-62; Headrick, *Tools*, ch. 3; Carlson, *African Fever, passim*. For the new work: see Harrison, "Important Subject," 108-26.

[4] Some authors focused on empire and medicine have put adopted a general narrative of triumph, while others have begun to question quinine's primacy. Curtin, *Image*, 226; Headrick, *Power*, 226; Deborah Brunton, *Medicine Transformed: Health, Disease and Society in Europe 1800-1930* (Manchester: MUP, 2004), 225. For the "mortality revolution": Philip D. Curtin, *Death by Migration: Europe's Encounter with the Tropical World in the Nineteenth Century* (New York: CUP, 1989), 40-61, and 104-29. For questioning, see Harrison, "Important Subject," 118.

and 1830s, however, set the foundation for the developments that led to quinine's increasing adoption in the 1840s.[5] This focused investigation also explores how the practical and professional dynamics related to naval medicine discussed in the first half of this dissertation played out at sea. Surgeons' authority within the Navy, the practical utility of their duties to its broader mission, and ongoing practical, theoretical, and methodological debates within British and naval medicine had significant and often life-and-death ramifications related to surgeons' ongoing confrontations with tropical fevers. This chapter begins by exploring the dangers of tropical disease and fevers, and naval surgeons' changing responses to this reality as British naval and imperial activity in West Africa continued to expanded in the early nineteenth century.

5.1 THE UNDERSTANDING OF BRITISH MORTALITY, 1790-1823

During the eighteenth century, tropical Africa's reputation for being deadly had spread among many British surgeons, sailors, soldiers, merchants, and slave traders.[6] By the 1790s, several variants of the sea shanty "Beware and take care of the Bight of Benin / For one that comes out, there are forty go in" were commonplace among British sailors.[7] This layman's knowledge slowly received medical and scientific backing. According to Mark Harrison, knowledge related to tropical disease increased as military and naval surgeons gained experience in India and the West Indies, and applied observational, clinical and anatomical methods to the

[5] For 18th and early-19th century West Indies and India: Harrison, *Medicine in an Age*, esp. parts I and II.
[6] Curtin, "'White Man's Grave:' Image and Reality," 95, and 98. For merchants, see Christopher Leslie Brown, "Empire Without America: British Plans for Africa in the Era of the American Revolution," in *Abolitionism and Imperialism in Britain, Africa, and the Atlantic*, ed. Derek R. Peterson (Athens: Ohio University Press, 2010), 87. For slave trade, see Christopher, 143-44, and 205-07; Rediker, *The Slave Ship*, 197-98; Behrendt, 53-58.
[7] For this version: Christopher Lloyd, *The Navy and the Slave Trade*, 2nd ed. (1948; London: Cass, 1968), 19; Marcus Rediker, *Between the Devil and the Deep Blue Sea: Merchant Seamen, Pirates and the Anglo-American Maritime World, 1700-1750*, paperback ed. (New York: CUP 1989), 47.

challenges that they faced. Nevertheless, much of the knowledge related to West African disease and mortality remained tied to the slave trade. Furthermore, it was also not sufficiently precise to accurately define West Africa's deadliness at a broader, collective scale.[8]

It was as British activity increased from the 1790s onward that a broader understanding of West Africa as a deadly region developed. During the French Wars, activity in the tropics connected to military, imperial, exploratory, commercial, anti-slave-trade, and antislavery interests expanded.[9] As a result, soldiers, sailors, merchants, and explorers died of malaria, yellow fever and dysentery in startlingly high numbers. For example, the British lost 12,700 of 20,200 troops during their campaign in St. Domingue, while 49% of the Europeans who settled in Sierra Leone in 1791 perished.[10] Disastrous African exploratory expeditions, such as Mungo Park's 1805 expedition, confirmed this reality.[11] Abolitionists' use of the continuing mortality of sailors against the slave trade also added to the image.[12]

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[8] Harrison, *Medicine in an Age*, 207-08, and 287-91. For slave trade generally: Rediker, *The Slave Ship*, 197-98, 271-72, and 273-76; Sowande Mustakeem, "'I Never Have Such a Sickly Ship Before': Diet, Disease, and Mortality in 18th-Century Atlantic Slaving Voyages." *Journal of African American History* 93 (2008): 478-490. For precision and statistics: Curtin, Image, 71; Headrick, *Tools*, 62; Headrick, *Power*, 228.

[9] Mary Wills, "The Royal Navy and the Suppression of the Atlantic Slave Trade, c. 1807-1867: Anti-Slavery, Empire and Identity," (PhD Thesis, University of Hull, 2012), 29-30, and 43. For the intersection of these factors in Africa, see Christopher L. Brown, *Moral Capital: Foundations of British Abolitionism* (Chapel Hill: University of North Carolina Press, 2006), chs. 5-6, and 314-330; Philip Morgan, "Ending the Slave Trade: A Caribbean and Atlantic Context," in *Abolitionism and Imperialism in Britain, Africa, and the Atlantic*, 110-112. For legitimate commerce: Christopher Leslie Brown, "The Origins of 'Legitimate Commerce'," in *Commercial Agriculture, the Slave Trade, and Slavery in Atlantic Africa*, eds. Robin Law, Suzanne Schwartz, and Silke Strickrod (Rochester: Boydell & Brewer, 2013), esp. 138-140, and 154-155. For exploration, Gascoigne, "Joseph Banks," 42-44.

[10] Curtin, *Image*, 484; For St. Domingue, see David Geggus, "Yellow Fever in the 1790s: The British Army in Occupied Saint Domingue," *Medical History* 23, no. 1 (Jan. 1979), 44-48, esp. 48; J.R. McNeill, *Mosquito Empires: Ecology and War in the Greater Caribbean, 1620-1914* (New York: CUP, 2010), 244-48. For Sierra Leone: Sierra Leone Company, *An Account of the Colony of Sierra Leone from Its First Establishment in 1793* (London: The Company, 1795), 47-49; Seymour Drescher, *The Mighty Experiment: Free Labor Versus Slavery in British Emancipation* (New York: OUP, 2002), 93, and 99-100.

[11] Heather J. Hoag, *Developing the Rivers of East and West Africa: An Environmental History* (New York: Bloomsbury Academic, 2013), 71-72; Mungo Park, *The Journal of a Mission to the Interior of Africa, in the Year 1805*, 2nd ed. (London: J. Murray, 1815), esp. 176-77, 199-201, 230-31, and 270-72.

[12] Behrendt, 55; Drescher, Mighty Experiment, 99; Richard H. Steckel and Richard A. Jensen, "New Evidence on the Causes of Slave and Crew Mortality in the Atlantic Slave Trade," *The Journal of Economic History* 46, no. 1 (1986): 57, and 61-63. For general situation: Curtin, *Disease*, 3.

In spite of the emerging view of the tropics as diseased and deadly, British activity in West Africa further expanded following the Napoleonic Wars. A range of imperial, legitimate commercial, humanitarian and evangelical impulses led to this further increased presence there. Abolitionists, merchants, missionaries and government officials' goals of suppressing the slave trade, promoting commerce, improving Africa, and gaining new geographical and scientific knowledge all served as impetuses for activity in the region. One commonality was that their commitments often downplayed or overrode the risk of disease and death.[13]

These factors first coalesced in British policy in the Sierra Leone Colony. From 1791, the goals of improving England's poor black populations and challenging the slave trade through commerce, civilization, and Christianity underlay the commitment of antislavery, humanitarian and commercial interests to Sierra Leone.[14] The colony's antislavery agenda gained momentum as the Sierra Leone Company proved economically unviable and the government consequently took control in 1807. By the 1810s and 1820s, Sierra Leone had become a space in which colonial officials, abolitionists, missionaries and merchants tested and debated different strategies based on their own goals and interests.[15]

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[13] Some sources on these various interests: Curtin, *Disease*, 2-3; Wills, 29; M.J. Turner, "The Limits of Abolition: Government, Saints and the 'African Question', c. 1780-1820," *The English Historical Review* 112, no. 446 (Apr. 1, 1997): 319-321. For evangelicalism: Roger Ansley, *The Atlantic Slave Trade and British Abolition, 1760*-1810 (Atlantic Highlands, NJ: Humanities Press, 1975), 184-193. For humanitarianism: Zoë Laidlaw, "Investigating Empire: Humanitarians, Reform and the Commission of Eastern Inquiry," *Journal of Imperial & Commonwealth History* 40, no. 5 (Dec. 15, 2012): esp. 749–750, and 752-753. On debate over risk of mortality: Drescher, *Mighty Experiment*, 99-100.

[14] For the term "commerce, civilization, and Christianity": Wills, 29; Turner, "Limits," 322, and 326-327; Andrew Porter, "'Commerce and Christianity': The Rise and Fall of a Nineteenth-Century Missionary Slogan," *The Historical Journal* 28, no. 3 (Sept. 1, 1985): 599-600, and 606-08. See also Everill, *Abolition*, 18-19; Brown, *Moral Capital*, 262-63, 279, 294-95, and 314-15; Suzanne Schwarz, "Commerce, Civilization, and Christianity: The Development of the Sierra Leone Company," in *Liverpool and Transatlantic Slavery*, eds. David Richardson, Suzanne Schwarz, and Anthony Tibbles (Liverpool: LUP, 2007), 265-76.

[15] Drescher, *Mighty Experiment*, 93-96; Everill, *Abolition*, 19-22, and 81; Turner, "Limits," 328-332, and 354; Seymour Drescher, "Emperors of the World: British Abolition and Imperialism," in *Abolitionism and Imperialism in Britain, Africa, and the Atlantic*, 136-138. For the forces involved in Sierra Leone as a colony, see Turner, "Limits," 334-353.

From the 1790s onward, commercial interests focused on developing knowledge for profit's sake also became increasingly important impetuses for activity. Interest in African resources and curiosity for practical knowledge had helped to drive earlier British interest in West Africa.[16] The abolition of the slave trade, however, forced a transition in Afro-European commerce as it coincided with increasing British industrial production and demand for raw materials and markets.[17] The resulting trade known as legitimate commerce focused especially on palm oil.[18] The government initially left this commercial development to private efforts, but intervened to protect its interests when necessary. This trend accelerated as ideas of improvement increasingly linked the multifaceted and sometimes conflicting missions of commerce, Christianity, civilization and slave trade suppression.[19] Over the first half of the nineteenth century, these commercial forces thus continued to shape Britain's strategy in West Africa.

Increasing exploratory efforts from the 1790s aimed at finding an efficient and healthy route to the interior also drove activity in West Africa, particularly as they moved beyond

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[16] For wealth, commerce, science, and exploration, see Tcho Mbaimba Caulker, *The African-British Long Eighteenth Century: An Analysis of African-British Treaties, Colonial Economics, and Anthropological Discourse* (Lanham, MD: Lexington Books, 2009), chs. 3-4. See also Brown, "Origins," esp. 138-140, and 154-55; Brown, *Moral Capital*, ch. 5.

[17] There is significant debate over the effects of abolition on West African economies. Paul E. Lovejoy, and David Richardson, "The Initial 'Crisis of Adaptation': The Impact of British Abolition on the Atlantic Slave Trade in West Africa, 1808-1820, in *From Slave Trade to 'Legitimate' Commerce: The Commercial Transition in Nineteenth-Century West Africa*, ed. Robin Law (New York: CUP, 1995), 32-33. For Britain's need for supplies of raw materials, new markets, and "legitimate commerce," see John Darwin, *The Empire Project: The Rise and Fall of the British World-System, 1830–1970* (New York: CUP, 2009), 36-39; Timothy Parsons, *The British Imperial Century, 1815-1914: A World History Perspective* (Lanham, MD: Rowman & Littlefield, 1999), 62-63.

[18] Palm oil was used as an industrial lubricant and as a base for soap. Martin Lynn, *Commerce and Economic Change in West Africa: The Palm Oil Trade in the Nineteenth Century* (New York: CUP, 1997), esp. 3, 12-16, 57-61, 82-86, and 97-98; Martin Lynn, "The West African Palm Oil Trade in the Nineteenth Century and the 'Crisis of Adaptation'," in *From Slave Trade to 'Legitimate' Commerce*, 62-66. For the rise of palm spreading from the Bight of Biafra, domestic slavery, and its effects: Patrick Manning, *Slavery and African Life: Occidental, Oriental, and African Slave Trades* (New York: CUP, 1990), 108, 144, and 148; Patrick Manning, "Slave Trade, 'Legitimate Trade,' and Imperialism Revisited: The Control of Wealth in the Bights of Benin and Biafra," in *Africans in Bondage: Studies in Slavery and the Slave Trade*, ed. Paul E. Lovejoy (Madison: UWP, 1986), 203-06, and 219-24.

[19] For commerce and early imperialism: Darwin, *Empire Project*, 39, and 123-124; Parsons, 65; John Gascoigne, "Joseph Banks," 42-43; Jeremy Black, *British Seaborne Empire* (New Haven: YUP, 2004), 192-193, and 209. For improvement: Porter, "Commerce and Christianity," 690-613; Richard Huzzey, *Freedom Burning: Anti-Slavery and Empire in Victorian Britain* (Ithaca: Cornell University Press, 2012), 134-135.

exploration mainly for geography's sake. Abolitionists, missionaries, naturalists and merchants had their own reasons for gaining knowledge and furthering their broader goals through exploration. Merchants specifically advocated exploration to gain knowledge of Africa's economy, resources, geography, and peoples, so at to bypass coastal middlemen. Private groups other than geographical societies and the government thus began funding and joining expeditions that attempted to meet multiple aims. The search for a route to the interior of Africa gained momentum in the initial decades of the nineteenth century due to the increasing intersection of these diverse goals.[20]

Beyond commerce, the rise of the Admiralty as a significant promoter and coordinator of exploratory activity following the Napoleonic Wars had equally significant implications for British activity. In West Africa, the Admiralty pursued several strategies. The Navy first supported and sanctioned expeditions organized by geographical societies and merchants, often sending officers or surgeons to accompany them. It also outfitted river expeditions when enticed by the perceived returns, and undertook coastal surveys to provide information that would further national interests. Nonetheless, the logistical problems, pathological risks, and resources needed for river and interior exploration reinforced the differing strategies that the Navy pursued, and led to a more reserved approach to exploration during the later-1820s and 1830s.[21]

The factor that most broadly shaped Britain's strategy in West Africa was abolitionists' calls for action to confront the continued Atlantic slave trade. From 1808 onward, the government committed a naval presence off the coast to target the slave trade out of moral,

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[20] For the intersection of factors, see also Headrick, *Tools*, 60. For commerce and exploration: Parsons, 64; Turner, "Limits," 322. For geographical exploration: Stafford, *Scientist*, esp. 9-10; David Lambert, *Mastering the Niger: James MacQueen's African Geography and the Struggle Over Atlantic Slavery* (Chicago: UCP, 2013), 11-16. For Niger River and search for routes to interior, see Hoag, ch. 3.

[21] For the Admiralty: Gough, 54-59; Lambert, *Mastering*, 11-12, and 15; Richard Drayton, "Knowledge and Empire," 249; Morag Bell, *Geography and Imperialism, 1820-1940* (Manchester: MUP, 1995), 16-19. For African exploration: Kennedy, *Last Blank Spaces*, 134-36; Curtin, *Image*, 206-208. For surveying: Wills, 38.

economic, and strategic interests.[22] The Navy's antislavery duties expanded further with the creation of the West African Squadron in 1819, placing naval suppression of the Atlantic slave trade at the center of Britain's West African strategy.[23] This escalation coincided with efforts to develop a system based on forceful diplomacy, treaties, and bilateral courts to support naval efforts. Sierra Leone gained importance as the Squadron's base, a resupply location, the home to the busiest Mixed Commission Court, and the destination for liberated Africans.[24] Nonetheless, the Navy remained one of the cornerstone of Britain's anti-slave-trade efforts with significant health and medical ramifications for sailors, medical officers, and the Admiralty.

The increase in British activity resulting from these converging factors led to higher overall mortality among sailors, soldiers, colonial officials, missionaries, and merchants. While reliable comprehensive statistics remain elusive until the 1830s, one estimate claims that between 33% and 56% of Britons sent to the West African coast died within their first year there.[25] The resulting unabated and continuing mortality during these decades led to an increase in the speed, scale, and precision with which observations regarding tropical disease and fevers accrued. This coincided with and likely contributed to an even more precise awareness of the risk

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[22] For the emergence of naval suppression: Sherwood, 114; Kenneth Morgan, *Slavery and the British Empire: From Africa to America* (New York: OUP, 2007), 202; Keith Hamilton, and Farida Shaikh, "Introduction," in *Slavery, Diplomacy, and Empire: Britain and the Suppression of the Slave Trade, 1807-1975*, eds. Keith Hamilton, and Patrick Salmon (Portland: Sussex Academic Press, 2009), 3.

[23] Sherwood, 114; Everill, *Abolition*, 82-83; Morgan, *Slavery*, 202; Eltis, 92. For naval suppression recently Huzzey, *Freedom*, ch. 3, esp. 42-43; Robert Burroughs and Richard Huzzey, eds., *The Suppression of the Atlantic Slave Trade: British Policies, Practices and Representations of Naval Coercion* (Manchester: MUP, 2015).

[24] Sherwood, 114-15; Eltis, esp. 81-82, and 84-90; Morgan, *Slavery*, 202; Maeve Ryan, "The Price of Legitimacy in Humanitarian Intervention: Britain, the Right of Search, and the Abolition of the West African Slave Trade, 1807-1867" in *Humanitarian Intervention: A History*, eds. Brendan Simms, and D.J.B. Trim (New York: CUP, 2011), 234-35. For the "world system": Huzzey, *Freedom*, 43-65; Robin Law, "Abolition and Imperialism: International Law and the British Suppression of the Atlantic Slave Trade' in *Abolitionism and Imperialism in Britain, Africa, and the Atlantic*, 150-74.

[25] While morality declined for those who survived their first year, it could be higher during epidemics. More specific mortality statistics before the 1840s are the notoriously fragmented and unreliable. Curtin, *Image*, 71; Carlson, *African* Fever, 1, and 11; Drescher, *Mighty Experiment*, 82. See James Watt, "The Health of Seamen in Anti-Slavery Squadrons," *MM* 88, no. 1 (2002): 69; Vaughan Miles Dutton, "Royal Navy Data in the 19th Century: Factors Affecting Data Quality," Dataset Report, UK Data Service (Sept. 2013), http://doc.ukdataservice.ac.uk/doc/7390/mrdoc/pdf/guide.pdf.

facing those serving in Africa.[26] As surgeons and colonial actors attempted to make sense of often disastrous situations, their understanding of tropical mortality became increasingly clear.

The steady flow of information that emerged from the late 1810s accrued slowly as news, real and anecdotal, made its way back from Sierra Leone and the Squadron's vessels.[27] The period opened ominously with an 1816-17 naval expedition to the Congo River, which cost the lives of 21 of 44 sailors and officers. These losses shocked the Admiralty into a more cautious approach to African exploration. Secretary of the Admiralty James Barrow commented that: "By a fatality that is almost inexplicable, never were the results of an expedition more melancholy and disastrous."[28] The Navy, however, was not alone in suffering near unsustainable mortality. In Sierra Leone, 16 of 24 missionaries sent by Church Missionary Society between 1804 and 1816 had quickly died. Merchants and their crews fell victim as well. One commercial master estimated that merchants' vessels lost roughly 25% of their crews per voyage.[29]

Facing this environment, as its commitments expanded, the Navy responded by devoting more surgeons and medical resources to the African Station. It also established military and naval hospitals in Sierra Leone and on the Isle of Ascension. As surgeons became increasingly vital to the Navy's effectiveness in pursuing its slave trade suppression mission, these became near-permanent resources. These medical commitments, however, were grossly insufficient given the needs created by growing numbers and rates of illness as the Navy's presence off West

[26] For increasing knowledge: Curtin, "White Man's Grave," 102; Curtin, *Disease*, 5; Bryson, *Report*, 35.
[27] For reports published in Britain: Anon, *Caledonian Mercury*, no. 148 (Mar. 27, 1817): 3; Anon, *The Morning Post*, no. 15373 (June 24, 1820): 3; Anon, *John Bull*, no. 7 (Jan. 29, 1821): 52.
[28] Kennedy, *Last Blank Spaces*, 135; Dane Kennedy, "Forgotten Failures of African Exploration," *The Public Domain Review*, accessed Oct. 13, 2015, http://publicdomainreview.org/2015/04/22/forgotten-failures-of-african-exploration/; James Hingston Tuckey, and Christen Smith, *Narrative of an Expedition to Explore the River Zaire, Usually Called the Congo: In South Africa, in 1816* (London: John Murray, 1818), xliii-xlvi, 152, 155, 203, and 221-23; Anon, *The Gentleman's Magazine*, 12, no. 1 (Jan. 1819): 53.
[29] Lynn, *Commerce and Economic Change*, 92; Maeve Ryan, "'A Most Promising Field for Future Usefulness': The Church Missionary Society and the Liberated Africans of Sierra Leone," in *A Global History of Anti-Slavery Politics in the Nineteenth Century*, ed. William Mulligan and Maurice Bric (New York: Palgrave Macmillan, 2013), 50.

Africa increased.[30] Furthermore, slave trade suppression operations represented one of the most arduous and deadly tasks that fell to the Navy. Coastal and river patrols, and calls at Freetown, Fernando Po, and Ascension exposed sailors to disease. Close contact between naval crews and African slaves also turned vessels into "crossroads and marketplace of diseases." Furthermore, the Navy felt obligated to overload the Squadron's small vessels with sailors to man handle captured slave ships, and to make up for attrition, which in turn increased the endemic and epidemic risk. In light of these circumstances, the African Station was quite unpopular.

While Africans who fell victim to the still thriving slave trade faced more deplorable conditions, medical officers faced burdens far beyond those of other naval personnel.[31] In the event of capturing a slave ship, one or two surgeons faced the overwhelming task of treating dozens to hundreds of liberated slaves at once and in close proximity. Patients in the direst of health often inundated the decks of both vessels and sickbays. As Alexander Bryson later stated, "there is perhaps not any condition in which human nature may be viewed in a more revolting aspect than in that of a crowded slave vessel with dysentery on board." In such situations, he argued, common sense and exigencies dictated surgeons' decisions more than their abilities or practical standards.[32] The rewards of prize money and glory, promotion opportunities, and commitment to the antislavery cause scarcely mitigated this harsh practical reality. Bryson characterized the Anti-Slave Trade Squadron as "the most disagreeable, arduous and unhealthy

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[30] For hospitals: Weir to the Victualling Board, Nov. 11, 1823, NA, ADM 105/4/no.19b; Burnett, memo, July 30, 1832, NA, ADM 105/70/f.4-6. Adell Patton Jr., *Physicians, Colonial Racism, and Diaspora in West Africa* (Gainesville, University Press of Florida, 1996), 61, and 64-65.

[31] Mustakeem, 490. For fever: Bryson, *Report*, 35-45; Weir to Victualling Board, Nov. 11, 1823, NA, ADM 105/4/no.19b; Weir, and Burnett, memo, Dec. 26, 1823, RNML/AL, Mss.242/1/f. 300-303. For conditions for slaves, see among other works: Sherwood, 119-20; Bryson, *Report*, 254-59.

[32] Bryson, *Report*, 256, quoted in Lloyd, *Navy*, 118; McLean, *Surgeons*, 68. See Peter Leonard, *Records of a Voyage to the Western Coast of Africa, in Her Majesty's Ship Dryad, and of the Service on that Station for the Suppression of the Slave Trade, in the Years 1830, 1831, and 1832* (Edinburgh, A. Shortrede for William Tait, 1833), 265-66; *The Literary Gazette*, no. 844 (Mar. 23, 1833), 177-79

service that falls to the lot of British officers and seaman."[33] It is fair to say that most of his colleagues, as well as many sailors and officers would have agreed.

One factor that also helps to explain surgeons' sense of hopelessness and frustration is the ineffectiveness of medical understandings and practices relating to fevers. As described in educational and practical contexts in previous chapters, medical practitioners increasingly saw diseases as arising from pathological changes in bodily structure and function. The assumption was that disrupted gross functions caused fevers to develop. Practitioners dutifully applied the constitutional, putrid, and nervous theories built on the prevailing neo-humoral system discussed in chapter four. These theories attributed fevers to imbalances of bodily fluids, internal putrefaction caused by noxious effluvia, and impaired nervous, circulatory, and chemical functions due to external stimuli.[34] They differed in how they interpreted the processes giving rise to fevers, respectively emphasizing nervous energy, bodily structures, and vital fluids. In this regard, they built on the anatomical pathology that became increasingly common in training, theory, and practice during the early nineteenth century.[35]

Experience with tropical environments challenged practitioners, but also led them to refine this miasmatic theory. Expanding on the etiological view that poisonous exhalations were

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[33] Bryson, *Report*, 161; Brown, *Poxed*, 117; For conditions of service, see McLean, *Surgeons*, 66-70; Wills, ch. 3. For rewards: Padraic Xavier Scanlan, "The Rewards of Their Exertions: Prize Money and British Abolitionism in Sierra Leone, 1808–1823," *Past & Present* 225, no. 1 (Nov. 1, 2014): 113–42.

[34] Curtin, Harrison, Carlson, and Headrick's works extensively discuss medical understandings, theories, treatments, and classifications of tropical fevers. For the constitutional theory: Headrick, *Power*, 227; Guenter B. Risse, "The Road to Twentieth Century Therapeutics: Shifting Perspectives and Approaches," in *The Inside Story of Medicines: A Symposium*, ed. Gregory Higby, and Elaine C. Stroud (Madison: American Institute for the History of Pharmacy, 1997), 55-56; R. H. Shryock, "Nineteenth Century Medicine: Scientific Aspects," *Cahiers D'Histoire Mondiale/Journal of World History* 3, no. 4 (1957): esp. 881–882; Noel G. Coley, "Early Blood Chemistry in Britain and France," *Clinical Chemistry* 47, no. 12 (Dec. 1, 2001): 2167. For the putrid theory: Harrison, *Medicine in an Age*, 62-67. For the nervous theory: Risse, "Road to Therapeutics," 55-57; Sean Dyde, "Cullen, a Cautionary Tale," *Medical History* 59, no. 2 (Apr. 2015): 223-224; Risse, "Brownian System," 45-51; Southwood Smith, *A Treatise on Fever* (Philadelphia: Carey & Lea, 1831), 8-10.

[35] Military and naval surgeons made progress describing the symptoms and courses of fevers. For the colonial and Edinburgh contexts: Harrison, *Medicine in an Age*, esp. 11, 184, and 191.

the pathological cause of fevers, they began to incorporate elements of the newer theories.[36] The constitutional theory's focus on the interplay between climate, constitution, and individual behavior gained influence. Many practitioners felt that tropical heat, intense sun, noxious odors, and damp and humid air debilitated Europeans. Theorists both in the colonies and back home then developed logically consistent explanations for how miasmatic poisons stimulated morbid changes, and caused fevers symptoms.[37] For example, naval surgeon and East India veteran Dr. James Johnson, an initially London-trained practitioner who later graduated from Aberdeen and St. Andrews, asserted that the tropical climate disrupted nervous reactions and produced excess bile in the liver, weakening Europeans' constitutions. In his view, fevers arose when "human and marsh Effluvia" then acted on individuals' weakened bodies. According to his interpretation, numerous excessive and depressive "passions" could also serve as predisposing causes by disturbing balance within the body.[38] These theories had significant practical ramifications.

The convergence of nervous, putrid and miasmatic theories initially led to a revival of the anti-phlogistic therapeutic regimen in the early 1800s. Based on the emphases on poisons, imbalances and inflammation, many surgeons aggressively employed bloodletting and mercury. The rationale was that rapid and sustained bloodletting from fever's onset supposedly reduced inflammation. When employing calomel and other mercurials, practitioners aimed to cleanse the body of bile and restore balance through salivation. Secondary treatments such as diaphoretics, emetics and purgatives supposedly sped up the body's evacuative processes and purged poisons

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[36] Curtin, *Image*, 76-77; Harrison, *Medicine in an Age*, 64, and 86. Smith, *Treatise on Fever*, 205; James Johnson, *The Influence of Tropical Climates on European Constitutions*, 2rd ed. (London: Motley and Harrison, 1818), 20, 23-24, and 106; John MacCullough, *Malaria: An Essay on the Production and Propagation of this Poison* (London: Longman, Rees, Orme, Brown, and Green, 1827), 14-34.
[37] For constitution: Harrison, *Medicine in an Age*, 47-49, and 85-86; Curtin, *Image*, 190-191; Lloyd, *Navy*, 131; Chakrabarti, *Medicine and Empire*, 125. For morbid changes: Carlson, *African Fever*, 23, 34, and 39; Smith, *Treatise on Fever*, 26-33.
[38] Harrison, *Medicine in an Age*, 89-93; Curtin, *Image*, 185, and 190-191; Carlson, *African Fever*, 35; Johnson, 2nd ed., 12-17, 20-21, 25, 41-42, and 382.

in a similar manner. As Mark Harrison has shown, much of the supposed clinical, scientific and anatomical backing for the resurgence of these treatments came from those military and naval surgeons who returned to Edinburgh in the 1810s.[39] While the training that surgeons chose to pursue at Edinburgh contributed to these practical developments, it led to empirical difficulties.

The theoretical system built around this etiology and therapeutic regimen was quite inefficient, and created significant difficulties in diagnosing and classifying fevers. Despite medical science's rising precision, the causes of fever, and fever classification systems remained unstandardized and unreliable. While practitioners attempted to classify fevers based on their symptoms, they quarreled over which indicator to use. By the early nineteenth century, a system based on the fever's pattern of temperature fluctuations was dominant. This divided fevers into continued synochus with no cycle, remittents with an irregular one, and intermittents that followed a pattern. Intermittents were subdivided into quotidian, tertian, and quartan based on the specific pattern. Numerous variations and appendages, however, had created overlapping categories and terminology that made the system unworkable. Since classification depended on practitioners' observations, it was also easy to confuse different fevers. For example, significant debate emerged over whether "yellow fever" was a distinct contagious or a virulent form of remittent fever. A diagnosis also could not be considered accurate until the fever had three days to complete a quartan cycle.[40] As a result, while these efforts illustrate the application of

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[39] The reassertion of antiphlogistics was also a backlash against Portuguese-led hybridization of European and African medical practices that had occurred during the eighteenth century in close relations with the transatlantic slave trade. Carlson, *African Fever*, 43-45; Curtin, *Disease*, 25; Harrison, *Medicine in an Age*, 175, 180-81, 191, and 202-03; Johnson, 2nd ed., esp. 49-52. For hybridization with African medical practices, see among others: Philip J. Havik, "Hybridising Medicine: Illness, Healing and the Dynamics of Reciprocal Exchange on the Upper Guinea Coast (West Africa)," *Medical History* 60, no. 2 (Apr. 2016): 181–205; José Pinto de Azeredo, *Essays on Some Maladies of Angola*, ed. Timothy D. Walker, trans. Stewart Lloyd-Jones (Dartmouth, Massachusetts: Tagus, 2016).
[40] Headrick, *Power*, 227; Curtin, *Image*, 75-76, and 183-4; James Lind, *An Essay on Diseases Incidental to Europeans in Hot Climates with the Method of Preventing Their Fatal Consequences* (London: T. Becket and P. A. De Hondt, 1768), 15-16. For yellow fever and contagion, see Harrison, *Medicine in an Age*, 261-84.

classification and analytical systems that arose in the eighteenth and nineteenth centuries, they did little to offer insight into the causes of fevers.

As British activity in tropical Africa expanded, existing medical approaches to fever were thus of limited use. Practitioners accepted a refined set of logical theories based on faulty premises, and struggled with a convoluted classification system. In this context, combinations of bloodletting, mercury and purgatives remained the dominant treatments. British practitioners had some success with hygienic measures, developing rules for clothing, diet, exertion, cleanliness, exposure, and accommodation. These intricate systems rested on the belief that "unseasoned Europeans may apply, with safety, certain preventative checks to the influence of the climate."[41] While they had some benefit, they did not alleviate the increasing pessimism that emerged during the 1820s as British colonial actors and naval forces struggled to deal with and make sense of a devastating series of fever epidemics.

5.2 MEDICAL CRISES AND EMPIRICAL APPROACHES, 1823-1830

Naval surgeons' sustained attempts to understand tropical fevers became more focused as mortality in West Africa increased in the 1820s. Beyond endemic mortality, British settlements had seen few fever epidemics during the late 1810s and early 1820s, likely due in part to periods of below average precipitation and drought.[42] Multiple outbreaks during the 1820s shattered this trend, as social and epidemiological conditions became ideal for fever outbreaks. Sierra Leone,

[41] Curtin, *Image*, 79-80, and 188-91; Headrick, *Power*, 227; Johnson, 2rd ed., 20, 381, and Part III, 380-424; MacCulloch, 132-164. For the nineteenth century topography of Africa: James Boyle, *A Practical Medico-Historical Account of the Western Coast of Africa* (London: Highley, 1831), ch. 1.
[42] Clive Alfred Spinage, *African Ecology: Benchmarks and Historical Perspectives* (New York: Springer, 2012), 156.

the Gold Coast fortresses, and the outposts at Ascension Island and Fernando Po had become more interconnected. The African Squadron expanded to an average of eight to ten ships, and 950 to 1,250 sailors and officers from the mid-1820s to the early 1830s. Patrol and resupply voyages, and merchant travel consequently gave rise to an increasingly integrated colonial network. These conditions precipitated increased disease exchange. From the 1820s, there was greater probability that outbreaks in one area would spread to other British settlements.[43] The series of epidemics that arose during the 1820s defined and shaped surgeons' efforts.

The example of the first virulent epidemic, which grew out of a yellow fever outbreak in Sierra Leone in 1823, is illustrative. Missionary Philip Vaughan noted that 77 Europeans died between early December 1822 and mid-June 1823, including three doctors whom he helped bury. He further stated that, "The medical men have not ascertained the character of the disease. Almost all die of the black vomit, and very few that have died have had more than three or four days' illness." By early-June, over half of Sierra Leone's resident Europeans had dead, including the Chief Justice, Acting Colonial Secretary, and three members of the Colonial Council.[44] The devastating fever spread to several African Squadron ships, and reached Ascension Island and Bathurst on the Gambia River.[45]

The most devastating naval outbreak occurred on the Squadron sloop *HMS Bann*. Four yellow fever cases appeared when the *Bann* lay at anchor off of Freetown in late March 1823. The captain sailed for the moderate climate of Ascension Island, hoping to forestall or ameliorate

[43] For the ecology of malaria and migration: James L.A. Webb Jr., *Humanity's Burden: A Global History of Malaria* (New York: CUP, 2009), esp. ch. 3, and 115-122; McNeill, *Mosquito Empires*, esp. 2-3, and 8-10. For intensifying of the Squadron's efforts, see table of its forces and cost in Eltis, 92.
[44] For Vaughan: Philip Vaughan, quoted in E.G. Ingham, *Sierra Leone After a Hundred Years* (London: Seeley, 1894), 217-218; Church Missionary Society, *Missionary Register for MDCCCXXIII* (London: Seeley, Jackson, & Halliday, 1823), 379. For the death toll: Spinage, 1262, and 1265. For accounts also see Boyle, 269-276.
[45] Robert Lawson, "Remarks on the Diagnosis and Cause of Yellow Fever," *TESL*, 4, sessions 1875-81 (London: David Bogue 1882), 160. For 1823 fevers: Bryson, *An Account of the Origin, Spread, and Decline of the Epidemic Fevers of Sierra Leone* (London: Henry Renshaw, 1849), 14-32.

the crisis. Nonetheless, within two months, 99 of 115 men had fallen ill; 34 had died. Following the *Bann's* release from quarantine at Ascension, the fever also spread to the island's garrison.[46] The toll, virulence, and apparent contagiousness of the fever did not escape the Admiralty's attention. Medical commissioners Burnett and Weir launched an investigation into the "origin, progress, and nature of the malignant and fatal fever." They carefully analyzed observations from the reports and logs of the *Bann* and Ascension garrison. Weir's report concluded that the *Bann*, "removed from the influence of Marsh Miasma… yet in despite of air, Climate, or Situation, the Disease gradually spread from Man to Man, and this cannot be satisfactorily accounted for in any other manner, than by admitting contagion to be the case." Based on analysis of the outbreaks' extended timing, however, Burnett's follow-up account rejected claims that the *Bann* had introduced contagious yellow fever to Freetown or Ascension.[47]

This was but the first of several ferocious epidemics that collectively gave surgeons increasing experience observing and confronting fevers. Virulent fevers again broke out in Sierra Leone and on the African Squadron in the mid and late-1820s. Due to high levels of endemic fever in the intervening years, the impression emerged that West Africa was in the midst of a sustained fever cycle. Scottish-educated naval Surgeon Dr. Peter Leonard recounted the popular belief, that "the concentrated form of endemial fever, and consequent mortality at Freetown, has for many years assumed a periodic return— that the years 1823-26-29 have been more sickly and fatal than the intermediate years." Furthermore, Alexander Bryson acknowledged that, "there existed a greater amount of sickness, both throughout the squadron, and throughout the different European settlements along the coast, than usually happens." Like most of those who lived

[46] Ascension garrison saw 28 cases and 15 deaths. Bryson, *Report*, 36-37, and 45; Burnett, *Official Report*, 3-5, 13-14, and 54-56; Weir to the Victualling Board, Nov. 11, 1823, NA, ADM 105/4/no.19b, f. 15-17.
[47] Weir to Victualling Board, Nov. 11, 1823, NA, ADM 105/4/no.19b, f. 1, and 19-20; Burnett, *Official Report*, 18, 22, and 51-53. For the *Bann* and contagion debate: Harrison, *Medicine in an Age*, 279-83; Bryson, *Account*, 19-25.

through the epidemics of the 1820s, he struggled to account for them, admitting that "there is no means of determining" what caused this phenomenon.[48]

Nonetheless, more detailed accounts of the perils that accompanied activity in West Africa emerged from the reports of endemic and epidemic mortality during the 1820s. Between 1826 and 1828, the government lost three Governors of Sierra Leone to fevers; eight of the fourteen European missionaries sent between 1823 and 1826 also died.[49] The trail of death extended well beyond Freetown. Over half of the British soldiers sent to "fill up the ranks of the African corps" in the early 1820s died of disease during the 1826 campaign against the Asante. Additionally, only a single man had survived Hugh Clapperton's 1825-28 overland Niger expedition.[50] Unfortunately, an even more virulent epidemic emerged at the end of the 1820s.

The 1829 fever epidemic that emerged in Sierra Leone and spread throughout European enclaves in West Africa was the most devastating yet encountered. Bryson recorded that, "it appears the disease first began to prevail as an epidemic in the town of Sierra Leone, in the shipping in the river, and also in that at anchor in the river Scarcies, a few leagues to the northward." While its origins remained unclear, the yellow fever quickly spread to the African Squadron's ships, which already faced increased risk. This outbreak coincided with the Squadron's move to intensify its suppression duties by venturing closer to shore and up rivers. This strategic decision had increased sailors' exposure to mosquitoes and to epidemic fevers.

[48] Spinage, 1262-63, and 1265. For Leonard: Leonard, esp. 111, and 224; Scanlan, "A Bloody War or a Sickly Season." For Bryson on fevers: Bryson, *Report*, 44. For a general account: For fever: see also Boyle, ch. 5.
[49] For colonial governors: Curtin, *Image*, 179; Anon, *Caledonian Mercury*, no. 16338 (May 13, 1826): 4; Anon, *Freedom's Journal* (Oct. 10, 1828): 230. For CMS missionaries: Jehu Hanciles, *Euthanasia of a Mission: African Church Autonomy in a Colonial Context* (Westport, CT: Praeger, 2002), 16; Church Missionary Society, *The Jubilee Volume of the Church Missionary Society for Africa and the East, 1848-1849* (London: Seeleys, 1849), 204.
[50] Bryson, *Report*, 44-45; Headrick, *Power*, 226; Gough, 173. For the Asante campaign: Ivor Wilks, *Asante in the Nineteenth Century: The Structure and Evolution of a Political Order*, paperback ed. (New York: CUP, 1989), 183-84. For Clapperton: Jamie Bruce Lockhart, *A Sailor in the Sahara: The Life and Travels in Africa of Hugh Clapperton, Commander RN* (New York: I.B. Tauris, 2007), 260-61.

Even before the 1829 epidemic, the late 1820s thus saw higher morbidity and mortality on the African Squadron, albeit with growing variation between vessels.[51]

Due to the epidemic that spread outward from Sierra Leone, however, the year 1829 was a demoralizing low point for the Squadron, which lost 202 of 792 men. The case of *HMS Eden* was the most devastating, quickly becoming part of Squadron lore and a reminder of the risks of African service. Yellow fever erupted onboard while at anchor in Freetown in early May 1829. The ship set sail for Fernando Po, arriving in dire straits three weeks later. At that point, the only remaining able-bodied officers were the First Lieutenant and the gunner. The ship's log recounted the deplorable conditions that developed during the voyage. It stated that "the men are dying almost daily amidst incessant rain and frequent tornadoes accompanied with much thunder and lightning; the main deck is crowded with sick and constantly wet…" Due to the death of its three medical officers, "…it was impossible to pay attention to the ventilation of the ship, or even to the personal comfort of the sick." After nearly a month, the *Eden* set sail for modern-day Príncipe and St. Helena with a skeleton crew and 23 convalescent sailors. Fever broke out again, making the deck a floating hospital and claiming the lives of 110 of 160 men by late 1829.[52]

Despite the enduring and mounting disease and death during this period, the African Squadron's surgeons resisted the pessimistic and fatalistic mindset that accompanied the representation of the "White Man's Grave." They instead maintained a practical, matter-of-fact attitude, and struggled to meet their taxing duties and to understand such protracted devastation. Surgeons' positivist confidence in their expertise and practical ability to find a solution to

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[51] For the fever's origins: Bryson, *Report*, 85. For the fever's progress: Bryson, *Report*, 88-93; Everill, *Abolition*, 83. For the broadest view: Bryson, *Account*, 33-48.

[52] For mortality: Bryson, *Report*, 92, and 177; Lloyd, *Navy*, 137. For the voyage: Bryson, *Report*, 62-64, also quoted in Lloyd, *Navy*, 134; Brown, *Poxed*, 117. See also Bryson, *Account*, 36-39; I.K. Sundiata, *From Slaving to Neoslavery: The Bight of Biafra and Fernando Po in the Era of Abolition, 1827-1930* (Madison: UWP, 1996), 35.

tropical fevers reinforced this approach. The trying circumstances of African service and plentiful cases that it provided offered committed surgeon-scientists the opportunity to observe fevers, and test strategies to treat and prevent them.

The case of the mid-1830 yellow fever outbreak aboard *HMS Sybille* is illustrative in this regard. Two epidemics had already battered the *Sybille* during three years of cruising off the African coast. Upon this latest outbreak, most of the crew turned despondent, fearing that the fever would spread like wildfire. Amidst the strain of treating 87 critical cases, Edinburgh-trained Surgeon Dr. Robert McKinnal devoted himself to observing the fever's character and course. After realizing that those attending the sick were at no greater risk than the crew, he set out to prove that the fever was not contagious. He ordered the assistant surgeon to collect a wineglass of aspirated "black bile" from a patient, and called over the officer of the watch. In dramatic fashion, he proceeded to fill "a glassful of the black vomit, [and] asked [Lieutenant Green] if he would like to have some of it." After being tersely rejected, McKinnal then "said 'Very well, here is your health Green,' and drank it off." News spread throughout the ship but he showed no ill effects, much to the crew's shock. While this act seems to border on reckless insanity, Alexander Bryson later lauded it as a "deliberate act of cool moral courage" in the service of medical science.[53] Perhaps more importantly, it offered proof that the fever was not contagious, an important first step toward diagnosing and treating future cases.

Moreover, the institutionalization of reports, case histories, and nosological returns within the service reflected and reinforced this empirical, positivist and scientific mindset and

[53] *HMS Sybille* lost more than 100 men in those three years. Alexander Bryson, *Report on the Climate and Principal Diseases of the African Station* (London: William Clowes and Sons, 1847), 55-56, and 90-92. H.B. Padwick, "Some Notes on Early Attempts at Prophylaxis Against "Coast Fevers" on the West Africa Station," *JRNMS* 8, no. 2 (1922): 93; McKinnal, "On the Origins, Progress, and Termination of a Malignant Yellow Fever, which Lately Affected the Crew of His Majesty's Ship *Sybille* on the Coast of Africa," *M-CR*, 18 (Oct., 1831), 38-41.

approach.[54] A limited range of these journals and reports related to the West African Squadron has survived, especially prior to the mid-1830s. Nonetheless, Alexander Bryson's reflective report on the African Station used the growing body of reports and journals from the Squadron to compile clinical, anecdotal and nosological accounts of each ship from 1823 onward. His work demonstrates that the records existed as a cohesive group in the mid-nineteenth century. Since the digests, registers and bundles of Medical Department in-letters indicate a culling of records in the intervening period, this chapter's analysis relies heavily on these accounts in his report.[55]

During the epidemics of the 1820s, Squadron surgeons' accounts contributed to the growing corpus of reports mentioned above. They provided a broader and more detailed picture of the problem to the medical commissioners back in London than ever before. The first practical recommendations emerged from the case of the *Owen Glendower*. In a report to the Admiralty, Weir and Burnett stated that a fever onboard had "been occasioned by the long exposure of the Officers and Men employed in Boats without any covering to shield them during the day from the sun, or in the Day or Night from the rain or dews." Based on this climatic understanding, they proposed employing tarpaulin, caskings, and chests to shield sailors from the weather, keep them warm, and provide a dry change of clothes.[56] This strategy of refining precautionary measures continued for several decades. Such practices had unintended positive effects, as we now can see that they improved health by reducing environmental and mosquito exposure.

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[54] Admiralty, *Regulations and Instructions for Medical Officers of His Majesty's Fleet* (London: W. Clowes, 1825), 26-27; Gilbert Blane to the Victualling Board, Oct. 13, 1829, NA, ADM 97/15; Gilbert Blane to Barrow, Jan. 27, 1830, NA, ADM 97/16; and Feb. 1830, NA, ADM 97/16.

[55] Most likely, selections were made from the records during their transfer over the years since their creation. Given these constraints, Bryson's meticulous nature allows for some confidence in the accuracy of the paraphrased and quoted material. This analysis supplements his work with the still existing journals and reports, Burnett's correspondence, and published articles and manuscripts where possible. For Bryson using the reports: Bryson, *Report*, ix. For the records: Naval Medical Department, "Recorded Letters," 1833-1856, NA, ADM 97/134-219; "Digest and Index," 1831-1862, NA, ADM 133/1-31; and "Registers," 1832-1862, NA, ADM 132/1-31.

[56] Weir and Burnett, Dec. 26, 1823, RNML/AL, Mss.242/1/f. 300-303. Bryson, *Report*, 38-39. See also instructions for boat service: Admiralty, *Regulations and Instructions* (1825), 19-20.

While the Admiralty and medical commissioners attempted to promulgate practices from metropolitan centers, most efforts aimed at refining the understanding, treatment and prevention of fevers originated from surgeons' efforts at sea and in West Africa. Dr. Robert McKinnal is archetypal of the approach taken by many surgeons. He received his initial training at Edinburgh from 1806-08 and was one of the veteran surgeons who returned to complete his degree after the Napoleonic Wars.[57] By 1830, McKinnal was known for the strict hygienic and behavioral rules that he enforced. Although these measures had failed to protect the *Sybille* from multiple epidemic fever outbreaks during three years on the patrol, he was eager to make use of the opportunities that they offered.[58] When fever first broke out after the *Sybille* took on several marines from the *Eden*, he made sure to observe its progression. He gave a minute clinical and pathological assessment, emphasizing that, prior to death, patients presented with

> black vomit, often accompanied by a dingy or livid hue of the countenance. A peculiar, shrunk, corrugated, and livid appearance of the extremities of the fingers, was not uncommon. Some died in convulsions, and others in a comatose state, without black vomit. A few went off with a dark-coloured, watery purging, often accompanied by syncope at stool and great exhaustion. Yellowness of the eyes and skin was very common before death…

This represented an astute description of what appears to have been yellow fever. His most intriguing observation was that those in close contact with the sick emerged relatively unscathed, which suggested that the fever was not contagious.[59] Similar observational methods in two subsequent outbreaks, including the one in which he drank black bile, led McKinnal to discount contagion, weather and filth as causes. Through process of elimination, observation and existing

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[57] He took Practice and Theory of Medicine, Anatomy and Surgery, and Chemistry from 1806-08. In 1816-17, he attended Practice of Medicine, Materia Medica, and Midwifery, and presumably the Royal Infirmary's wards. He graduated in 1818 after writing a dissertation on dysentery in India. Comrie, and Gairdner, "Biographical Index"; University of Edinburgh, EUA/IN1/STA/3, vols. 1806-1808, and 1816-1818. University of Edinburgh, *List of Graduates*, 56.
[58] Bryson, *Report*, 51-52.
[59] *Ibid.*, 52-53; Bryson, Account, 52-57; McKinnal, "Origins, Progress, and Termination," 38-39.

theory, he concluded that the fevers "arose principally from noxious emanations from the interior of the ship, probably caused by the decomposition of the wood from the long-continued exposure of heat and moisture."[60] These daring findings reflected the empirical and practical scientific skills grounded in medical training and experience that overtook naval medicine.

Despite surgeons' increasing efforts to observe fevers, they too shared in the confused and conflicting conclusions regarding fevers' origins common throughout the profession. These logically consistent ideas led them down several false paths. Conditioned by miasmatic theories, surgeons focused on environmental, hygienic and behavioral predisposing causes. Based on his own experience and surgeons' reports, Bryson argued that fevers could be attributed to accepted predisposing and exciting causes in most cases. He singled out "undue exposue to the vicissitues of the weather, either on shore or in boats near the shore, combined with fatigue, cold, wet, insolation, or with intemperance, and other imprudences included under the head of irregularities."[61] Even though, surgeons remained mired in this theoretical framework, the beneficial consensus that had emerged was that "boat service" in open launches exposed crews to the "miasmas" given off by decaying swamp vegetation, and should be carefully planned.[62]

Despite the circuitous nature of the debate over the causes of fevers, naval surgeons and other practitioners continued their attempts to find a curative solution. The examples of cinchona bark and its extract quinine stand out in hindsight as surgeons' practical observations provided evidence for their utility from the 1820s. Their medical uses, however, were far from a foregone

[60] His career of committed naval practice likely contributed to his contraction of the chronic consumptive disorder from which he died. Bryson, *Report*, 54-56; McKinnal, "Origins, Progress, and Termination," 40-41; Scanlan, "A Bloody War or a Sickly Season." For his death: Bryson, Report, 52; C.F.H. Marx and R. Willis, *On the Decrease of Disease Effected by the Progress of Civilization* (London: Longman, Brown, Green, and Longman, 1844), 53.

[61] Bryson, *Report*, 45. See also the cases of *HMS Bann*, and *HMS Cyrene* (Bryson, *Report*, 36, and 38), which claimed exposure "to the heat of the sun's rays," and "intemperance and exposure on shore" caused fever outbreaks. For a combination, see the case of *HMS Atholl* in Bryson, *Report*, 43.

[62] While not correct in the pathological process, the focus on river swamps aligns with some mosquito-rich areas that can spread tropical fevers. See the case of *HMS Swinger* (Bryson, *Report*, 41).

conclusion. Quinine was only one of around a dozen compounds isolated by French chemists in the late 1810s and early 1820s with potential clinical value.[63] The older botanical cinchona bark had been a source of debate since Andean communities made Europeans aware of it in the sixteenth century. During the eighteenth century, colonial experience and encouraging trials led to a period of upturn in its therapeutic reputation and use. By late-century, some practitioners recommended it as a treatment, and to a lesser extent as a prophylactic in powdered form.[64]

However, this was by no means a linear development. A turn against the bark occurred in the early nineteenth century. Practitioners tended to employ it after heavy bleeding and purging to combat putrefaction, or as a tonic for nervous debility. Based on these uses and difficulty distinguishing fever types, the bark was also often administered in non-malarial cases. These practices were therefore ineffective and led to false conclusions.[65] Beyond these problems, the bark also had large natural variations in alkaloid concentration, could be easily mistaken with other plants, and was often adulterated. Patients also resisted taking it due to its extreme bitterness, even when mixed with alcohol.[66] Opponents consequently dismissed the bark based on these factors, its mixed empirical results, and the lack of a convincing explanation for why it cured some fevers and not others.[67]

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[63] Other alkaloids discovered in these years included morphine, and in Pelletier and Caventou's laboratory caffeine and strychnine. For quinine: Webb, 94. For alkaloids: L.D. Kapoor, *Opium Poppy: Botany, Chemistry, and Pharmacology* (Binghamton, NY: The Haworth Press, 1995), 241.

[64] Webb, 95-97; Harrison, *Medicine in an Age*, 130; Andreas-Holger Maehle, "Four Early Clinical Studies to Assess the Effects of Peruvian Bark," *Journal of the Royal Society of Medicine* 106, no. 4 (Apr. 2013): 150–55; Andreas-Holger Maehle, *Drugs on Trial: Experimental Pharmacology and Therapeutic Innovation in the Eighteenth Century* (Atlanta: Rodopi, 1999), ch. 4. For the late-eighteenth century: Carlson, *African Fever*, 46; Curtin, *Image*, 192; Lind, esp. 27, 38, 67, 228, and 286-87.

[65] The bark's effects are specific to malaria and require sufficient doses in early fever stages. Webb, 97; Harrison, *Medicine in an Age*, 131-33; Curtin, *Image*, 81-82, 192-94; Carlson, *African Fever*, 46. For the confusion of practices, see Lind, 56, and 232-35; James Johnson, *The Influence of Tropical Climates More Especially the Climate of India on European Constitutions* (London: J. Callow, 1815), 41.

[66] Carlson, *African Fever*, 47; Webb, 97-98; Curtin, *Disease*, 23; Alexander Bryson, "On the Prophylactic Influence of Quinine," *MTG* 8 (Jan. 7, 1854): 6–7.

[67] See also Curtin, *Image*, 82; Gelfand, *Rivers*, 16; Johnson (1815), 40-41, 125, 139, 182-83, and 231.

Despite this broader trend, the Navy's surgeons most clearly resisted the turn against cinchona bark, and continued to employ it. Just a year after Dr. James Johnson asserted in 1814 that the bark should only be used as a tonic, the Navy recommended its prophylactic use in the hope of preventing fevers. For those seamen sent out on boat service, the *Instructions* stated that surgeons should provide one-eighth of an ounce of bark mixed in wine morning and evening as a preventative tonic. Several scholars have noted that this recommendation was often not followed rigorously. Many surgeons grew lax in administering bark, as sailors objected to its extremely bitter taste and provisions remained inadequate for sustained prophylactic use.[68] Nonetheless, cinchona bark saw a slow revival during the 1820s as naval surgeons' empirical findings, modest theoretical advances, and growing skepticism regarding bloodletting and mercury came together.

It was the melding of nervous debility into the miasmatic system that provided the justification for employing cinchona bark. As practitioners emphasized the debility produced by fevers, tonics and stimulants became a crucial adjunct to antiphlogistics.[69] Furthermore, anecdotal evidence regarding the bark's potential value emerged as surgeons employed it according to their instructions and judgment. More instances where bark appeared to forestall fever slowly accumulated. For example, in August 1826, the surgeon of *HMS North Star* gave bark-wine to twenty sailors sent on boat service and on shore for provisions. The Lieutenant in charge refused to take the prophylactic, and the surgeon wrote that it was "not a little singular that he was the only one of the whole party who suffered from fever." Similar experiential evidence also emerged during the 1829 epidemics, and on other African Squadron ships.[70]

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[68] Curtin, *Image*, 82, and 192; Curtin, *Disease*, 23; Carlson, *African Fever*, 48. For recommendation: Admiralty, *Regulations and Instructions* (1825), 21-22. For lax practices: Bryson, "Prophylactic Influence of Quinine," 6–7.
[69] Harrison, *Medicine in an Age of Commerce*, 194; Gelfand, *Rivers*, 16.
[70] For the *North Star*: Bryson, *Report*, 49. See also the cases of *HMS Sybille*, *Primrose*, and *Dryad*: Bryson, *Report*, 53, 80, and 84.

The isolation of the alkaloid quinine from cinchona bark in 1820 by two French chemists at the forefront of laboratory pharmacology was the most significant development that led to further change in the therapeutic landscape. European and British clinical trials to determine its effectiveness began in the mid-1820s and led to claims by some practitioners that it was a "miracle drug." Quinine production consequently spread quickly throughout Europe during the 1820s. Beyond reports of promising clinical results, quinine also had several material advantages, including its increased chemical reliability and less bitter taste in comparison with bark, and the rising importance given to tonics. It, however, did not immediately overtake bark due to its high price and the continued commitment of many practitioners to bloodletting and mercury.[71] Furthermore, within the Navy, inadequate quinine provisions, and surgeons and captains' negotiations over its administration restricted its use. Officers' doubts about the bark's effectiveness also transferred to quinine, further constraining surgeons' clinical choices. Lastly, due to the Navy's earlier commitment to bark, many surgeons remained wedded to that drug.[72]

Despite some modest advances, significant obstacles thus ensured that there was no immediate breakthrough within or beyond the Navy. As disease and mortality continued, West Africa's reputation as deadly solidified. Colonial Britons' outlook generally became increasingly pessimistic as they tried to process the dire situation of the late 1820s. One colonist claimed that "the climate of Sierra Leone is so bad that nothing can live in it, not even a musquito [sic]." In regard to supposedly salubrious Fernando Po, the superintendent morbidly issued orders to his work crews: "Gang No. 1 to be employed digging graves as usual. Gang no. 2 making coffins

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[71] Curtin, *Image*, 194-95; Harrison, *Medicine in an Age*, 197-98; Gelfand, *Rivers*, 15-16; Pierre-Joseph Pelletier, and Joseph-Bienaimé Caventou, *Analyse chimique des quinquina: suivie d'observations médicales sur l'emploi de la quinine et de la cinchonine* (Paris: Chez L. Colas Fils, 1821); François Magendie, *Formulaire pour la préparation et l'emploi de plusieurs noiveaux médicamens,* 4th ed. (Paris: Chez Méquignon-Marvis, 1824), 59-72. For quinine's promise, see also Webb, 102-104; Headrick, *Tools*, 66; Carlson, *African Fever*, 47.

[72] Admiralty, *Regulations and Instructions* (1825), 21, and appendix 1; Carlson, *African Fever*, 48-49.

until farther [sic] orders."[73] Beyond British colonial settlements, the pessimistic mood also overtook the African Squadron. Surgeon Peter Leonard's memoir recounts meeting another Squadron ship, whose captain predicted the death of the part of his crew admitted to the colonial hospital in Freetown following a fever outbreak during river boat service.[74]

Consequently, the "White Man's Grave" began to gain popular credence because it expressed the increasingly perceived reality of the region. This representation appears to have originated in West Africa among colonial Britons who borrowed it from a Portuguese commission. It appeared in magazines and journals during the demoralizing 1820s, and saw increasing use during the early 1830s.[75] A widely read travel account, *The White Man's Grave*, brought the term into widespread usage from the mid-1830s. It asserted that, "In England the very name of Sierra Leone is synonymous with pestilence and death; it is known as the White Man's Grave— the Sepulchre of Europeans." The same work quotes a colonial shopkeeper's claim that, "No white man was justified in coming there whose means, however limited, would admit of bare existence in England; to come was a species of suicide."[76] While several reviews criticized the work as a highly derisive exaggeration, such biting descriptions reflected many peoples' perceptions, and the saying's staying power.[77] The next section investigates this popular image, the Navy's expanding commitments in West Africa, and surgeons' continued attempts to empirically and scientifically understand and combat fevers during the 1830s.

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[73] For the Bathurst example: Leonard, 76. For the gang orders: Leonard, 169; Richard D. Semba, *The Vitamin A Story: Lifting the Shadow of Death* (Basel, Switzerland: Karger, 2012), 8.
[74] For the case of *HMS Plumper*: Leonard, 39-40, and 73; Boyle, 133-34.
[75] Curtin, *Image*, 179; Carlson, *African Fever*, 10; Anon, *The Monthly Repository of Theology and General Literature*, New Series, 4 (1830): 193; Anon, *Northampton Mercury*, no. 31 (Sept. 22, 1832); 2; Anon, *Colburn's New Monthly Magazine*, part 2 (1833), 209.
[76] Curtin, *Image*, 324; F. Harrison Rankin, *The White Man's Grave: A Visit to Sierra Leone, in 1834* (London: Richard Bentley, 1836), 138-39, and 141-42.
[77] B.L., *The London and Westminster Review*, vol. 3 & 25, no. 2 (July 1836): 311-13. Anon, *The Metropolitan Magazine* 16 (1836): 9; Anon, *The United Service Magazine*, part 1 (1837): 365.

5.3 THE POLITICS AND TENSIONS OF EMPIRICAL SCIENCE, 1830-1838

The application of medical science in and off of West Africa during the 1830s again led to increased and refined knowledge related to its hostile disease environment. In a broader context, as discussed in previous chapters, the medical profession, the Navy and British society adopted this approach during the 1820s and 1830s. The resulting understanding of British activity contributed to the questioning of Britain's presence and strategy in West Africa. Increasing recognition of logistical and strategic issues challenged the persuasiveness of the antislavery, commercial and civilizational rationales for British activity.[78] As the lynchpin of British strategy and a natural point of debate regarding antislavery and imperial interests, Sierra Leone came under intense scrutiny. As Seymour Drescher and others have shown, critics attacked Sierra Leone as an economic and strategic failure as the campaign for emancipation geared up in the early 1830s. The general critique was that its agricultural, commercial and civilizing efforts were uneven in their development and disappointing in their returns.[79]

While critics put forth ideological and economic challenges, they also attacked Sierra Leone's poor climate and high mortality. For example, geographer and imperialist James MacQueen invoked the memory of those lives lost during the 1820s.[80] The attacks on Sierra Leone and the pessimistic view of West Africa's climate both helped to draw British activity into question. This process played out in parliamentary commissions and debates. An 1827 Royal Commission produced a detailed medical geographic study that dismally portrayed Sierra

[78] Curtin, "White Man's Grave," 103; Lambert, *Mastering*, 150-152.
[79] Everill, *Abolition*, 81-83, 85, and 87; Drescher, *Mighty Experiment*, 96-100; Lambert, *Mastering*, 150-154; David Lambert, "Sierra Leone and Other Sites in the War of Representation over Slavery," *History Workshop Journal*, 64 (Sept. 2007), 108; Bronwen Everill, "The Colony Has Made No Progress in Agriculture': Contested Perceptions of Agriculture in the Colonies of Sierra Leone and Liberia," in *Commercial Agriculture, the Slave Trade and Slavery in Atlantic Africa*, 187-190.
[80] For MacQueen, see Lambert, *Mastering*, esp. 162-164.

Leone's climate and mortality. By 1830, a parliamentary committee chaired by Radical MP Joseph Hume concluded that West Africa "may be considered as generally unhealthy and dangerous to European constitutions, and in some years to a very great degree."[81]

In Parliament, Hume brought the ideological, economic and climatic critiques together in an 1830 attack on the imperial and commercial project in Sierra Leone. He portrayed Sierra Leone as a wasteful humanitarian escapade and questioned its viability based on analysis that showed its unstable population and continued deficits. He also asserted that "the climate was fatal to all Europeans who were sent out, and so unhealthy was Sierra Leone itself, that the Blacks perished there nearly as fast as the Whites." Abolitionist and humanitarian leader Thomas Fowell Buxton rebutted that Hume overstated Sierra Leone's economic difficulties and unhealthiness. Tacitly acknowledging the reality of disease, however, he accused the government of sending "a description of soldiers totally unfit for the climate, when it was known that a force of black or brown men would be sufficient."[82]

In the end, the combination of these problems led the committee chaired by Hume to recommend reducing the British personnel assigned to the coast of West Africa, "in the Naval, Medical and Civil Departments, to the smallest number possible." While the government issued orders to reduce the British presence in West Africa and to replace non-essential personnel with Africans, Sierra Leone's role as the logistical and legal base for naval suppression ensured that the government could not abandon it altogether.[83] Somewhat counterintuitively, the Navy

[81] Lambert, *Mastering*, 152, and 166-167; Curtin, *Disease*, 16; Carlson, *African Fever*, 11; James Rowan, and Henry Wellington, "Report of the Commissioners of Inquiry into the State of the Colony of Sierra Leone," *PP*, 1826-27 (312): vii, 267, p. 8-12, and 104-111; Joseph Hume, "Report from the Select Committee on the Settlements of Sierra Leone and Fernando Po," *PP*, 1830 (611): x, 405, p.3.
[82] Drescher, *Mighty Experiment*, 98-99. For Hume: *Hansard*, 2nd ser., Vol. 25 (June 15, 1830), col. 395-399. For Buxton: *Hansard*, (June 15, 1830), col. 399-400.
[83] For the proposal to cut down British personnel: Curtin, *Disease*, 16; Carlson, *African Fever*, 11; Curtin, "White Man's Grave," 103-104; Hume, "Report on the Settlements of Sierra Leone," 3.

actually further expanded its commitments to naval suppression efforts during the 1830s.[84] Even then, this strategy came under increasing scrutiny due to its failure to make significant progress in ending the slave trade, and growing recognition of the difficulties that it faced.[85]

During the 1820s and 1830s, the tactical and logistical issues that the Navy faced became increasingly apparent both in the Admiralty and among antislavery advocates. The impracticality of patrolling the coast of West Africa forced the Squadron to focus on certain regions. Its shifting priorities, however, allowed the slave trade to return to areas where there was a weaker naval presence. When the fleet's older sloops and brigs encountered illicit slavers, they often could not intercept the faster slave ships. A muddled international legal situation also allowed slavers to use flags and papers of convenience to avoid capture and condemnation.[86] The conditions associated with naval suppression also remained deplorable as the Navy still overloaded its ships with men, and the horrific conditions on slave ships continued.[87]

Despite these issues, few calls for complete withdrawal of the Squadron emerged in the 1820s and 1830s. In response to the debates over suppression strategy, the government devoted increasing attention to developing the treaty and court structure that allowed the Squadron to capture more illicit slavers. The emergence of this legal-diplomatic framework did not fully address the strategic problems that had begun to receive criticism. Naval suppression remained the cornerstone of the broader strategy, and the Admiralty and Foreign Office attempted to shift

[84] For the Squadron's expansion again, see Eltis, 92. For abolitionists and suppression: Seymour Drescher, *Abolition: A History of Slavery and Antislavery* (New York: Cambridge University Press, 2009), 273-75.
[85] For questioning of the suppression strategy: Everill, *Abolition*, 82-83, and 101; Lambert, *Mastering*, 152.
[86] Everill, *Abolition*, 82-84; Sherwood, 114-116. For the moving and porous nature of patrols: Eltis, 91. For chasing and capturing slavers: Eltis, 84-85; Ryan, "Price of Legitimacy," 234. For an example, see Leonard, 33-35.
[87] Leonard's *Records of a Voyage* included evidence of the difficulties encountered during suppression efforts. As Padraic Scanlan has shown, Leonard's memoirs present contradictory views on slavery and the slave trade due in part to his frustrations with suppression efforts and commitment to imperialism. Sherwood, 119-120; Eltis, 91; Bryson, *Report*, 256. For Leonard see: Leonard, esp. iii-iv; Anon, *The Literary Gazette*, no 844 (Mar. 23, 1833): 177-180; Scanlan, "A Bloody War or a Sickly Season."

blame for the disappointing progress. The Admiralty's tepid enthusiasm for the mission also led to accusations that it was not fully committed to pursuing its duties.[88]

While these accusations reflected Admiralty officials' frustrations with the strategy, most Squadron officers and surgeons remained begrudgingly committed to their duties. They called on the Navy to move the station's base to one of the islands off of the Bight of Biafra. The 1830 Royal Commission backed the proposed move to Fernando Po, concluding that the island would be a more convenient base given the Squadron's focus on the Bights of Benin and Biafra. It also stated that "there is reason to suppose that it will prove more healthy than any of the Settlements yet made on the Coast."[89] Campaigning by Sierra Leonean interests and questioning of Fernando Po's salubrity, however, ensured that the island did not supplant Sierra Leone.[90]

During the 1830s, a general consensus emerged that the combination of colonial settlements and naval force alone could not suppress the Atlantic slave trade. Antislavery, imperial and naval interests, however, could never agree on the necessary strategic and logistical changes to improve the system. Despite this strategic stalemate, the African Squadron and its surgeons confronted the continuing realities of service, and began to more systematically develop scientific knowledge during the 1830s.[91] This resulted from the convergence of surgeons exceeding their duties on their own initiative, parliamentary and Admiralty-ordered efforts, and practical developments within the medical profession.

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[88] This part of the British antislavery world system was, in part, a response to the difficulties of accomplishing suppression (Huzzey, *Freedom*, 51-65). For the diplomatic and legal system, see also Eltis, 95-90; Sherwood, 114-116; Drescher, *Abolition*, 273-74. For the Foreign Office and Admiralty: Eltis, 90; Sherwood, 115-116.

[89] These islands are today São Tomé, Príncipe, and Bioko. House of Commons, "Report on the Settlements of Sierra Leone," 4-5; Brown, *Poxed*, 117; Sundiata, 34; Everill, *Abolition*, 89-90; Lambert, *Mastering*, 168-170. See also Robert T. Brown, "Fernando Po and the Anti-Sierra Leonean Campaign, 1826-1834," *The International Journal of African Historical Studies* 6, n. 2 (1973): 249-264.

[90] *Hansard*, 2nd ser., Vol. 25 (June 15, 1830), col. 399; Leonard, 36, 227-230, and 239; Bryson, *Report*, 20, 68-70, and 73-75. Beyond the previous footnote, see Sundiata, 35-36; Lambert, *Mastering*, 172-174.

[91] Everill, *Abolition*, 97-98, and 102; Curtin, *Image*, 344; Huzzey, *Freedom*, 12, and 208.

Taking advantage of the opportunities presented by Britain's expanding presence in West Africa, during this period, surgeons and colonial practitioners wrote a diverse range of reports and books recounting their experience and presenting their medical and scientific findings. James Boyle, a veteran naval surgeon seconded to Sierra Leone as Colonial Surgeon, published a sweeping medical study of West Africa that embraced the approach of medical topography. His apparent hope was that doctors could develop solutions to the problems posed by African service and protect British manpower and resources. Boyle's account brought together his observations from colonial service, and "the records, also, of our naval and military medical practitioners" through case histories, compilation, and synthetic analysis. Beyond medical topography, he also relied heavily on clinical practices such as case observation and postmortem dissection.[92]

Although Boyle's study was more ambitious and synthetic than much of the work completed by surgeons during the late 1820s and 1830s, his approach was symptomatic of broader developments in naval practice. From the late 1830s, surgeons increasingly applied the clinical, pathological, surgical, and anatomical methods that they learned and refined during their education and service. Above all, they thus gathered more sophisticated empirical data. Their efforts underpinned Bryson's assessment that there had been "great improvement both in the monthly and quarterly returns, but more particularly in the journals" kept by surgeons especially during the 1830s. In several ways, Bryson was exemplary in this regard. He served on the African Station as an Assistant Surgeon from 1831-32. His journal presented a broad clinical and pathological analysis of case histories and clinical matters grounded in pathological knowledge,

[92] Curtin, *Image*, 344; Curtin, *Disease*, 25; Lambert, *Mastering*, 165-166. For the general approach and records: Boyle, v-x, and xv. See also reviews of Boyle: Anon, *M-CR* 16, no. 32 (Apr. 1, 1832): 408; Anon, *LMSJ* 2, no. 28 (Aug. 11, 1832): 54-55. For medical topography: Boyle, xiii-xiv, ch. 1, and ch. 6; Anon, *M-CR* (Apr. 1, 1832): 408-411; Anon, *LMSJ* (Aug. 11, 1832): 55-57; Anon, *EMSJ* 37 (Jan. 1832): 136–145. For examples of the other approaches: Anon, *M-CR* (Apr. 1, 1832): 412, and 417-420; Anon, *LMSJ* (Sept. 8, 1832): 176–177. For Boyle's scientific analysis of the 1823 and 1829 fever epidemics, see Boyle, ch. 5.

observation, and dissection-based findings. His call to practitioners to scientifically and pathologically explain the action of mercury, using all available evidence, demonstrated a faith in positivist and empirical medical science that junior surgeons increasingly shared.[93]

Meanwhile, shifts in the Squadron's demography and mortality patterns also helped to drive surgeons' increasing commitment to empirical analysis. Junior surgeons took the place of Napoleonic veterans during the 1830s. While there were many Scottish-educated surgeons in this new generation, there were also many London-trained medical officers. Regardless, both groups brought increasing practical scientific medical training, and commitment to these approaches to bear on their work within the Navy. Beyond this, Bryson assessed that, "between 1831 and 1836 the squadron, considering the nature of the climate in which it was employed, continued healthy; the active exciting [immediate precipitating] cause of epidemic fever having remained apparently dormant upon the whole line of coast." Thus, despite continued coastal and river patrols, there was only one epidemic episode. Furthermore, endemic fevers and deaths were mainly tied to long periods of boat service.[94] This lull in fever's virulence allowed surgeons to devote more attention to recording and examining their observations, and doing so in light of previous epidemics. For a brief period, the experience of seasoned surgeons, and fresh perspectives of recently educated junior medical officers also overlapped.[95]

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[93] Curtin, *Image*, 344; Curtin, "White Man's Grave," 106; Carlson, *African Fever*, 37; Bryson, *Report*, xiii; Admiralty, *Regulations and Instructions f* (1835), art. 40, p. 40-41. For the cases and mercury: Bryson, ADM 101/88/3, f. 27-28, and 34-35. For his clinical remarks: Bryson, f. 34-38.

[94] While uncertain why this lull in outbreaks had occurred, he attributed it more to favorable climatic conditions than surgeons' therapeutic interventions. Bryson, *Report*, 94, 97-99, and tables from 105-110. For quote: Bryson, *Report*, 129. See also Troubridge, and Wilson, "Statistical Reports. Part II.," *PP*, 1841, Session 2(53): vi, 247, p. 1-74.

[95] The number of Napoleonic-era surgeons assigned to active service decreased during the 1830s, particularly on trying stations such as the African Squadron. The small vessels assigned to the Squadron also increasingly carried young Assistant Surgeons often with limited naval experience. Bryson represents this new generation that replaced the generation of Napoleonic veterans. Gelfand, *Rivers,* 57; McLean, *Surgeons*, 66-68. See also Bryson to Burnett, Oct. 5, 1832, NA, ADM 97/133/1741. For Bryson, see Bryson, NA, ADM 101/88/3, f. 34-38, and Alexander Bryson, "Journal of HM Brigantine Griffon, " 1832-33, NA, ADM 101/103/4, vol. 1, f.19-20, and vol. 2, f. 18-19.

Surgeons' continuing scientific efforts contributed to gradual theoretical and practical changes. The combination of everyday practice and retrospective analysis led to shifts in fever classification and treatments during the late-1820s and 1830s. Authorities and practitioners attempted to further refine their understanding of fevers' progression. Physician Southwood Smith, also known as a public health figure, expressed the rationale of these efforts based on morbid pathology. He stated that, "the evidence is as complete as observation during life and inspection after death can make it, [sic] that a morbid change does take place in a certain number of organs in every case of fever." Their attempts to describe this pathological process led to a profusion of theories linking decaying organic matter to marsh-swamp miasmas, inflammation and dysfunction of the nervous system.[96] An increasing consensus that tropical heat and moisture accelerated putrefaction and thus miasmas also underpinned these refined theories.[97]

Robert McKinnal presented his own nervous-miasmatic theory in an 1831 article analyzing the fever epidemics abroad the *Sybille*. His belief that miasmas emanating from the ship's hold had triggered the outbreaks led him to develop a logical if misleading general theory. McKinnal addressed differences in outbreaks between ships, arguing that the risk of epidemic fever "depends on the kind, age, and quality of the wood of which the vessel has been built, or with which she has been repaired. Atmospheric causes contribute also, no doubt, to the production of the disease, not only by favouring decomposition and the formation of noxious effluvia, but also by rendering the body more susceptible of their influence."[98]

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[96] Smith, *Treatise on Fever* 27-28; Boyle, 321, and 337; Bryson, *Report*, 5, 42, and 74; Harrison, *Medicine in an Age*, 95-96, 102, and 186-187. For Bryson's views: see Bryson, NA, ADM 101/88/3, f. 37-38.
[97] Smith, *Treatise on Fever*, 24; Boyle, 42, and 124; Leonard, 69; Bryson, *Report*, 13, and 162; Maccullough, 58-63, and 139-145; Curtin, *Image*, 349.
[98] For McKinnal: McKinnal, "Origins, Progress, and Termination," 40; partially quoted in Lloyd, 134-35; Bryson, *Report*, 54-55. For atmospheric influences, See also Boyle, 75-76. For continued life of constitution and habit, see Anon, *LMSJ* (Aug. 11, 1832), 57–58, and 175. For these possible origins of fevers: Curtin, *Image*, 350.

The focus of many practitioners on the climate's observable effects not only ensured the staying power and increasing sophistication of miasmatic theories, but allowed alternative systems for classifying fevers to develop. Questions about the positions that yellow fever, climate, and geography should hold within the system based on remittent and intermittent divisions emerged. In light of the epidemics of the 1820s, practitioners increasingly recognized yellow fever as a distinct disease.[99] Furthermore, topographical research led to a new conception of fevers grounded in an empirical understanding of geographic differences. Based on these factors, Boyle proposed a classification system for fevers that appended geography onto the existing ones. This new system, as Philip Curtin has emphasized, freed Boyle and others from the orthodoxy of existing medical practices.[100]

The practical developments of the 1830s, however, cannot be attributed solely to Boyle's influence. The combination of the rising use and sanction of scientific approaches and the questioning of existing fever understandings allowed surgeons to place greater emphasis on experiential and observational findings. This led to the adoption of a more cautious approach to treating fevers during the 1830s. Based on results from bloodletting and mercury, more surgeons began to see them as ineffective and even potentially deleterious. In his 1831 study, Boyle posited that the circumstances of each case should inform the course of treatment.[101] Bryson concluded that, "On the Coast of Africa the empirical use of calomel is still had recourse to in too many instances, and with a credulous and blind assiduity administered to an unmeaning

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[99] Curtin, *Image*, 185. For the debate over yellow fever: Harrison, *Medicine in an Age*, 261-284. For an example and description of yellow fever's supposed nature, treatment, and contagiousness, see John Coulter, "Journal of HM Surveying Ship Aetna," 1837-38, NA, ADM 101/81/2, f. 24-28.

[100] Among Boyle's divisions were climatic bilious remittent, endemic remittent, and yellow fever. Curtin, *Image*, 347-348; Curtin, *Disease*, 25; Carlson, *African Fever*, 37. See Boyle, i-iii, and chs. 2-5; Anon, *EMSJ* (Jan. 1832), 145-147.

[101] Curtin, *Image*, 357-358; Curtin, *Disease*, 25. For bloodletting: Boyle, 114-116, and 132-135. Anon, *M-CR* (Apr. 1, 1832), 412-414; Anon, *EMSJ* (Jan. 1832), 147, and 149-150. For mercury: Boyle, 116, and 175-80; Anon, *EMSJ* (Jan. 1832), 150-51, and 163-64.

extent for the purpose of producing ptyalism. Unfortunately for medical science its most strenuous advocates have hitherto been unable to explain satisfactorily the real nature of the benefits they expect to result from its use nor can they define its action…"[102]

Beyond Bryson's views, an emerging consensus comes through in one naval surgeon's asseessment that "general bleeding, although it appeared to be beneficial in the majority of cases, could not be employed in all; and when practicable, the lowness of type, and alarming debility of the second stage, rendered it necessary to proceed with the utmost caution; the state of the pulse and tendency to congestion were the principal guides in this respect." In regard to mercury, another surgeon asserted that it "had previously been exhibited in larger doses, but severe salivation was not approved of, as those who were so treated, if they recovered, suffered from repeated attacks of the disease subsequently."[103] Despite the increasing consensus, numerous instances in which surgeons still employed bleeding and mercury can also be cited. Some practitioners even continued to aggressively employ bleeding and mercury in epidemic fever cases.[104] It is thus fair to say that fever therapeutics had entered a period of flux.

Nonetheless, over time, the use of bleeding and mercury declined, and quinine's standing slowly grew because practitioners acknowledged that it was an effective additional tool. The cautious approach to bark and quinine that emerged can be seen in Boyle's recommendations. He first highlighted cinchona bark's unpredictable effects in different fever types and cases, and sided against employing it beyond a tonic role. Based on practical experience and case histories, however, Boyle recommended tonic quinine in combination with mercury for remittent and

[102] For Bryson's quote: Bryson, NA, ADM 101/88/3, f. 34.
[103] For bloodletting: Bryson, *Report*, 128. See also Bryson, *Report*, 112, 114, 118, and 124. For mercury: Bryson, *Report*, 76-77, and 113. See also Leonard, 73-75.
[104] For antiphlogistics: Carlson, *African Fever*, 44; Bryson, *Report*, 111-12, 114, 118, and 124; Boyle, 196.

intermittent fevers.[105] Surgeons' clinical use of quinine and experiments during this period also yielded mixed results. Bryson summed up the emerging view, writing that quinine and cinchona bark while "already noticed as tedious and uncertain are of great benefit, and naturally assist in prevention debilitating paroxysms of fever." Positive results began to accumulate gradually, and the use of quinine increased as more surgeons began to employ it on their own authority.[106]

The result of these therapeutic developments was an increase in the state of flux within medical practice on the coast of West Africa. Surgeons' divergent views still largely determined the combination of treatments that each employed. Edinburgh graduate Dr. James McWilliam's journal detailing his service aboard *HMS Scout* illustrates the complex practical views of a scientifically inclined naval surgeon.[107] During the Springs of 1837 and 1838, the *Scout* patrolled the mouth of the Calabar River, anchoring "in the most sickly part of the river" and detaching boats up river to Old Calabar for roughly two weeks. McWilliam reported that "bark and rum were regularly given to the men night and morning, and apparently with good effect, as the whole of the party, with but one exception, returned to the ship in good health." Employing bark prophylaxis according to the letter of his orders, McWilliam did not expand the practice or attempt to test quinine as a therapeutic. In fever cases, he employed a wide-ranging combination of treatments, including bleeding, cathartics, mercury, antimonials, opium, tonic quinine, saline

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[105] Headrick, *Tools*, 66. For views on bark: Boyle, 116, 159-160, 164, 169, 197, and 199; Anon, *M-CR* (Apr. 1, 1832), 413; Anon, *EMSJ* (Jan. 1832), 152. For views on quinine: Curtin, *Image*, 358; Boyle, 115-16, 136, 180, 187, 190, 197, 215, 217, and 291.

[106] Headrick, *Tools*, 66; Bryson, *Report*, 77, and 118. For quote: Bryson, NA, ADM 101/88/3/f. 35.

[107] McWilliam joined the Navy in 1829 after completing his initial training at the University of Edinburgh. During leaves, he continued his training in London hospitals and at Edinburgh where he graduated with a dissertation on tropical fever pathology in 1840. At Edinburgh, he took Practice of Medicine, Chemistry, Natural History, and Military Surgery from 1825-1827, and Institutes of Medicine and Surgery in 1833. He passed his exams in physiology, botany, and chemistry with average marks, and anatomy, surgery, midwifery, medical practice and Materia Medica with highest marks. His journal received the Blane Gold Medal in recognition of his medical and scientific achievements. Admiralty, "Service Record of James O. McWilliam," NA, ADM/196/8/f.110; McWilliam, "Exercise book of Alexander Keith," June 1839, WL, MS.6831/1; Anon, *MTG* (May 17, 1862): 520. For his training: University of Edinburgh, EUA/IN1/STA/3, vols. 1825-1827, and 1833-1834; University of Edinburgh, EUA/IN1/STA/8, Vol. 1840; University of Edinburgh, *Lists of Graduates*, 123; Willcox, "McWilliam," 127–29.

mixtures and anodynes.[108] The existence of parallel and even conflicting schools of thought in a single person, let alone the profession, was not uncommon.

The fluidity of tropical medical practices, and failure of quinine and bark to overtake bleeding and mercury as primary treatments invite additional observations. While quinine benefited from some positive results, and its improved taste, increased standardization, and deceasing cost made it more acceptable to many, it faced several obstacles. The Navy's pioneering role in adopting prophylactic bark-wine and continued commitment to this practice made it difficult for quinine to make significant inroads.[109] Furthermore, quinine's apparent failures in other areas led to continued opposition. There was profound disagreement regarding the protocol and dosage for administering it. Facing such conflicting findings, most practitioners continued to employ quinine as a low-dose, late-stage tonic, while a few began to experiment with it as a first-line, high-dose treatment for intermittent fevers. Quinine prophylaxis, however, still remained the least common view among naval surgeons.[110]

The refined understanding of the threat that tropical fevers posed developed more rapidly than these modest therapeutic shifts. Beyond the etiological, nosological, and therapeutic realms, the government, Army and Navy all began to apply the emerging approach of medical statistics to questions of disease and mortality. Surgeons gradually developed unimpeachable statistical evidence that West Africa was the deadliest service station during the 1820s and 1830s. The report of the 1827 Royal Commission on Sierra Leone already included a variety of mortality

[108] Bryson, *Report*, 116-117, and 126. For Old Calabar: G. I. Jones, *The Trading States of the Oil Rivers: A Study of Political Development in Eastern Nigeria* (Oxford: OUP, 2000), 11-13; Toyin Falola, and Bukola Adeyemi Oyeniyi, *Nigeria* (Santa Barbara: ABC-CLIO, 2015), 296.
[109] Curtin, *Image*, 355; Carlson, *African Fever*, 51; Admiralty, *Regulations and Instructions* (1835), art. 9, p. 23-24. For difficulties that McWilliam had in administering bark without wine: Bryson, *Report*, 116.
[110] Carlson, *African Fever*, 49-50, and 52-53; Curtin, *Disease*, 23. For the question of dosage, largely in an American context, see Dale C. Smith, "Quinine and Fever: The Development of the Effective Dosage," *Journal of the History of Medicine and Allied Sciences* 31, no. 3 (1976): 343–367. For mention of these differences in opinion, see Boyle, 196.

statistics related to the British presence in West Africa, but did not carry out aggregate analysis.[111] The more comprehensive army and naval statistical projects of the 1830s turned to West Africa in reports published in 1840-41 to be discussed in the next chapter. Nonetheless, the institutional focus on nosological returns from the 1830s gave added impetus to the clinical reporting practices fostered by the Naval Medical Department.[112]

This turn toward quantification coincided with the end of the lull in fever's virulence in the late-1830s. An elevated pattern of endemic and epidemic fevers emerged, capped off by the death of ten surgeons between mid-1837 and mid-1838. This alarming recurrence drew the attention of Burnett and the Lords Commissioners.[113] Individual shipboard disasters dramatized the situation. One of the more devastating outbreaks befell *HMS Bonetta*, on which virulent yellow fever resisted treatment. As the situation deteriorated, the two medical officers, captain, master, and twenty-eight seamen and marines contracted the fever. By that point, they "were all lying aboard deck in a most helpless and melancholy state, three with black vomit, and to all appearance beyond the aid of medicine. The vessel was in a very filthy condition, the stench from the holds being almost insupportable, and totally incompatible with health."[114] In the wake of the epidemics of late-1837 and 1838, the Admiralty finally ordered regularized reporting of all fever outbreaks and deaths on the African Squadron.[115] This reinforced the scientific approach

[111] Headrick, *Power,* 228. For application of statistics: Carlson, *African Fever*, ch. 5; Headrick, *When Information Came of Age*, esp. 81-89; Curtin, *Death*, 162-165; Curtin, *Image*, 360-361. For 1820s and 1830s: Headrick, *Tools*, 62-63; Rowan, and Wellington, 12-13, 20, and 108-110.

[112] Carlson, *African Fever*, 69; Dutton, "Royal Navy Data in the 19th Century"; Alexander M. Tulloch, "Statistical Report on the Sickness, Mortality, and Invaliding among the Troops in Western Africa, St. Helena, the Cape of Good Hope, and the Mauritius. Prepared from the Records of the Army Medical Department and War-Office Returns," *PP*, 1840(228): xxx, 135, p. 7-8; Wilson, "Statistical Reports on the Health of the Navy," *PP*, 1841, Session 2(53), vi, 247, p. 1-74. For statistics and reporting: Curtin, *Image*, 344; Bryson, *Report*, xiii.

[113] Bryson, *Report*, 129-135. See Burnett, memo, July 23, 1838, NA, ADM 105/38/f.108.

[114] Bryson, *Report*, 121-122. See also John Wilson Elliot to Burnett, Feb. 17, 1838, NA, ADM 97/144/289. For another case, see Coulter, NA, ADM 101/81/2, f. 24-28.

[115] For returns on the death of medical officers: Burnett, memos, July 23, 1838, NA, ADM 105/38/f.108; and July 23, 1838, NA, ADM 105/38/f.108. For medical reports on fever: McKechnie to Burnett, Aug. 12, 1837, NA, ADM

that had emerged institutionally and among the Squadron's surgeons. It also coincided with another period of expansion of the ships and manpower assigned to the African Squadron that began in the late-1830s. Abolitionists and government officials, including Foreign Secretary Lord Palmerston, focused their attention, and their growing national and public influence on the global project of slave trade suppression.[116]

5.4 THE STRUGGLE AGAINST THE WHITE MAN'S GRAVE

During the early nineteenth century, increased British imperial activity in and off the coast of West Africa led to both the perception and reality of sustained losses. The Royal Navy's crews involved in the suppression of the slave trade, colonial forces and actors in Sierra Leone, and rising palm oil traders zealously pursued their missions, and suffered from high mortality and morbidity. The horrific state and health of recaptured slaves also continued to focus attention on the horrors of the slave trade. Under different circumstances, the British might have followed through with recommendations to effectively withdraw from tropical Africa. Nonetheless, the antislavery, commercial, civilizational and imperial missions became increasingly influential, and the interests backing them ever more powerful. Due to the metropolitan decision to continue and expand operations in and off the coast of West Africa, the Navy had to confront the conditions of African service. Surgeons in particular faced the arduous and important duty of fighting the harsh disease environment and appalling conditions on both the African Squadron and illicit slavers.

97/143/2556; McKechnie to Burnett, Sept. 27, 1837, NA, ADM 97/143/2557; Burnett, memos, July 24, 1838, NA, ADM 105/72/f.14-16; and Aug. 17, 1838, NA, ADM 105/72/f.19-20.

[116] See Eltis, 92; Drescher, *Abolition*, 273-75.

As British imperial and naval activity increased in the early nineteenth century and a network of interlinked colonial settlements emerged, colonial Britons faced a series of recurring fever epidemics during the 1820s and 1830s. The pessimism that emerged among British colonial actors gave rise to the belief that disease and death awaited Britons in West Africa, as well as the depiction of the region as the White Man's Grave. Despite having first-hand knowledge of the human costs of the White Man's Grave, colonial practitioners and naval surgeons rejected viewing the reality that they confronted in this way. They rather maintained a hardened, duty-bound and positivist mindset, which drove them to search for a medical solution to the problems posed by tropical fevers. Naval surgeons especially took advantage of the opportunities that service offered, relying increasingly on empirical, observation-based methods during often-desperate attempts to forestall fever outbreaks.

As colonial practitioners and naval surgeons committed themselves to their medical duties and efforts, they increasingly questioned the theoretical and therapeutic system that prescribed early-nineteenth-century fever practices. Mark Harrison has shown that military and colonial surgeons' practical efforts in the late-eighteenth and early-nineteenth century Atlantic and India refined the miasmatic theoretical system in ways that initially led them to advocate a return to heavy bloodletting, mercury and purging. By the 1830s, however, a new generation of Scottish and London-educated practitioners and naval surgeons trained in the latest medical scientific and anatomical pathological approaches ran head-on into the ineffectiveness of the existing system and practices. While it was difficult to move from understanding the fever problem to developing new solutions, the same empirical practices that provided evidence for the White Man's Grave led to increasing disagreements over pathological and therapeutic theories.

Furthermore, although bleeding and mercury slowly declined in the face of overwhelming empirical evidence of their ineffectiveness, they had significant staying power as no clear alternative immediately gained favor. The naval medical service and its surgeons diverged from many other practitioners, embracing therapeutic and prophylactic cinchona bark at an individual and an institutional level during the 1810s and 1820s. Nonetheless, skepticism among the medical ranks, logistical issues, and resistance from sailors and officers all blunted the acceptance of this early recommendation. Furthermore, even as quinine showed promising results and gained supporters in the 1820s and 1830s, it had to struggle to displace anti-phlogistic and cinchona therapies. It remained largely a secondary tonic drug.

In regard to the issues encountered in African service, the Naval Medical Department and its surgeons embraced the empirical scientific mindset and approaches that became increasingly common and influential throughout British medical training and the profession, and in a broader naval context. In a broader colonial perspective, their efforts gave evidentiary backing to the portrayal of West Africa as the White Man's Grave. In short, by the mid-to-late 1830s, surgeons' actions rooted in practical necessity and a commitment to empirical observational approaches had given rise to confusion, as well as the seeds of new practices. As the next chapter will show, this generation of surgeons set the stage for a fundamental transformation of naval and tropical medicine in the 1840s and 1850s. The coming chapter examines how strategic and practical developments related to activity in West Africa, and the broader contexts recurring throughout this dissertation shaped surgeons' efforts and tropical medical practices, culminating in the widespread use of quinine from the late 1840s.

6.0 THE POLITICS OF AN EMPIRICAL REALIZATION: SCIENCE, NAVAL SURGEONS, AND MEDICINE IN WEST AFRICA, 1838-1860

Preparing his initial clinical report in late 1841, as the Niger Expedition convalesced at Fernando Po and Ascension from a disastrous fever outbreak, Acting Surgeon Dr. Morris Pritchett juxtaposed his observations with British and Continental medical and natural scientific theories. He stated that "the vast strides which every department of Science is making in the present day requires renewed vigilance on the part of the professors of the healing art to keep pace with the general improvement, and to render available as well for the prevention as for the care of disease any facts which may present themselves amidst the numerous fields of discovery connected with the Collateral Sciences."[1] Like Pritchett, many African Squadron surgeons placed their faith in medical science's ability to produce therapeutic solutions. As shifts occurred in Britain's West African strategy and medical practice between the late 1830s and the 1850s, their efforts built toward a new practical consensus regarding the treatment and prevention of fevers, and the use of quinine.

Naval surgeons' scientific efforts gained increasing urgency from the late-1830s onward, as shifts in Britain's strategy in West Africa and the rise of institutionalized science shaped their actions. The pivotal change that shaped British policy was humanitarians' mobilization of public opinion and African interests around an interventionist antislavery, commercial and civilizational mission in the late 1830s. As abolitionists' national influence rose, their global efforts became

[1] Pritchett, "Medical Journal of HM Steam Vessel Wilberforce," ADM 101/127/3, report, p. 1.

increasingly focused on the suppression of the slave trade.[2] Due in large part to abolitionists' agitation, Britain's commitment to slave trade suppression expanded, and it adopted a more coercive naval presence.[3] This had significant consequences for surgeons' practical duties, as they confronted the White Man's Grave's continued toll. Liberal, free trade interests, epidemic disasters, and continued mortality helped to call naval suppression into question during the 1840s.[4] Surgeons desperately extended their scientific efforts to confront tropical fevers as naval suppression, political pressure and public outrage grew. These developments ultimately increased medical officers' national reputation and authority, and culminated in the widespread adoption of quinine prophylaxis.[5]

The existing literature has emphasized that the continued rise of empirical practices among British practitioners in West Africa led to a transformation in tropical medicine. The near-axiomatic narrative contends that quinine's emergence at the expense of antiphlogistic treatments led to a rapid decline in European mortality and helped to open Africa to New Imperialism in the later-nineteenth century.[6] This narrative sees quinine as a progressive result of the application of clinical, sanitary and statistical approaches— as Philip Curtin termed it, a "triumph of empiricism."[7] This process, however, was far from predicable, seamless or uncontested. Mark Harrison has investigated the politically, professionally and practically

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[2] Curtin, *Image*, 290-93; Curtin, "White Man's Grave," 104; Everill, *Abolition*, 107-08; Parsons, 61-62; J. Gallagher, "Fowell Buxton and the New African Policy, 1838–1842," *Cambridge Historical Journal* 10, no. 1 (Jan. 1950): 36–58; P. J. Cain and A. G. Hopkins, *British Imperialism: 1688-2000*, 2nd Ed. (New York: Longman, 2002), 99.
[3] For expansion of the Squadron: Sherwood, 115, and 117; Eltis, 92-93; Parsons, 61-62.
[4] Among others: Harrison, "Important Subject," 113-14, 116, and 119-20; Huzzey, *Freedom*, 112-24; Drescher, *Mighty Experiment*, 187-89.
[5] For an analysis of surgeons, the Squadron and professional reforms, see Harrison, "Important Subject," 109-25. For rise of science generally: Richard R. Yeo, "Scientific Method," 283.
[6] For quinine and "mortality revolution," see: Curtin, *Image*, 362; Curtin, "White Man's Grave," 109-10; Curtin, *Death*, 40-61, and 104-29 Headrick, *Tools*, 69-70; Headrick, *Power*, 226; Brunton, 225. For quinine and colonial conquest, see also Brockway, 130; Bouda Etemad, *Possessing the World: Taking the Measurements of Colonisation from the Eighteenth to the Twentieth Century* (New York: Berghahn Books, 2007), 25.
[7] Curtin, *Image*, esp. 357, and 361; Headrick, *Tools*, 66-70; Headrick, *Power*, 230-35; Carlson, *African Fever*, esp. 48-54, 70-71, 79-81, and 86-89.

contentious nature of the medical issues related to British activity in West Africa, as well as naval surgeons' attempts to employ these issues to increase their professional standing.[8]

This chapter analyzes the key role that naval surgeons' empirical and clinical scientific efforts played in changing medical practices in and off the coast of West Africa from the late 1830s. It emphasizes how the convergences and tensions between strategic, political and practical circumstances related to British activity in West Africa conditioned and shaped surgeons' efforts and their impact.[9] This approach foregrounds the relationships between changing approaches to slave trade suppression, the rise of science as a practical and professional force, and surgeons' scientific activities. Surgeons faced ongoing medical difficulties, increasing theoretical and practical questions, and growing hostility toward the suppression mission during the 1840s. Nonetheless, their positivist faith in science's ability to alleviate fevers continued, and Admiralty policies and orders increasingly backed and systematized their efforts. On the African Squadron, sanitary practices emerged, quinine rose in therapeutic prominence, and mortality declined. This chapter begins by investigating the changing strategic impulses behind British activity in West Africa, and examining their ramifications for naval surgeons' medical practices.

6.1 HUMANITARIANISM, SCIENCE, AND NAVAL PRACTICE, 1838-1843

Given the perception of the "White Man's Grave" that had emerged by the mid-1830s, it is somewhat perplexing that British activity in West Africa became more interventionist from the late 1830s. This shift in Britain's strategy coincided with the height of the antislavery

[8] Harrison, "Important Subject," 109-25.
[9] For tropical medicine in the 18th and early 19th century West Indies: Harrison, *Medicine in an Age*, esp. part 3.

movement's national influence, as humanitarian interests became the deciding parliamentary bloc keeping Lord Melbourne's Whig Government in office. As slave trade suppression increasingly became a central focus of abolitionists' global efforts, they applied increasing pressure on the government, and forced it to commit Britain to the antislavery-civilization strategy.[10] Commercial and imperial interests also came together in the overarching strategy during this period. The palm oil trade continued to rise in economic and strategic importance due to industrialization. British merchants increasingly attempted to open new palm oil supplies, and drove the government toward increased diplomatic and military commitments.[11] This trend accelerated as the idea of improving Africa also came to link commercial, civilizational, antislavery and imperial interests during the 1830s.[12] Britain consequently adopted a more interventionist, multi-purposed approach in West Africa.

During the 1830s, some forward-thinking merchants involved in West African trade tried to open new trade routes to bypass coastal middlemen. For example, the Niger River expeditions aimed to find a navigable, healthy trade route following confirmation of the river's course in 1831.[13] Scottish merchant MacGregor Laird, son of a prominent Glasgow shipbuilder, led one of these trading expeditions in 1832. He commissioned two steamships, enlisted experienced

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[10] McLean, *Surgeons*, 66-67; Curtin, "White Man's Grave," 104; Drescher, *Abolition*, 273-74; Curtin, *Image*, 290-91, and 302; David Murray, *Odious Commerce: Britain, Spain and the Abolition of the Cuban Slave Trade* (1980, repr.; New York: CUP, 2002), 134; L.G. Mitchell, *Lord Melbourne, 1779-1848* (New York: OUP, 1997), 195.
[11] Curtin, *Image*, 295; Lynn, *Commerce*, 3, 12-16, and 88-89; Lynn, "West African Palm Oil Trade," 62-66. For an African domestic slavery and palm oil production: Patrick Manning, *Slavery, Colonialism and Economic Growth in Dahomey, 1640-1960* (New York: CUP, 1982), esp. 13-14, and 50-56. For commercial-imperial system: Darwin, *Empire Project*, 36-39, and 123-24; Parsons, 62-63; Robert Johnson, *British Imperialism* (New York: Palgrave Macmillan, 2003), 18-21. For early imperial interventions: Cain, and Hopkins, 85-87, and 99-100. See also Martin Lynn, "British Policy, Trade, and Informal Empire in the Mid-Nineteenth Century," in *The Oxford History of the British Empire: Volume III: The 19th Century*, ed. Andrew Porter (New York: OUP, 1999): 101-21.
[12] For these links, see also John Gascoigne, "Joseph Banks," 42-43; Black, *British Seaborne Empire*, 192-93, and 209. For improvement and its role, see Curtin, *Disease*, 3; Huzzey, *Freedom*, 134-35; Porter, "Commerce and Christianity," 609-13.
[13] Gelfand, *Rivers*, 38-39; Kennedy, *Last Blank Spaces*, 135; Lambert, *Mastering*, 12; Hoag, 74-76. For palm oil trade in the Niger Delta region: Lynn, *Commerce*, 89-93.

African hands such as naval Captain John Beecroft and explorer Richard Lander, and convinced the Admiralty to send an officer as an observer. Despite these efforts, virulent fever struck the expedition, and took the lives of 39 of 48 Europeans by the time it withdrew in August 1833.[14]

Despite these disastrous results, Laird and Glasgow merchant Robert Jamieson remained committed to opening commerce on the Niger. Trying to rationalize the failure, Laird wrote that "the sudden change from the open sea to a narrow and winding river, the want of the sea-breeze, and the prevalence of the deadly miasma to which we were nightly exposed…" caused the fevers. He then posited that steamships could counter this by sailing quickly through the delta's miasma-ridden mangrove swamps.[15] While most British merchants continued with coastal trade, Jamieson organized a series of smaller expeditions up the Niger under the command of Captain Beecroft in 1835-36 and 1839-40. The first expedition suffered 16% mortality; the second, on which Beecroft and a British engineer led an African crew, had greater success.[16]

Even as the fusion of interests that underlay activity in West Africa increased, the "civilization, Christianity, and commerce" approach faced growing criticism during the 1830s. In Sierra Leone, it had failed to suppress the slave trade or "civilize" Africans. This reflected the practical impossibility of forcing African populations and polities that maintained significant independent agency to adopt British antislavery, commercial, and moral conceptions without a

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[14] Hoag 76-77; Headrick, *Tools*, 60-62, and 73; Gelfand, *Rivers*, 38-45. For disease, see also David Livingstone, "On Fever in the Zambesi: A Note from Dr. Livingstone to Dr. M'William," *TESL* 1 (1863): 235–41; MacGregor Laird, and R. A. K. Oldfield, *Narrative of an Expedition Into the Interior of Africa: By the River Niger, in the Steam-Vessels Quorra and Alburkah, in 1832, 1833 and 1834*, vol. 1. (London: Richard Bentley, 1837), 32-33, and 178-79. For the Lairds: Kenneth Warren, *Steel, Ships and Men: Cammell Laird, 1824-1993* (Liverpool: LUP, 1998), ch. 2.

[15] Hoag, 78; Curtin, *Image*, 296-98; Laird, and Oldfield, vol. 1, 121-22. For the role of steamships: Hoag, 82; Headrick, *Tools*, ch. 1; Martin Lynn, "From Sail to Steam: The Impact of the Steamship Services on the British Palm Oil Trade with West Africa, 1850-1890," *The Journal of African History* 30, no. 2 (1989): 227–45; Robert V. Kubicek, "The Colonial Steamer and the Occupation of West Africa by the Victorian State, 1840–1900," *The Journal of Imperial and Commonwealth History* 18, no. 1 (Jan. 1990): 9–32.

[16] Kenneth Onwuka Dike, "John Beecroft, 1790—1854: Her Britannic Majesty's Consul to the Bights of Benin and Biafra 1849-1854," *Journal of the Historical Society of Nigeria* 1 (1956): 11. For expeditions: Curtin, *Image*, 298; Curtin, *Disease*, 20; John Beecroft, "On Benin and the Upper Course of the River Quorra, or Niger," *JRGS* 11 (1841): 184–92. For Laird on African crews: Hoag, 82.

larger and more coercive colonial presence.[17] Rather than rejecting the strategy, many humanitarians asserted that Britain had not pursued civilizational, commercial and antislavery activities zealously enough to succeed. During the 1830s, the existing interests and the humanitarian-evangelical idealism underlying activity in West Africa thus converged. For example, beyond his merchant interests, Laird added an economic dimension to antislavery and humanitarian viewpoints. He argued that Africa needed to be civilized through "the extension and security of legitimate commerce." As part of his proposal, like many abolitionists, Laird emphasized the necessity of suppressing the slave trade in tandem with efforts aimed at commercial and civilizational improvement.[18]

During the late 1830s, a coalition of humanitarian and abolitionist interests advocated a more holistic and interventionist suppression strategy. Abolitionist leader Thomas Fowell Buxton focused humanitarian attention toward international efforts, and a parliamentary investigation into relations with indigenous colonial groups.[19] In late 1837, he turned to the slave trade. Buxton collated writings on it and suppression efforts, and solicited information from experienced African hands. He then devised a comprehensive plan to end the Atlantic slave trade, published in multiple parts between 1838 and 1840. Rising interest in improvement via "civilization, commerce, and Christianity" heavily influenced his thinking.[20] He first rejected Britain's suppression strategy, judging that "millions of money and multitudes of lives have been

[17] Headrick, *Power*, 228-29; Everill, *Abolition*, 33-34, 82-83, 107-8; Porter, "Commerce and Christianity," 609. For missions and Africa: Richard J. Reid, *A History of Modern Africa: 1800 to the Present* (Chichester: Wiley-Blackwell, 2012), 126-29; J. Kofi Agbeti, *West African Church History* (Leiden: Brill Archive, 1986), 9-10.
[18] Headrick, *Power*, 229; Hoag. 82-83; Huzzey, *Freedom*, 135; Laird, and Oldfield, vol. 2, 353-79, esp. 354.
[19] Lambert, *Mastering*, 176-77; Curtin, *Image*, 299; Everill, *Abolition*, 107; Peter Stamatov, *The Origins of Global Humanitarianism: Religion, Empires, and Advocacy* (New York: CUP, 2013), 178. For the Aborigines Committee: Zoe Laidlaw, *Colonial Connections, 1815-45: Patronage, the Information Revolution and Colonial Government* (Manchester: MUP, 2005), 147-59. For antislavery fragmentation: Huzzey, *Freedom*, 9-16.
[20] For collaboration and Buxton's plan: Hoag, 83-84; Curtin, *Image*, 300-02; Lambert, *Mastering*, esp. 2-3, 20, and 177-8. For improvement and the broader strategy: Huzzey, *Freedom*, 134-35; Everill, *Abolition*, 108-10.

sacrificed" while the slave trade had continued to expand. Buxton then argued for measures to strengthen and strategically reform the Squadron.[21]

Meanwhile, the Admiralty and Squadron officers took notice of the mounting public criticism and rising humanitarian power. Foreign Secretary Lord Palmerston, a shrewd supporter of naval suppression, pressured the Admiralty to more forcefully pursue the mission. By late 1839, the Admiralty had expanded the size of the Squadron to an average of seventeen ships and 1,200 men, divided its patrols into two groups to cover more of the West African coast, and ordered them closer into shore. As part of a broader antislavery strategy, Palmerston also pursued forceful diplomacy, coercing other nations into agreeing to antislavery treaties, including ones that authorized the capture of Portuguese and non-identified ships equipped to carry slaves.[22] This aggressive pursuit of suppression played out in specific incidents, including the 1840 blockade of the Gallinas, in which Lt. Joseph Denman, tasked with negotiating an anti-slave-trade treaty, ordered the illegal destruction of a Spanish slave-trader's baracoons.[23]

Buxton attempted to leverage the abolitionist movement's national and strategic power, lobbying vigorously for the parts of his plan that moved beyond naval and diplomatic

[21] Lambert, *Mastering*, 177; Huzzey, *Freedom*, 135; Drescher, *Mighty Experiment*, 166; Lloyd, *Navy*, 275-77. For Buxton's plan: Howard Temperley, *White Dreams, Black Africa: The Antislavery Expedition to the River Niger, 1841-1842* (New Haven: YUP, 1991), 9-15, and 20-22; Buxton, *The African Slave Trade and its Remedy* (London: John Murray, 1840), 16-35, 40-59, and 203-09, esp. 203. For Squadron reform: Curtin, *Image*, 299-300; Buxton, *African Slave Trade and its Remedy*, 283-85, 301-43, and 518-22.
[22] For Squadron's manpower and division: Eltis, 92; Curtin, *Image*, 300, and 304. For coercive diplomacy: Eltis, 89, and 107; Huzzey, *Freedom*, 58-59; Bethell, 155-66; Drescher, *Abolition*, 273-75.
[23] Denman's actions drew praise from the Admiralty and Palmerston, but did not stand up to a suit for property destruction. During mid-1839, Squadron ships also escorted five American-flagged slavers into New York Harbor to publicly express Britain's frustration, and intentionally humiliate the US into action. For Denman: Huzzey, *Freedom*, 115-116; Sherwood, 117; Bethell, 183; Anon, *TFA*, no. 6 (Apr. 19, 1841): 83-84; House of Commons, "Correspondence with the British Commissioners Relating to the Slave Trade," *PP*, 1842(402): xlii, 1, p. 9; Dudley Ryder, and the Select Committee on the West Coast of Africa, "Report from the Select Committee on the West Coast of Africa," *PP*, 1842(551): xi, 1, p. 140, 285-286, and 424; William Hutt, "First Report from the Select Committee on Slave Trade," *PP* 1847-48(272): xxii, 1, p. 62-67. For the American example: Warren S. Howard, *American Slavers and the Federal Law, 1837-1862* (Berkley: University of California Press, 1963), 37; Peter Duignan and Lewis H. Gann, *The United States and Africa: A History* (New York: CUP, 1987), 29.

suppression efforts. He asserted that legitimate commerce was the key to convincing Africans that they should abandon the slave trade. Buxton then proposed a plan to develop plantations as a commercial base to spread agriculture, trade and civilization along the Niger and throughout West Africa. As a first step, he called for a Niger expedition to negotiate local antislavery treaties and open commercial relations.[24] As Bronwen Everill has argued, Buxton's strategy expanded the increasing links between commerce, Christianity, and civilization into a sweeping colonial antislavery scheme. It won significant support from some abolitionist, commercial, imperial, and scientific interests by incorporating many of their ideas and goals related to West Africa.[25]

Despite his lobbying efforts, Prime Minister Lord Melbourne and Palmerston were wary of Buxton's expansive and semi-utopian proposals. They questioned the colonial expansion built into the strategy and its portrayal as a practical solution. Buxton launched a public campaign for his plan that further leveraged humanitarians' social and political power to lobby for an exploratory Niger expedition.[26] Even as mobilization of supporters and respectable opinion through the Society for the Extinction of the Slave Trade and the Civilization of Africa, and lobbying wore down official resistance, significant opposition emerged. Pacifist, abolitionist, anti-colonial, free trade and pro-Sierra Leonean interests expressed reservations regarding its morality, viability and rationality. Given his personal interest in suppression, Palmerston also would have been especially aware of the disease risks associated with the proposed measures.[27]

[24] Drescher, *Mighty Experiment*, 166; Temperley, 9-15, and 20-22; Carlson, *African Fever*, 14; Curtin, *Disease*, 19; Buxton, *Letter on the Slave Trade* (London: John W. Parker, 1838), ix, 146-47, 155, and 161. For legitimate commerce and treaties: Buxton, *African Slave Trade and its Remedy*, 271-73; Buxton, *Letter*, 186-95, and 197-99. For the expedition: Buxton, *Letter*, 150-51, and 203-04; Curtin, *Image*, 300-1; Lambert, *Mastering*, 177.
[25] Everill, *Abolition*, 108-10. For converging interests: Lambert, *Mastering*, 14.
[26] The Radicals' desertion from the government had forced a brief resignation in May 1839. Curtin, "White Man's Grave," 104; Curtin, *Image*, 290-91, and 300-03; Murray, *Odious*, 134. For this campaign, see Temperley, 22-32.
[27] Chartists stormed the stage of a regional meeting of the African Civilization Society. Lambert, *Mastering*, 3; Drescher, *Mighty Experiment*, 166; Everill, *Abolition*, 111-12; Temperley, 33-38, 57, and 63; David Turley, *The Culture of English Antislavery, 1780-1860* (New York: Routledge, 2004), 178.

It was the Squadron's expansion and forceful attempts to prosecute suppression in the late 1830s that had the most significant ramifications for surgeons. These shifts increased the Squadron's exposure to tropical diseases, ensuring that mortality and debilitating illness remained higher than other stations. Indeed, Bryson later concluded that the Squadron suffered a high number of epidemic fevers in 1837-38. Mortality, however, fell by more than 50% in 1839 and further in 1840 as surgeons adjusted to the circumstances arising from the newly adopted interventionist strategy.[28] Surgeons' demanding practical responsibilities also helped to reshape their professional aspirations and outlooks. For example, in mid-1837, Assistant Surgeon Morris Pritchett found himself responsible for 280 liberated slaves upon capturing a Portuguese slave ship. Expounding on the "scenes of misery and disease" aboard slave ships, he reported that "in the present instance from Dysentery prevailing on board, professional assistance was more particularly required." Pritchett then segued into raising objections to the share of prize money that surgeons received, which was smaller than that given to other officers despite the integral role that surgeons played in suppression efforts.[29] For better or for worse, these dynamics also likely underlay the increasing authority delegated to the Squadron's surgeons.

As army and naval surgeons increasingly encountered fevers in the late 1830s, they redoubled their efforts to refine their understanding of tropical disease.[30] Rigorous reporting practices began to yield more precise clinical and statistical data in the form of detailed reports and case histories. But the information from these accounts was not yet fully synthesized.[31] The

[28] Bryson's initial calculations were 128.8 per 1000 men in 1837, 129.9 in 1838, 69.6 in 1839, and 37.4 in 1840. Curtin, *Image*, 300; McLean, *Surgeons*, 67-68. For mortality statistics: Bryson, *Report*, 134-35, and 146-47. For cases: Bryson, *Report*, 121-23, 126-28, and 140-41.
[29] Pritchett to Burnett, May 23, 1837, ADM 97/142/1281, f. 1-2; McLean, *Surgeons*, 66-68; Harrison, "Important Subject," 114; Watt, "Health," 71. For another example: A Navy Surgeon, *Lancet* 29, no. 749 (Jan. 6, 1838): 530.
[30] For interests and strategy in Africa: Curtin, *Image*, 289-303; Headrick, *Power*, 228-29; Headrick, *Tools*, 60.
[31] Curtin, *Image*, 344-345. For medical reports on fever: Alexander McKechnie to Burnett, Aug. 12, 1837, NA, ADM 97/143/2556; and Sept. 27, 1837, ADM 97/143/2557; John Wilson Elliot to Burnett, Feb. 17, 1838, ADM

immediate breakthrough came from home-stationed army surgeon Dr. Alexander Tulloch's report on the African Corps, which gave a statistical picture of the health of troops in West Africa. Through compilation and comparison, he found that the average annual death rate for troops stationed in West Africa from 1819-36 was nearly one in two, and that the annual hospitalization rate averaged three times per soldier.[32] Across this period, he calculated that 1,298 of 1,685 white troops had died and the remaining 387 soldiers were invalids at some point. Only 33 of the infirm had managed to return to service. Indigenous African troops suffered lower morality than white soldiers, but Tulloch stopped short of calling for a transition to African manpower, or of projecting declining mortality trends forward.[33]

The Navy's statistical report on the African Station came too late to aid in planning the reformed suppression strategy. Despite indications of a decline in mortality and disability due to illness from 1839, surgeons still saw the Squadron as the most arduous naval assignment.[34] From 1837-40, the Squadron had an annual mortality rate of 92 per 1000 sailors ($\sigma = 37$), a disability rate of 43 per 1000 men ($\sigma = 13$), and a sickness rate of 1.82 times ($\sigma = 0.16$) per sailor.[35] While the African Corps suffered greater mortality and invaliding, the number of sailors lost or disabled

97/144/289; Burnett, memos, July 24, 1838, ADM 105/72/f.14-16; Aug. 17, 1838, ADM 105/72/f.19-20; and Aug. 17, 1838, ADM 1/3532/140-153. For death and invaliding of medical officers: Burnett, memos, July 23, 1838, ADM 105/38/f.108; and July 23, 1838, ADM 105/38/f.108; McWilliam to Burnett, Jan. 30, 1839, ADM 97/147/351.

[32] The mortality rate was 483 per 1000 men. Curtin, *Disease*, 4-5; Curtin, *Image*, 71; Headrick, *Power*, 228; Tulloch, "Statistical Report," 1840, 7-8; Anon, "Western Africa and its Effects on the Health of Troops," *USJNMM* 12, no. 2 (Aug. 1840): 514. For Tulloch, see also Carlson, *African Fever*, 61-68.

[33] African troops' mortality rate (30.1 per 1000 men) was 6.2% of white enlisted troops (483 per 100 men). Anon, *USJNMM* (Aug. 1840): 514-515, and 517-519; Tulloch, "Statistical Report," 1840, 7, and 26-27.

[34] Ellis, 192; Harrison, "Important Subject," 112-13; Carlson, *African Fever*, 68; Wilson, "Statistical Reports for 1830-1836," 1-74. For Squadron's expansion in the late 1830s: Sherwood, 115-17; Eltis, 92-93; Curtin, *Image*, 295-96. For mortality and arduous, unpopular duty: Harrison, "Important Subject," 113-14; McLean, *Surgeons*, 66-68.

[35] Surgeons referred to disability as invaliding, which was defined as being taken off of active duty due to illness. Calculations made by author from Bryson, "Statistical Reports on the Health of the Navy for the Years 1837-1843. Part III," *PP*, 1854(505): lxviii, 9, p. 65, 73, 81, and 89. These statistics disagree with the 33% mortality rate on the African Squadron for 1838 to 1843 from Harrison based on Watt's work. There are two methodological errors as Watt's chart presents a mortality rate of 33 per 1000 sailors and an invaliding rate of 63 per 1000 sailors based on data from 1837-1843, and 1856-1875. Harrison, "Important Subject," 112; Watt, "Health," 71.

was substantially higher in most years.[36] The true impact of these trends also depended on the thinner margin of casualties that naval vessels could absorb during operations. These dynamics also allowed surgeons to more confidently and forcefully voice concerns over the Squadron's health, and assert professional claims based on the practical importance of their medical work.[37]

By mid-1839, after the Melbourne government had assented to Buxton's plan, attention shifted to the Niger Expedition. During planning, the Foreign Office designed a sweeping interventionist venture to negotiate treaties, open commercial relations, begin missionary efforts, demonstrate the superiority of European civilization, found a model cotton farm, and advance scientific research. This was in part the result of collaborative planning with the Admiralty, African Civilization Society (ACS), and Church Missionary Society (CMS). By the time the Expedition launched, it included naval personnel and surgeons, CMS missionaries, ACS-recruited scientists, a diplomat and an agriculturalist to meet this expansive variety of goals.[38]

The pursuit of practical knowledge became one of the Expedition's unifying threads. The ACS recruited Edinburgh-trained geologist Dr. William Stanger, as well as a zoologist, botanist, and mineralogist to accompany the Expedition.[39] More importantly, the Admiralty devised an ambitious set of logistical, technological and scientific precautions. Given the Niger River's inhospitable reputation, Palmerston and the Admiralty were well aware of the potential dangers.

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[36] Except during the Anglo-Asante War (1825-1826), there were more sailors on the Squadron than soldiers in West Africa. Bryson, "Statistical Report," 1854, 65, 73, and 81; Tulloch, "Statistical Report," 1840, 7, Table 1.

[37] Harrison, "Important Subject," 112; Ninian Hill, *Lancet* 30, no. 785 (Sept. 15, 1838): 865; Anon, *Lancet* 30, no. 764 (Apr. 21, 1838): 121. For professionalization: Harrison, "Important Subject," 109-12, and 113-14.

[38] The early-nineteenth-century Age of Reform saw the rise and convergence of abolitionist, humanitarian, evangelical, commercial, imperial, and scientific interests. Curtin, *Image*, 302-303; Kennedy, *Last Blank*, 136; Lambert, *Mastering*, 2-3, 14, and 177-180; Hoag, 60, 70, 73, and 84.

[39] Kennedy, *Last Blank Spaces*, 69; Society for the Extinction of the Slave Trade and for the Civilization of Africa, *Report of the Committee of the African Civilization Society to the Public Meeting of the Society Held at Exeter Hall on the 21st June, 1842* (London: J. Murray 1842), i-iii. *For expedition science, see* W.J. Hooker and J.D. Hooker, "Botany of the Niger Expedition," in *Niger Flora, Or An Enumeration of the Plants of Western Tropical Africa*, ed. W.J. Hooker (London: Hippolyte Bailliere, 1849), 73–87; William Stanger, "On the Geology of Some Points on the West Coast of Africa, and of the Banks of the River Niger," *Proceedings of the Geological Society*, 4 (1846): 190-3.

Like Buxton, they believed that they could "diminish the danger" by applying "practical science."[40] The government commissioned three steamships designed to reduce exposure to noxious airs, and ordered the Expedition to steam quickly through the delta.[41] The Admiralty also outfitted the ships with a chemical-mechanical ventilation system designed by Edinburgh chemistry lecturer and inventor Dr. David B. Reid. An influential figure in the sanitary movement, Reid cautiously stated that the ventilation system needed to be combined with "the frequent inspection and examination of the hold, to the removal of moisture," and other precautionary measures.[42] Despite a chorus of skeptical warnings, this combination of measures and faith in divine providence gave many supporters of the Expedition a false sense of security.[43]

Meanwhile, the Admiralty and the Medical Department devoted particular attention to preparations for the Expedition. Burnett chose seven surgeons based on their qualifications, previous service, and fitness from a pool of medical officers who volunteered, including two Surgeons, seven Assistant Surgeons and twelve Acting Assistant Surgeons. This represented a large complement of medical officers given that the Expedition consisted of only three ships, only exceeded in relative terms during that period by the expeditionary fleet sent to China during the First Opium War.[44] The surgeons appointed to the Expedition were a combination of practitioners with significant African service and fervent humanitarian volunteers. Desire for

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[40] Temperley, 50; Curtin, *Image*, 345. For Laird on Niger and miasma: Headrick, *Tools*, 64-65; Gelfand, *Rivers*, 45-46; Hoag, 78; Laird, and Oldfield, vol. 1, 121-22. For Buxton: Buxton, *African Slave Trade and its Remedy*, 8, 286, 305-306, 348-349, 454, and 491-492; Buxton, *Letter*, 117, 164, 187-189, and 191-192.
[41] Curtin, *Image*, 177, 333, and 351-52; Headrick, *Tools*, 68; Hoag, 85; Gelfand, *Rivers*, 49; Temperley, 49-52.
[42] Temperley, 50-52; Gelfand, *Rivers*, 49; Headrick, *Tools*, 68; Carlson, *African Fever*, 15. For quote: D.B. Reid, *TFA*, no. 5 (Mar. 24, 1841): 70. For his explanations of the system, see also D.B. Reid, *TFA*, no. 3 (Feb. 1, 1841): 43-47. For Reid as a scientist: Hamlin, *Public Health*, 221-23, and 227-28; David Boswell Reid, "On the Extension of the Study of Physics," in *Report of the Fifth Meeting of the BAAS Held at Dublin in 1835* (London: J. Murray, 1836), 126; David Boswell Reid, "On the Amount of Air Required for Respiration," in *Report of the Eighth Meeting of the BAAS Held at Newcastle in August 1838* (London: J. Murray, 1839), 131–32.
[43] Curtin, *Disease*, 20; Temperley, 52-53; Anon, *The African Repository* 17 (Oct. 15, 1841): 310–11.
[44] David McLean, "Surgeons of The Opium War: The Navy on the China Coast, 1840-42," *English Historical Review* 121, no. 491 (2006): 487–504.

professional advancement, commitment to the antislavery-humanitarian cause, and scientific fervor shaped their worldviews and motivated them. As highly qualified members of the generation that joined the Navy in the late-1820s and 1830s, they shared a high level of clinical and scientific training and competence.[45]

Burnett named African Squadron veteran Dr. James McWilliam as lead surgeon, and Englishmen Dr. Morris Pritchett and William B. Marshall as the acting surgeons of the other ships. While McWilliam was Edinburgh and London-educated, Pritchett and Marshall were London hospital-trained surgeons who had served in African and tropical environments.[46] As noted earlier, Pritchett served a three-year tour on the African Squadron after entering the Navy in 1836, and earned his degree in 1839.[47] Already fifteen years into his career, Marshall had served on an 1834 expedition to New Zealand. This group shared similar skills and motivations, including a commitment to clinical science. Marshall was known for his advocacy of the continued cultivation of scientific and general knowledge through education and practice. He had reported on cholera service and the operations of a colonial hospital during the 1830s.[48] Marshall was also the most active humanitarian. During the New Zealand expedition, he had objected on

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[45] For preparations: McWilliam, *Medical History*, 1-6. For surgeons: Barrow to Burnett, July 3, 1840, NA, ADM 97/26/1115; Trotter to Burnett, July 3, 1840, ADM 97/150/1113, including ADM 97/150/334: Society for the Extinction of the Slave Trade, xxiii.

[46] The backgrounds of the Niger Expedition's surgeons reflected the increasing educational diversity within the medical service. Many of the surgeons who joined during this period had gained practical scientific educations at London hospital schools, but there were also many others who still attended Edinburgh and Glasgow.

[47] For McWilliam: R. R. Willcox, "The Niger Expedition of 1841," *The Medical Bookman and Historian*, vol. 2 (July 1948): 309. For Pritchett: Pritchett to Burnett, May 23, 1837, NA, ADM 97/142/1281; John Tennent, and Pritchett, "Medical Journals for HMS Echo," 1836-1839, ADM 101/98/2.

[48] Bonner, 183-184; Anon, "Tears for Pity," *The Monthly Review* (Aug. 1824): 434-435; Anon, "An Essay on Medical Education," *M-CR* 5 (Oct. 1826): 634; Marshall, *Tears for Pity* (London: T. Cadell, 1823); Marshall, *An Essay on Medical Education* (London: Burgess and Hill, 1827). For Marshall's clinical work: Marshall to Burnett, June 30, 1832, NA, ADM 97/132/166; July 6, 1832, ADM 97/132/402; and July 11-15, 1832, ADM 97/132/534, ADM 97/132/558, ADM 97/132/583, and ADM 97/132/588. Marshall, "Gleanings During Three Years Spent in the Indian Seas, Swan River, and King George's Sound," *M-CR* 28, no. 55 (Jan. 1, 1838): 209–13; Marshall to Burnett, Sept. 10, 1839, NA, ADM 97/148/2152. For Pritchett: Pritchett to Burnett, Dec. 17, 1840, ADM 97/151/3119.

humanitarian grounds to the Expedition's imperial assertions and punitive actions.[49] Professional commitment and ambition, desire to earn distinguishment and promotion, and belief in the Expedition's humanitarian goals appear to have motivated them to volunteer.

While Burnett also appointed four Assistant Surgeons, Thomas R.H. Thomson became the most illustrious. A native of the Isle of Man, Thomson took over as one of the acting surgeons midway through the Expedition. Likely London-educated, he had also taken extra-mural and scientific classes in Edinburgh.[50] Following service on the Channel Fleet and in Haslar Hospital after joining the Navy in 1837, he had participated in the late-1830s campaign in South America to protect trade interests and target the illicit slave trade. He thus had experienced crossing the tropics and had clinically reported on at least one tropical fever case.[51]

Medical reports on the preparations for the Expedition demonstrate that the surgeons and the Admiralty were well aware of the risks that fevers posed. Beyond the ventilation system, McWilliam and Burnett laid out medical and hygienic rules based on previous experience. These included measures to minimize exposure to noxious miasmas, prohibit intemperance, and provide a hearty diet and breathable yet coverable clothing. McWilliam also requested elevated medical provisions. He wrote that "I have extended the present Scales far beyond those for men of war, in order that the Medical Officers, of the ships, may be enabled to treat the Endemics

[49] Marshall testified before Buxton's Select Committee on Aboriginal Affairs. He also engaged in ethnographic observation and wrote a Maori vocabulary. For his efforts: Lydia Wevers, *Country of Writing: Travel Writing and New Zealand, 1809-1900* (Auckland: Auckland University Press, 2002),104-06; Marshall, *Ratari.* (Sydney, 1834); Marshall, *A Personal Narrative of Two Visits to New Zealand in His Majesty's Ship Alligator, A.D. 1834* (London: James Nisbet & Co., 1836), iii-xvi, and 330-340. For his objections: Wevers, 106-08; Jane Samson, *Imperial Benevolence: Making British Authority in the Pacific Islands* (Honolulu: University of Hawaii Press, 1998), 18-19.

[50] Botanical Society of Edinburgh, *Fourth and Fifth Annual Report and Proceedings of the Botanical Society* (Edinburgh: Maclachlan & Stewart, 1841), 10; Thomson, *The Brazilian Slave Trade, and Its Remedy* (Douglas, Isle of Man: John Mylrea, 1850), 86. For memberships, see Laura Franey, "Ethnographic Collecting and Travel: Blurring Boundaries, Forming a Discipline," *Victorian Literature and Culture* 29, no. 1 (Mar. 2001): 221.

[51] Admiralty, "Thomas Richard Haywood Thomson," ADM/196/8/f.320; Anon, *The Nautical Magazine* 26 (Apr. 1838): 546; Thomson to Burnett, June 17, 1840, ADM 97/150/1680; William Hutt, "Second Report," 106. See John F. Cady, *Foreign Intervention in the Rio de La Plata, 1838-50; A Study of French, British, and American Policy in Relation to the Dictator Juan Manuel Rosas*, (1929, repr.; New York: AMS Press, 1969).

with which the crews may be affected, with every Advantage which Medicine affords…"[52] Furthermore, Burnett ordered the surgeons to follow the prescribed measures, ensure cleanliness and dryness, minimize shore service, and use the codified practices for bark prophylaxis.[53]

As the Expedition sailed for and ascended the Niger River in mid-1841, the scientists and surgeons pursued both their practical duties and individual pursuits. They took meteorological readings, collected botanical specimens during island and coastal port stops, and observed a volcanic eruption in the Cape Verdes.[54] McWilliam reported a sailor's death from a fractured skull, participated in the vaccination of fourteen African children at Monrovia, and took detailed meteorological readings.[55] Upon reaching the Niger in early August, the ships took nine days to reach open river despite the "quick steam" orders. While the Expedition negotiated treaties, the surgeons made ethnographic, scientific and practical observations, and vaccinated children at village of Acassah near the Nun mouth. During this period, McWilliam, assisted by Drs. Pritchett and Stanger, also conducted a clinical examination and dissection of the first fatal fever case.[56]

Epidemic fever broke out on the *Albert* midway upriver on 3 September and spread to the other vessels as they set sail for the confluence of the Niger and Tchadda Rivers to found the model farm. The surgeons' responsibilities increased as Marshall, his assistant surgeon, and

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[52] McWilliam received 8.75 lbs. of quinine, 7.625 lbs. oz. of cinchona. Carlson, *African Fever*, 15; Curtin, *Image*, 345; McWilliam, *History*, 1-6; Trotter to Burnett, Aug. 25, 1840, NA, ADM 97/150/1720; McWilliam to Burnett, Sept. 8-Oct. 19, 1840, ADM 97/150/1882. Nov. 2, 1840, ADM 97/151/2574; and Feb. 24, 1841, ADM 97/151/3983.
[53] Barrow to Burnett, Mar. 26, 1841, NA, ADM 97/27/4401.
[54] Gelfand, *Rivers*, 51; Temperley, *White Dreams*, 70-82; McWilliam, 101/82/2, f. 159-62, 164-65, and 168-70; Anon, "The Niger Expedition," *The Nautical Magazine* 10 (1841): 732-36.
[55] McWilliam to Burnett, July 3, 1841, NA, ADM 97/153/3298; 5; McWilliam, ADM 101/82/2, f. 165, and 168. For early cases reported by others: Marshall to Burnett, July 28, 1841, ADM 97/153/2832; Pritchett to Burnett, July 24, 1841, ADM 97/153/3112 in ADM 97/154/3628.For vaccination, see also Marshall to Burnett, Dec. 24, 1840, ADM 97/151/3202; McWilliam to Burnett, Aug. 17, 1841, ADM 97/153/3175 in ADM 97/154/3628. For meteorology, see also Robert Jamieson to McWilliam, Sept. 1, 1840, WL, RBM, MS.6829/1; McWilliam, ADM 101/82/2, f. 280-300.
[56] Gelfand, *Rivers*, 51-52; Harrison, "Important Subject," 115; McWilliam, ADM 101/82/2, f. 166-168, and 171-180; Pritchett, ADM 101/127/3, case 12; Pritchett, *Some Account*, 2-4; Pritchett, ADM 101/127/3, 5-7. See also McWilliam to Burnett, Aug. 17, 1841, ADM 97/153/3175 in ADM 97/154/3628; Her Majesty's Commissioners to Lord John Russell, Aug. 4, 1841, in" Expedition Papers," 31. For meteorological, ethnographic and scientific observation continuing upriver: McWilliam, ADM 101/82/2, f. 180-182; Hoag, 85-86; Franey, 221.

more sailors fell sick. By 18 September, eighty sailors lay convalescing at the confluence, eight had died, and the *Soudan* had become a floating hospital.[57] While confident in their ability to manage the crisis, McWilliam and Pritchett disagreed on whether to evacuate the convalescent. Pritchett wrote that many of the sick were not strong enough to endure the journey, and expressed skepticism that a change in climate would help them. McWilliam, however, pulled ranks and reported to the commanding officer that he considered a "change of climate to be indispensible" and recommended dispatching the most severe cases to Fernando Po.[58]

In these desperate circumstances, McWilliam's advice won out. The commanding captain ordered the *Soudan* to head for Fernando Po on 19 September with Thomson as acting surgeon. At the confluence, the outbreak continued and the *Wilberforce* withdrew rather than risk having to abandon the ship due to lack of able-bodied crew. While the *Albert* continued with the planned ascent, over twenty more men had fallen sick by 5 October, including the captains and engineers. The task of taking the steamship several hundred miles downriver fell to Drs. McWilliam and Stanger. Captain Trotter reported that the Expedition would have been in dire straits "had not Dr. Stanger, the geologist, in the most spirited manner, after consulting Tredgold's work on steam, and getting some little instruction from the convalescent engineer, undertaken to work the engine… whilst Dr. M'William, in addition to his enormous press of duty as a medical officer, conducted the ship down the river in the most able and judicious manner."[59]

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[57] Gelfand, *Rivers*, 52-53; Harrison, "Important Subject," 115; Pritchett, *Account*, 7-77; Pritchett, ADM 101/127/3, cases 13-44; McWilliam, ADM 101/82/2, f. 15-88.

[58] For Pritchett: Pritchett to Burnett, NA, Sept. 19, 1841, NA ADM 97/153/3574 in ADM 97/154/3628; and Sept. 18, 1841, ADM 97/153/3570 in ADM 97/154/3628. For McWilliam: McWilliam to Burnett, Sept. 18, 1841, ADM 97/153/3573 in ADM 97/154/3628; Commissioners to Russell, Sept. 18, 1841, in "Expedition Papers," 43.

[59] Gelfand, *Rivers*, 53-54; Harrison, "Important Subject," 115; Hoag, 86. For the evacuation: Commissioners to Russell, Oct. 9, 1841, in "Expedition Papers," 43; Pritchett, ADM 101/127/3, cases 45-47; Pritchett, *Account*, 77-86. For Thomson's reports: Thomson to Burnett, Oct. 8, 1841, NA, ADM 97/154/4130; Thomson to Burnett, Oct. 8, 1841, NA, ADM 97/154/4129. For Trotter's report: Barrow to G.W. Hope, Jan. 19, 1842, in "Expedition Papers," 45; Anon, *The Nautical Magazine* 11 (1842): 193-4.

After leaving the river, the Expedition regrouped at Fernando Po and withdrew to Ascension, as the mates, masters, engineers, stokers, and all of the officers except one lieutenant, Pritchett and Thomson had fallen sick. Captain Trotter reported to the Admiralty that, "When I add that Dr. M'William is of opinion that few, if any, will be fit to return to the coast of Africa who have had the fever… their Lordships will be able to form an idea of the paralyzed state of the steam-vessels."[60] Beyond the toll of disease, Trotter also drew attention to the "exertions and fatigue" of the surgeons. During their descents, McWilliam, Pritchett and Thomson did not have assistant surgeons to aid them in the arduous work that the crisis required. Pritchett supposedly "performed the duties of apothecary, nurse, and cook, as well as those of medical attendant; [and] never undressed for nearly six weeks."[61] While McWilliam received aid from Dr. Stanger and another crewman, Trotter felt that his service bringing the *Albert* down river should "be considered the more remarkable" due to his medical duties. Indeed, despite downplaying that he assumed command of the *Albert* in his own reports, McWilliam became a national hero.[62]

Meanwhile, the surgeons began processing their journals and reports. In late October, McWilliam submitted a backlog of returns, writing to Burnett that "on the ground, of being a good deal worn out, I must claim your indulgence" for the delay.[63] During the Fall and Winter spent at Fernando Po, Rollas Island and Ascension, McWilliam and Pritchett also began compiling their accounts, considering the "river fever's" causes, symptoms, pathology and

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[60] Barrow to Hope, in "Expedition Papers," 47. For Fernando Po and Rollas Island: Pritchett, ADM 101/127/3, cases 48-50; Pritchett, *Account*, 87-90; McWilliam, ADM 101/82/2, f. 132-145. For Ascension: Pritchett, ADM 101/127/3, cases 51-52; Pritchett, *Account*, 90; McWilliam, ADM 101/82/2, f. 145-152.

[61] Royal College of Surgeons of England, "Pritchett, Morris," http://livesonline.rcseng.ac.uk/biogs/E003003b.htm.

[62] Harrison, "Important Subject," 115-116; Barrow to Hope, report from Trotter, in "Expedition Papers," 46-47; Anon, "Medical Heroism," *The Medical Examiner* 3 (Nov. 1847): 580–581.

[63] McWilliam to Burnett, Oct. 23, 1841, NA, ADM 97/154/4363. For similar claims, see Pritchett to Burnett, Sept. 19, 1841, ADM 97/153/3574 in ADM 97/154/3628.

treatments.[64] As the dimensions of the human crisis became clearer, the recently ascended Tory Government recalled the Expedition. The *Wilberforce* was the last of the ships to withdraw from Africa in late July 1842, following a brief ascent of the Niger to relieve the model farm during which the entire crew contracted fever. By the time the Expedition returned to England, over 130 of the 145 white members of the initial crew had contracted the fever and 55 had died.[65]

Beyond this narrative of events, medical and imperial historians have seen the Niger Expedition as a pivotal moment sparking a decade of medical practical reforms by providing added proof of quinine's effectiveness, and giving rise to new debates over fevers. Although Mark Harrison has begun to question the Expedition's exceptionality, this critique can be taken further. The Expedition was far from unprecedented in the disease pattern and mortality that befell it, as well as the medical practices and approaches that its medical officers adopted.[66] Nonetheless, the scale of the crisis, the Expedition's continued exposure while upriver, and surgeons' commitment to empirical scientific practices allowed for the accumulation of more empirical evidence. While quinine has dominated much of the previous work on the medical crisis that befell the Niger Expedition, its impact went much further. McWilliam, Pritchett and Thomson considered and contributed to a broader range of medical and scientific subjects, issues, and debates than quinine, which deserve consideration.

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[64] Thomson to Burnett, Oct. 8, 1841, NA, ADM 97/154/4129; and Oct. 12, 1841, ADM 97/155/382; McWilliam to Burnett, Nov. 26, 1841, ADM 97/154/4470. For accounts: McWilliam, ADM 101/82/2, f. 210-276; Pritchett to Burnett, Nov. 5, 1842, ADM 97/156/2985.

[65] For the extended withdrawal: Gelfand, *Rivers*, 54-55; Hoag, 96-87; Harrison, "Important Subject," 116; William Allen, and Thomson, *A Narrative of the Expedition Sent by Her Majesty's Government to the River Niger, in 1841: Under the Command of Captain H. D. Trotter, R.N.*, vol. 2 (London: Richard Bentley, 1848), 211-212; Barrow to Hope, in "Expedition Papers," 47; William Allen to Russell, Sept. 5, 1842, in "Expedition Papers," 64. Recently for death toll: Headrick, *Power*, 229; Lambert, *Mastering*, 178, and 204; McWilliam, *History*, 126-128; Admiralty, "A Return of the Mortality Which Occurred on Board the Ships Sent to Explore the Niger." *PP*, 1843(83): xxxi, 335.

[66] Curtin, *Image*, 303, and 344; Harrison, "Important Subject," 116.

Although facing expanding duties and increasing fatigue during the crisis, McWilliam, Pritchett and Thomson made the maintenance of their clinical journals a priority. While their detailed notes are striking, the scale of the epidemic provided clinical and scientific opportunities and latitude for trial and observation. Their extensive practical-theoretical analysis, based on their medical and scientific training and experience, framed their clinical reports and published narratives.[67] Their most unambiguous finding from this rigorous observation was classifying the epidemic as African remittent rather than yellow fever. Based on his clinical and postmortem analyses, Pritchett wrote that "the Febris Africana would appear to be seldom accompanied by the Claret grounds or generous discharge usually known as the black vomit, at least in the cases which occurred in the 'Wilberforce' it was wanting."[68] McWilliam also reported that his postmortem dissections "corroborate in most respects views derived from former experience on the Coast of Africa." In particular, he observed the combination of a yellow hue to the skin and bile buildup in multiple organs, which he attributed to deranged liver function, but did not classify as a symptom of yellow fever.[69]

As the medical officers received increasing authority during the crisis, they began searching for an effective treatment based on their observations, scientific understanding and collegial exchanges. They initially relied on the regime of modest bleeding, mercury, purgatives, and diaphoretics. Thomson also employed quinine as a tonic-stimulant during fever remissions.[70]

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[67] In addition to medical journals and published accounts, see Pritchett to Burnett, Sept. 19, 1841, NA, ADM 97/153/3574 in ADM 97/154/3628; and Sept. 18, 1841, ADM 97/153/3570 in ADM 97/154/3628; McWilliam to Burnett, Sept. 18, 1841, ADM 97/153/3573 in ADM 97/154/3628; Oct. 23, 1841, ADM 97/154/4363; Nov. 26, 1841, ADM 97/154/4470; and Nov. 26, 1841, ADM 97/154/4466; Thomson to Burnett, Oct. 8, 1841, ADM 97/154/4130; and Oct. 8, 1841, ADM 97/154/4129.

[68] Pritchett, Sept. 14, 1842, ADM 101/127/3, report, p. 50-52, and, cases 13, and 15; Pritchett, *Account*, 10, and 15.

[69] McWilliam expressed as his rationale that dissection allowed correlation of symptoms to internal pathology. Gelfand, *Rivers*, 56; Carlson, *African Fever*, 38-39; McWilliam, ADM 101/82/2, f. 16, 27-28, 102-07, 137, 141, and 218-28, quote from 218; McWilliam to Burnett, Nov. 26, 1841, ADM 97/154/4466; McWilliam, *History*, 142-48.

[70] Carlson, *African Fever*, 51; Curtin, *Disease*, 25; Allen, and Thomson, vol. 2, 162-164.

Pritchett in particular tried to manipulate treatments to address pathological symptoms and respond based on the impacts of preceding treatments. He became increasingly frustrated, concluding that "mercury, which has hitherto been viewed by many as the sheet anchor has certainly failed in the River Niger; blood-letting has been declared highly injurious; quinine was proved equally abortive in the early stages." McWilliam similarly questioned the accepted protocol. Discussing bloodletting, he claimed that the resulting "amendment is transient. The remission will not be prolonged, and the succeeding accession will be equally severe." Like Pritchett, this led him to cut back on bleeding and mercury as aggressive primary treatments.[71]

In regard to causal and miasmatic theories, however, McWilliam and Pritchett reached differing conclusions. McWilliam felt that "the general character of the morbid anatomy seems to prove that the cause of the disease was a poison introduced into the blood," but could not give a satisfactory explanation regarding the specific process at work. Pritchett expressed frustrations with the miasmatic system's lack of precision as he juxtaposed scientific theories and his observations. Typical of his conclusions was his statement that "we have no sufficient data on which to determine the healthy or unhealthy nature of any specific place besides that which is dearly obtained from experience."[72] Reflecting the general state of pathological theory at that point, neither presented an adequate alternative to the existing miasmatic explanation of fevers.

This was not for lack of effort, as attempts to identify the chemical process of miasmas had gained attention in the 1820s and 1830s, as practical chemistry increasingly focused on applied problems. As Philip Curtin has noted, in the run-up to the Expedition, King's College Professor J.F. Daniell lobbied the Admiralty to test his theory that decaying matter in seawater

[71] Gelfand, *Rivers*, 55-56; Carlson, *African Fever*, 44-47. For Pritchett: Pritchett, Sept. 14, 1842, ADM 101/127/3, report, p. 52-56, and 59. For McWilliam: McWilliam, *History*, 194-197; McWilliam, ADM 101/82/2, f. 243-45.
[72] For McWilliam: McWilliam, *History*, 148. For Pritchett: Pritchett, Sept. 14, 1842, ADM 101/127/3, report, p. 39.

released hydrogen sulfide, which acted as a miasma.[73] The Admiralty responded by collecting and analyzing West African seawater in early 1840. Based on tests showing high hydrogen sulfide levels, Burnett ordered additional testing. McWilliam thus collected samples and conducted field tests at various points along the coast and on the Niger. These continued tests failed to show elevated hydrogen sulfide levels or other chemical anomalies. Surgeons thus could not identify a fever-causing poison that could be targeted through hygienic practices.[74]

Most significantly, the Niger Expedition's conclusions related to the effectiveness of quinine have become near axiomatic in medical and imperial histories.[75] Pritchett, McWilliam and Thomson administered bark-wine according to the existing policy based on its tonic value, and substituted quinine based on their own judgment with varying results. Pritchett was the least enamored, rejecting the broader use of quinine based on underwhelming empirical results. McWilliam and Pritchett came to encouraging conclusions regarding quinine's utility as a high-dose stimulating tonic. McWilliam administered eight to ten grains (518.4 to 648.0 mg) when "vital energy" flagged and when function began to stabilize. His evaluation was that "no rule can be laid down for the exhibition of a particular remedy; but no medicine was found so efficacious as quinine in diminishing the severity of the paroxysms."[76]

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[73] Curtin, *Image*, 350; Barrow to Burnett, Nov. 20, 1840, ADM 97/26/2800; Daniell, *TFA* no. 2 (Jan. 15, 1841): 18-23; Daniell, *TFA* no. 3 (Feb. 1, 1841): 40-41; Daniell, *TFA* no. 4 (Feb. 25, 1841): 53. For practical chemistry: Harrison, *Medicine in an Age*, 48-50.

[74] Curtin, *Image*, 350-51. For theory and the Navy: Burnett, memo, Nov. 20, 1840, NA, ADM 97/151/2800; Daniell to Burnett, Feb. 5, 1841, ADM 97/151/3724; Daniell, *TFA* no. 4 (Feb. 25, 1841): 54-55; Reid, *TFA* no. 5 (Mar. 24, 1841): 66-68; Daniell, *ENPJ* 31, no. 1 (Apr. 1841): 183–88; Daniell, *LMG* 28 (July 16, 1841): 669–72, and (July 23, 1841): 700–04. For testing: McWilliam, *History*, 161-67; McWilliam, ADM 101/82/3, f. 162, and 234-39. For the Niger: McWilliam, *History*, 166-75; McWilliam to Burnett, Feb. 19, 1842, NA, ADM 97/155/288; McWilliam, and Pritchett to Burnett, Apr. 25, 1842, ADM 97/155/1204. See also Reid, *Illustrations of the Theory and Practice of Ventilation* (London: Longman, Brown, Green and Longmans, 1844), esp. 400-14.

[75] Beyond Curtin, Harrison, Gelfand, and Headrick's works, see among others Chakrabarti, *Medicine and Empire*, 125-26; Brockway, 127-31.

[76] For practices: Curtin, *Image*, 355; Harrison, "Important Subject," 116. For Pritchett and McWilliam: Gelfand, *Rivers*, 56; Chakrabarti, *Medicine and Empire*, 125; Pritchett, Sept. 14, 1842, ADM 101/127/3, report, p. 56, and 59; McWilliam, ADM 101/82/2/245, f. 244-5; McWilliam, *History*, 197-8.

Perhaps even most important were Thomson's efforts experimenting with quinine on the *Soudan* and at Fernando Po. In a later *Lancet* article, he reported that in several remittent fever cases, "I gave the quinine in doses of eight and ten grains daily, with perfect success." This was the result of a clinical experiment in which he administered high doses of quinine to patients in early fever stages. Based on the observation that quinine "had the effect of arresting the bad symptoms," Thomson began self-experimenting with prophylactic quinine midway through the Expedition. He consequently remained free from fever until discontinuing quinine on his return to England in mid-1842. While his theoretical explanation that continued therapeutic quinine arrested the transition of fevers between intermittent and remittent phases proved incorrect, Thomson provided added proof of quinine's effectiveness. Forecasting prophylaxis' extension, he asked in his 1845 article "whether quinine in full doses has the power or not of warding off entirely the remittent fever?"[77] The next section explores the strategic and practical developments that spurred surgeons' efforts to investigate this question during the 1840s.

6.2 SCIENCE AND NAVAL MEDICINE IN A PERIOD OF UPHEAVAL, 1843-1850

The Niger Expedition's monetary and human costs publicly overshadowed these medical findings, which took over a year to come to press. The publicity that Buxton built for the Expedition had backfired, as public opinion turned. Many Britons regarded it as a dismal failure and began to consider whether Britain should limit its presence in West Africa. The national

[77] Among others: Curtin, *Image*, 355-56; Curtin, *Disease*, 23; Harrison, "Important Subject," 116; Carlson, *African Fever*, 51; Headrick, *Tools*, 58; Headrick, *Power*, 231; Chakrabarti, *Medicine and Empire*, 125-26; Brockway, 131; Mitcham, 51. For report and quotes: Allen, and Thomson, vol. 2, 162-64; Thomson, "On the Value of Quinine in African Remittent Fever," *Lancet* 47, no. 1174 (Feb. 28, 1846): 244.

power and influence of the humanitarians also collapsed as accusations of willful arrogance and misplaced priorities hit home, working class objections to abolitionists' mission grew, and abolitionists admitted that free-labor sugar was economically unviable.[78] This atmosphere forced Buxton to acknowledging before the World Anti-Slavery Convention in 1843 that his scheme had failed. With bitter finality, he stated that "Providence has erected a wall of malaria around it [West Africa] which we cannot break through."[79] Indeed, the 1840s saw a fundamental questioning of the premises underlying Buxton's strategy as liberal, utilitarian, free trade and imperial interests gained power. For example, Charles Dickens invoked the Expedition to attack evangelical humanitarians' foolhardy and misguided focus on the plight of "savages" and "railroad Christianization."[80] While debates regarding British activity in West Africa, slave trade suppression, imperialism, and tropical medicine shifted in the following decade, these changes did not emerge solely from the Niger Expedition.[81]

While growing public outrage and questioning of Britain's strategy in West Africa did not translate into withdrawal, it created an existential crisis for slave trade suppression during the 1840s. The seeds for this growing rancor regarding suppression had emerged before the Expedition's failure. In 1839-40, the government had dispatched Irish abolitionist and civil servant Dr. Robert R. Madden to investigate questions related to the slave trade, commerce and

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[78] Curtin, *Image*, 303-04; Drescher, *Mighty Experiment*, 168; Hoag, 86-87; Allen, and Thomson, vol. 2, 211-12; Patrick Brantlinger, *Dark Vanishings: Discourse on the Extinction of Primitive Races, 1800-1930* (Ithaca: Cornell University Press, 2003), 69, and 87. For the challenges to abolitionism: Drescher, *Abolition*, 277-79.
[79] Broken by the Expedition's failure, Buxton largely withdrew from public life after 1843 (Lambert, *Mastering*, 178, and 204). Drescher, *Abolition*, 279-80; British and Foreign Anti-Slavery Society, *Proceedings of the General Anti-Slavery Convention Called by the Committee of British and Foreign Anti -Slavery Society, and Held in London, from Tuesday, June 13th, to Tuesday, June 20th, 1843* (London: John Snow, 1843), 248.
[80] Dickens wrote a critique of the Expedition in *The Examiner* (Aug. 1848), and a parody in *Bleak House*. Curtin, *Image*, 343; Brantlinger, *Dark*, 72; Grace Moore, *Dickens and Empire: Discourses of Class, Race and Colonialism in the Works of Charles Dickens* (Burlington, VT: Ashgate, 2004), 68-69; Charles Dickens, *The Oxford Illustrated Dickens: The Uncommercial Traveller; And, Reprinted Pieces* (1958, repr.; New York: OUP, 1989), 118, and 133.
[81] Curtin and Harrison have debated the Niger Expedition's ongoing legacy, but have not fully considered the shift in antislavery debate. Curtin, *Image*, 305, and 344; Harrison "Important Subject," 115-16; Lambert, *Mastering*, 179.

mortality in the West African colonies. His 1841 report brought to a head tensions that had been growing since the late 1830s. Madden rebuked merchants, arguing that their sale of cheap manufactures in West Africa economically supported the slave trade. An adversarial relationship consequently developed between antislavery-humanitarian forces, and merchants and free traders in regard to Britain's West African strategy.[82]

Although the failure of the Niger Expedition offered a moment in which the newly ascended Tory Government could have launched an all-out attack on the humanitarians' platform and power, it instead focused on undermining Madden's report. Prime Minister Robert Peel appointed a select committee to reinvestigate Madden's findings. The Niger Expedition and the African Squadron remained secondary focuses as conflicting interests ensured little possibility of agreement on broader strategic questions. British merchants adopted antislavery rhetoric and leveraged their influence, convincing the Committee that suppression of the slave trade required the active promotion of "legitimate" free trade. This began the strategic questioning of the emphasis on naval suppression and the Buxtonian strategy, as well as a reorientation of the Squadron toward an imperial-commercial strategy and set of tactics.[83]

As the governments of the 1840s implemented this liberal reorientation of British official strategy, the African Squadron gained new duties and justifications for its existence. As the Squadron received backing for interventions to protect British commercial interests, its naval suppression mission continued, and manpower peaked at an average of thirty ships and 3,700

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[82] Gallagher, "Fowell Buxton," 58; Curtin, *Image*, 305; Huzzey, *Freedom*, 139; John Oldfield, "After Emancipation: Slavery, Freedom, and the Victorian Empire," in *The Victorian Empire and Britain's Maritime World, 1837-1901: The Sea and Global History*, ed. Miles Taylor (London: Palgrave Macmillan, 2013), 55-56; Ryder, and the Select Committee on the West Coast of Africa, "Report. Part I," iii; Dudley Ryder, and the Select Committee on the West Coast of Africa, "Report from the Select Committee on the West Coast of Africa. Part 2. Appendix and Index," *PP*, 1842(551-ii): xii, 1, appendix, no. 1, p. 1. For Madden's reports: Select Committee, "Report. Part II," appendices, no. 3, 8, and 15.

[83] Gallagher, "Fowell Buxton," 58; Curtin, *Image*, 305-306; Curtin, *Disease*, 21-22; Huzzey, *Freedom*, 139; Ryder, and the Select Committee on the West Coast of Africa, "Report. Part I.," iv-x.

men during the mid-to-late 1840s. At the same time, the Squadron also transitioned to steamships and pursued extended boat service blockading areas that refused to fall in line with British antislavery and commercial policies.[84] The continued dangers of coastal and river operations, however, resulted in several fever outbreaks in 1844-45, the most serious of which was the well-known *Eclair* incident. The perceived inhumane treatment of British sailors during that incident led to increased questioning and serious reconsideration of naval suppression. Medical campaigners and humanitarians' efforts converged with the debate over free trade, as the campaign to remove grain and sugar tariff protections succeeded in the mid-1840s.[85] In 1845, free trader and MP William Hutt seized on a petition calling for the removal of the African Squadron based on the inhumanity of the slave trade's increasing horrors. He reframed abolitionists' arguments, attacking policies that allowed Africans to remain economically dependent on that trade. Even his initial unsuccessful motion demonstrated a shift in public opinion that allowed further debate over the existing strategy.[86]

During the 1840s, the interests that opposed the naval suppression strategy gained increasing influence. In 1848, Hutt brought a second slave trade motion before Parliament, and won assent to create a select committee that held more than two years of hearings. By framing his inquiry around larger questions of labor, migration and trade, Hutt attracted an "anti-coercionist" coalition that included free traders, protectionists, liberals, imperialists and humanitarians. As the inquiry expanded, the parliamentary and public moods seemed to turn against the Preventative Squadrons. Hutt pressed his advantage and finally proposed a motion in

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[84] For Squadron reforms: Gallagher, "Fowell Buxton," 58; Carlson, *African Fever*, 17; Eltis, 92-93; W.E.F. Ward, *The Royal Navy and the Slavers: The Suppression of the Atlantic Slave Trade* (New York: Pantheon Books, 1969), 37. The most in-depth coverage remains Lloyd, *Navy*, ch. 7-9. For manpower: Elits, 92.
[85] The removal of tariffs strained colonial economies and trade as prices plummeted. The palm oil trade remained a notable exception. Drescher, *Mighty Experiment*, 158-166, and 174-187; Gallagher, "Fowell Buxton," 58.
[86] Drescher, *Mighty Experiment*, 187-188; Huzzey, *Freedom*, 114; Curtin, *Image*, 315-316.

1850 calling for legal changes that would allow the withdrawal of the naval patrols off the coasts of West Africa and South America. Prime Minister Lord John Russell and Foreign Minister Palmerston staunchly defended the existing strategy. They defeated the measure only by threatening resignation. Organized opposition to naval suppression only ebbed when the Royal Navy and government succeeded in stopping the flow of slaves to Brazil a few months later.[87]

In the course of their practical duties and clinical scientific efforts, the Squadron's surgeons had to navigate the hostile attitudes toward suppression and humanitarian activity emerging in Britain, and the consequent shifts in the Navy's mission off of West Africa. They also had to respond to the evidence and conclusions about tropical disease, mortality and medical practices that emerged during public and parliamentary investigations. The Niger Expedition's failure and political infighting initially overshadowed several encouraging statistical and clinical findings. As part of his inquiry, Dr. Madden had found bloodletting declining, the use of mercury moving toward greater moderation, and bark-wine becoming increasingly popular among both surgeons and European communities on the coast of West Africa.[88] In 1840, he reported that precautions could ameliorate some of effects of the insalubrious African climate. In that same year, Dr. Wilson's statistical report on the health of naval forces found that the African Squadron had lower morality rates than army troops ashore in West Africa from 1830-36.[89]

Meanwhile, there had been no immediate official response to the Niger Expedition's reports regarding quinine. The Admiralty generally did not regard the journals and reports as

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[87] Preventative Squadrons refers to the suppression squadrons operating off West Africa, Brazil, and the West Indies. Huzzey, *Freedom*, 112-24; Drescher, *Mighty Experiment*, 188, and 191; Bethell, 304; Curtin, *Image*, 316.

[88] Curtin, *Image*, 350, and 356-58; Ryder, and the Select Committee on the West Coast of Africa, "Report. Part II," appendix, no. 21, p. 415, and 424-27. For medical topography and climate: Ryder, and the Select Committee on the West Coast of Africa, "Report. Part II," appendix no. 21, p. 412-13, 417-22, 430-32, and 438-48.

[89] Harrison, "Important Subject," 112-13; Carlson, *African Fever*, 68; John Wilson, "Statistical Reports, 1830-36," esp. 35; Ryder, and the Select Committee on the West Coast of Africa, "Report. Part II," appendix, no. 21, p. 433. See also Alexander M. Tulloch, "Comparison of the Sickness, Mortality, and Prevailing Diseases Among Seamen and Soldiers, as Shewn by the Naval and Military Statistical Reports," *JSSL* 4 (Apr. 1841): 1–16.

sufficient proof for a change in institutional policy. Surgeons still retained wide latitude in making decisions regarding the use of bark and quinine. This was in part because it took McWilliam and Pritchett over a year to publish their accounts, and Thomson even longer to publish his contributions.[90] They also simultaneously prepared scientific articles. Pritchett wrote a report on the Expedition's diet; McWilliam analyzed his and Dr. Stanger's meteorological and geological notes. Thomson reported on the ornithological and botanical species that he had observed and collected on the Niger.[91] Only when all three received new assignments to far-away stations in mid-1843 did their naval duties interrupt these scientific pursuits.[92]

At the same time, the Squadron's expansion, transition to steamships, and increasing involvement in commercial protection had significant implications for surgeons' work. Despite the broader political and strategic struggles, surgeons continued to perform their duties. They produced a steady stream of reports on health, conditions and fevers. The experienced generation of surgeons who had joined the Navy during the late 1830s and early 1840s now spearheaded efforts to institute practical reforms that questioned existing fever practices and encouraged further scientific investigation.[93] Irish Assistant Surgeon James Peters' testimony before the 1842 Select Committee provides examples of this increasing reliance on empirical evidence. Based on

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[90] For quinine: Carlson, *African Fever*, 54, and 61; Harrison, "Important Subject," 117. For accounts, see also Whitaker to McWilliam, June 9, 1843, and Everard Home, to McWilliam, Mar. 8, 1845, WL, RBM, MS.6829/1.

[91] For Pritchett: Pritchett, *The Nautical Magazine*, no. 11 (1842): 283; Pritchett to Burnett, Feb. 26, 1842, NA, ADM 97/154/5067. For McWilliam: R.R. Madden to McWilliam, Jan. 20, 1843, WL, RBM, MS.6829/1; McWilliam, *History*, 268-287. For Thomson: Hooker, and Hooker, 114, 127, and 128; Thomson, "Description of a New Species of Genetta, and of Two Species of Birds from Western Africa," *Annals and Magazine of Natural History* 10, no. 64 (Nov. 1, 1842): 203–205.

[92] Pritchett and Thomson had been promoted. Thomson served a tour on the antislavery patrol off Brazil. McWilliam headed to Australia on convict voyages. Pritchett sailed for China and Borneo, where he died in 1846. For Thomson: Bethell, 210; Admiralty, ADM/196/8, f. 320. For McWilliam: Admiralty, ADM/196/8, f. 110. McWilliam, "Medical Journal of the Convict Ship Forfarshire," ADM 101/28/1; McWilliam, "Medical Journal of the Convict Ship Hyderabad," ADM 101/35/8; McWilliam to Burnett, Aug. 9, 1844, NA, ADM 97/161/1765. For Pritchett: Anon, "Admiral Sir John. C.D. Hay, Bart., M.P.," *The Biograph and Review*, part 2, vol. 6. (London: E.W. Allen, 1881), 91; Royal College of Surgeons of England, "Pritchett, Morris," http://livesonline.rcseng.ac.uk/biogs/E003003b.htm.

[93] For reforms and surgeons; Bryson, *Report*, 148, and 161; Ryder, and the Select Committee on the West Coast of Africa, "Report. Part I," 354. For impact on empirical evidence: Gelfand, *Rivers*, 57; Carlson, *African Fever*, 61.

his experience and exchanges with fellow surgeons, he portrayed cruising off the African coast as safer than river service.[94] He simply dismissed the hydrogen sulfide theory, stating that "I have applied the tests which were sent out to me, to all the waters of the different rivers, and it is all farcical in the extreme… the water is no more tainted than pure water would be from a well in England." Given the theory's failure and contradictory evidence regarding the incubation periods of fevers, he refused to speculate about causation.[95]

One development that many naval surgeons noticed was that colonists and practitioners increasingly turned to quinine as a tonic, as the use of both bloodletting and mercurials began to decline in the early-to-mid 1840s. A growing minority also began to employ quinine as a curative agent. Despite the lag in theoretical understanding, these changes in therapeutic practices came from the ongoing accumulation of anecdotal and published findings.[96] Peters' views on fever treatments continued to reflect the state of flux that existed early in this process and his growing confidence in surgeons' abilities. He felt that bark-wine and quinine had a positive effect, but did not know whether that was therapeutic or "because it gave the men confidence." He also encouraged the turn away from mercury, stating that he had "seen men die under the extreme use of calomel."[97] Although significant heterogeneity remained in general practices and the use of quinine, the African Squadron's mortality declined in the early 1840s,

[94] Peters was a supporter of suppression through commerce. For the relative reputations and dangers of these different assignments: Ryder, and the Select Committee on the West Coast of Africa, "Report. Part I," 354, 356-57, and 361-62.
[95] Ryder, and the Select Committee on the West Coast of Africa, "Report. Part I," 359, and 363.
[96] Harrison, "Important Subject", 116; Webb, *Humanity's Burden*, 107. For decline of bleeding: Bryson, *Report*, 149, 152, and 169. For decline of calomel: Bryson, *Report*, 166, and 175. For continued use of calomel: Bryson, *Report*, 162, 164, and 174-175. For quinine tonic and treatment: Bryson, *Report*, 150, and 152. For prophylaxis: Bryson, *Report*, 149, 154, and 168. In remittents: Charles Cowan, *PMJRMS* 6, no. 137 (May 13, 1843): 124–28; C. Searle, *Lancet* 40, no. 1037 (July 15, 1843): 555–556. In intermittents: Dr. Symonds, *PMSJ* 1, no. 5 (Oct. 31, 1840): 73–77; M. Bouyer, *PMSJ* 1, no. 20 (Feb. 13, 1841): 331–32; Velpeau, *PMSJ* 2, no. 46 (Aug. 14, 1841): 379–82.
[97] For naval vs. merchant vessels surgeons: Select Committee on the West Coast of Africa, "Report. Part I," 360-361. For treatments: Select Committee, "Report. Part I," 359.

reaching 18.2 per 1000 men in 1843. This was in spite of higher sickness rates due in large part to greater manpower needs to blockade slaving areas and extend boat service.[98]

However, multiple fever outbreaks in 1844-45 demonstrated the continued dangers of the strategy adopted in the early 1840s. Most significant was a virulent yellow fever epidemic on *HMS Eclair* in mid-to-late 1845. Mark Harrison has extensively studied this case paying attention to it as an international incident and as the impetus for national debates over yellow fever and quaratine policies. Battered by fever, the *Eclair* limped to the Portuguese island of Boa Vista in the Cape Verdes for relief. Soon after its arrival, however, fever ravaged Boa Vista. Rather than face Portuguese authorities, the *Eclair* sailed for England, where it underwent under a three-week quaratine. By the time of its release, the epidemic had taken even more of the crew.[99] Public outrage over the sailors' deteriorating health and rising mortality before their very eyes allowed medical campaigners, anti-contagionists, humanitarians and free traders to target quaratine policy.[100] For several years thereafter, Superintendent-General of Quarantine Dr. William Pym and naval surgeons led by Burnett came into bitter conflict over the fever's contagiousness and quarantine practices. They debated the *Eclair* incident, and the nature of yellow fever without reaching any consensus.[101]

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[98] Bryson, *Report*, 148-78, esp. 158-60, and 169. For quinine as a tonic: E. J. Burton, *PMSJ* 3, no. 71 (Feb. 5, 1842): 365–368; and *PMSJ* 3, no. 72 (Feb. 12, 1842): 392–395. For resistance: Anon, *PMJRMS* 5, no. 117 (Dec. 24, 1842): 260–261; John M. Deere, *PMJRMS* 7, no. 169 (Dec. 23, 1843): 230; Anon, *PMSJ* 8, no. 15 (July 10, 1844): 229.

[99] Bryson, McWilliam, and eight other surgeons volunteered to join the *Eclair* (Burnett, memo, Feb. 5, 1846, RNM, AL, Mss.242/4/f. 169-171). Harrison, "Important Subject," 122; Mark Harrison, *Contagion: How Commerce Has Spread Disease* (New Haven: YUP, 2012), 80-84, 89, 91, and 94-95; "*Eclair* Papers," Oct. 1846, NA, ADM 97/166/5426. For fumigation: Burnett, memo, Oct. 7, 1845, Mss.242/4/f. 81-86. For recommendations: Matthew Tayler to Burnett, Sept. 30, 1845, ADM 97/164/2486; T.W. Heuber to Burnett, Oct. 1, 1845, ADM 97/164/2487; Conway J. Edwards to Burnett, Oct. 2, 1845, ADM 97/164/2507; Hugh W. Diamond to Burnett, Oct. 4, 1845, ADM 97/164/2747; John Milton to Burnett, Oct. 6, 1845, ADM 97/164/2772. For other outbreaks Bryson, *Report*, 163-67.

[100] Harrison, "Important Subject," 112, and 116-23; Harrison, *Contagion*, 83-85; Harrison, *Medicine in an Age*, 255-56, and 259-60.

[101] Harrison, *Contagion*, 85-89; Harrison, *Medicine in an Age*, 276-77; Curtin, *Image*, 345-47. See Burnett, memos, Oct. 29, 1845, RNM, AL, Mss.242/4/f. 87-93; Nov. 8, 1845, Mss.242/4/f. 103-04; Nov. 21, 1845, Mss.242/4/f. 109-17; Nov. 27, 1845, Mss.242/4/f. 135-54; Mar. 20, 1846, Mss.242/4/f. 205-6; and Apr. 5, 1846, Mss.242/4/f. 215-17.

At the same time, Portuguese officials made diplomatic accusations regarding the Boa Vista fever. In an attempt to take advantage of Dr. McWilliam's status as a national hero and authority on fevers, the Privy Council sent him to Boa Vista to conduct an inquiry. Based on his argument that remittent fever had struck the Niger Expedition, the government expected that he would clear the Navy of accusations that the *Eclair* had knowingly landed with a contagious fever aboard. McWilliam maintained his scientific principles, concluding from the evidence that the *Eclair* was responsible for the contagious remittent fever epidemic.[102] The Admiralty dispatched naval Inspector of Hosptials Dr. Gilbert King to produce a second report, which found that the fever had arisen from endemic climatic conditons and thus cleared the Navy. While McWilliam attempted to defend his work, his naval career never recovered. Facing a cold reception from Burnett and the Admiralty, he accepted the post of Medical Inspector to the Board of Customs, which he held for the rest of his career.[103]

The government and Admiralty recognized the risks that the *Eclair* incident and evidence of continuing mortality on the African Squadron presented. In October 1846, the Lords Commissioners directed Burnett to question medical officers who had served in West Africa "upon the illnesses contracted there— the localities which are regarded as most injurious to the health of those employed— the precautions which may be taken to divert or diminish Fever, and

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102 Harrison, "Important Subject," 121-122; Harrison, *Contagion*, 89-90, and 96-98; Willcox, "McWilliam," 138-139; McWilliam, *History*, 179-180. See McWilliam, *Report on the Fever at Boa Vista*. (London: Harrison, 1847); McWilliam to Burnett & the Admiralty, Mar. 23, 1846, NA, ADM 97/168/1478; McWilliam to Burnett, Apr. 4, 1846, ADM 97/168/1390-1391; Apr. 25, 1846, ADM 97/168/1392; May 29, 1846, ADM 97/168/1394; June 5, 1846, ADM 97/168/1683; Nov. 9, 1846, ADM 97/169/3579; and Nov. 22, 1846, ADM 97/169/3629; Burnett, memos, Sept. 28, 1846, RNM, AL, Mss.242/4/f. 376-377; and Oct. 30, 1846, Mss.242/4/f. 395-402.

103 Harrison, "Important Subject," 124; Harrison, *Contagion*, 98-99; Willcox, "McWilliam," 139; Admiralty, ADM/196/8, f. 110; Burnett, memos, Nov. 27, 1846, RNM, AL, Mss.242/4/f. 427-29; and Nov. 2, 1847, Mss.242/5/f. 151-52. For King: Burnett, memos, Feb. 22, 1844, NA, ADM 105/73/f.407-10; June 23, 1845, Mss.242/4/f. 65-66; and Nov. 2, 1847, Mss.242/5/f. 151-52. For response: McWilliam, *Dr. M'William's Remarks on Dr. King's "Report on the Fever at Boa Vista, Ordered by the House of Commons to Be Printed, 10th March, 1848"* (London: John Churchill, 1848). For reputation: Anon, *The Medical Examiner* 3 (Nov. 1847): 580–81.

the modes of treatment that may be regarded as most effectual." They adopted a scientific rationale for such a report, writing that "a long and perilous experience must now have supplied valuable data."[104] Based on these orders, Burnett assigned Bryson to conduct an inquiry into the health of the African Station. An African and West Indian Station veteran, Bryson spent four months analyzing the Squadron's journals, reports, returns, and pay books dating back to 1820. Beyond compiling the medical history of each voyage, he analyzed issues of disease causation, progression, treatment and prevention through exacting clinical and statistical methods.[105] By this time, statistical approaches had gained broader acceptance within the medical profession and the naval service, and pathological understandings of disease became increasingly prominent.[106]

Capturing the changes occurring on the Squadron from the 1830s onward, and presenting his own conclusions, Bryson recommended preventative hygienic and sanitary measures based on practical experience and knowledge. For example, he concluded that "it is obvious that the nearer boats approach the shore the greater the risk of contracting disease; and this again is much increased by landing, and still more by sleeping on shore." Bryson thus recommended stricter rules related to shore leaves, boat service and operations during epidemics. He emphasized sanitary practices addressing bilges, fumigation, washing and moisture. Bryson also targeted shore leaves in Freetown, arguing that they should be curtailed due to added dangers related to climate, fatigue, intemperance and overcrowding. His evidence for viewpoints already being empirically adopted ultimately led to stricter enforcement of preventative policies.[107]

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[104] Carlson, *African Fever*, 68-69; W.P. Ward to Burnett, Oct. 23, 1846, ADM 97/33/3153.
[105] Gelfand, *Rivers*, 57; Carlson, *African Fever*, 68-69, and 76; Curtin, *Image*, 345; Curtin, *Disease*, 24; Wickenden, 47-48; Admiralty, "Dr. Alexander Bryson," NA, ADM/196/8, f. 37, and ADM/196/77, f. 93; Barrow to Burnett, Oct. 23, 1847, NA, ADM 97/169/3153; Burnett, memo, Feb. 25, 1847, RNM, AL, Mss.242/4/f. 508-509.
[106] For medical statistics among others: Carlson, *African Fever*, 68; Gigerenzer and Swijtink, 46.
[107] For his preventative recommendations: Lloyd, *Navy*, 132-33, and 136; Brown, *Poxed*, 118; Curtin, *Image*, 349, and 354. For those already being adopted. Bryson, *Report*, 5, 203, and 228.Curtin, *Image*, 353-54; Lloyd, *Navy*, 133.

Bryson's conclusions in relation to quinine have received the most attention from medical and imperial historians. Like Thomson, he found that it was an "unequivocally valuable" treatment. Bryson went further presenting evidence to support the bolder claim that cinchona bark and quinine were "extremely useful agents for the prevention of fever… although it would appear that their powers have been considerably underrated, and their administration it is apprehended but indifferently understood; still the numerous instances on record in which they have been successfully employed, leave no room to doubt that their more general use upon the station is most urgently required." In particular, comparative empirical and statistical analysis allowed him to draw population-level conclusions about treatments based on Squadron records without creating an alternative causal explanation for fevers.[108] In regard to incubation zones and periods, for example, Bryson demonstrated that fevers rarely broke out more than a mile out to sea, and that they appeared roughly two weeks after boat service. To increase the prophylactic effectiveness of bark and quinine, he recommended that surgeons continue administering them to men ashore and on boat service "for at least fourteen days after their return."[109]

When published in June 1847, Bryson's *Report* gained an enthusiastic reception from Burnett and the Admiralty, who quickly distributed it to the African Squadron's officers and surgeons. The Navy hoped that solutions to the Squadron's sickness and mortality problems would aid in the public and parliamentary defense of their efforts.[110] The Admiralty swiftly adopted Bryson's precautionary recommendations, which built on existing empirical practices.

[108] Carlson, *African Fever*, 69-70, and 75-76; Mitcham, 51; Gelfand, *Rivers*, 57-59; Myers, "Most Disagreeable Service," 47; Bryson, *Report*, 218, and 244.

[109] For prophylaxis: Headrick, *Tools*, 68; Curtin, *Image*, 356; Harrison, "Important Subject," 118; Chakrabati, *Medicine and Empire*, 126. For irregularity of bark use: Lloyd, *Navy*, 137; Gelfand, *Rivers*, 57. For incubation and prophylaxis: Curtin, *Image*, 354-55; Curtin, *Disease*, 24; Headrick, *Power*, 231-32; Carlson, *African Fever*, 70-71; Mitcham, 51; Lloyd, *Navy*, 137-38; Bryson, *Report*, 178, and 219.

[110] Carlson, *African Fever*, 71; W.P. Ward to Burnett, June 2, 1847, NA, ADM 97/33/1279; Burnett, memos, June 3, 1847, RNM, AL, Mss.242/5/f. 1-2; June 3, 1847, ADM 97/171/1169; and June 5, 1847, RNM, AL, Mss.242/5/f. 3. See also Anon, *M-CR*, 51 (Oct. 1, 1847): 431–52; Anon, *EMSJ* 69 (1848): 107–38.

From late 1847, captains had to provide their reasons for ordering boat service operations. The Admiralty also encouraged captains to anchor at least a mile off the coast when possible, and enforced leave restrictions in Freetown.[111] Nonetheless, Bryson's work was not without its critics. Then Capt. Denman objected to Bryson's statements regarding the use of bark during the 1841 Gallinas campaign.[112] More publicly, William Pym protested Bryson's criticism of the *Eclair*'s quarantine. The debate became personally bitter, forcing Bryson to publish a rebuttal.[113]

Meanwhile, at a national level, Hutt's parliamentary campaign increased public awareness of ongoing medical debates related to the mortality and suffering of British sailors and African slaves. This helped to further shape the emergence of medical scientific efforts on the Squadron.[114] Thomson's testimony before Hutt's Select Committee in May 1848 allows us to examine his career and views.[115] By then, he had further honed his scientific skills on patrols off Brazil and East Africa, and gained membership in the Ethnological and Zoological Societies.[116] Thomson had published his article on quinine prophylaxis' use during the Niger Expedition, and written the Expedition *Narrative*'s medical, scientific, linguistic and ethnographic sections.[117] His testimony presented statistical, demographic and economic analysis of the Brazilian and

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[111] See also Curtin, *Image*, 354-355; Lloyd, *Navy*, 133; Frederick Edwyn Forbes, *Six Months' Service in the African Blockade, from April to October, 1848, in Command of H.M.S. Bonetta* (London: Richard Bentley, 1849), 123-24.
[112] Joseph Denman to Burnett, July 17, 1848, NA, ADM 97/177/2027; Bryson to Burnett and the Lords Commissioners, July 25, 1848, ADM 97/177/2155.
[113] Wickenden, 48; Carlson, *African Fever*, 78; Gelfand, *Rivers*, 57. William Pym, *Observations Upon Bulam, Vomito-Negro, or Yellow Fever, with a Review of "a Report Upon the Diseases of the African Coast, by Sir William Burnett and Dr. Bryson"* (London: J. Churchill, 1848); Bryson, *Account*, esp. 118. For debate: Burnett, memo, May 8, 1849, RNM, AL, Mss.242/6/f. 165-71; Anon, *EMSJ* 71 (Apr. 1849): 482–85. On *Eclair*: Bryson, *Report*, 179-94.
[114] Curtin, *Image*, 315-316. For racism in the discourse of sacrifice, see Harrison, "Important Service," 120.
[115] The Committee likely called him to testify due to a proposal to use African soldiers and sailors to further legitimate trade and suppression. Hutt, "Second Report," 106-132; Allen, and Thomson, vol. 2, 402-436, esp. 422-3.
[116] For his service: Admiralty, ADM/196/8, f. 176; Hutt, "Second Report," 106. For memberships: Allen, and Thomson, vol. 1, title page; Franey, 221. For collection of a mongoose specimen in Madagascar: Anon, "Galidictis Vittata," *Proceedings of the Zoological Society of London*, part 16, 1848 (London: Longman, Brown, Green, and Longman, 1848), 22-23. See also a postmortem report: Thomson to Burnett, Sept. 6, 1846, NA, ADM 97/169/4267.
[117] Carlson, *African Fever*, 51; Chakrabarti, *Medicine and Empire*, 126; Brockway, 131; Thomson, "On the Value of Quinine," 244-245. For Niger Expedition *Narrative*: Curtin, *Image*, 320-321; Allen, and Thomson, vol. 2, esp. 217-231, and 439-511.

African slave trades and their suppression. He offered evidence in support of naval efforts to further legitimate commerce, opposed the strategic destruction of slave baracoons, and advocated for the use of more African personnel.[118]

Despite the medical advances made in the 1830s and 1840s, Thomson painted a grim picture of the "loss of health and the suffering" on the Squadron. Based on empirical and statistical analysis, he argued that mortality and disability rates alone did not show the full picture of disease's impact. He testified that, "I can safely say, that I have scarcely ever served with one whose constitution was not more or less shaken. In talking with Dr. Bryson, he agreed with me that the actual amount of detriment to health does not appear in the statistics…"[119] Beyond this, the unfavorable political exigencies and public opinion during the 1840s ensured that the Committee tailored its questions. It did not ask Thomson about the decline in mortality since the 1820s, nor ongoing medical and scientific advances including quinine. Furthermore, experience had reinforced and proven to the public that West Africa was the "White Man's Grave."[120] Attacks on the Squadron's steamships exacerbated this reputation, as opponents and naval surgeon noted analogies to the conditions that factory workers and African slaves faced, and campaigned for improvements to address the ships' extreme heat and ill health.[121]

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[118] Hutt, "Second Report," 112-17, and 129-30. For his analysis, which argued for a reduced naval force tasked with promoting commerce, see also Thomson, *Brazilian Slave Trade, and Its Remedy*, viii-xiii, and 65-86. For the contest between the slave trade and legitimate commerce: Manning, *Slavery, Colonialism, and Economic Growth*, 51-53.

[119] Hutt, "Second Report," 125. See also Lloyd, *Navy*, 147-148. For the particular risk in the Bights of Benin and Biafra where the slave trade continued to thrive, see Select Committee on the Slave Trade, 127-128.

[120] Thomson retired in the early 1850s, as recurring fever attacks had rendered him unfit for sea duty. He surveyed several invalided seamen before retiring. He moved to Liverpool where he went into private practice through the mid-1860s. For the continued White Man's Grave: Curtin, *Image*, 353; William Whitaker Shreeve, *Sierra Leone: The Principal British Colony on the Western Coast of Africa* (London: Simmonds, 1847), 2. For his later career: Thomson to Burnett, Oct. 14, 1853, NA, ADM 97/205/3155; Oct. 29, 1853, ADM 97/206/3439; Dec. 10, 1853, ADM 97/206/4121; and Dec. 17, 1853, ADM 97/206/4217. For work in Liverpool: T. R. H. Thomson, *Lancet* 61, no. 1532 (Jan. 8, 1853): 42–43; Thomson, *The Boston Medical and Surgical Journal* 49, no. 24 (Jan. 11, 1854): 475–77; Thomson, *Lancet* 70, no. 1766 (July 1857): 7–9; Thomson, *BMJ* 1, no. 193 (Sept. 8, 1860): 712.

[121] Harrison, "Important Subject," 120-21, and 124. Bryson, *Report*, 161; Anon, *Lancet* 49, no. 1243 (June 26, 1847): 680; A Medical Student, *Lancet* 54, no. 1370 (Dec. 1, 1849): 592; Frederick James Brown, *Lancet* 56, no.

In the midst of increasing criticism of and strategic changes to suppression efforts, the Admiralty and Squadron's officers and surgeons continued to pursue the scientific efforts focused on fevers that had emerged in 1846-47. The Medical Department also devoted increased resources and personnel to the Squadron.[122] Burnett ordered surgeons to prepare reports on all fever outbreaks, and reformed the chronically mismanaged hospital on Ascension.[123] Along with the Squadron's Commodore, he prepared regular reports on mortality and invaliding.[124] Perhaps most importantly, spurred by Bryson's recommendations, Burnett requested permission to supply ships with quinine-wine. He wrote to the Lord Commissioners in June 1847, that he had:

> for sometime past had under consideration whether a plan might not be devised of giving the Bark in the form of Quinine and… succeeded with the aid of our Chemist in obtaining a Solution of Quinine every five minims of which contain one grain of Quinine, and I was very glad, on trial, to find that the Solution of Quinine mixes, and incorporates itself with Teneriffe Wine in the most perfect manner without the least decomposition ensuing. I would therefore request their Lordships approval of certain portions of Teneriffe wine being so prepared, and, with instruction issued to ships proceeding to such Stations.

The Lords Commissioners quickly consented, and Burnett ordered the preparation of 600 quart bottles containing a four-grain quinine solution mixed with one ounce of wine. Working with chemists and Bryson, he then distributed them to the African Station for initial trials.[125]

1419 (Nov. 9, 1850): 538–39; and *Lancet* 57, no. 1427 (Jan. 4, 1851): 30–31; Henry Landor, *PMSJ* 15, no. 11 (May 28, 1851): 293–295. For sanitary movement: Schweber, 112-16; Hamlin, *Public Health*, 2-3.

[122] For high scale of medical stores used on African Station: J.T. Cunningham to Burnett, June 8, 1844, NA, ADM 97/161/1494; For vaccination as a scientific mission on Squadron: J. Foote to Burnett, July 7, 1844, ADM 97/161/1507; John Douglas to Burnett, Apr. 11, 1845, ADM 97/163/838; Jonathan Bernard to Burnett, May 23, 1845, ADM 97/163/1334; J. Walsh to Burnett, Jan. 1, 1846, ADM 97/166/5328.

[123] Burnett, memos, Nov. 14, 1845, RNM, AL, Mss.242/4/f. 105-106; July 2, 1847, Mss.242/5/f. 30-37; Mar. 14, 1851, NA, ADM 105/68/f.59-60; and Dec. 2, 1852, ADM 105/68/f.413-419; Robert McCrae to Burnett, Aug. 16, 1847, ADM 97/173/3190; and Feb. 26, 1848, ADM 97/176/1133; Edward G. Irving to Burnett, Sept. 23, 1850, ADM 97/189/3303. For Ascension Hospital: Gilbert King to Burnett, July 30, 1847, ADM 97/172/2293; Burnett, memos, Aug. 6, 1847, RNM, AL, Mss.242/5/f. 73-78; and June 24, 1848, ADM 97/177/1579.

[124] For orders: W.P. Ward to Burnett, Jan. 7, 1848, NA, ADM 97/34/5320; and Mar. 9, 1848, ADM 97/34/6644. For returns: Charles Hotham to Burnett, Nov. 1847, ADM 97/175/6367; and Nov. 1847, ADM 97/175/6368; W.P. Ward to Burnett, Sept. 30, 1848, ADM 97/34/6280. For reports: Burnett, memos, Jan. 12, 1848, RNM, AL, Mss.242/5/f. 236; Feb. 8, 1848, Mss.242/5/f. 261-262; Feb. 16, 1848, Mss.242/5/f. 273-274; and Mar. 14, 1848, Mss.242/5/f. 312.

[125] Carlson, *African Fever*, 79-80; Mitcham, 51; Curtin, *Image*, 356; Myers, "Most Disagreeable Service," 49; Burnett, memos, June 25, 1847, RNM, AL, Mss.242/5/f. 28-29; June 25, 1847, NA, ADM 97/171/1573. For a

Bryson and Burnett prepared instructions, ordering the daily administration of quinine-wine for fourteen days following open exposure to the climate. The political pressures surrounding the Squadron's efforts, increasing empirical and statistical evidence, and the rising use of quinine among Europeans residing in West Africa drove Burnett and the Admiralty to authorize this change in policy and approach. By mid-1848, the Army had also issued a similar circular policy.[126] This was in spite of the fact that doctors still had not developed an adequate theoretical explanation for how quinine worked. Practitioners continued to work within the existing paradigm. For example, Thomson attribute fevers to a "peculiarity of atmosphere— call it miasma, malaria, or any other name."[127] In support of the quinine policy, Burnett ordered a grand clinical trial on the African Squadron. Despite detailed instructions, quinine provisions proved inadequate, and surgeons had to experiment with protocols and dosage. They initially had encouraging but mixed results.[128] The next section investigates this clinical trial and its ramifications for naval medical practice, especially surgeons' rising faith in the therapeutic value of quinine through the 1850s.

chemist's report: Lloyd Bulloch to Burnett, May 26, 1847, ADM 97/172/2074. For ascent: Robert Hamilton to Burnett, June 29, 1847, ADM 97/33/1671, also quoted in Carlson, *African Fever*, 79-80. For trial preparations: Burnett, Bryson, and William Kent, "Correspondence Related to Quinine," 1847, ADM 97/173/3397.

[126] Carlson, *African Fever*, 80-81; Gelfand, *Rivers*, 59; Curtin, *Disease*, 24; Harrison, "Important Subject'," 118; Bryson, "On the Prophylactic Influence of Quinine," *MTG* (Jan. 7, 1854): 13-14. For Europeans' adopting quinine: Webb, *Humanity's Burden*, 107; Brockway, 131; Curtin, *Image*, 356-57; Bryson, *Report*, 244. For an evaluation of quinine: Edward Heath, "Medical Journal of Her Majesty's Sloop Rapid," 1846-1847, NA, ADM 101/116/4, f. 16. For Army circular, see also Headrick, *Tools*, 68.

[127] Curtin, *Image*, 356-57; Curtin, *Disease*, 26; Lloyd, and Coulter, vol. 4, 163; Thomson, "On the Value of Quinine," 145. See also Heath, ADM 101/116/4, f. 15.

[128] Carlson, *African Fever*, 80; Gelfand, *Rivers*, 59. For the initial trial reports: George H. Sidely to Burnett, Aug. 11, 1849, NA, ADM 97/185/4663; Archibald Armstrong to Burnett, Dec. 16, 1849, ADM 97/185/4591; James G. Walsh to Burnett, Apr. 1, 1850, ADM 97/188/1459; J. Acheson to Burnett, Oct. 7, 1850, ADM 97/190/4493.

6.3 NAVAL MEDICAL SCIENCE AND ITS EFFECTS IN WEST AFRICA, 1850-1860

As the Navy formulated and implemented its clinical trial on the African Squadron, Britain's West African strategy became increasingly expansive and interventionist. In 1847, the African Squadron, which consisted of 36 ships and 4,445 men, hovered near its peak in manpower.[129] Despite humanitarian and free trade attacks on naval suppression, the palm oil trade continued rise in national importance. The emergence of a new generation of gentlemanly merchants helped drive Britain toward greater imperial interventions in West Africa, including the bombardment of Lagos to supposedly protect missionary and trade interests in 1851.[130] The growing influence of liberalism, free trade and informal empire led to a reframing of the Squadron's priorities that culminated under Commodore Sir Charles Hotham. The Squadron increasingly became a tool for pursuing legitimate commerce and gentlemanly capitalism. While continuing its suppression duties, it pursued efforts to open African market and to ensure British supremacy in areas of significant commercial interest. Although some free trade purists objected to coercive methods, Palmerston, the Admiralty, and many merchants supported this interventionist imperial policy.[131] This changing commercial-imperial strategy converged with the rise of scientific practices within the Medical Department during the late 1840s and early

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[129] Huzzey, *Freedom*, 112-24; Drescher, *Mighty Experiment*, 188-91; Bethell, 304; Curtin, *Image*, 316; Eltis, 92.
[130] Lynn, *Commerce*, esp. 13-18 and 98-101; Lynn, "West African Palm Oil Trade," 67-70; Manning, *Slavery, Colonialism, and Economic Growth*, 13-14, and 51-53; Kristin Mann, *Slavery and the Birth of an African City: Lagos, 1760-1900* (Bloomington: Indiana University Press, 2007), ch. 4, and esp. 118-22. For the generation of gentlemanly capitalists: Darwin, *Empire Project*, 125.
[131] Mark C. Hunter, "The Hero Packs a Punch: Sir Charles Hotham, Liberalism and West Africa, 1846–1850," *MM* 92, no. 3 (Jan. 1, 2006): esp. 282–83. For more in depth discussions, see also Lynn, "Imperialism of Free Trade," 22–40; Lynn, "British Policy," 101-21. For Robert Jamieson and other merchants' free trade and self-interested objections to the Niger Expedition: Temperley, *White Dreams*, 58-60.

1850s. As quinine's use in the Navy rose, quinine prophylaxis began to make further imperial interventions more feasible.[132]

Although government interest in the Niger had waned after the 1841 Expedition, the palm oil trade's rising importance in the Delta region drove a new wave of commercial voyages. Palm oil merchants and slave traders both maintained a presence in the Bights of Biafra and Benin throughout the 1840s. A series of trading expeditions on the Niger driven by commercial, liberal imperial, and secondarily humanitarian-antislavery interests began again in the mid 1840s. The partnership of Jamieson and Beecroft led to an 1845 expedition with an African crew and three Europeans that avoided fever.[133] In the late 1840s, Macgregor Laird reentered the African trade scene, founding the African Steamship Company in 1849 and winning the government mail contract for West Africa in 1852. During this period, a closer relationship developed between Laird, other palm oil traders, and the Colonial Office and Admiralty. Laird's duties brought him into contact with officers, surgeons, and geographic minds interested in African exploration.[134]

Explorer Heinrich Barth's initial report from the ground during an overland West African expedition that the Benue branch of the Niger was navigable and economically prosperous reignited Laird's interest in outfitting another Niger Expedition in early 1853. Taking advantage of the disappearance of the Barth expedition in the months following the initial report, as well as the Navy's ongoing imperial interventions, Laird won the support of the Admiralty and Foreign Secretary Earl Clarendon. By mid-1853, the Admiralty recommended a small expedition to explore the Niger, Tchadda, and Benue Rivers, search for Barth, and open new trade relations.

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[132] Notable examples include the campaigns in Lagos, and extension of antislavery operations during the 1850s. Carlson, *African Fever*, 81. For Lagos and growing intervention from the 1840s through the 1860s: Mann, *Slavery and the Birth of an African City*, 84-85, and 91-109; Curtin, *Image*, 314-15; Parsons, 65-67; Huzzey, *Freedom*, 147.
[133] Hoag, 87; Curtin, *Image*, 308-10; Anon, *The Scotsman* (Feb. 25, 1846): 2; and (June 6, 1846): 2.
[134] For Laird's commercial efforts: McConnaha, 29; Headrick, Tools, 74. For explorers: Curtin, *Image*, 321.

Nonetheless, as a precaution in response to previous disasters, the government restricted the number of white sailors, and commissioned Laird to organize and oversee the Expedition.[135]

As this Niger Expedition came into fruition, it brought to a climax the developments occurring in naval medical practice during the late 1840s and early 1850s. As the African Squadron's duties expanded, surgeons participated in and reported back the results of the quinine trial. Between 1850 and 1852, they refined the protocols for quinine prophylaxis and generally reported positive results. Surgeon Edward Heath wrote that, "a simple statement of facts will best show the great good resulting from the daily use of the Quinine wine under circumstances of unwanted exposure." Several of his colleagues similarly reported few fever cases or deaths during many months of antislavery patrols.[136] The use and distribution of quinine subsequently continued to increase as evidence emerged and confidence in its utility increased.[137] Nonetheless, because a scientific explanation of why quinine was effective remained elusive, quinine practices still remained dependent on empirical knowledge and practitioners' opinions. Some surgeons and naval officers remained skeptical of quinine and did not implement the new instructions. Furthermore, uncertainty over its use, dosage, and effects also remained, and some practitioners questioned the continued inability to explain its chemical and physiological actions.[138]

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135 Curtin, *Image*, 310-1; Hoag, 87; Carlson, *African Fever*, 85-86; Headrick, Tools, 69; Kennedy, *Last Blank Spaces*, 136-7; McConnaha, 29; Admiralty to FO, May 23, 1853, "Baikie's Expeditions Up the Niger," NA, FO 2/18; Baikie, *Narrative of an Exploring Voyage up the Rivers Kwo'ra and Bi'nue* (London: John Murray, 1856), 3-4.

136 For quoted source: Edward Heath to Burnett, Apr. 15, 1851, ADM 97/192/233. See also Charles Kevern to Burnett, Jan. 1, 1852, ADM 97/197/34. Robert McCrea to Burnett, Nov. 1, 1850, ADM 97/190/4297; R.N. Beaumont to Burnett, May 24, 1852, ADM 97/200/3262; John Terran to Burnett, June 15, 1852, ADM 97/198/1251.

137 Carlson, *African Fever*, 81; Curtin, *Image*, 356. For the use of quinine, and requests for it: Burnett, memo, Apr. 7, 1849, RNM, AL, Mss.242/6/f. 151; Alexander Milne to Burnet, Sept. 15, 1851, NA, ADM 97/196/4655.

138 Curtin, *Image*, 356-357; Curtin, *Disease*, 24; Headrick, *Tools*, 68-69. For the empirical debate over quinine: R. G. Mayne, *LJM* 2, no. 20 (Aug. 1850): 725–29; Charles Beckett, *PMSJ* 14, no. 22 (Oct. 30, 1850): 594–98; Robert Dundas, *MT* 3, no. 66 (Oct. 4, 1851): 346–38; Robert Dundas, *LJM* 4, no. 41 (May 1852): 454–59. For quinine's effects: Anon, *PMSJ* 13, no. 2 (Jan. 24, 1849): 52; Robert Dundas, *LJM* 3, no. 36 (Dec. 1851): 1103–13; Anon, *PMSJ* 16, no. 11 (May 26, 1852): 271–73; Thomas Nicholson, *AMJ* 1, no. 39 (Sept. 30, 1853): 856–57. For attempts to find a cheaper alternative: Anon, *LJM* 1, no. 1 (Jan. 1849): 101–2; Anon, *LJM* 2, no. 16 (Apr. 1850): 400.

Medical officers' commitment to and the scale of the Navy's quinine program cannot be fully understood without reference to the changes occurring more broadly in British science. Natural and medical science's increasing institutionalization and sophistication during the 1840s culminated in their extension to practical and social fields due to increasing positivist faith in their abilities.[139] As surgeons embraced this broader mindset and approach, they began to demonstrate the seeds of a fundamental practical breakthrough. For example, the sailors employed in the bombardment of Lagos saw few fever cases and no fatalities due to quinine prophylaxis.[140] More broadly, African Squadron Rear Admiral H.W. Bruce reported that mortality had declined to 16.2 per 1000 men in 1851-52. He attributed this "as far as human agency is concerned, to the use of quinine wine, the skill of the Medical Officers, and the careful attention of the commanders to the general sanitary conditions of their respective ships." Indeed, as the Squadron's mortality rates declined and efficiency increased, the Navy's manpower commitments to the Station began to fall.[141] Yet, despite the accumulating evidence, skepticism about quinine lingered. In addition to problems with supply, bitterness, side effects and resistance from sailors, there was still no adequate explanation for the drug's action.[142]

The public demonstration of quinine prophylaxis's effectiveness on the 1854-55 Niger Expedition was the culmination of the increasing practical importance of clinical scientific efforts. A group of junior surgeons who joined the Navy in the late 1840s and were committed to scientific explanations conducted the quinine trials and reported back to Burnett. While Thomas Huxley is the most well known of these surgeons, the most important for this narrative is

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[139] Yeo, "Scientific Method," 283. See also Hessenbruch, 107.
[140] For Lagos and quinine: Bryson, "Prophylactic Influence of Quinine," 6-7. See also Colonial Office, "The Reports Made for the Year 1849 to the Secretary of State Having the Department of the Colonies," *PP*, 1850(1232): xxxvi, 25, p. 95-96.
[141] H.W. Bruce to the Secretary of the Admiralty, Oct. 4, 1852, NA, ADM 97/200/3703. For manpower: Eltis, 92.
[142] Headrick, *Tools*, 69; Etemad, 32; Chakrabarti, *Medicine and Empire*, 127; Curtin, *Image*, 356.

Orkney-born, Edinburgh graduate Dr. William Balfour Baikie.[143] While at Edinburgh, Baikie attended twenty-four classes from 1842-47, served as student president of the Royal Medical Society, and earned the prestigious student assistant appointment at the Royal Infirmary.[144] Already a committed natural scientist when he joined the Navy, Baikie served at Haslar Hospital from 1849 and became one of Richardson's protégés.[145] While there, he conducted ethnographic and zoological research, helped to write a manual on natural historical methods, and proposed an expedition to the River Magdalena in Colombia.[146] Although nothing came of that proposal, the Admiralty appointed him assistant surgeon-naturalist to Laird's expedition based on Richardson and Royal Geographical Society President Sir Roderick Murchison's recommendations.[147]

By mid-1854, the Admiralty had worked out the particulars of Baikie's assignment, and medical and scientific preparations for the expedition were underway. Like McWilliam earlier, Baikie requested an extensive list of medicines that went beyond standard scales. After negotiating with Burnett, he received most of these supplies, including a pound of quinine sulphate.[148] Baikie also worked closely with Bryson, designing a comprehensive medical regime.

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[143] For Huxley: Williams, *Naturalists at Sea*, 253, and 260-261; White, *Thomas Huxley*, 6-9.

[144] Baikie took Anatomy thrice, Practice and Institutes of Medicine, Botany, Chemistry, Clinical Medicine, Clinical Surgery, Materia Medica, and Surgery twice, and Midwifery, Military Surgery, Medical Jurisprudence, Natural History, and Pathology once. He had average examination results. University of Edinburgh, EUA/IN1/STA/3, vols. 1842-1847, and EUA/IN1/STA/8, vol. 1847; University of Edinburgh, *Lists of Graduates*, 141; Anon, *EMJ* 10 (Feb, 1865): 763; W. McConnaha, "Baikie and the Prevention of Malaria," *JRNMS* 93, no. 1 (2007): 28.

[145] McConnaha, 28-29; Anon, *The Gentleman's Magazine* 1, no. 3 (Mar. 1865): 375; Baikie, *List of Books and Manuscripts Relating to Orkney and Zetland; or in Which These Islands Are Mentioned* (Kirkwall: J.N. Anderson, 1847); Baikie and Robert Heddle, *Historia Naturalis Orcadensis: Zoology, Part I* (Edinburgh: J. and W. Paterson, 1848). For Richardson: Lloyd, and Coulter, vol. 4, 29, and 72-76; McLean, *Surgeons*, 53; White, *Thomas Huxley*, 24. For Baikie and Richardson: John McIlraith, 179; Baikie to Burnett, Feb. 7, 1852, NA, ADM 97/196/4787.

[146] Baikie, "Ethnographic Hints," *The Naturalist* 2 (1852): 207; Baikie, *Zoologist* 11-12 (1854): 3811-14, 3845-47, 3950-52, 4018-20. For the proposed expedition: W.J. Alexander, Arthur Adams, and Baikie to Burnett, Sept. 20, 1852, NA, ADM 97/200/3603. For the manual: Arthur Adams, Charles Barron, and Baikie, *A Manual of Natural History for the Use of Travellers* (London: J. Van Voorst, 1854); Anon, *Zoologist* 12 (1854): 4405.

[147] McConnaha, 29. For RGS: Stafford, *Scientist*, 162-63; Admiralty to Roderick Murchison, May 23, 1853, NA, FO 2/18. For scientists: Admiralty to Foreign Office, Oct. 17, 1853, FO 2/18. For Baikie volunteering: Burnett, memo, June 9, 1853, RNM, AL, Mss.242/7/f. 4-5.

[148] For orders regarding his position as surgeon, botanist, and naturalist: Baikie to the Foreign Office, May 4, 1854, NA, FO 2/18; Admiralty to Baikie, May 8, 1854, FO 2/18; Admiralty to Foreign Office, May 20, 1854, FO 2/18. For

In these instructions, Bryson wrote that the risk posed by the poor disease environment could be substantially reduced "by judicious arrangements, a rapid passage through the swamps of the delta" and quinine. He recommended reducing the number of British sailors, sailing during the rainy summer season, employing strict hygienic rules, and "taking quinine in the proportion of from six to eight grains per diem" from the moment the expedition entered the Niger until two weeks after leaving it.[149]

Equipped with naval, merchant and missionary personnel, and with Baikie as naval surgeon, the Niger Expedition set sail in May 1854. The civilian captain Beecroft died of fever in Fernando Po before the Expedition had reached the Niger Delta. The naval commander who had relieved the Expedition ultimately gave command to Baikie. Over four months, the Expedition ascended 240 miles of the Niger, encountering only one case of fever and no additional deaths.[150] Baikie's assumption of command allowed him to stringently enforce Bryson's instructions, including forcing all twelve British members to take quinine-wine. The Expedition's return captivated Britain, as no one had died while sailing the river in stark contrast to previous experience.[151]

Despite this success, Baikie waited to publish his findings on quinine prophylaxis. He may have felt that the results spoke for themselves and reinforced evidence emerging from the

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more on preparations, see "Tchadda Expedition Papers," 1854, ADM 97/203/730. For medical stores: Baikie to Burnett, Apr. 25, 1854, ADM 97/210/556; May 5, 1854, ADM 97/210/795; and May 8, 1854, ADM 97/211/862.

[149] Carlson, *African Fever*, 85-86; Headrick, *Tools*, 69; Headrick, *Power*, 232; Myers, "Most Disagreeable Service," 49-50; McConnaha, 29-31; Bryson, 1854, NA, ADM 97/203/730, esp. f. 4; and 16-19. See also Baikie, *Narrative*, 5, 34, and 453; Thomas Joseph Hutchinson, *Narrative of the Niger, Tshadda & Binuë Exploration* (Longman, Brown, Green, and Longmans, 1855), 211-21.

[150] Hoag, 87-88; Headrick, *Power*, 232; Kennedy, *Last Blank Spaces*, 70; Carlson, *African Fever*, 86-87; Curtin, *Image*, 311; McConnaha, 29; Admiralty to Foreign Office, Aug. 7, 1854, NA, FO 2/18; Thomas Miller to the Admiralty, June 23, 1854, FO 2/18; and June 29, 1854, FO 2/18; Baikie to Admiralty, Jan. 3, 1855, FO 2/18; and June 29, 1854, ADM 97/214/3774.

[151] Beyond the often cited sources above, see also Curtin, "White Man's Grave," 105, and 109; Hoag, 90; McConnaha, 31; Kennedy, *Last Blank Spaces*, 136-137; Brockway, 131; Myers, "Most Disagreeable Service," 50; Baikie, *Narrative*, 5, and 453.

ongoing quinine trials, but the trickier scientific question of how to fit his experience into the miasmatic system lingered. After attributing the success to Bryson's advice, Baikie used clinical, pathological, meteorological and topographical data to assert that fevers were one general disease arising from the release of vegetation-based miasmatic germs.[152] Beyond this, Baikie's clinical work based on specimens and observations taken on the Niger, and natural scientific, geographical, and ethnographic research using his notes also took up much of his time.[153] Bryson was thus the first to publish on quinine's role in the Expedition, linking it to the more general extension of prophylaxis within the Navy. The Expedition's civilian surgeon, Thomas Hutchinson of Fernando Po, published his analysis soon after, which extolled Bryson's guidance, embraced quinine prophylaxis, and supported reducing the use of bloodletting and mercury.[154]

While Baikie only published on quinine in his 1856 *Narrative* and an 1857 article, this does not mean he was uninterested in this portion of his findings. In his lengthy post-expedition report to Burnett, Baikie wrote of quinine that, "too much can hardly be said in favour of this invaluable drug. Taken as a prophylactic it fortifies the constitution and preserves the health in

[152] Carlson, 78-79; Curtin, *Image*, 357; Baikie, *Narrative*, 452-453; Baikie to Burnett, Mar. 23, 1855, NA, ADM 97/218/8088, f. 7-10, and 35. For his theory: Baikie, "On Remittent Fever, Especially as Its Appears on the West Coast of Africa: With Some Remarks on the Term 'Fever,'" *EMJ* 2, no. 9 (Mar. 1857): 803-815.

[153] McConnaha, 31-32; A. Werner, "English Contributions to the Study of African Languages," *Journal of the Royal African Society* 29, no. 117 (Oct. 1, 1930): 509–28. For an electric eel from the Niger: Anon, *BMJ* 1, no. 38 (Sept. 19, 1857): 795; John Richardson and Baikie, "Notes on Electric Fishes," in *Report of the Twenty-Seventh Meeting of the BAAS*, vol. 27 (London: J. Murray, 1858), 115. For meteorological observations: Baikie, "Observations up the River Niger, by Dr. Baikie," in "Papers of Dr. W. B. Baikie," 1854-55, BLM, Add. Ms. 32449, f. 21-62. For geographical science: Baikie, "Brief Summary of an Exploring Trip up the Rivers Kwòra and Chàdda (Or Benué) in 1854," *JRGS* 25 (Jan. 1, 1855): 108–121; Baikie, "Report of the Late Expedition Up the Niger and Tchadda Rivers," in *Report of the Twenty-Fifth Meeting of the BAAS*, vol. 25 (London: J. Murray, 1856), 146–147. For early Hausa Bible translations: Baikie, "Bible. Paraphrases: Portions of the Bible in a W. African Dialect," in "Papers of Dr. W. B. Baikie," BLM, Add. Ms. 32449, f. 63 onward. On trade and civilization: Baikie, "On Recent Discovery in Central Africa and the Reasons Which Exist for Continued and Renewed Research," in *Report of the Twenty-Sixth Meeting of the BAAS*, vol. 26 (London: J. Murray, 1857), 105–107.

[154] Headrick, *Power*, 232; Headrick, *Tools*, 69; Bryson, "Prophylactic Influence of Quinine," 6-7. For Hutchinson: Hutchinson, *Narrative*, 211-221; Thomas Joseph Hutchinson, *Impressions of Western Africa: With Remarks on the Diseases of the Climate and a Report on the Peculiarities of Trade Up the Rivers in the Bight of Biafra* (Longman, Brown, Green, Longmans, & Roberts, 1858), 226-245; H.W. Bruce to Admiralty and Burnett, Nov. 14, 1853, NA, ADM 97/207/4671. For his later use of quinine: T.J. Hutchinson to John Liddell, Sept. 29, 1856, ADM 97/229/3918; T.J. Hutchinson to John Liddell, Dec. 20, 1856, ADM 97/230/5360.

notoriously sickly regions; and when under the hand of ruthless disorder, it expels the invader, and restores the system." As indicated in this dissertation's opening vignette, Baikie eagerly lauded the imperial ramifications of this realization. He argued that, through the use of a prophylactic quinine regimen, "the ability to penetrate hitherto unknown lands is acquired, spreading far and wide the blessings and advantages of civilization and of commerce."[155] Furthermore, his research on fevers came together in an 1857 article published in the *Edinburgh Medical Journal*. He connected remittent fevers to germatic poisons in hot, damp and swampy localities, posited a refined ten-day incubation period, and advocated quinine prophylaxis in place of mercurials. Baikie thus presented one of the more advanced theoretical explanations of fever's causes, progression, and treatment that could emerge prior to germ theory.[156]

Scholarship since the mid-twentieth century has seen the 1854-55 Niger Expedition as a defining moment in the national realization of quinine's power. In medical, governmental, and imperial circles, this represented the culmination of nearly a decade of scientific efforts. The argument that quinine opened West Africa to increased British commercial and imperial expansion has also become commonplace with the extension of the palm oil trade inland and Lagos' 1861 colonization being early examples.[157] Baikie himself advocated an ambitious humanitarian-commercial civilizational mission made possible by quinine. He returned to the Niger in 1857 as part of a larger commercial expedition that set up a trading post and founded a CMS mission, and remained a prodigious naturalist and ethnographer while stationed there as

[155] Gelfand, *Death*, 61-62; Carlson, *African Fever*, 79; Brown, *Pax Britannica*, 115-116; Lloyd, and Coulter, vol. 4, 182; Lloyd, Navy, 138; McConnaha, 32; Myers, "Most Disagreeable Service," 50-51. For quotes: Baikie to Burnett, Mar. 23, 1855, NA, ADM 97/218/8088, f. 32-33, and 38; Baikie, *Narrative*, 328, and 453-454. See also Christopher Lloyd, "Baikie's Exploration of the Niger and His Use of Quinine," *History Today* 21 (1971): 740–746.
[156] Carlson, *African Fever*, 79; Baikie, "On Remittent Fever,'" *EMJ* 2, no. 9 (Mar. 1857): 803-04, and 806-13.
[157] Carlson, *African Fever*, esp. 88-89; Brockway, 127, and 130-31; Hoag 89-90; Headrick, *Tools*, 70; McConnaha, 31-32; Baikie, *Narrative*, 394; Baikie to Burnett, Mar. 23, 1855, ADM 97/218/8088, f. 32-33.

missionary-consul until his death in 1864.[158] The extension of quinine prophylaxis within the Navy and among white colonial populations meanwhile continued from the 1850s onward.[159] It became a mainstay of African exploration, as demonstrated by the practices of missionary-explorer Dr. David Livingstone.[160]

6.4 NAVAL MEDICAL SCIENCE, THE ROYAL NAVY, AND THE EMPIRE

Despite the preceding analysis, the impact of quinine from the 1850s must not be analyzed uncritically. A number of scholars have emphasized the fact that quinine was not a

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158 Carlson, *African Fever*, 88-89; Headrick, *Tools*, 74; Hoag, 90; McConnaha, 31-32; James Watt, "Naval and Civilian Influences on Eighteenth- and Nineteenth-Century Medical Practice," *MM* 97, no. 1 (Jan. 1, 2011): 158; Esther Breitenbach, "Scottish Encounters with Africa in the Nineteenth Century," in *Africa in Scotland, Scotland in Africa: Historical Legacies and Contemporary Hybridities*, 2014, 25-29; Felix K. Ekechi, *Missionary Enterprise and Rivalry in Igboland, 1857-1914* (London: Frank Cass, 1972), 4-8. Femi J. Kolapo, "CMS Missionaries of African Origin and Extra-Religious Encounters at the Niger-Benue Confluence, 1858-1880," *African Studies Review* 43, no. 2 (Sept. 1, 2000): 90-91, 95, 97, and 105-109. For advocacy of activity, see McGregor Laird to the Earl of Clarendon, Foreign Office, Mar. 3, 1855, NA, FO 2/18; Baikie to the Royal Geographical Society, Jan. 9, 1856, FO 2/23; Baikie to the Earl of Clarendon, Oct. 11, 1856, FO 2/23. For his later scientific work: Baikie, "Singular Account of the Sail Fluke (Zeugoterus Velivolans)," *The Zoologist* 18 (1860): 6993–94; Botanical Society of Edinburgh, "Letter from Dr. W. Balfour Baikie to Dr. Christison," *TPBSE* 6 (1860): 82–84; and "Notice of the Palm-House in the Royal Botanical Gardens at Edinburgh," *TPBSE* (1860): 128–136; Baikie, *Observations on the Hausa and Fulfulde Languages* (London, 1861); Baikie, "Despatch From Dr. Baikie, Commander of the Niger Expedition, to Earl Russell," *PRGS* 6, no. 1 (Dec. 9, 1861): 22–23; "Report on the Countries in the Neighborhood of the Niger," *PRGS* 7, no. 2 (1862): 66–68; and "Letter from Dr. Baikie," *PRGS* 8, no. 6 (1863): 263–64; Dr. J. E. Gray, "On the Development of the Sternal Callosities in Cyclanosteus Senegalensis, and on the Synonyms of Cyclanosteus and Its Allied Genera," *PRGS* 33, no. 1 (Jan. 1, 1865): 422–428; J Kirk and W. B Baikie, "Notes of a Journey from Bida, in Nupa, to Kano, in Hausa, Performed in 1862 by Dr. W. B. Baikie, R.N.," *PRGS* 11, no. 2 (1866): 49–50; Charles Augustus Ludwig Reichardt and Baikie, *Grammar of the Fulde Language* (London: Church Missionary House, 1876); Baikie and James Frederick Schön, trans., *Letāfi ta Zabúra. The book of Psalms* (London: British and Foreign Bible Society, 1881).

159 For positive evaluations from Squadron medical journals: Samuel S.D. Wells, "Medical Journal of HM Frigate Brilliant," 1857, ADM 101/217, f. 85; William Macleod, "Medical Journal of HM Ship Madagascar," 1859, ADM 101/286, f. 45-47; James Farrely, "Medical Journal of HM Steam Sloop Trident, 1859, ADM 101/129, f. 16-17. See also Watt, "Naval and Civilian Influences," 158-59; Bryson, "Statistical Report of the Health of the Royal Navy, for the Year 1857," *PP*, 1859, Session 2(138): xvii, 541, p. 82-85; Alexander E. Mackay, "Statistical Report of the Health of the Royal Navy, for the Year 1862," *PP*, 1865(419): xxxv, pt. 2, 169, p. 184-86.

160 Gelfand, *Death*, 63-65; Andrew C. Ross, *David Livingstone: Mission and Empire* (New York: Hambledon Continuum, 2006), 14, and 24. See Livingstone, "On Fever in the Zambesi," *TESL* 1 (1863): 235–41; Anon, *BMJ* 1, no. 26 (June 29, 1861): 682–84; J.C. Cameron, *Lancet* 78, no. 1993 (Nov. 9, 1861): 456–57.

panacea that suddenly opened the floodgate for European imperialism. Demand for quinine increased exponentially, outstripping cinchona bark supplies and increasing quinine prices. British attempts to shore up Andean cinchona stocks and transplant trees to India dominated the 1850s and 1860s, but it was not until 1872 that Dutch plantations in Java and Batavia provided alternative supplies. Quinine's bitter taste, effectiveness against a limited range of fevers, continued theoretical debates, and practitioners' ability to decide treatments based on their judgment also remained as obstacles.[161]

Over the last several decades, the historiography has also hotly debated the importance of quinine in reducing European mortality in the tropical world and serving as a tool of empire has. Philip Curtin pioneered the view that quinine was one of the factors that led to a "mortality revolution." Along with the move away from bleeding and mercury, it contributed to a steep decline in British mortality in West Africa from the 1840s through the 1860s. The importance of sanitary practices, including changes in settlements placement, the nature of accommodations, and behavioral advice, have also received increasing attention. Despite these changes, West Africa remained the deadliest station in both the Army and Navy with extremely elevated morbidity through the early 1900s. Analyzing quinine's relative impact, Mark Harrison has thus argued that the importance of quinine has been exaggerated.[162] Nonetheless, more British

[161] Etemad, 31-32; Curtin, "White Man's Grave," 100-1; Curtin, *Death*, 65; Gelfand, *Death*, 87; Carlson, *African Fever*, 48. For bio-prospecting: Chakrabarti, *Medicine and Empire*, 126; Etemad, 26-30; Headrick, *Power*, 233-34; Brockway, esp. 112-24; Daniel R. Headrick, *The Tentacles of Progress: Technology Transfer in the Age of Imperialism, 1850-1940: Technology Transfer in the Age of Imperialism, 1850-1940* (New York: OUP, 1988), 231-37. See also Carlos Pérez, "Quinine and Caudillos: Manuel Isidoro Belzu and the Cinchona Bark Trade in Bolivia, 1848-1855" (Ph.D. Diss.; University of California, Berkley, 1998). For practical difficulties encountered by Livingstone, see among others Gelfand, *Death*, 67-68, and 80-86.

[162] On the African Squadron, mortality fell from 65 per 1000 men in 1825-45 to 22 per 1000 men from 1858-67. Another calculation shows that mortality rates declined 59.5% between the early and late 1840s, but after Bryson's reforms hovered at the 27 per 1000 men from 1848 to 1867. Etemad, 34-35; Curtin, *Disease*, 26-27; Curtin, "White Man's Grave," 109-10; Headrick, *Tools*, 69-70; Chakrabarti, *Medicine and Empire*, 127. For debate: Brunton, 225; Curtin, *Image*, 344-62; Curtin, *Death*, 40-61, and 104-29; Harrison, "Important Subject," 118, and 125-26.

imperial agents survived in tropical regions by mid-century than any time before. Quinine thus served as one of the foundations that opened new strategic and ideological possibilities for British imperial and global activity.

Scholarship has often portrayed the adoption of quinine prophylaxis within the Royal Navy and throughout British colonial settlements in West Africa as a medical and imperial story of science's triumph over the "White Man's Grave" in the 1840s and 1850s. While this narrative captures some of the implications of this formative period, it does not give adequate due to naval surgeons' central role in these efforts. This chapter has analyzed the connections between surgeons' practical efforts, and the broader circumstances and developments that shaped British activity in West Africa. It has contended that the practical, scientific, professional and political debates that underpinned the efforts of surgeons stationed in and off the West African coast must be understood based on their interactions with Britain's shifting and contested strategic and political interests in West Africa.[163] The naval surgeons who spearheaded the scientific efforts that transformed tropical medical practices were part of a naval force, medical apparatus, and scientific community with particular strategic and practical concerns. When combined with the necessity of performing their duties under trying circumstances, these institutional and practical dynamics ensured naval surgeons' key role in confronting the scourge of tropical fevers.

During the 1840s and early 1850s, surgeons navigated a series of shifts in the motivations and tactics for the Navy's presence off of West Africa. The combination of the unprecedented national influence that humanitarians and abolitionists achieved, and Palmerston's coercive diplomatic and naval strategy led to an interventionist approach to naval slave trade suppression efforts. The rise of Buxton's humanitarian-antislavery strategy for the improvement of West

[163] Harrison, "Important Subject," 109-25 has begun to unpack some of the professional, political, and scientific debates that shaped the practice and development of naval medicine on the African Squadron.

Africa during the late 1830s and early 1840s led the outfitting of the 1841-42 Niger Expedition as the first step in a grand colonial-civilization scheme. The expanded naval activity associated with these developments heightened the threat to and toll of disease on the Navy's sailors. As they dealt with the consequences, naval surgeons applied empirical, clinical, experimental and statistical scientific methods and approaches. The efforts of the Niger Expedition's surgeons and the Army and Navy's medical statistical studies yielded promising initial results in regard to preventative hygienic measures and quinine. Nonetheless, frustration with the miasmatic theoretical system and questioning of the Navy's presence off of West Africa largely overshadowed these findings during the early 1840s.

Political and strategic questioning of Britain's interventionist slave trade suppression strategy increased after the failure of the 1841-42 Niger Expedition and the decline of humanitarians and abolitionists' national influence. One of the key developments was the rising influence and power of free trade and commercial interests due to British industrial and national interests' growing reliance on the palm oil trade. The attacks on British activity in West Africa culminated in Hutt's campaign against naval slave trade suppression. The existing strategy's intolerable and unsustainable cost to British seamen's health and lives was one of the grounds for his attacks. Surgeons were caught in the middle of these charged debates, which made their scientific efforts more pressing. This combination of factors led surgeons to further embrace and apply the latest scientific approaches. Their campaign to find a practical solution to fevers culminated in Bryson's recommendations, and the clinical trial of quinine prophylaxis on the African Squadron during the late 1840s and early 1850s. While naval surgeons and colonial practitioners embraced quinine during that influential period, the success of the 1854-55 Niger Expedition brought public recognition, and ensured continued institutional backing.

During these years, naval surgeons' scientific pursuits and activities were contingent and turbulent in nature. The medical service's culture of competence and scientific practice, the proliferation and rising importance of practical scientific training within British medical education, the development and institutionalization of science throughout Britain, and the political-strategic situation related to British activity in West Africa converged. They helped to ensure that surgeons' findings gained the official and public backing that ultimately led to the adoption and enforcement of preventative measures capped by quinine prophylaxis. As several historians have noted, French colonial and military examples provides a provocative counterpoint to the story of quinine's adoption in the British colonial world. In 1834, during the campaign of colonial conquest in Algeria, French Army surgeon Dr. François Maillot performed a series of empirical experiments with quinine in Bône military hospital. His clear empirical, clinical, and statistical findings in support of high-dose quinine prophylaxis met outright resistance from the Parisian and military medical establishment, led by famed Dr. François Broussais. Absent the practical scientific culture and colonial strategic circumstances associated with the mid-century case of the Royal Navy, French military and colonial practitioners did not systematically adopt quinine prophylaxis until the 1880s.[164] The case of the rise of quinine in the Royal Navy thus illustrates the practical importance and ramifications of the medical service's broader embrace of empirical science during the early-to-mid nineteenth century.

[164] Etemad, 32-33; Chakrabarti, *Medicine and Empire*, 127-128; David Prochaska, *Making Algeria French: Colonialism in Bône, 1870-1920* (New York: CUP, 1990), 88-89; William B. Cohen, "Malaria and French Imperialism," *The Journal of African History* 24, no. 1 (Jan. 1, 1983): 23–36. For more secondary accounts: Curtin, *Disease*, 24-26; Curtin, *Death*, 65; Carlson, *African Fever*, 50-53; Headrick, *Tools*, 66-67; Headrick, *Power*, 230. For Maillot's accounts: François-C. Maillot, "Note sur les maladies qui ont régné à Bône pendant de mois de Juin 1834," *Journal Hehdomaire des Progres des Sciences* 4 (1834): 328–40; François-C. Maillot, *Traité des fièvres irritations cérébro-spinales intermittentes d'après des observations recueillies en France, en corse et en Afrique* (Paris: Chez J.-B. Baillière, 1836).

7.0 CONCLUSION: NAVAL SURGEONS, SCIENCE AND MEDICINE IN AN AGE OF TRANSITIONS

Between 1815 and the late 1850s, naval medicine underwent an institutional, professional, and practical transformation as surgeons, the leaders of the medical service, and the Admiralty responded to changes throughout the British medical profession and society. The Navy's medical service became increasingly professionalized during the early nineteenth century. Surgeons' qualifications, status, authority, and respectability also rose. These developments were integrally tied to shifts in medical practice, as surgeons applied empirical scientific approaches to their medical and natural scientific work. This transition reshaped British medical education and training during this period, which in turn drove the practical reorientation that occurred throughout the medical profession and within naval medicine. The naval medical service and the Admiralty embraced and attempted to systematize this observational and analytical mindset. The rising importance of scientific competence thus drove the development of naval medicine during this formative age.

The vital nature of surgeons' medical duties as the Navy attempted to meet expanding imperial and global missions made these shifts possible. While some military and colonial practitioners began to embrace empirical science in the late eighteenth century, empirical efforts came to dominate policy, practice, and professional culture during the early-to-mid nineteenth century. Naval surgeons, the Medical Department, and the Admiralty put increased emphasis on the practical utility of medicine. Commitments related to antislavery patrols, gunboat diplomacy and commerce, convict transportation, and naval exploration took an increasing toll in resources, lives, and suffering. The health of sailors became a significant political, logistical, and practical issue within the Navy, before Parliament, and in the medical and national presses. Against this backdrop, the Admiralty reorganized the medical service, acknowledging surgeons' expertise, ceding authority to leading medical officers, and backing some natural and medical scientific activities in the hope of aiding its operations. Surgeons in turn invoked the utility of their efforts, particularly as they campaigned for improved service conditions. Their responses to tropical fevers on the West African Squadron illustrate this convergence of strategic interest, clinical efforts, and broader developments driven by scientific concerns.

One running thread has been that shifts within the medical profession significantly shaped the professional and practical development of naval medicine. The reforms within the medical service, particularly rising qualifications and improving working conditions, reflected changes throughout British medicine. Nonetheless, naval conditions, status, and pay continued to lag behind those in the army and throughout much of the profession, where there was also substantial improvement. The increasing ambitions and assertiveness of naval surgeons and medical students were thus a product of ongoing professionalization. Their changing mindset gave added momentum to the surgeon and student-led reform movement that grew during the 1840s and early 1850s. It also added to the Navy's growing difficulties recruiting and keeping comparatively competent surgeons. This forced the Admiralty to grant concessions that acknowledged surgeons' professional role and status in the mid-1850s.

Using the collective demography of the Navy's medical officers to further investigate these broader professional dynamics, this analysis has connected shifts in naval surgeons' ethnic and educational backgrounds to educational overproduction and labor overcrowding. Scottish medical schools churned out students during the post-Napoleonic era, oversaturating the British medical labor market. Scottish and Scottish-educated surgeons thus continued to dominate the ranks of the naval medical service from the Napoleonic Wars through the 1830s. The reforms and expansion of enrollments at the London hospital schools, however, led to rising competition with Scottish schools, and a shift in the sources of professional overcrowding. From the 1830s through the 1850s, English and London-educated surgeons joined the Navy in significant numbers, taking over as the largest groups in the sea-going ranks and slowly rising through the service. A similar process occurred with Irish and Irish-educated surgeons from the 1850s, as by mid-century, better opportunities led more Scottish-educated and London-trained students to avoid the Navy. This was the root of the recruiting difficulties during the 1840s and 1850s. Nevertheless, Scottish and Scottish-educated surgeons maintained a significant presence within the naval medical ranks, and controlled many of the leadership positions even as their representation declined through the 1860s.

The impact of these shifts in medical officers' backgrounds was tied to changes occurring in British medical education. At the turn of the century, the Universities of Edinburgh and Glasgow offered the most prestigious educations, emphasizing the applications of medical theories. During the first half of the nineteenth century, approaches incorporated from Continental clinical medicine and pathological anatomy led to serious questions about the efficacy of the existing model, which drove British medical schools to incorporate clinical, surgical, and anatomical training. Through an analysis of the reforms made to the University of Edinburgh's medical curriculum, we saw that scientific classes geared toward empirical practical skills became vital parts of medical training. At the same time, the practical importance of training in medical theory declined. These shifts were far from linear or seamless. Competition between Scottish and London schools, and the resistance of an older generation of professors led to contentious infighting. The demands of a younger generation of students, teachers, and surgeons for new practical opportunities and training, however, won out. The reforms that occurred at Edinburgh exemplify the broader restructuring of medical education at leading British schools based on the increasing influence of scientific approaches and principles. One of the ramifications of these reforms was that increasingly more Edinburgh-trained and British-educated practitioners brought these practical views and skills into their careers. These dynamics allowed those students who joined the Navy to shape naval medicine.

This dissertation has also investigated the rising influence of natural and medical science on naval practices, policies, and debates. Previous works have analyzed the Royal Navy's contributions to nineteenth-century science based principally on the efforts of Victorian figures who served as civilian naturalists. Charles Darwin, who sailed on the *HMS Beagle*, and Joseph Hooker, who volunteered for the Ross Antarctic expedition, are perhaps the most famous examples. The role of naturalist and scientist, however, more often fell to naval surgeons. Many medical officers embraced this responsibility, as global service and expeditions offered opportunities to pursue scientific interests in diverse and challenging environments. While Sir Dr. John Richardson and Thomas Huxley are the most renowned naval surgeon-naturalists of this period, numerous other examples can be cited.[1] Along with Drs. Baikie, Bryson, McWilliam, and Thomson, they illustrate the contributions of naval surgeons to the British medical and scientific communities. Naval surgeons participated in scientific societies, published in leading journals,

[1] Other examples include zoologist Arthur Adams, zoologist and paleontologist George Busk, botanist and explorer Dr. Alexander Collie, zoologist and botanist Thomas Braidwood Wilson. In terms of fiction, one can think of Patrick O'Brien's naval doctor Stephen Maturin. There was a similar group of French surgeon-naturalists, including René Primevère Lesson, Jacques Bernard Hombron, and Joseph Paul Gaimard, and naturalist and anatomist Jean René Constant Quoy.

and became influential figures within scientific circles, especially in public health, epidemiology, statistics, and zoology. While scientific opportunities attracted competent medical officers, they competed for limited resources as the Navy focused on efficiently meeting its duties.

This dissertation has highlighted natural scientific activities because natural science's methodological and conceptual unity allowed surgeons to apply empirical approaches in medical practice. Naval surgeons' clinical role and duties maintained primacy, even as broader scientific activities informed their medical work. They relied on the approaches that they learned in training and refined through individual and collective practice as they confronted the disparate experiences of naval service. This led to greater positivist faith that medical science could provide practical solutions. While therapeutic breakthroughs lagged behind, increasing therapeutic caution emerged, especially in the use of antiphlogistics. Surgeons moved toward a less interventionist and more analytically responsive approach. This led to a gradual, albeit still ongoing, decline in bloodletting, mercury, and purging based on practical moderation. Nevertheless, the existing system had substantial staying power that was only overcome with the shift toward germ theory later in the century.

The case study of surgeons' responses to tropical fevers has highlighted the medical ramifications of increasing British humanitarian, commercial, and imperial activity in West Africa. This example has served as a barometer for investigating the institutional, professional, and practical shifts throughout British and naval medicine. Sustained and epidemic mortality, resulting from sailors' increased exposure to the African disease environment, reinforced the emerging depiction of West Africa as the White Man's Grave during the 1820s and 1830s. Surgeons resisted this popular image, instead pursuing positivistic scientific practices. Britain's expanded pursuit of naval slave trade suppression from the late 1830s created both new challenges and clinical opportunities for naval doctors. The 1841-42 Niger Expedition illustrates surgeons' commitment to understanding fevers as they faced crises, and shows that the seeds for a shift in therapeutic practices had emerged. Bloodletting and mercury began to fall out of favor, as practitioners turned to quinine. Increasing debate regarding the continuation of naval suppression during the 1840s gave urgency to surgeons' scientific efforts. Sir William Burnett and medical officers thus spearheaded efforts to systematize reporting practices, carry out clinical analytical and medical statistical projects, and conduct trials of preventative and therapeutic measures. This culminated in the proliferation of quinine as a treatment and prophylaxis. This depiction of colonial medicine as British imperial and commercial interventions increased in West Africa demonstrates the desperation that often characterized surgeons' efforts. It also establishes that quinine's emergence as a tool of empire was a more complicated process than just the "triumph of empiricism." It was the result of surgeons and colonial practitioners' painstaking application of empirical scientific practices that overtook naval medicine more broadly.

This narrative of naval medicine has explored broader themes related to British medicine and science, and their importance during the Age of Reform. The transition from natural history to natural science in education, practice, and professionalization during the early nineteenth century played out both in naval medicine and throughout British society. It allowed professionalized natural and medical science, particularly its mindset and approaches, to gain political and social authority. The importance of methodological and conceptual utility as a rationale for the rise of science also played out well beyond the Navy. Perhaps most importantly, empirical science's perceived and material utility had sweeping impacts. The rise of science helped to drive the Industrial Revolution, underpinned the sanitation-oriented public health movement, and allowed for the emergence of statistics as an analytical approach. Naval medicine also encapsulates the questions regarding the politicization of practical science's applications that emerged during this period. Competing visions and uses of science related to professional, reformist, humanitarian, liberal, commercial, and imperial interests played out in a variety of British scientific and medical debates. The example of naval medicine thus makes clear the messiness and contingent nature of scientific efforts, and the difficulties arising when applying them to practical problems. Nonetheless, naval surgeons saw themselves as part of a scientific community held together by belief in the probability of progress in scientific knowledge and practice. While their efforts also shed light on the Kuhnian aspects of practical, professional, and policy changes, they also show the incomplete and contradictory outcomes that often resulted.

This project has also considered questions related to Scottish actors' and institutions' importance to British medicine and science. Despite work in the history of medicine noting the importance of Scottish schools and practitioners, the transition in and diversification of the medical and scientific educations offered at Scottish universities during the early nineteenth century had more significant impacts than previously noted. While English schools, including Oxford and Cambridge, helped to shape British science, medical training had an equally significant role. British and especially Scottish universities often taught natural history, anatomy, and practical sciences in their medical faculties. Edinburgh in particular provided an alternative model for a unified conceptual approach to natural and medical scientific training. Its students became part of a practical elite jockeying for status and recognition. Scottish students and schools particularly achieved their professional and scientific goals within the British armed forces and empire, where they made significant contributions. They thus played a greater role as

British and colonial medical and scientific professionals than often acknowledged, particularly in relation to the development and extension of scientific approaches and institutions.

One issue that has circulated in the background of this dissertation has been whether the issues raised by the rise of empirical science within naval medicine can tell us anything about science today. The resurgence of popular interest in Sherlock Holmes in the past few years has brought attention back to nineteenth-century empirical science and medicine. Arthur Conan Doyle's Edinburgh medical training in the 1870s, during the generation that saw empirical science reach its height under Professors Dr. Joseph Lister and Joseph Bell, informed the characters of Holmes and Dr. Watson. Doyle modeled both on his professors and fellow students, while also incorporating the practical essence of his empirical and experimental education. As a retired army surgeon, Dr. Watson represents many of the issues discussed in relation to military and naval medicine, especially practitioners' professional and practical skills and aspirations. Holmes more broadly exemplified empirical science's idealized curiosity and practical investigative skills as extended into the worldly and social realms.[2]

In addition to this popular recognition, nineteenth-century and contemporary science both illustrate the continuing limits of science's applications. Like the upheaval that characterized the transition in nineteenth-century medicine and science, current medical and scientific education and practice have come into question. Despite nineteenth-century scientists and naval surgeons' successes, the flaws in their positivist scientific confidence have significant parallels to those in contemporary medicine and science. Despite a continued belief in science's supposed authority and precision, examples from medical and scientific practice demonstrate their continued

[2] Among many studies, see R.E. Peschel and E. Peschel, "What Physicians Have in Common with Sherlock Holmes: Discussion Paper," *Journal of the Royal Society of Medicine* 82, no. 1 (Jan. 1989): 33–36; P.L. Selvais, "A Study in White: Dr. Watson in the Medical Press," *Journal of the Royal Society of Medicine* 89, no. 6 (June 1996): 329–31.

imprecision, and especially the reality of error.[3] Even with impressive breakthroughs consistently occurring, the emphasis placed on the authority of replicability has particularly come under doubt. For example, recent studies have questioned the substantial overestimation of the reliability and precision of research in psychology. A large percentage of influential studies cannot be replicated and critics have highlighted the worrying roles of systematic issues related to research, funding, and publication pressures, as well as the devaluing of confirmation studies.[4] Furthermore, fewer practitioners and scientists have the resources and expertise needed to replicate many studies due to increasing specialization and instrumentalization. In medical and scientific education and practice, one promising response has been attempts to reemphasize interdisciplinarity, and the interactions between science, nature, and humanity. This represents at least in part a reassertion of the conceptual unity that has supposedly held the sciences together.[5]

[3] For error and medical practice, see The National Academies of Sciences, Engineering, and Medicine, "Urgent Change Needed to Improve Diagnosis in Health Care or Diagnostic Errors Will Likely Worsen, Says New Report," Sept. 22, 2015, http://www8.nationalacademies.org/onpinews/newsitem.aspx?RecordID=21794; Martin A. Makary and Michael Daniel, "Medical Error—the Third Leading Cause of Death in the Us," *BMJ* 353 (May 3, 2016): doi:10.1136/bmj.i2139.

[4] Open Science Collaboration, "Estimating the Reproducibility of Psychological Science," *Science* 349, no. 6251 (Aug. 28, 2015), doi:10.1126/science.aac4716; Barbara A. Spellman, "A Short (Personal) Future History of Revolution 2.0," *Perspectives on Psychological Science* 10, no. 6 (Nov. 1, 2015): 886–99; Daniel T. Gilbert, Gary King, Stephen Pettigrew, and Timothy D. Wilson, "Comment on 'Estimating the Reproducibility of Psychological Science'," *Science* 351, no. 6277 (Mar. 4, 2016): 1037. For the initial recognition of the problem, see among others Joseph P. Simmons, Leif D. Nelson, and Uri Simonsohn, "False-Positive Psychology Undisclosed Flexibility in Data Collection and Analysis Allows Presenting Anything as Significant," *Psychological Science* 22, no. 11 (Nov. 1, 2011): 1359–66. For the depiction of this crisis in science more broadly, see Economist.com, "Human After All," *The Economist*, Oct. 17, 2013, http://www.economist.com/blogs/babbage/2013/10/science-wrong; The Economist, "Trouble at the Lab," *The Economist*, Oct. 19, 2013, http://www.economist.com/news/briefing/21588057-scientists-think-science-self-correcting-alarming-degree-it-not-trouble; The Economist, "How Science Goes Wrong," *The Economist*, Oct. 19, 2013, http://www.economist.com/news/leaders/21588069-scientific-research-has-changed-world-now-it-needs-change-itself-how-science-goes-wrong.

[5] Andrew Barry and Georgina Born, *Interdisciplinarity: Reconfigurations of the Social and Natural Sciences* (London: Routledge, 2011); David R. Lambert, Stephen J. Lurie, Jeffrey M. Lyness, and Denham S. Ward, "Standardizing and Personalizing Science in Medical Education," *Academic Medicine: Journal of the Association of American Medical Colleges* 85, no. 2 (Feb. 2010): 356–62; Samir Johna and Simi Rahman, "Humanity Before Science: Narrative Medicine, Clinical Practice, and Medical Education," *The Permanente Journal* 15, no. 4 (2011): 92–94; Andrew Miles, Jonathan Elliott Asbridge, and Fernando Caballero, "Towards a Person-Centered Medical Education: Challenges and Imperatives," *Educación Médica* 16, no. 1 (Jan. 2015): 25–33.

APPENDIX A

QUANTITATIVE METHODS AND FINDINGS

A.1 METHODOLOGICAL DESCRIPTION

As I approached this project, I began to conceive of Royal Naval surgeons as a group that lent itself to a prosopographical quantitative analysis.[1] Based on discussion with professors and fellow graduate students regarding quantitative database construction, and training that has emphasized contextualizing research questions and analysis, I adopted a flexible approach to data collection.[2] I constructed my database of nineteenth-century naval surgeons based on open-ended hypotheses exploring their ethnic distribution, training, and career markers. The approach to Georgian and Victorian army surgeons in Ackroyd *et al.* led to my focus on measures such as appointment and promotion dates, and ethnic and educational background.[3]

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[1] This section is adapted from Myers, "Demography," 44-45. Prosopography is the use of individual biographical information in quantitative analysis of a population sharing a common characteristic. Koenraad Verboven, Myriam Carlier, and Jan Dumolyn, "A Short Manual to the Art of Prosopography," in *Prosopography Approaches and Application: A Handbook*, ed. K.S.B. Keats-Rohan, (Oxford: Occasional Publications of the Unit for Prosopographical Research, 2007), 39-41. K.S.B. Keats-Rohan, "Biography, Identity, and Names: Understanding the Pursuit of the Individual in Prosopography," in *Prosopography Approaches and Applications*, 143.
[2] See Melissa A. Hardy, and Alan Bryman, "Common Threads among Techniques of Data Analysis," in *The Handbook of Data Analysis* (London: Sage Publications, 2004), 5; Jane E. Miller, *The Chicago Guide to Writing About Numbers* (Chicago: UCP, 2004), 11-13, 219, 238, and 244.
[3] Ackroyd, *et al.*, v, 15-19, and Appendices 1 and 2; Verboven, *et al.*, 55-56.

Based on the historical structure of the naval medical service after the Napoleonic Wars, I chose to restrict my study population to medical officers who entered the Navy or received promotion between 1815 and 1870. This captured the surgeons who were active within the service during this period, while excluding those who remained on the rolls and collected half pay but did not serve in the Navy. I then constructed a dossier of surgeons during that period from the British Admiralty's quarterly published *Navy Lists*.[4] I collected their names, appointment, promotion and dropout years, moving by five-year intervals from 1815 until they all left the Navy.[5] Time management and data representativeness guided my collection approach, especially my decision to process the lists in intervals. Given the labor-intensive task of biographically identifying surgeons, processing all 220 versions of *The Navy List* published during this period was unrealistic.[6] I also dropped non-career surgeons (those that served less than five years) from my study since they were the hardest to identify and could skew the data related to career naval surgeons. This intervaled approach, however, likely missed some transient and late-career surgeons, particularly in the decades following the Napoleonic Wars. Nonetheless, it allowed me to capture and analyze the shifts that occurred in the ethnic and educational composition of the Navy's medical officers between 1815 and 1870.

The most labor-intensive step in constructing my database was compiling surgeons' individual demographic information. I began by searching for surgeons' biographical details through mixed-source triangulation.[7] I first looked for secondary sources containing surgeons'

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[4] Keats-Rohan, 146-147; Admiralty, *The Navy List* (London: H.M.S.O., 1815-1905).
[5] Dropout is a collective category for the point at which surgeons left naval service whether through resignation, retirement, death, or dismissal.
[6] Verboven, *et al.*, 51-52, and 58; Keats-Rohan, 147-150.
[7] Keats-Rohan, 147; Verboven, *et al.*, 53-54, and 56; Todd D. Jick, "Mixing Qualitative and Quantitative Methods: Triangulation in Action," *Administrative Science Quarterly* 24, no. 4 (1979): 602-604; A.W. Carus, and S. Ogilvie, "Turning Qualitative into Quantitative Evidence: A Well-Used Method Made Explicit," *Economic History Review* 62, no. 4 (2009): 893.

personal information and then proceeded to digitally search primary journals and manuscripts, especially those available through Google Books and Internet Archives. I identified the ethnicity and education of 65 to 70% of the surgeons in the database primarily from sources such as university student and graduate rolls,[8] primary reports on examinations, awards and fellowships,[9] and national medical registers in later decades.[10] I looked primarily at whether surgeons were Scottish, English, Irish, Welsh, or Colonial, and what institutions they attended for their medical training. In terms of primary archival research contributing to the database, I decided to focus my attention on the University of Edinburgh's educational records. Beyond the prominence of the University of Edinburgh as a medical school and contributor of naval medical officers, I had already conducted exploratory research in its detailed institutional and student records.[11] I found an additional 20% of the surgeons in my database along with their years of attendance in Edinburgh's matriculation indices without overextending my research time and resources.

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[8] University of Edinburgh, *List of Graduates*; University of Glasgow, ed., *A Roll of the Graduates of the University of Glasgow, 1727-1897* (Glasgow: J. McLehose, 1898); W. Innes Addison, ed. *The Matriculation Albums of the University of Glasgow from 1728 to 1858* (Glasgow: James Maclehose and Sons, 1913); Peter John Anderson, ed., *Officers and Graduates of University and King's College, Aberdeen, 1495-1860* (Aberdeen: New Spalding Club, 1893); William Johnston, *Roll of the Graduates of the University of Aberdeen, 1860-1900* (Aberdeen: AUP, 1906); Peter John Anderson, ed., *Fasti Academiae Mariscallanae Aberdonensis*, vol. 2 (Aberdeen: For the New Spalding Club, 1893); James Fowler Kellas Johnstone, ed., *Fasti Academiae Mariscallanae Aberdonensis*, vol. 3 (Aberdeen: For the New Spalding, 1898); James Maitland Anderson, ed., *The Matriculation Roll of the University of St. Andrews, 1747-1897* (Edinburgh: W. Blackwood and Sons, 1905); R. N. Smart, ed., *Biographical Register of the University of St. Andrews, 1747-1897* (St. Andrews: University Library, 2004); George Dames Burtchaell, Thomas Ulick Sadleir, and Trinity College, eds., *Alumni Dublinenses: A Register of the Students, Graduates, Professors and Provosts of Trinity College*, rev. ed. (1924; Dublin: A. Thom & Co., 1935); Queen's University, *The Queen's University Calendar, 1876* (Dublin: Alexander Thom, 1876); Saint Bartholomew's Hospital and Medical College, *Saint Bartholomew's Hospital and Medical College: Student's Handbook* (London: Tip. Spottiswoode, 1861).

[9] I found individuals in the *British Medical Journal, Edinburgh Medical Journal, Edinburgh Medical & Surgical Journal, Gentleman's Magazine, The Lancet, Medical Times & Gazette, Medico-Chirurgical Review, The Nautical Magazine & Naval Chronicle, Provincial Medical & Surgical Journal,* and *United Services Journal*.

[10] Anon, *The Medical Directory for 1872, and General Medical Register* (London: J & A Churchill, 1872); British Medical Directory Office, *The British Medical Directory: For England, Scotland, and Wales* (London: British Medical Directory Office, 1853); General Medical Council, *The Medical Register: Pursuant to an Act Passed in the XXI. & XXII. Victoriae, Cap. XC.* (London: Office of the General Council, 1859).

[11] For student records: J.D. Comrie, and John J. Gairdner, "Biographical Index of Edinburgh Medical Graduates, 1705-1866," 1933, EUL CRC, Research Annex; University of Edinburgh, "Medical Class & Matriculation Lists," vols. 1802-1867, EUL CRC, UA, EUA/IN1/STA/3.

Beyond the general database, I constructed several sub-databases. The first focused on a sub-sample of naval surgeon-naturalists and scientists. I compiled a list of approximately fifty individuals based on naval medical reports and ship medical journals that I collected in the British National Archives, and individuals referenced in David McLean's *Surgeons of the Fleet*. I extracted their demographic and career information from the larger database in order to run a more focused analysis, which is included in chapter four. I also constructed two sub-databases based on the University of Edinburgh's student records. While working with Edinburgh's matriculation records, I found that they recorded students' class registrations, as well as the exam questions and scores of degree candidates. I created one sub-database containing the classes that Edinburgh-educated naval surgeons attended. This sub-database yielded the findings analyzed in the third chapter regarding the course attendance of naval surgeons educated at Edinburgh.[12] Beyond this, I also created another sub-database containing information on Edinburgh-graduate naval surgeons' medical dissertations. I then classified these dissertations by subject, field, and date of graduation based on their titles.[13]

While I had initially planned to run a range of ordinary-least-square and mixed-effect regressions to explore how surgeons' ethnic and educational backgrounds affected their careers within the Navy, data quality issues made clear that my initial analytical plan was unrealistic. I was unable to positively identify a substantial percentage of medical officers in the early decades of my study, particularly those who joined the Navy before 1830. Further complicating this was the realization that the proportion of unidentified individuals declined over the course of the

[12] I also created another including the exam questions and results of those that graduated from Edinburgh, which this dissertation has not used. University of Edinburgh, "Medical Class & Matriculation Lists," vols. 1802-1867, EUL CRC, UA, EUA/IN1/STA/3; University of Edinburgh, "General and Medical Examinations," vols. 1833-1847, EUL CRC, UA, EUA/IN1/STA/8.
[13] University of Edinburgh, *List of Graduates in Medicine in the University* gives the titles of students' dissertations. Through the mid-1830s, these titles are in Latin, which required translation.

study. The professionalization and increasing regulation that emerged within the British medical profession during the early nineteenth century, along with the rise of scientific and medical print culture led to improved and more reliable recordkeeping by mid-century, allowing for the identification of more of the naval surgeons in my database. Furthermore, I came to appreciate that the logistical decision to rely on Edinburgh's student records could potentially skew the results in terms of identification. Based on these issues, I concluded that the missing data was not missing in a random manner. Furthermore, since there was anecdotal evidence to indicate change over time in both surgeons' ethnic and educational demography, but not the exact pattern, methods to extrapolate data did not seem promising.

Given these issues, I decided to largely restrict my data analysis to tabulation, graphical time-point depictions, and cohort-based analyses. These approaches yielded a wealth of information on naval surgeons' backgrounds in the forms of tables grouped by cohorts of entry into the Navy, and graphs showing running distributions of the naval medical service's composition by the five-year intervals. While analysis also produced a range of chi-square and monte-carlo exact statistical tests comparing the multi-decadal cohorts, statistical tests remained a secondary concern when interpreting and writing the sections analyzing the shifts that occurred in the ethnic and educational backgrounds of naval surgeons. I have included the information on these tests in those instances where they were statistically significant and analytically relevant.

A.2 THE DEMOGRAPHY OF NAVAL SURGEONS, 1800-1870

Table 3. The Ethnicity of Medical Officers by Highest Rank Attained in the Navy, and Year of Entry into the Navy.

		Lower Ranks	Upper Ranks	All Ranks
		N (%)	N (%)	N (%)
1795-1829	Scottish	106 (43.6)	38 (46.9)	144 (44.4)
	English	77 (31.7)	31 (38.3)	108 (33.3)
	Irish	54 (22.2)	10 (12.3)	64 (19.8)
1830-1849	Scottish	118 (31.1)	44 (27.7)	162 (30.1)
	English	170 (44.9)	77 (48.4)	247 (45.9)
	Irish	82 (21.6)	34 (21.4)	116 (21.6)
1850-1870	Scottish	84 (21.0%)	25 (19.5)	109 (20.6)
	English	146 (36.5)	38 (29.7)	184 (34.8)
	Irish	164 (41.0)	62 (48.4)	226 (42.8)
Chi-Square- Lower Ranks: χ^2= (4, F=63.52, p<0.001)				
Chi-Square- Upper Ranks: χ^2= (4, F=47.08, p<0.001)				
Chi-Square-All Ranks: χ^2= (4, 103.76, p<0.001)				
Thirty Colonial and Welsh surgeons were dropped from the table				
Lower Ranks are Assistant Surgeon and Surgeon. Upper Ranks are Physicians, Staff Surgeons, Deputy Medical Inspectors, Medical Inspectors and Director-Generals.				

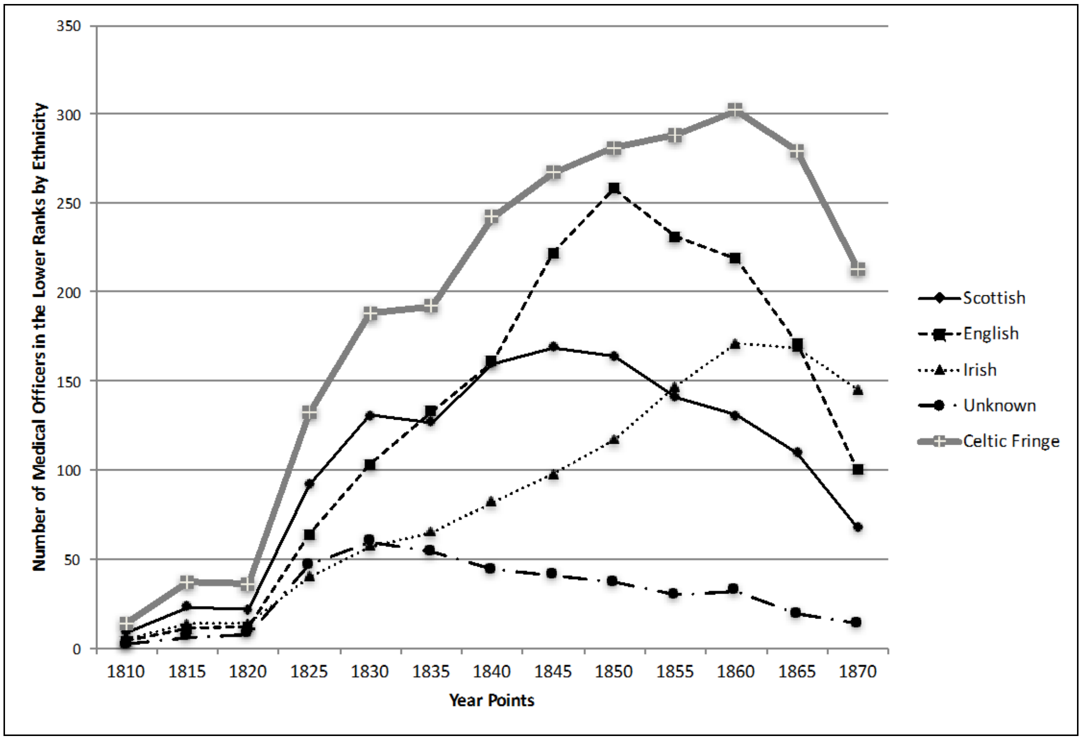

Figure 5. Number of Medical Officers in the Lower Ranks by Ethnicity with Unknown and Celtic Fringe, 1810-1870. Lower Ranks are Assistant Surgeon and Surgeon.

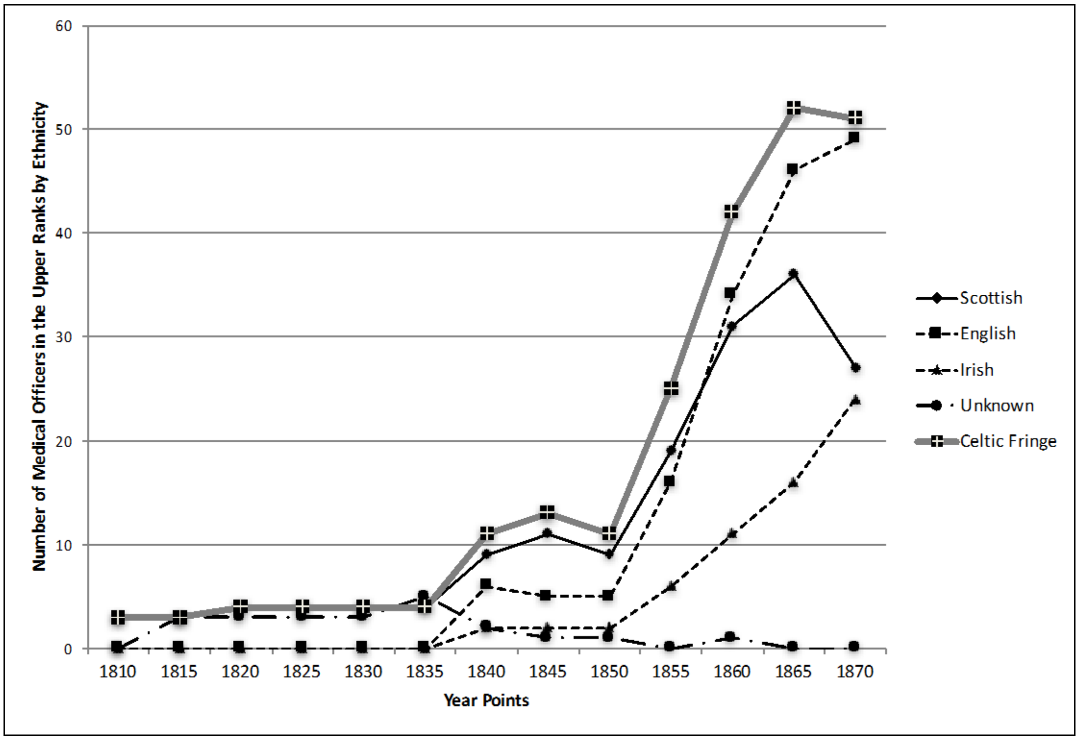

Figure 6. Number of Medical Officers in the Upper Ranks by Ethnicity with Unknown and Celtic Fringe, 1810-1870. Upper Ranks are Physicians, Staff Surgeons, Deputy Medical Inspectors, Medical Inspectors and Director-Generals.

Table 4. The Primary Place of Medical Education of Medical Officers by Highest Rank in the Navy, and Year of Entry into the Navy.

		Lower Ranks	Upper Ranks	All Ranks
		N (%)	N (%)	N (%)
1795-1829	University of Edinburgh	120 (49.8)	24 (29.3)	144 (44.6)
	Other Scottish Schools	39 (16.2)	37 (45.1)	76 (23.5)
	Irish Medical Schools	23 (9.5)	1 (1.2)	24 (7.4)
	English Medical Schools	59 (24.5)	20 (24.4)	79 (24.5)
1830-1849	University of Edinburgh	103 (27.3)	29 (18.2)	132 (24.6)
	Other Scottish Schools	100 (26.5)	64 (40.3)	164 (30.6)
	Irish Medical Schools	35 (9.3)	12 (7.5)	47 (8.8)
	English Medical Schools	139 (36.9)	54 (34.0)	193 (36.0)
1850-1870	University of Edinburgh	60 (15.0)	17 (13.1)	77 (14.6)
	Other Scottish Schools	77 (19.3)	33 (25.4)	110 (20.8)
	Irish Medical Schools	145 (36.3)	47 (36.2)	192 (36.3)
	English Medical Schools	117 (29.3)	33 (25.4)	150 (28.4)
Chi-Square- Lower Ranks: χ^2= (6, F= 169.97, p<0.001)				
Chi-Square- Upper Ranks: χ^2= (6, F= 67.07, p<0.001); Fisher's Exact, Monte-Carlo Simulation (10,000 Iterations)= 65.95, p-value [lower and upper-bounds]<0.001)				
Chi-Square- All Ranks: χ^2= (6, F= 227.90, p<0.001)				
Percentages calculated within each rank group. Lower Ranks are Assistant Surgeon and Surgeon. Upper Ranks are Physicians, Staff Surgeons, Deputy and Full Medical Inspectors and Director-Generals.				

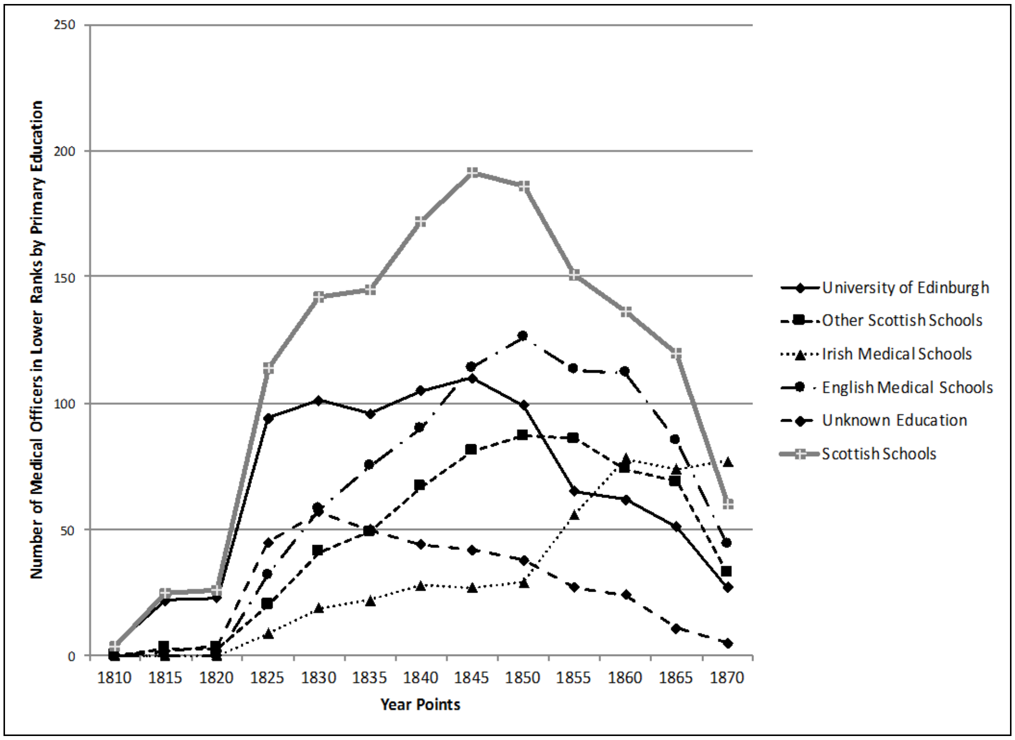

Figure 7. Number of Medical Officers in the Lower Ranks by Primary Place of Medical Education with University of Edinburgh Disaggregated, 1810-1870. Scottish Schools combines Edinburgh and Other Scottish Schools. Other Scottish Schools include Universities of Glasgow, Aberdeen, and St. Andrews. Irish Medical Schools include Dublin, and Queen's Universities. Scottish Schools adds the University of Edinburgh. Irish Medical Schools include Dublin, and Queen's Universities. English Medical Schools include five London hospital schools: St. Thomas', Guy's, St. George's, St. Bartholomew's, and University Hospital of London.

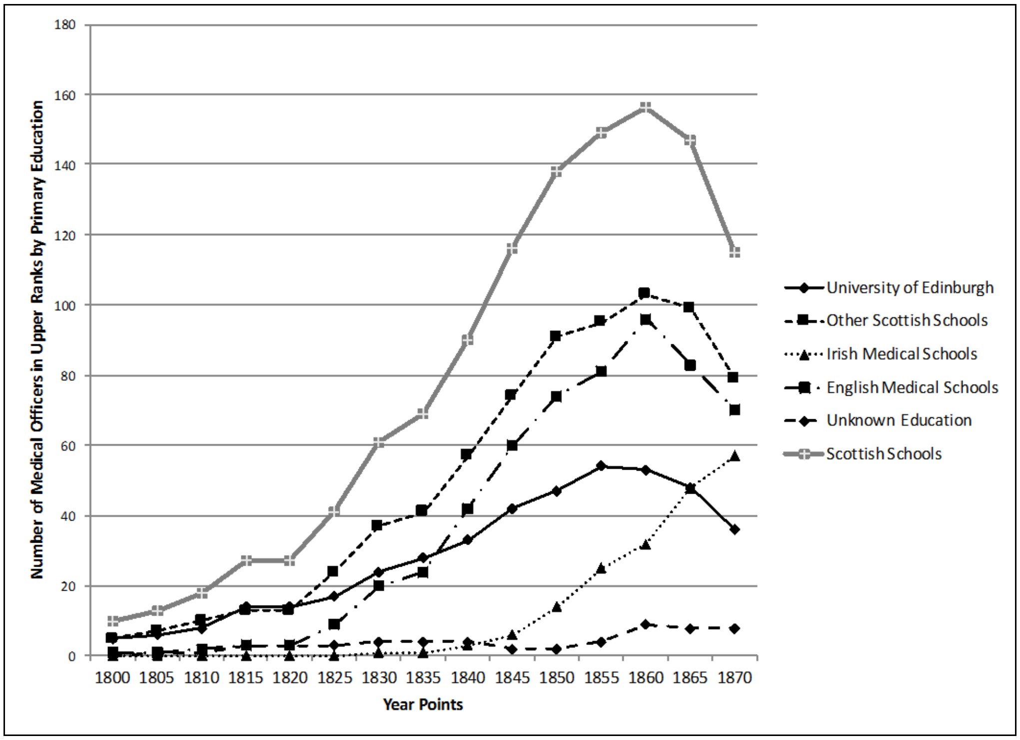

Figure 8. Number of Medical Officers in the Upper Ranks by Primary Place of Medical Education with University of Edinburgh Disaggregated, 1810-1870.

A.3 NAVAL SURGEONS AND EDINBURGH EDUCATION, 1800-1850

Table 5. Number of Medical Officers Who Repeated Medical Courses Course at the University of Edinburgh by Number of Times Repeated, 1800-1850.

	Two Times	Three Times	Four Times
Practice of Medicine	54	7	-
Chemistry	40	11	-
Materia Medica	20	3	-
Anatomy	19	5	1
Surgery	17	4	-
Institutes/Theory	16	-	-
Anatomy & Surgery	12	1	-
Clinical Medicine	10	11	2
Clinical Surgery	10	-	-
Midwifery	8	-	-
Botany	6	-	-
Military Surgery	4	-	-
Natural History	1	-	-

Table 6. Fields of the Dissertations Completed by Medical Officers Who Attended Edinburgh by Year of Graduation, 1800-1870.

	1800-1829		1830-1849		1850-1870	
	N	%	N	%	N	%
Pathology & Medical Practice	44	80.00	54	61.36	16	32.00
Pathology & Medical Theory	0	0.00	6	6.82	5	10.00
Midwifery	3	5.45	4	4.55	12	24.00
Surgery	4	7.27	9	10.23	4	8.00
Physiology & Medical Theory	0	0.00	3	3.41	7	14.00
Materia Medica	2	3.64	2	2.27	2	4.00
Anatomy	0	0.00	5	5.68	1	2.00
Medical Jurisprudence	0	0.00	3	3.41	3	6.00
Military Surgery	2	3.64	2	2.27	0	0.00
Total	55		88		50	

Table 7. Number of Courses that Medical Officers Attended at the University of Edinburgh by Ethnicity, 1800-1850.

	Scottish	English	Irish	Colonial	Total
	N (%)	N (%)	N (%)	N	N (%)
1 to 5	79 (43.2)	14 (40.0)	26 (53.1)	3	122 (44.0)
6 to 10	79 (43.2)	17 (48.6)	17 (34.7)	2	117 (42.2)
11 to 15	17 (9.29)	3 (8.6)	3 (6.1)	2	25 (9.0)
16 to 23	8 (4.37)	1 (2.9)	3 (6.1)	1	13 (4.7)
Individuals	183	35	49	8	277
Average (SE)	6.54 (0.31)	6.74 (0.59)	6.04 (0.58)	8.75 (1.83)	6.55 (0.25)

Percentages calculated within each ethnicity.
Welsh were dropped, and percentage was not calculated for Colonial due to small sample size.
Chi-Square tests were not significant for ethnicity including Colonial (p>0.63), and ethnicity excluding Colonial (p>0.80). Fisher's exact for monte-carlo simulation with 10,000 iterations not significant (p-lower bound>0.53, p-upper bound>0.56).

Table 8. Number of Courses that Medical Officers Attended at the University of Edinburgh by Highest Rank, 1800-50.

	Lower Ranks	Upper Ranks	Total
	N (%)	N (%)	N (%)
1 to 5	107 (47.1)	16 (31.4)	123 (44.2)
6 to 10	95 (41.9)	22 (43.1)	117 (42.1)
11 to 15	17 (7.5)	8 (15.7)	25 (9.0)
16 to 23	8 (3.52)	5 (9.8)	13 (4.7)
Total	227	51	278

Chi-Square: χ^2= (3, F=8.98, p-value=0.03)

Table 9. OLS Regressions for the Natural Log of the Number of Courses that Medical Officers Attended at the University of Edinburgh on Years of Attendance and Courses Attended.

	Model A		Model B		Model C	Approx.%
	Heteroskedastic-Consistent Reg.		Reg. Excluding Outliers		Robust Reg.	Change in # of Courses Taken
	B (HC-s.e.)	B	b (s.e.)	β	b (s.e.)	For 1 Unit of Ind. Variable
(1) Years of Attendance	0.071* (0.013)	0.136	0.088*	0.176	0.073* (0.038)	7.3-8.0% a year
(2) Taken Practice of Medicine	0.320* (0.033)	0.199	0.285*	0.181	0.295* (0.035)	29.5-32.0%
(3) Taken Institutes of Medicine	0.289* (0.030)	0.197	0.255*	0.186	0.281* (0.033)	28.1-28.9%
(4) Taken Chemistry	0.286* (0.040)	0.162	0.236*	0.128	0.283* (0.039)	28.3-28.6%
(5) Taken Clinical Medicine	0.271* (0.029)	0.195	0.253*	0.195	0.267* (0.031)	26.7-27.1%
(6) Taken Materia Medica	0.270* (0.027)	0.183	0.252*	0.181	0.260* (0.031)	26.0-27.0%
(7) Taken Clinical Surgery	0.241* (0.027)	0.165	0.236*	0.175	0.244* (0.030)	24.1-24.4%
(8) Taken Pathology	0.227* (0.042)	0.116	0.215*	0.115	0.227* (0.047)	22.7%
(9) Taken Anatomy & Surgery	0.221* (0.031)	0.141	0.215*	0.147	0.220* (0.034)	22.0-22.1%
(10) Taken Military Surgery	0.190* (0.032)	0.111	0.202*	0.125	0.199* (0.035)	19.0-19.9%
(11) Taken Midwifery	0.155* (0.033)	0.109	0.176*	0.133	0.160* (0.033)	15.5-16.0%
(12) Taken Botany	0.140* (0.029)	0.089	0.148*	0.102	0.143* (0.032)	14.0-14.3%
(13) Taken Surgery	0.140** (0.046)	0.085	0.097*	0.063	0.125** (0.043)	12.5-14.0%
Constant	0.142		0.201		0.172	
Adjusted R^2	0.908		0.928		0.79	
N	278		248		278	
*Significant at p<0.001, one-tailed; **significant at p=0.001, one-tailed						
# Multicollinearity in many Course Taken variables could not be addressed by means-centering, or excluding variables						
#Breusch-Pagan and White's Test both statistically significant						

APPENDIX B

BIOGRAPHICAL APPENDIX

William Pulteney Alison, M.D. Regius Professor of Medical Jurisprudence (1820-1821), Professor of the Institutes of the Medicine (1821-1842) & Professor of the Practice of Medicine (1842-1855), University of Edinburgh; President of the Royal College of Physicians of Edinburgh (1836-38); Vice-President of the British Medical Association; social reformer

William Balfour Baikie, M.D., Surgeon R.N.: British Consul on the Niger (1857-64), Assistant Surgeon & Acting Commander of the 1854-55 Niger (Tshadda) Expedition; Commander of 1857 Niger Expedition

Sir George Ballingall, M.D., Surgeon, British Army: Regius Professor of Military Surgery (1823-55), University of Edinburgh; President of the Royal College of Surgeons of Edinburgh (1836-38)

Sir John Barrow, Baronet: Second Secretary of the Admiralty (1804-45); President of the Royal Geographical Society

John Hughes Bennett, M.D.: Professor of the Institutes of Medicine (1848-74), University of Edinburgh; pathologist and histologist

James Boyle, Surgeon R.N.: Colonial Surgeon to Sierra Leone; tropical medicine theorist

Sir Henry William Bruce, Admiral R.N.: Commodore of the African Squadron (1851-53); Commander-in-Chief, Pacific Station (1854-57); Commander-in-Chief, Portsmouth (1860-63)

Alexander Bryson, M.D., Director-General of the Medical Department R.N. (1864-69): Vice-President of the Epidemiological Society; chief medical statistician of the Navy

Sir William Burnett, M.D., Director-General of the Medical Department R.N. (1832-55): Medical Commissioner, Victualling Board of the Admiralty (1823-32)

Sir Thomas Fowell Buxton, Baronet, M.P.: chairman of the House of Commons Select Committee on Aborigines Tribes (1837); founder of the Society for the Extinction of the Slave Trade and for the Civilization of Africa (1839-43)

Sir Edwin Chadwick: Commissioner of the Poor Laws (1833-47); Commissioner of the Metropolitan Commission of Sewers (1848-49); Commissioner of the General Board of Health (1848-54); sanitationist and social reformer

Sir Robert Christison, M.D., Baronet: Regius Professor of Medical Jurisprudence (1822-32) & Regius Professor of Materia Medica (1832-77), University of Edinburgh; President of the Royal College of Physicians of Edinburgh (1838-40, 1846-48); President of the British Medical Association (1875); toxicologist

Edward Hodges Cree, M.D., Surgeon R.N.: author of personal journal published as *Naval Surgeon*

John Frederic Daniell: Professor of Chemistry (1831-45), King's College, London

Joseph Denman, Rear Admiral R.N.: Commander of the 1840 Gallinas Campaign; Commander-in-Chief, Pacific Station (1864-66)

Andrew Duncan Junior, M.D.: Regius Professor of Medical Jurisprudence (1807-19) & Regius Professor of Materia Medica (1821-32), University of Edinburgh; President of the Royal College of Physicians of Edinburgh (1822-24)

Andrew Duncan Senior, M.D.: Professor of the Institutes of Medicine (1776-1821), University of Edinburgh; President of the Royal College of Physicians of Edinburgh (1790-92, 1824-25)

Edward Forbes: Regius Professor of Natural History (1854-55), University of Edinburgh; President of the Geological Society of London

John Goodsir: Professor of Anatomy (1846-67), University of Edinburgh; cellular biologist

Sir James Graham, 2nd Baronet, M.P.: First Lord of the Admiralty (1830-34, 1852-55); Home Secretary (1841-46)

Robert Graham, M.D.: Professor of Botany (1818-20), University of Glasgow; Professor of Botany (1820-45), University of Edinburgh; President of the Royal College of Physicians of Edinburgh (1840-42)

James Gregory, M.D.: Professor of the Practice of Medicine (1790-21), University of Edinburgh; President of the Royal College of Physicians of Edinburgh (1798-1801)

William Gregory, M.D.: Professor of Chemistry (1839-44), King's College, University of Aberdeen; Professor of Chemistry (1844-58), University of Edinburgh

James Hamilton Junior, M.D.: Professor of Midwifery (1800-39), University of Edinburgh; President of the Royal College of Physicians of Edinburgh (1812-15)

William Henderson, M.D.: Professor of Pathology (1842-1868), University of Edinburgh; homeopathic physician

Sir John Frederick William Herschel, Baronet: President of the Royal Astronomical Society; Master of the Mint (1850-55); editor of the *Manual of Scientific Enquiry*

James Home, M.D.: Regius Professor of Materia Medica (1798-1821) & Professor of the Practice of Medicine (1821-42), University of Edinburgh; President of the Royal College of Physicians of Edinburgh (1809-12)

Thomas Charles Hope, M.D.: Professor of Chemistry, University of Edinburgh; President of the Royal College of Physicians of Edinburgh

Charles Hotham, Captain R.N.: Commodore of the African Squadron (1847-49); Governor of Victoria, Australia (1855)

Alexander von Humboldt: Prussian naturalist, geographer, and explorer

William Hutt, M.P.: chairman of the House of Commons Select Committees on the Slave Trade (1847-50); Vice-President of the Board of Trade & Paymaster General (1860-65)

Thomas Henry Huxley, Assistant Surgeon, R.N.: Assistant Surgeon to the *Rattlesnake* Expedition (1846-50); President of the Geological Society of London; President of the Royal Society of London; President of the British Association for the Advancement of Science (1869-70)

Robert Jameson, Regius Professor of Natural History (1804-54), University of Edinburgh

Robert Jamieson: Glasgow merchant and palm oil trader

James Johnson, M.D., Assistant Surgeon R.N.: founder and editor of the *Medico-Chirurgical Review*, tropical medical theorist

Gilbert King, M.D., Inspector of Fleets and Hospitals R.N.: author of the Navy's Boa Vista reports; author of the reports on Ascension Hospital

Macgregor Laird: Liverpool and Glasgow merchant and palm oil trader

Thomas Laycock, M.D.: Professor of the Practice of Medicine (1855-76), University of Edinburgh

William Leyson, Surgeon R.N.: Assistant Surgeon to the Northwest Passage Expedition, 1824-5

Richard Robert Madden, M.D.: Commissioner of Inquiry into the Settlements on the West Coast of Africa (1839-41)

William Barrett Marshall, Surgeon R.N.: Acting Surgeon to the 1841-42 Niger Expedition Robert McCormick, Deputy Inspector of Hospitals and Fleets R.N.: Surgeon to *HMS Beagle* (1831 only) & the Ross Antarctic Expedition (1839-43)

Alexander McKechnie, Inspector of Hospitals and Fleets, R.N.: Inspector of the Baltic Fleet, Assistant Surgeon to *HMS Sybille*

Robert McKinnal, M.D., Surgeon R.N.: Surgeon to *HMS Sybille*

James Ormiston McWilliam, M.D., Surgeon, retired Deputy Inspector of Hospitals and Fleets R.N.: Medical Inspector to the Customs Office; Secretary of the Epidemiological Society of London; Chief Medical Officer and Surgeon to the 1841-42 Niger Expedition

Viscount Melbourne, William Lamb, M.P.: Chief Secretary of Ireland (1827-28); Home Secretary (1830-34); Prime Minister (1834, 1835-41)

James Miller: Professor of Surgery (1842-64), University of Edinburgh

Alexander Monro tertius, M.D.: Professor of Anatomy & Surgery (1800-31); Professor of Anatomy (1831-1846), University of Edinburgh; President of the Royal College of Physicians of Edinburgh (1825-27)

Sir Roderick Murchison, Baronet: President of the Geological Society of London, President of the Royal Geographical Society

Viscount Palmerston, Henry John Temple, M.P.: Secretary at War (1809-28); Home Secretary (1852-55); Foreign Secretary (1830-34, 1835-41, 1846-51); Prime Minister (1855-58, 1859-65)

Lyon Playfair, M.D., M.P., Baronet, Professor of Chemistry (1858-69), University of Edinburgh; Commissioner on the Health of Towns (1843-45); President of the Chemistry Society of London; President of the British Association for the Advancement of Science (1885); Postmaster General (1873-74); Chairman of Ways and Means (1880-83); Vice-President of the Committee on Education (1886).

Morris Pritchett, M.D., Surgeon R.N.: Acting Surgeon to the 1841-42 Niger Expedition

Sir William Pym, Surgeons' Mate R.N., Inspector-General of Army Hospitals: Superintendent-General of Quarantine (1826-61); Chairman of the Central Board of Health (1832); tropical medical theorist

David Boswell Reid: Lecturer in Practical Chemistry, University of Edinburgh; Commissioner on the Health of Towns (1843-45); Professor of Physiology and Hygiene (1859), University of Wisconsin; Medical Inspector to the U.S. Sanitary Commission; sanitationist

Sir John Richardson, Inspector of Hospitals and Fleets R.N.: Inspector of Haslar Hospital; Surgeon to the Coppermine Expedition (1819-22); Surgeon to the Franklin Arctic Expedition (1825-26); Surgeon to the Rae Arctic Expedition (1848-49)

James Russell: Regius Professor of Clinical Surgery (1802-30), University of Edinburgh; President of the Royal College of Surgeons of Edinburgh (1796-98)

Earl John Russell, M.P.: Paymaster of the Forces (1830-34); Leader of the House of Commons (1834-41, 1852-55); Home Secretary (1835-39); Colonial Secretary (1839-41, 1855); Foreign Secretary (1859-65); Lord President of the Council (1854-55); Prime Minister (1846-52, 1865-66)

Daniel Rutherford, M.D.: Professor of Botany (1786-1819), University of Edinburgh, President of the Royal College of Physicians of Edinburgh (1796-98)

James Young Simpson, M.D., Baronet: Professor of Midwifery (1840-70), University of Edinburgh; President of the Royal College of Physicians of Edinburgh (1850-52)

John Snow: physician; sanitationist; epidemiologist; authority on cholera transmission

James Syme: Regius Professor of Clinical Surgery (1833-69), University of Edinburgh, President of the Royal College of Surgeons of Edinburgh (1849-51)

Allen Thomson, M.D.: Professor of Institutes of Medicine (1842-1848), University of Edinburgh; Professor of Anatomy (1848-77), University of Glasgow; Vice-President of the Royal Society of London

John Thomson, M.D.: Regius Professor of Military Surgery (1806-22) & Professor of Pathology (1831-41), University of Edinburgh

Thomas Richard Heywood Thomson, M.D., Surgeon R.N.: Acting Surgeon to the 1841-42 Niger Expedition

Thomas Steward Traill, M.D.: Regius Professor of Medical Jurisprudence, University of Edinburgh; President of the Royal College of Physicians of Edinburgh

Henry Dundas Trotter, Captain, retired Rear Admiral R.N.; commander of the 1841-42 Niger Expedition

John William Turner: Professor of Surgery (1831-36), University of Edinburgh

Thomas Wakley, M.P.: surgeon, founder of *The Lancet*

John Weir, M.D., Physician R.N.: Medical Commissioner, Victualling Board of the Admiralty (1817-32)

APPENDIX C

FURTHER READINGS AND LITERATURE

Given the diverse historiographies discussed in the introduction and throughout this dissertation, I have included this appendix to provide readers with a supplementary resource that gives additional works organized within sections based on analytical themes and trends. Although these historiographical lists include the most significant works discussed and cited within the body chapters, they move well beyond the sources already employed in both scope and number. They introduce a broader selection of works that elucidate the major debates, trends, and contexts related to these rich literatures, and may also serve as a helpful resource for scholars interested in exploring any of these themes. Due to the formatting requirements for this dissertation, the titles provided solely in this appendix, along with their full publication information, can also found in the bibliography.

C.1 MARITIME AND NAVAL MEDICINE

While the study of the history of maritime health and medicine, beyond naval medicine, has roots in the 1960s and 1970s, it has gained attention in the last fifteen years.

For surveys of Anglo-American and British maritime health and medicine, see Zachary Friedenberg, *Medicine Under Sail* (2002), Kevin Brown, *Poxed and Scurvied: The Story of Sickness & Health at Sea* (2011), and chapters from David Boyd Haycock and Sally Archer, eds., *Health and Medicine at Sea, 1700-1900* (2009), especially David Boyd Haycock, "Introduction: Health, Medicine and the Maritime World: A History of Two Centuries."

For the health of the British merchant marine, see Tim Carter, *Merchant Seamen's Health, 1860-1960: Medicine, Technology, Shipowners and the State in Britain* (2014), and Gordon C. Cook, *Disease in the Merchant Navy: A History of the Seamen's Hospital Society* (2007).

For maritime quarantine, see William Charles Lettington, "The History and Epidemiology of Maritime Quarantine and Medical Inspection in the Port of London" (PhD Diss., 1974), and John Booker, *Maritime Quarantine: The British Experience, c. 1650-1900* (2007).

For diet and scurvy: see J. Watt, E.J. Freeman, and William F. Bynum, eds., *Starving Sailors: The Influence of Nutrition Upon Naval and Maritime History* (1981), and most recently, Jane Samson, "Scurvy Martyrdom: Allen Gardiner and the Patagonian Mission," *JMR* (2013).

The majority of the literature published on British naval medicine focuses on the eighteenth-century, and the French Revolutionary and Napoleonic Wars. For the eighteenth century, scholarship has focused on medical practice, science, and the campaign against scurvy.

For medical practice and science, see Patricia Kathleen Crimmin, "British Naval Health, 1700-1800 : Improvement over Time?," in *British Military and Naval Medicine, 1600-1830* (2007), N.A.M. Rodger, "Medicine and Science in the British Navy of the Eighteenth Century," in *L'homme, la santé et la mer* (1997), Erica M. Charters, "'The Intention Is Certain Noble' : The Western Squadron, Medical Trials, and the Sick and Hurt Board during the Seven Years War (1756-63)," in *Health and Medicine at Sea, 1700-1900* (2009), David Boyd Haycock, "Exterminated by the Bloody Flux : Dysentery in Eighteenth-Century Naval and Military Medical Accounts," *JMR* (2002), and J.A. Sulivan, "The Distillation and Purification of Water at Sea," *MM* 65 (1979).

For scurvy, see David I. Harvie, *Limeys: The True Story of One Man's War Against Ignorance, the Establishment and the Deadly Scurvy* (2002), Patricia Kathleen Crimmin, "The Sick and Hurt Board and the Problem of Scurvy," *JMR* (2013), Glyndwr Williams, "Scurvy on the Pacific Voyages in the Age of Cook," *JMR* (2013), W.M. McBride, "'Normal' Medical Science and British Treatment of the Sea Scurvy, 1753-1775," *JHMAS* (1991), Michael Bartholomew, "James Lind and Scurvy: A Revaluation," *JMR* (2002), Graham Sutton, "Putrid Gums and 'Dead Men's Cloaths': James Lind Aboard the Salisbury," *JRSM* (2003), R.E. Hughes, "James Lind and the Cure of Scurvy: An Experimental Approach," *Medical History* (1975), and Christopher Lloyd, "The Introduction of Lemon Juice as a Cure for Scurvy," *Bulletin of the History of Medicine* 35 (1961).

For analyses of campaigns and cases, see Erica Charters, *Disease, War, and the Imperial State: The Welfare of the British Armed Forces during the Seven Years' War* (2014), Julián de Zulueta, "Health and Military Factors in Vernon's Failure at Cartagena," *MM* (1992), J.D. Alsop, "Sickness in the British Mediterranean Fleet: The Tiger's Journal of 1706," *War & Society* (1993), and Robert Allan Houston, "New Light on Anson's Voyage, 1740-4: A Mad Sailor on Land and Sea," *MM* (2002).

For the institutionalization of naval medicine in administration, hospitals, and surgeons' careers, see N.A.M. Rodger, "Medicine, Administration and Society in the Eighteenth-Century Royal Navy," in *Ix Deutsch-Französisches Symposium Zur Geschichte Der Schiffahrts- Und Marinemedizin* (1988), James H. Thomas, "Jack Tar, Mr Sawbones and the Local Community: The Impact of Haslar Hospital, Gosport, 1750-1800," *Hatcher Review* (1988), Kathleen Harland, "The Royal Naval Hospital at Minorca, 1711: An Example of an Admiral's Involvement in the Expansion of Naval Medical Care," *MM* (2008), and James Watt, "James Ramsay, 1733-1789: Naval Surgeon, Naval Chaplain and Morning Star of the Anti-Slavery Movement," *MM* (1995).

Naval medicine during the French and Napoleonic Wars has the longest history as a field, wrapped up with the mystique of the Napoleonic Navy, Nelson, and Trafalgar. Recent scholarship has focused on the medical service's professional development and advances in medical care. Two ongoing areas of interest are Nelson and medicine at Trafalgar, and the triumph over scurvy.

For the institutional development of naval medicine, see Lawrence Brockliss, John Cardwell, and Michael Moss, *Nelson's Surgeon: William Beatty, Naval Medicine, and the Battle of Trafalgar* (2005), John Cardwell, "Royal Navy Surgeons, 1793-1815: A Collective Biography," in *Health and Medicine at Sea, 1700-1900* (2009), and E.H. Turner, "Naval Medical Service, 1793-1815," *MM* (1960).

For the development of naval medical care, especially preventative medicine and surgery, see Michael Crumplin, *Men of Steel: Surgery in the Napoleonic Wars* (2007), Michael Crumplin, "Surgery in the Royal Navy During the Republican and Napoleonic Wars (1793-1815)," in *Health and Medicine at Sea, 1700-1900* (2009), Jonathan Charles Goddard, "The Navy Surgeon's Chest: Surgical Instruments of the Royal Navy During the Napoleonic War," *JRSM* (2004), Jane Bowden-Dan, "Dirt, Diet and Discipline: Medical Developments in Nelson's Navy: Dr. John Snipe's Contribution," *MM* (2004), and Guenter B. Risse, "Britannia Rules the Seas: The Health of Seamen, Edinburgh, 1791-1800," *JHMAS* (1988).

For Nelson and Trafalgar, see James Watt, "Surgery at Trafalgar," *MM* (2005), James Lowry, *Fiddlers and Whores: The Candid Memoirs of a Surgeon in Nelson's Fleet* (2006), and P.D.G. Pugh, *Nelson and His Surgeons: An Account of the Illnesses and Wounds Sustained by Lord Nelson and His Relationship with the Surgeons of the Day* (1968).

For scurvy, see Stephen R. Brown, *The Age of Scurvy: How a Surgeon, a Mariner and a Gentleman Helped Britain Win the Battle of Trafalgar* (2005), and Brian Vale, "The Conquest of Scurvy in the Royal Navy 1793-1800: A Challenge to Current Orthodoxy," *MM* (2008).

The nineteenth century was somewhat neglected in the historiography on naval medicine, but has diversified rapidly over the past fifteen years. Rigorous scholarship on the twentieth century and the World Wars has also emerged during this period, but falls beyond the scope of this dissertation. The literature on the nineteenth century has followed multiple strands, including naval medicine's professionalization, as well as its role in imperialism and warfare.

For the two general overviews of the nineteenth century, see David McLean, *Surgeons of the Fleet: The Royal Navy and Its Medics from Trafalgar to Jutland* (2010), and Christopher Lloyd, and Jack L.S. Coulter, *Medicine and the Navy: 1200-1900: Volume IV: 1815-1900* (1963).

More focused examples of medical practice and surgeons' work have dominated research on this period. Naval surgeons' role on Australian convict voyages has gotten the most attention.

For Australian convict voyages, see Katherine Foxhall, *Health, Medicine, and the Sea: Australian Voyages, c. 1815–60* (2012), Robin Haines, *Doctors At Sea: Emigrant Voyages to Colonial Australia* (2005), Katherine Foxhall, "From Convicts to Colonists: The Health of Prisoners and the Voyage to Australia, 1823–1853," *The Journal of Imperial and Commonwealth History* (2011), R.V. Jackson, "Sickness and Health on Australia's Female Convict Ships, 1821-1840," *IJMH* (2006), Neil Westphalen, "Naval Medicine and the European Settlement of Australia," in *Navy and the Nation: The Influence of the Navy on Modern Australia* (2005), Mark Staniforth, "Diet, Disease and Death at Sea on the Voyage to Australia, 1837-1839," *IJMH* (1996), and D.R. McNeil, "Medical Care Aboard Australia-Bound Convict Ships, 1786-1840," *Bulletin of the History of Medicine* (1952).

Other stations and campaigns that have received coverage are the Crimean War, the West African Squadron, and the First Opium War. For the Crimean War, see John A. Shepherd, *The Crimean Doctors: A History of the British Medical Services in the Crimean War* (1991), and Christopher Penn, "The Medical Staffing of the Royal Navy in the Russian War, 1854–6," *MM* (2003). For the West African Squadron, see Mark Harrison, "An 'Important and Truly National Subject': The West Africa Service and the Health of the Royal Navy in the Mid Nineteenth Century," in *Health and Medicine at Sea, 1700-1900* (2009), and James Watt, "The Health of Seamen in Anti-Slavery Squadrons," *MM* (2002). For the Opium War, see David McLean, "Surgeons of The Opium War: The Navy on the China Coast, 1840-42," *English Historical Review* (2006),

Naval medical practice more generally has received its own attention in recent years, linking it to broader developments throughout the medical profession. For medical practice, see David Mclean, *Public Health and Politics in the Age of Reform: Cholera, the State and the Royal Navy in Victorian Britain* (2006), David McLean, "Protecting Wood and Killing Germs: 'Burnett's Liquid' and the Origins of the Preservative and Disinfectant Industries in Early Victorian Britain," *Business History* (2010), A. Richard Biddle, "'As His Was Not a Surgical Case It Was Not My Duty to Attend Him': The Surgeon's Role in the Nineteenth-Century Royal Dockyards," *Medical History* (2013), and Marieke M. Hendriksen, "Consumer Culture, Self-Prescription, and Status: Nineteenth-Century Medicine Chests in the Royal Navy," *Journal of Victorian Culture* (2015).

For the work on the professionalization and institutional reform of naval medicine in the nineteenth century, see Christopher Penn, "Sir William Burnett (1779-1861), Professional Head of the Royal Naval Medical Department and Entrepreneur," *Journal of Medical Biography* (2004), G.C. Cook, "Richard Dobson Kt MRCS FRS (1773-1847) and the Inferior Status of Naval Medicine in the Early Nineteenth Century: End of the Fleet Physicians," *Notes & Records of the Royal Society* (2005), and Christopher Robert Howard Penn, "Sir William Burnett and the Medical Staffing of the Royal Navy, 1815-1856" (MA Thesis, 2001).

For the literature devoted to groups and individual surgeons, see S. Karly Kehoe, "Accessing Empire: Irish Surgeons and the Royal Navy, 1840-1880," *Social History of Medicine* (2013), Michael Levien, ed., *Naval Surgeon: The Voyages of Dr. Edward H. Cree, Royal Navy, as Related in His Private Journals, 1837-1856* (1982), William Barr, *Resurrecting Dr. Moss: The Life and Letters of a Royal Navy Surgeon, Edward Lawton Moss MD, RN, 1843-1880* (2008), Gwen Chessell, *Alexander Collie: Colonial Surgeon, Naturalist and Explorer* (2008), and Julia Turner, *Dr. William Edward Dillon, Navy Surgeon in Livingstone's Africa* (2014).

There have been a number of works that have bridged the temporal divide across the French and Napoleonic Wars, looking both backward and forward in time. For works on surgeons and medical practice whose analysis covers both from the eighteenth century through the nineteenth century, see Mark Harrison, *Medicine in an Age of Commerce and Empire* (2010), Brian Vale and Griffith Edwards, *Physician to the Fleet: The Life and Times of Thomas Trotter, 1760-1832* (2011), Mark Harrison, "Scurvy on Sea and Land: Political Economy and Natural History, c. 1780–c. 1850," *JMR* (2013), James Watt, "Naval and Civilian Influences on Eighteenth- and Nineteenth-Century Medical Practice," *MM* (2011), Christopher Lawrence, "Disciplining Disease: Scurvy, the Navy, and Imperial Expansion, 1750-1825," in *Visions of Empire: Voyages, Botany, and Representations of Nature* (1996), Ross Lawrenson, "Medical Practice in New Zealand (1769-1860)," *Vesalius* (2004), A.L. Revell, *Haslar: The Royal Hospital* (1978), and Ulrich Tröhler, "Quantification in British Medicine and Surgery, 1750-1830: With Special Reference to Its Introduction Into Therapeutics : A Thesis" (PhD Diss., 1978).

For works that cover the eighteenth century and the French and Napoleonic Wars, see Christopher Lloyd, and Jack L.S. Coulter, *Medicine and the Navy, 1200-1900: Volume III: 1714-1815* (1963), Margarette Lincoln, "The Medical Profession and Representations of the Navy, 1750-1815," in *British Military and Naval Medicine, 1600-1830* (2007), and Patricia Kathleen Crimmin, "The Sick and Hurt Board: Fit for Purpose?," in *Health and Medicine at Sea, 1700-1900* (2009).

C.2 MILITARY AND COLONIAL MEDICINE

The histories of military and colonial medicine have adopted a broader and more interconnected approach in the past fifteen years. In many ways, literature on naval medicine has recently followed trends emerging in these interconnected subject areas. This list presents a selection of the important works on these extensive subjects.

For a selection of globally oriented works on British colonial medicine, see Roy M. MacLeod, ed., *Disease, Medicine, and Empire: Perspectives on Western Medicine and the Experience of European Expansion* (1988); Pratik Chakrabarti, *Materials and Medicine: Trade, Conquest and Therapeutics in the Eighteenth Century* (2010), Poonam Bala, ed., *Medicine and Colonialism: Historical Perspectives in India and South Africa* (2011), and Pratik Chakrabarti, *Medicine and Empire: 1600-1960* (2013).

This broader research builds on a rich literature analyzing the history of medicine in colonial India. For this literature from its foundation, see David Arnold, *Colonizing the Body: State Medicine and Epidemic Disease in Nineteenth-Century India* (1993), Mark Harrison, *Public Health in British India: Anglo-Indian Preventive Medicine, 1859-1914* (1994), Mark Harrison, *Climates and Constitutions: Health, Race, Environment and British Imperialism in India, 1600-1850* (1999), Biswamoy Pati and Mark Harrison, eds., *Health, Medicine, and* Empire: Perspectives on Colonial India (2001), Paul C. Winther, *Anglo-European Science and the Rhetoric of Empire: Malaria, Opium, and British Rule in India, 1756-1895* (2003), Sanjoy Bhattacharya, Mark Harrison, and Michael Worboys, *Fractured States: Smallpox, Public Health* *and Vaccination Policy in British India 1800-1947* (2005), Biswamoy Pati and Mark Harrison, eds., *The Social History of Health and Medicine on Colonial India* (2008), and Ishita Pande, *Medicine, Race and Liberalism in British Bengal: Symptoms of Empire* (2010).

For the literature focusing on colonial medicine in the Atlantic, which overlaps with military and naval medicine, see recently Mark Harrison, *Medicine in an Age of Commerce and Empire* (2010), and John Rankin, *Healing the African Body: British Medicine in West Africa, 1800-1860* (2015). For a selection showing the older tradition of work on Atlantic colonial medicine, see Adell Patton, Jr., *Physicians, Colonial Racism, and Diaspora in West Africa* (1996), Anne Digby, "'A Medical El Dorado'? Colonial Medical Incomes and Practice at the Cape," *Social History of Medicine* (1995), and Christopher Fyfe, *Africanus Horton, 1835-1883: West African Scientist and Patriot* (1972).

The literature on British army and military medicine in the eighteenth and nineteenth centuries has followed a number of parallel themes, including institutionalization, professionalization, and medical practice.

For a selection from the general overviews and more popular histories, see Geoffrey L. Hudson, ed., *British Military and Naval Medicine, 1600-1830* (2007), and Martin Howard, *Wellington's Doctors: The British Army Medical Services in the Napoleonic Wars* (2002).

For a selection on institutionalization and medicine in the age of imperial warfare, see Peter Mathais, "Swords and Ploughshares: The Armed Forces, Medicine, and Public Health in the Late Eighteenth Century," in *War and Economic Development: Essays in Memory of David Joslin* (1975), Harold J. Cook, "Practical Medicine and the British Armed Forces After the 'Glorious Revolution'," *Medical History* (1990), J.D. Alsop, "Warfare and the Creation of British Imperial Medicine, 1600-1800," in *British Military and Naval Medicine, 1600-1830* (2007), and Erica Charters, *Disease, War, and the Imperial State: The Welfare of the British Armed Forces during the Seven Years' War* (2014).

For works on medical practice and education, see Matthew H. Kaufman, *Surgeons at War: Medical Arrangements for the Treatment of the Sick and Wounded in the British Army during the Late 18th and 19th Centuries* (2001), and Matthew H. Kaufman, *The Regius Chair of Military Surgery in the University of Edinburgh, 1806-55* (2003).

For the professionalization of military medicine, including the influence of Scots, see Catherine Kelly, *War and the Militarization of British Army Medicine, 1793–1830* (2011), Marcus Ackroyd, *et al.*, *Advancing with the Army: Medicine, the Professions and Social Mobility in the British Isles 1790-1850* (2006), and J.S.G. Blair, "The Scots and Military Medicine," in *The Influence of Scottish Medicine: An Historical Assessment of Its International Impact* (1988).

For the leading works on military medicine in the twentieth century and the World Wars, see Mark Harrison, *The Medical War: British Military Medicine in the First World War* (2010), and Mark Harrison, *Medicine and Victory: British Military Medicine in the Second World War* (2004).

C.3 TROPICAL MEDICINE

The history of tropical medicine, especially in relation to British imperialism, has been a vibrant topic of study for decades. While the approaches to tropical medicine have taken diverse tacks to analyzing the multi-century European interaction with tropical fevers, two themes have dominated the field. The emergence of tropical medicine as a specialized field of British medicine in the late-nineteenth and early-twentieth centuries has gained significant attention in recent years. A more established focus on the White Man's Grave and the adoption of quinine as the preferred treatment and prophylaxis for malarial fevers continues as well.

For general histories of tropical medicine and disease, see Randall Packard, *The Making of a Tropical Disease: A Short History of Malaria* (2007), James L.A. Webb Jr., *Humanity's Burden: A Global History of Malaria* (2009), Christopher Wills, *Yellow Fever, Black Goddess: The Coevolution of People and Plagues* (1996), and David Arnold, *Warm Climates and Western Medicine: The Emergence of Tropical Medicine, 1500-1900* (Atlanta: Rodopi, 1996).

For the emergence of tropical medicine as a specialization of British and European medicine, see Deborah J. Neill, *Networks in Tropical Medicine: Internationalism, Colonialism, and the Rise of a Medical Specialty, 1890–1930* (2012), Douglas M. Haynes, *Imperial Medicine: Patrick Manson and the Conquest of Tropical Disease* (2001), and Michael Worboys, "Germs, Malaria and the Invention of Mansonian Tropical Medicine: From 'Diseases in the Tropics' to 'Tropical Diseases,'" *Clio Medica* (1996).

For tropical disease and medicine in the early modern and modern Caribbean, see J.R. McNeill, *Mosquito Empires: Ecology and War in the Greater Caribbean, 1620-1914* (2010), and Mark Harrison, *Medicine in an Age of Commerce and Empire: Britain and Its Tropical Colonies, 1660-1830* (2010).

The development of West Africa's reputation as the White Man's Grave and the adoption of quinine as a prophylactic drug is the subject of an extensive historiography. A selection of the directly related works is presented here. Broader scholarship on the cinchona tree, its bark and quinine is not included. The references to the imperial ramifications of quinine are also too numerous to list comprehensively.

The White Man's Grave and the transformation of tropical medicine and health in the early-to-mid nineteenth century was a career-long focus of Africanist and Atlanticist Philip Curtin. He followed several shorter accounts that placed the subject within slave trade suppression efforts and naval medicine more generally. For Philip Curtin's work, see Philip D. Curtin, *The Image of Africa: British Ideas and Action, 1780-1850* (1964), ch. 12-14, Philip D. Curtin, "'The White Man's Grave:' Image and Reality, 1780-1850," *Journal of British Studies* (1961), Philip D Curtin, *Death by Migration: Europe's Encounter with the Tropical World in the Nineteenth Century* (1989), Philip D. Curtin, "The End of the 'White Man's Grave'? Nineteenth-Century Mortality in West Africa," *The Journal of Interdisciplinary History* 21, no. 1 (1990), and Philip D. Curtin, *Disease and Empire: The Health of European Troops in the Conquest of Africa* (1998).

For the work preceding him, see Christopher Lloyd, and Jack L.S. Coulter, Medicine *and the Navy: 1200-1900: Volume IV: 1815-1900* (1963), and Christopher Lloyd, *The Navy and the Slave Trade: The Suppression of the African Slave Trade in the Nineteenth Century* (1949, repr., 1968).

For the scholarship that followed Curtin's initial work, see Michael Gelfand, *Rivers of Death in Africa* (1964), Daniel R. Headrick, *The Tools of Empire: Technology and European Imperialism in the Nineteenth Century* (1981), ch. 3, Dennis G. Carlson, "African Fever, Prophylactic Quinine, and Statistical Analysis: Factors in the European Penetration of a Hostile West African Environment," *Bulletin of the History of Medicine* (1977), and Dennis G. Carlson, *African Fever: A Study of British Science, Technology, and Politics in West Africa, 1787-1864* (1984).

The most recent treatments have again expanded the scope beyond tropical medicine and the mortality revolution that improved European health in the tropics. The West African Squadron's operations, the construction of the White Man's Grave, and the broader ramifications for British imperialism have gained their own attention.

For the West African Squadron and tropical medicine, see Mark Harrison, "An 'Important and Truly National Subject': The West Africa Service and the Health of the Royal Navy in the Mid Nineteenth Century," in *Health and Medicine at Sea* (2009), John C. Mitcham, "Patrolling the White Man's Grave: Disease and the Anglo-American Anti-Slavery Squadrons, 1841-1862," *The Northern Mariner* (2010), and James Watt, "The Health of Seamen in Anti-Slavery Squadrons," *MM* (2002), For the White Man's Grave, see László Máthé-Shires, "Imperial Nightmares: The British Image of 'The Deadly Climate' of West Africa, c. 1840-74," *European Review of History: Revue Européenne D'histoire* (2001). For British imperialism and African fever, see John Rankin, *Healing the African Body: British Medicine in West Africa, 1800-1860* (2015), and part of Daniel R. Headrick, *Power Over Peoples: Technology, Environments, and Western Imperialism, 1400 to the Present* (2010).

The French counterexample has received less attention in its own right. Some of the work focusing mainly on the British case, especially Philip Curtin's books, also presents the French case as a comparative example. Historians have highlighted the discovery of quinine's effectiveness by French army surgeons during the colonization of Algeria in the 1830s, and the delay in widespread use of quinine within the French armed forces until the 1870s.

For the work devoted to French tropical medicine and quinine, as well as its recent successors, see Commander Hamet, "Malaria and Military Medicine During the Conquest of Algeria," *Military Surgeon* (1932), William B. Cohen, "Malaria and French Imperialism," *The Journal of African History* (1983), Marie-Cecile Thoral, "Colonial Medical Encounters in the Nineteenth Century: The French Campaigns in Egypt, Saint Domingue and Algeria," *Social History of Medicine* (2012), and Michael A. Osborne, *The Emergence of Tropical Medicine in France* (2014).

C.4 RISE OF PROFESSIONAL SCIENCE

The rise of institutionalized science throughout British society has been a subject of study dating back to the early twentieth century. While it began as a positivist, heroic narrative emphasizing particular narratives and discoveries, the development of different applications and fields of science came to dominate the literature. Since the 1970s, approaches that emphasize the societal prevalence, complexities and ramifications of the rise of science have become increasingly common. Given the breadth of the literature and history of science's emergence of as a discipline, this historiographical list represents a selection of major themes and works.

The oldest strand of this broader society-focused historiography analyzes the increasing authority and professionalization of science during the nineteenth century. Generally, see Jack Morrell, *Science, Culture and Politics in Britain: 1750-1870* (1997). For the new conception of scientific knowledge and fields, see David M. Knight and Matthew Eddy, ed., *Science and Beliefs: From Natural Philosophy to Natural Science, 1700-1900* (2005), Martin J. Daunton, ed., *The Organisation of Knowledge in Victorian Britain* (2005), David Clifford, Elisabeth Wadge, Alex Warwick, and Martin Willis, eds., *Repositioning Victorian Sciences: Shifting Centres in Nineteenth-Century Scientific Thinking* (2006), Richard R. Yeo, "Scientific Rhetoric and the Rhetoric of Science, 1830-1917," in *The Politics and Rhetoric of Scientific Method: Historical Studies* (2012), and Jon Klancher, *Transfiguring the Arts and Sciences: Knowledge and Cultural Institutions in the Romantic Age* (2013).

For academic and professional organization, see Jack B. Morrell, "Individualism and the Structure of British Science in 1830," *Historical Studies in the Physical Sciences* (1971), Roy M MacLeod and Peter Collins, *The Parliament of Science: The British Association for the Advancement of Science 1831-1981* (1981), and Jack Morrell and Arnold Thackray, *Gentlemen of Science: Early Years of the British Association for the Advancement of Science* (1981).

For expertise and its basis: Robert H. Kargon, *Science in Victorian Manchester: Enterprise and Expertise* (1977), Susan Faye Cannon, *Science in Culture: The Early Victorian Period* (1978), and Roy M. MacLeod, ed., *The "Creed of Science" in Victorian England* (2000).

Early-nineteenth-century science became increasingly fraught as ideological and methodological conflicts rose. This led to efforts by prominent scientists to develop a universalizing conception of science based on the identity of "scientist." For professional politics and the creation of professional science, see Nicolaas A. Rupke, *The Great Chain of History: William Buckland and the English School of Geology (1814-1849)* (1983), Trevor H. Levere, *Poetry Realized in Nature: Samuel Taylor Coleridge and Early Nineteenth-Century Science* (1987), Adrian Desmond, *The Politics of Evolution: Morphology, Medicine, and Reform in Radical London* (1989), Nicolaas A. Rupke, *Richard Owen: Victorian Naturalist* (1994), and James Brooke-Smith, "'A Great Empire Falling to Pieces': Coleridge, Herschel, and Whewell on the Poetics of Unitary Knowledge," *Configurations* (2012).

The relationship of science's development to British society is an interconnected theme that has emerged from these debated over the institutionalization, professionalization, and authority of science. Generally, see Jack Morrell, *Science, Culture and Politics in Britain: 1750 - 1870* (1997), Bernard Lightman, ed., *Victorian Science in Context* (1997), Richard G. Olsen, *Science and Scientism in Nineteenth-Century Europe* (2008), and Diarmid A. Finnegan, *Natural History Societies and Civic Culture in Victorian Scotland* (2009).

For public science, see Martin J.S. Rudwick, "Charles Darwin in London: The Integration of Public and Private Science," *Isis* (1982), Lorraine Daston, "The Moral Economy of Science," *Osiris* (1995), Roy M. MacLeod, *Public Science and Public Policy in Victorian England* (1996), Roy M. MacLeod, ed., *Government and Expertise: Specialists, Administrators and Professionals, 1860-1919* (1988), Aileen Fyfe and Bernard Lightman, eds., *Science in the Marketplace: Nineteenth-Century Sites and Experiences* (2007), and David N. Livingstone and Charles W.J. Withers, eds., *Geographies of Nineteenth-Century Science* (2011).

For popular forms of science, see Roger Cooter, *The Cultural Meaning of Popular Science: Phrenology and the Organization of Consent in Nineteenth-Century Britain* (1984), Alison Winter, *Mesmerized: Powers of Mind in Victorian Britain* (1998), and James A. Secord, *Victorian Sensation: The Extraordinary Publication, Reception, and Secret Authorship of Vestiges of the Natural History of Creation* (2000).

C.5 RISE OF SCIENTIFIC FIELDS AND APPLICATIONS

Natural history and science were the first fields to undergo professional, methodological and social change from the late-eighteenth century onward. The literature initially approached this subject through naturalists and natural history. For some of the major overviews on natural history, see Alexander B. Adams, *Eternal Quest: The Story of the Great Naturalists* (1969), David Elliston Allen, *The Naturalist in Britain: A Social History* (1976), Paul Lawrence Farber, *Finding Order in Nature: The Naturalist Tradition from Linnaeus to E.O. Wilson* (2000), and David Elliston Allen, *Naturalists and Society: The Culture of Natural History in Britain, 1700-1900* (2001). For specific individuals and approaches: Nicolaas A. Rupke, *Richard Owen: Victorian Naturalist* (1994), Christopher Fox, Roy Porter, and Phillip Sloan, "The Gaze of Natural History," in *Inventing Human Science: Eighteenth-Century Domains* (1995), and Mary Terrall, *Catching Nature in the Act: Réaumur and the Practice of Natural History in the Eighteenth Century* (2014).

A second approach to the natural sciences in the nineteenth century has focused on the development of individual fields. For Geology, see Nicolaas A. Rupke, *The Great Chain of History: William Buckland and the English School of Geology (1814-1849)* (1983), Martin J.S. Rudwick, *The Great Devonian Controversy: The Shaping of Scientific Knowledge Among Gentlemanly Specialists* (1985), and James A. Secord, *Controversy in Victorian Geology: The Cambrian-Silurian Dispute* (1986). For Physics, see Iwan Rhys Morus, *When Physics Became King* (2005). For Mathematics, see Raymond Flood, Adrian Rice, and Robin Wilson, eds., *Mathematics in Victorian Britain* (2011). For Astronomy, see David Aubin, Charlotte Bigg, and H. Otto Sibum, eds., *The Heavens on Earth: Observatories and Astronomy in Nineteenth-Century Science and Culture* (2010). For Biology, see William Coleman, *Biology in the Nineteenth Century: Problems of Form, Function and Transformation* (1971). For Chemistry, see Robert Bud and Gerrylynn K. Roberts, *Science Versus Practice: Chemistry in Victorian Britain* (1984), and Jan Golinski, *Science as Public Culture: Chemistry and Enlightenment in Britain, 1760-1820* (1992).

Some recent works have also focused on areas that did not develop into their own scientific fields until later in the nineteenth century. For Meteorology, see Vladimir Janković, *Reading the Skies: A Cultural History of English Weather, 1650-1820* (2001), and Katharine Anderson, *Predicting the Weather: Victorians and the Science of Meteorology* (2005). For energy, see Crosbie Smith and M. Norton Wise, *Energy and Empire: A Biographical Study of Lord Kelvin* (1989), and Crosbie Smith, *The Science of Energy: A Cultural History of Energy Physics in Victorian Britain* (1998). For water, see Christopher Hamlin, *A Science of Impurity: Water Analysis in Nineteenth Century Britain* (1990).

The works on specific fields investigate aspects ranging from professionalization to practice and societal implications. For a more explicit focus on practice, see G.S. Rousseau, and Roy Porter, eds., *The Ferment of Knowledge: Studies in the Historiography of Eighteenth-Century Science* (1980), and Jim Endersby, *Imperial Nature: Joseph Hooker and the Practices of Victorian Science* (2008). One theme for practice has been its connection to the meaning of science. See Bernard Lightman, ed., *Victorian Science in Context* (1997), and Martin J. Daunton, ed., *The Organisation of Knowledge in Victorian Britain* (2005).

The social uses of the natural sciences and their connections to the politics and practice of science have become another important theme. For work in the connection to intellectual ideas and movements, see Trevor H. Levere, *Poetry Realized in Nature: Samuel Taylor Coleridge and Early Nineteenth-Century Science* (1981), and Richard G. Olsen, *Science and Scientism in Nineteenth-Century Europe* (2008).

For the social practice of science, see Nancy Stepan, *The Idea of Race in Science: Great Britain, 1800-1960* (1982), Geoffrey Cantor, *Michael Faraday: Sandemanian and Scientist: A Study of Science and Religion in the Nineteenth Century* (1991), John Gascoigne, *Joseph Banks and the English Enlightenment: Useful Knowledge and Polite Culture* (1994), Paul White, *Thomas Huxley: Making the "Man of Science"* (2003), and Adrian Desmond and James Moore, *Darwin's Sacred Cause: How a Hatred of Slavery Shaped Darwin's Views on Human Evolution* (2009).

The development of the social sciences through the application of methods from the natural sciences to political and social questions has been a separate literature. The social sciences emerged in the mid-nineteenth century, but developed slowly from that point in time.

For the development of social scientific fields, see Lawrence Goldman, "The Origins of British 'Social Science': Political Economy, Natural Science and Statistics, 1830–1835," *The Historical Journal* (1983), Andrew Abbott, *Chaos of Disciplines* (2001), and Theodore M. Porter and Dorothy Ross, eds., *The Cambridge History of Science: Volume 7, The Modern Social Sciences* (2003). For the case of anthropology, see George W. Stocking Jr., *Victorian Anthropology* (1987), Sadiah Qureshi, *Peoples on Parade: Exhibitions, Empire, and Anthropology in Nineteenth-Century Britain* (2011), and Efram Sera-Shriar, *The Making of British Anthropology, 1813–1871* (2013).

For social science's social uses, see Nancy Stepan, *The Idea of Race in Science: Great Britain, 1800-1960* (1982), Cynthia Eagle Russett, *Sexual Science: The Victorian Construction of Womanhood* (1989), Noel W. Thompson, *The People's Science: The Popular Political Economy of Exploitation and Crisis, 1816-34* (1984), Lawrence Goldman, *Science, Reform, and Politics in Victorian Britain: The Social Science Association 1857–1886* (2002), and Richard G. Olsen, *Science and Scientism in Nineteenth-Century Europe* (2008). For some works discussing applications of the social sciences, see Daniel R. Headrick, *When Information Came of Age: Technologies of Knowledge in the Age of Reason and Revolution, 1700-1850* (2000), and Seymour Drescher, *The Mighty Experiment: Free Labor Versus Slavery in British Emancipation* (2002).

For the social uses of medicine specifically, see Peter Baldwin, *Contagion and the State in Europe, 1830-1930* (1999); and Erwin H. Ackerknecht, "Anticontagionism Between 1821 and 1867: The Fielding H. Garrison Lecture," *International Journal of Epidemiology* (2009).

For marginal and discredited sciences, see Roger Cooter, *The Cultural Meaning of Popular Science: Phrenology and the Organization of Consent in Nineteenth-Century Britain* (1984), and Alison Winter, *Mesmerized: Powers of Mind in Victorian Britain* (1998).

The emergence of the statistical movement helped to transform the discourse, approaches and authority of the natural and social sciences. It is not until later in the nineteenth century that statistics itself can be labeled a science. For the emergence of statistics as a methodological field, see Michael J. Cullen, *The Statistical Movement in Early Victorian Britain: The Foundations of Empirical Social Research* (1975), Theodore M. Porter, *The Rise of Statistical Thinking, 1820-1900* (1986), Gerd Gigerenzer and Zeno Swijtink, *The Empire of Chance: How Probability Changed Science and Everyday Life* (1989), Theodore M. Porter, *Trust in Numbers: The Pursuit of Objectivity in Science and Public Life* (1995), Gérard Jorland, Annick Opinel, and George Weisz, eds., *Body Counts: Medical Quantification in Historical and Sociological Perspective* (2005), and Libby Schweber, *Disciplining Statistics: Demography and Vital Statistics in France and England, 1830–1885* (2006).

The development of nineteenth-century science also had a close relationship to technology and industry. For a selection of works on this distinct theme, see Donald Cardwell, *The Development of Science and Technology in Nineteenth-Century Britain: The Importance of Manchester*, ed. Richard L. Hills (2003), Christine MacLeod, *Heroes of Invention: Technology, Liberalism and British Identity, 1750-1914* (2007), and Wolfgang Krohn, Edwin T. Layton Jr., and Peter Weingart, eds., *The Dynamics of Science and Technology: Social Values, Technical Norms and Scientific Criteria in the Development of Knowledge* (2012).

C.6 RISE OF SCOTTISH SCIENCE

The importance of Scotland to the development of British science is explicitly discussed in its own specialized literature. The eighteenth century and the legacy of the Scottish Enlightenment have dominated this analysis. For the Scottish Enlightenment era, see Jack B. Morrell, "The University of Edinburgh in the Late Eighteenth Century: Its Scientific Eminence and Academic Structure," *Isis* (1971), Arthur L Donovan, *Philosophical Chemistry in the Scottish Enlightenment: The Doctrines and Discoveries of William Cullen and Joseph Black* (1975), Roger L. Emerson, *Academic Patronage in the Scottish Enlightenment: Glasgow, Edinburgh and St Andrews Universities* (2008), and David B. Wilson, *Seeking Nature's Logic: Natural Philosophy in the Scottish Enlightenment* (2009). For Scottish medicine in this era, see Charles W.J. Withers and Paul Wood, eds., *Science and Medicine in the Scottish Enlightenment* (2002), Guenter B. Risse, ed., *New Medical Challenges During the Scottish Enlightenment* (2005), and Roger L. Emerson, *Essays on David Hume Medical Men and the Scottish Enlightenment: Industry, Knowledge and Humanity* (2009).

Several authors have discussed the transition of Scottish science in nineteenth century in shorter articles and essays. While dynamic work occurred in the early decades of the century, infighting and institutional politics supposedly led to a partial decline of the University of

Edinburgh as a scientific center. Public, industrial and university science all continued. For these works, see Jack B Morrell, "Practical Chemistry in the University of Edinburgh, 1799-1843," *Ambix* (1969), Jack B. Morrell, "Science and Scottish University Reform: Edinburgh in 1826," *The British Journal for the History of Science* (1972), Jack B. Morrell, "The Patronage of Mid-Victorian Science in the University of Edinburgh," *Science Studies* (1973), John R.R. Christie, "The Rise and Fall of Scottish Science," in *The Emergence of Science in Western Europe* (1975), Stephen Shapin., "'Nibbling at the Teats of Science': Edinburgh and the Diffusion of Science in the 1830s'," in *Metropolis and Province: Science in British Culture, 1780-1850* (1983), and Diarmid A. Finnegan, *Natural History Societies and Civic Culture in Victorian Scotland* (2009).

C.7 RISE OF COLONIAL AND NAVAL SCIENCE

Separate literatures have analyzed the contributions of colonial science to imperialism and the broader development of science. The role of science, technology and medicine in aiding imperial expansion has long been a theme in the historiography. The roles of individuals, institutions, the environment, and exchanges with indigenous peoples in the development of colonial science have more recently received attention. The contributions of colonial science to the development of British science more broadly have also been more recent themes.

For surveys of colonial science and imperialism, see Daniel R. Headrick, *The Tools of Empire: Technology and European Imperialism in the Nineteenth Century* (1981), Michael Adas, *Machines as the Measure of Men: Science, Technology, and Ideologies of Western Dominance* (1989). Roy M. MacLeod, ed., *Nature and Empire: Science and the Colonial Enterprise* (2000). Bouda Etemad, *Possessing the World: Taking the Measurements of Colonisation from the Eighteenth to the Twentieth Century* (2007), and Daniel R. Headrick, *Power Over Peoples: Technology, Environments, and Western Imperialism, 1400 to the Present* (2010).

For surveys of British colonial science in the nineteenth century, see John Gascoigne, *Science in the Service of Empire: Joseph Banks, the British State and the Uses of Science in the Age of Revolution* (1998), Richard Drayton, *Nature's Government: Science, Imperial Britain, and the "Improvement" of the World* (2000), and Brett M. Bennett and Joseph M. Hodge, eds., *Science and Empire: Knowledge and Networks of Science Across the British Empire, 1800-1970* (2011). For the French example, see James Edward McClellan and François Regourd, *The Colonial Machine: French Science and Overseas Expansion in the Old Regime* (2011).

For natural history and science in the British imperial context, see Robert A. Stafford, *Scientist of Empire: Sir Roderick Murchison, Scientific Exploration and Victorian Imperialism* (1989), Phillip Sloan, "The Gaze of Natural History," in *Inventing Human Science: Eighteenth-Century Domains* (1995), Lucile H. Brockway, *Science and Colonial Expansion: The Role of the British Royal Botanic Gardens* (2002), Steven Ruskin and Sir John Frederick William Herschel, *John Herschel's Cape Voyage: Private Science, Public Imagination, and the Ambitions of Empire* (2004), Jim Endersby, *Imperial Nature: Joseph Hooker and the Practices of Victorian Science* (2008), and Lawrence Dritsas, *Zambesi: David Livingstone and Expeditionary Science in Africa* (2010).

There has been a significantly smaller literature devoted to science and technology in the European and Royal Navies, see Pieter Van der Merwe, ed., *Science and the French and British Navies, 1700-1850* (2003), Don Leggett and Richard Dunn, eds., *Re-Inventing the Ship: Science, Technology and the Maritime World, 1800-1918* (2012), and Glyn Williams, *Naturalists at Sea: Scientific Travellers from Dampier to Darwin* (2013). For more on the Royal Navy, see Archibald Day, *The Admiralty Hydrographic Service, 1795-1919* (1967), and parts of Trevor H. Levere, *Science and the Canadian Arctic: A Century of Exploration, 1818-1918* (1993) and Michael S. Reidy, Gary R. Kroll, and Erik M. Conway, *Exploration and Science: Social Impact and Interaction* (2007).

C.8 RISE OF MEDICAL SCIENCE

The rise of medical science has been a subject of long-standing interest to historians of medicine. This theme has occupied a more ambivalent position within the history of science due to the institutional and analytical separation of the histories of medicine and science within the Anglo-American and European academies. This selection of works discussing various aspects of medical science in the nineteenth century thus draws largely from the history of medicine. For a consideration of some of the issues involved in this tradition, see John Harley Warner, "The History of Science and the Sciences of Medicine," *Osiris* (1995).

For the overarching survey of the development of medical science in Europe and the United States during the nineteenth century, see W.F. Bynum, *Science and the Practice of Medicine in the Nineteenth Century* (1994). For the roots of this traced back to the Enlightenment, see Roy Porter, "Medical Science and Human Science in the Enlightenment," in *Inventing Human Science: Eighteenth-Century Domains* (1995). For the development of medical science in the industrial and Victorian age, see A.J. Youngson, *The Scientific Revolution in Victorian Medicine* (1979), and Ivan Waddington, *The Medical Profession in the Industrial Revolution* (1984).

The oldest strand of literature devoted to the development of medical science focused on the transformation of medicine in the Parisian hospitals in the late-eighteenth and early-nineteenth centuries. The recent interpretation is that the mindset and approaches developed in Parisian medicine spread throughout Western Europe in the early nineteenth century. For the classical works, see Erwin Heinz Ackerknecht, *Medicine at the Paris Hospital, 1794-1848* (1967), and Michel Foucault, *The Birth of the Clinic: An Archaeology of Medical Perception*, trans. A.M. Sheriden (1973).

In addition to clinical hospital medicine, the rise of surgery as a scientific field of medicine has been another long-standing field of focus. For the classical essay, see Owsei Temkin, "The Role of Surgery in the Rise of Modern Medical Thought," in *The Double Face of Janus and Other Essays in the History of Medicine* (1951, repr., 1977). For a selection of the initial work drawing out this theme for European and British medicine, see Owen H. Wangensteen and Sarah D. Wangensteen, *The Rise of Surgery: From Empiric Craft to Scientific Discipline* (1978), Toby Gelfand, *Professionalizing Modern Medicine: Paris Surgeons and Medical Science and Institutions in the 18th Century* (1980), and David Hamilton, "The

Nineteenth-Century Surgical Revolution- Antisepsis or Better Nutrition?," *Bulletin of the History of Medicine* (1982). For an analysis of the development of British surgery, see Peter Stanley, *For Fear of Pain, British Surgery, 1790-1850* (2003).

The literature on the development of medical science in the nineteenth century has expanded to incorporate a broader analysis of science in medical practice since the 1980s. The theme that launched much of this broader perspective on medical science in practice was public health and preventative medicine. For a selection of the major works on the rise of public health and sanitary medicine, see Wesley W. Spink, *Infectious Diseases: Prevention and Treatment in the Nineteenth and Twentieth Centuries* (1978), Anthony S. Wohl, *Endangered Lives: Public Health in Victorian Britain* (1983), Anne Hardy, *The Epidemic Streets: Infectious Disease and the Rise of Preventive Medicine, 1856-1900* (1993), and Christopher Hamlin, *Public Health and Social Justice in the Age of Chadwick: Britain, 1800-1854* (1998).

The role of anatomy and dissection in medical training and practice was another theme that arose during the 1980s. By analyzing the spread of anatomical and physiological approaches from France to Britain, this work has most explicitly highlighted the French influence on British and European medicine. For works analyzing the spread of anatomy, see Russell C. Maulitz, *Morbid Appearances: The Anatomy of Pathology in the Early Nineteenth Century* (1987), William Coleman and Frederic L. Holmes, eds., *The Investigative Enterprise: Experimental Physiology in Nineteenth-Century Medicine* (1988). For the rise of anatomy in British medical training and its impact on British medicine and society, see Ruth Richardson, *Death, Dissection and the Destitute*, 2nd ed. (2000), Alan Bates, *The Anatomy of Robert Knox: Murder, Mad Science and Medical Regulation in Nineteenth-Century Edinburgh* (2010), Helen Patricia MacDonald, *Possessing the Dead: The Artful Science of Anatomy* (2010), and Fiona Hutton, *The Study of Anatomy in Britain, 1700–1900* (2013).

Research on the impact of medical science on medical theory, understandings of disease, and medical practice has also been an area of focus over the last several decades. The delay in science's impact on British medical practice until the mid-nineteenth century has been one of the broad conclusions from this work. For the shift away from humoral medical practices, and the rise of the germ theory and laboratory medicine, see Christopher Lawrence, "Incommunicable Knowledge: Science, Technology and the Clinical Art in Britain 1850-1914," *Journal of Contemporary History* (1985), K. Codell Carter, *The Decline of Therapeutic Bloodletting and the Collapse of Traditional Medicine* (2012), Michael Worboys, *Spreading Germs: Disease Theories and Medical Practice in Britain, 1865-1900* (2000), and Andrew Cunningham and Perry Williams, eds., *The Laboratory Revolution in Medicine* (2002). For eighteenth-century precedents and nineteenth-century development, see Andreas-Holger Maehle, *Drugs on Trial: Experimental Pharmacology and Therapeutic Innovation in the Eighteenth Century* (1999), and Ulrich Tröhler, *"To Improve the Evidence of Medicine": The 18th Century British Origins of a Critical Approach* (2000). For the much-studied example of antiseptic measures, see N.J. Fox, "Scientific Theory Choice and Social Structure: The Case of Joseph Lister's Antisepsis, Humoral Theory and Asepsis," *History of Science* (1988), and Lindsay Granshaw, "'Upon This Principle I Have Based a Practice': The Development and Reception of Antisepsis in Britain, 1807-1890," in *Medical Innovations in Historical Perspective* (1992).

The rise of the social history of medicine has further expanded the scope of analyses of scientific medicine. The politics and conflicts that emerged within the medical profession and society have become the focus of a subset of literature on the social constructions of medical practice. For a selection, see Adrian Desmond, *The Politics of Evolution: Morphology, Medicine, and Reform in Radical London* (1989), Evelleen Richards, “The ‘Moral Anatomy’ of Robert Knox: The Interplay Between Biological and Social Thought in Victorian Scientific Naturalism,” *Journal of the History of Biology* (1989), John Harley Warner, “The Idea of Science in English Medicine: The ‘Decline of Science’ and the Rhetoric of Reform, 1815-45,” in *British Medicine in an Age of Reform* (1991), and Robert M. Veatch, *Disrupted Dialogue: Medical Ethics and the Collapse of Physician-Humanist Communication (1770-1980)* (2005).

C.9 THE BRITISH MEDICAL PROFESSION

The literature on the transformation of the British medical profession beyond science and medical practice is also an extensive one dating back to the 1970s. Issues related to professionalization and shifts in the medical profession’s organization and status were one of the early stands of this scholarship. For the leading surveys of the transformation of the medical profession, see M. Jeanne Peterson, *The Medical Profession in Mid-Victorian London* (1978), and Ivan Waddington, *The Medical Profession in the Industrial Revolution* (1984). For the rise of general practitioners, and their role in the profession’s transformation, see Irvine Loudon, *Medical Care and the General Practitioner, 1750-1850* (1986), and Anne Digby, *The Evolution of British General Practice 1850-1948* (1999). For the most recent analysis discussing the development of the profession in relation to the medical market, see Anne Digby, *Making a Medical Living: Doctors and Patients in the English Market for Medicine, 1720-1911* (1994, repr., 2002).

For the role of the medicine’s expanding public influence in professional development, see Ruth Richardson, *Death, Dissection and the Destitute*, 2nd Ed. (1987), Roy Porter, *Health for Sale: Quackery in England, 1660-1850* (1989), and Elizabeth Fee and Dorothy Porter, “Public Health, Preventive Medicine, and Professionalization: England and America in the Nineteenth Century,” in *Medicine in Society: Historical Essays* (1992).

One related theme to professionalization, which has developed a distinct literature, is medical politics and reform. For a collection fitting medicine’s development into the political reformist dynamics within the profession and British society, see Roger French and Andrew Wear, eds., *British Medicine in an Age of Reform* (1991). For more on medicine and doctors during the reformist era, see Irvine Loudon, “Medical Practitioners 1750-1850 and the Period of Medical Reform in Britain,” in *Medicine in Society: Historical Essays* (1992), and Stephen Jacyna, *Philosophic Whigs: Medicine, Science and Citizenship in Edinburgh, 1789-1848* (1994). For a selection on the medical reform movement, see Jean Loudon and Irvine Loudon, “Medicine, Politics and the Medical Periodical 1800-50,” in *Medical Journals and Medical Knowledge: Historical Essays* (1992), Irvine Loudon, “Medical Education and Medical Reform,” in *The History of Medical Education in Britain* (1995), Ian A. Burney, “Medicine in the Age of Reform,” in *Rethinking the Age of Reform: Britain 1780-1850* (2003), and M.J.D. Roberts, “The Politics of Professionalization: MPs, Medical Men, and the 1858 Medical Act,” *Medical History* (2009).

The development of the hospital system in the nineteenth century has been a theme linked to its medical professional implications, as well as its societal ones. Many hospitals were founded around a charitable mission as poverty became an increasingly visible social issue. For a selection of works on the themes of hospitals, charity, and poverty, see Geoffrey Rivett, *The Development of the London Hospital System, 1823-1982* (1986), Ruth Richardson, *Death, Dissection and the Destitute*, 2nd ed. (2000), and Keir Waddington, *Charity and the London Hospitals, 1850-1898* (2000).

The transformation of medical education in the nineteenth century, and its professional, practical and scientific ramifications, has received significant attention beyond the themes described above. For overviews of British medical education, see Charles Newman, *The Evolution of Medical Education in The Nineteenth Century* (1957), Frederick Noël Lawrence Poynter, ed., *The Evolution of Medical Education in Britain* (1966), and Thomas Neville Bonner, *Becoming a Physician: Medical Education in Britain, France, Germany, and the United States, 1750-1945* (2000). For a cross-section of focused works, see P.M. Mazumdar, "Anatomical Physiology and the Reform of Medical Education: London, 1825-1835," *Bulletin of the History of Medicine* (1983), Mark Weatherall, *Gentlemen, Scientists, and Doctors: Medicine at Cambridge, 1800-1940* (2000), Susan C. Lawrence, *Charitable Knowledge: Hospital Pupils and Practitioners in Eighteenth-Century London* (1996), Keir Waddington, *Medical Education at St. Bartholomew's Hospital, 1123-1995* (2003), and Fiona Hutton, *The Study of Anatomy in Britain, 1700–1900* (2015).

The changes occurring in Scottish medicine in relation to professionalization and education have developed into a distinct sub-literature of special interest to this dissertation. For general themes in Scottish medicine, see Derek A. Dow, ed., *The Influence of Scottish Medicine: An Historical Assessment of Its International Impact* (1988), Helen M. Dingwall, *A History of Scottish Medicine: Themes and Influences* (2003), and Jacqueline Jenkinson, *Scottish Medical Societies, 1731-1939: Their History and Records* (1993). For the dynamic period during the Scottish Enlightenment, see Charles W.J. Withers and Paul Wood, eds., *Science and Medicine in the Scottish Enlightenment* (2002), Guenter B. Risse, ed., *New Medical Challenges During the Scottish Enlightenment* (2005), and Johanna Geyer-Kordesch, "Comparative Difficulties: Scottish Medical Education in the European Context (c. 1690-1830)," in *The History of Medical Education in Britain* (1995).

The rise of Scottish medicine in the eighteenth century and into the nineteenth century was centered on Edinburgh. For the medical profession and university and extra-mural education in Edinburgh, see Anand C. Chitnis, "Medical Education in Edinburgh, 1790-1826, and Some Victorian Social Consequences," *Medical History* (1973), R.D. Lobban, *Edinburgh and the Medical Revolution* (1980), Guenter B. Risse, *Hospital Life in Enlightenment Scotland: Care and Teaching at the Royal Infirmary of Edinburgh* (1986), Lisa M. Rosner, *Medical Education in the Age of Improvement: Edinburgh Students and Apprentices 1760-1826* (1991), Stephen Jacyna, *Philosophic Whigs: Medicine, Science and Citizenship in Edinburgh, 1789-1848* (1994), and Tara Womersley and Dorothy H. Crawford, *From Bodysnatchers to Lifesavers: Three Centuries of Medicine in Edinburgh* (2010).

For more on the University of Edinburgh's rise in the eighteenth century, and its transition in the nineteenth century, see Christopher Lawrence, "The Edinburgh Medical School and the End of the 'Old Thing' 1790-1830," in Vol. 7 of *History of Universities* (1988), C. Lawrence, "Alexander Monro Primus and the Edinburgh Manner of Anatomy," *Bulletin of the*

History of Medicine (1988), Stephen Jacyna, “Theory of Medicine, Science of Life: The Place of Physiology Teaching in the Edinburgh Medical Curriculum, 1790-1870,” in *The History of Medical Education in Britain* (1995), Matthew H. Kaufman, *Medical Teaching in Edinburgh During the 18th and 19th Centuries* (2003), and Matthew H. Kaufman, *The Regius Chair of Military Surgery in the University of Edinburgh, 1806-55* (2003).

For an overview of similar transformations occurring in other Scottish medical schools, see Derek Dow and Michael Moss, “The Medical Curriculum at Glasgow in the Early Nineteenth Century,” in Vol. 7 of *History of Universities* (1988), and Carolyn Pennington, *The Modernisation of Medical Teaching at Aberdeen in the Nineteenth Century* (1994).

C.10 BRITAIN IN THE WORLD

The historiography on British imperialism and more recently Britain in the world has had a rich and long history in its own right. The selection presented here is by necessity partial and tailored to the particular themes that intersect with this dissertation. For a selection of pertinent overviews, see C.A. Bayly, *Imperial Meridian: The British Empire and the World, 1780-1830* (1989), P.J. Cain and A.G. Hopkins, *British Imperialism: 1688-2000*, 2nd Ed. (1993), Ronald Hyam, *Britain’s Imperial Century, 1815-1914: A Study of Empire and Expansion*, 3rd Ed. (2002), and C.A. Bayly, *The Birth of the Modern World, 1780-1914* (2003).

The rise of informal imperialism grounded in liberalism, free trade, gentlemanly capitalism, and antislavery has been an influential narrative in this literature. For some of the works bringing together informal imperialism, free trade, and gentlemanly capitalism, see Martin Lynn, “Consul and Kings: British Policy, “the Man on the Spot’, and the Seizure of Lagos, 1851,” *The Journal of Imperial and Commonwealth History* (1982), Martin Lynn, “The ‘Imperialism of Free Trade’ and the Case of West Africa, c. 1830-c. 1870,” *The Journal of Imperial and Commonwealth History* (1986), and Raymond E. Dumett, *Gentlemanly Capitalism and British Imperialism: The New Debate on Empire* (1999). For liberalism and antislavery along with these themes, see Anthony J. Barker, *Slavery and Anti-Slavery in Mauritius, 1810-33: The Conflict Between Economic Expansion and Humanitarian Reform Under British Rule* (1996), Mark C. Hunter, “The Hero Packs a Punch: Sir Charles Hotham, Liberalism and West Africa, 1846–1850,” *The Mariner’s Mirror* (2006), and Bronwen Everill, *Abolition and Empire in Sierra Leone and Liberia* (2012).

The role of commercial development in nineteenth-century British imperialism has also been a theme for more focused analysis for decades. This has been particularly the case for the analysis of the palm oil trade and economic transformation of West Africa in the nineteenth century. For the studies describing the broad economic and political implications, see Kenneth Onwuka Dike, *Trade and Politics in the Niger Delta, 1830-1885; an Introduction to the Economic and Political History of Nigeria* (1956), and G.I. Jones, *The Trading States of the Oil Rivers: A Study of Political Development in Eastern Nigeria* (1963). For the theme of commerce and civilization, see Andrew Porter, “‘Commerce and Christianity’: The Rise and Fall of a Nineteenth-Century Missionary Slogan,” *The Historical Journal* (1985).

For the palm oil trade and its ramifications, see Robin Law, ed., *From Slave Trade to "Legitimate" Commerce: The Commercial Transition in Nineteenth-Century West Africa* (1995), Martin Lynn, *Commerce and Economic Change in West Africa: The Palm Oil Trade in the Nineteenth Century* (1997), and Silke Strickrodt, *Afro-European Trade in the Atlantic World: The Western Slave Coast, c.1550-c. 1885* (2015). For specific considerations of the palm oil trade, see Martin Lynn, "Change and Continuity in the British Palm Oil Trade with West Africa, 1830-55," *The Journal of African History* (1981), Martin Lynn, "From Sail to Steam: The Impact of the Steamship Services on the British Palm Oil Trade with West Africa, 1850-1890," *The Journal of African History* (1989), and Paul E. Lovejoy and David Richardson, "From Slaves to Palm Oil: Afro-European Commercial Relations in the Bight of Biafra, 1741-1841," in *Maritime Empires: British Imperial Maritime Trade in the Nineteenth Century* (2004).

The role of continued antislavery campaigns in the nineteenth century and their connections to British global and imperial policy has been a subject of long-term focus, and has received renewed attention in increasing years. For some of the broader considerations, see Anthony J. Barker, *Slavery and Anti-Slavery in Mauritius, 1810-33: The Conflict Between Economic Expansion and Humanitarian Reform Under British Rule* (1996), Seymour Drescher, *The Mighty Experiment: Free Labor Versus Slavery in British Emancipation* (2002), Richard Huzzey, *Freedom Burning: Anti-Slavery and Empire in Victorian Britain* (2012), and Bronwen Everill, *Abolition and Empire in Sierra Leone and Liberia* (2012).

The campaign to suppress the slave trade, the Royal Navy's West African Squadron, and the associated diplomatic campaign have been the subjects of an older and continuing historiography. For the West African Squadron, see Christopher Lloyd, *The Navy and the Slave Trade: The Suppression of the African Slave Trade in the Nineteenth Century* (1949, repr., 1968), Siân Rees, *Sweet Water and Bitter: The Ships That Stopped the Slave Trade* (2011), and Mary Wills, "The Royal Navy and the Suppression of the Atlantic Slave Trade c. 1807-1867: Anti-Slavery, Empire and Identity" (PhD Diss., 2012). For the 1841 Niger Expedition, see Howard Temperley, *White Dreams, Black Africa: The Antislavery Expedition to the River Niger 1841-1842* (1991).

For broader considerations of British policy, see David Eltis, *Economic Growth and the Ending of the Transatlantic Slave Trade* (1987), and Keith Hamilton and Patrick Salmon, eds., *Slavery, Diplomacy and Empire: Britain and the Suppression of the Slave Trade, 1807-1975* (2009). For British policy in Africa, see J. Gallagher, "Fowell Buxton and the New African Policy, 1838–1842," *Cambridge Historical Journal* (1950), Martin Lynn, "Britain's West African Policy and the Island of Fernando Po, 1821–43," *The Journal of Imperial and Commonwealth History* (1990), I.K. Sundiata, *From Slaving to Neoslavery: The Bight of Biafra and Fernando Po in the Era of Abolition, 1827-1930* (1996), and Kristin Mann, *Slavery and the Birth of an African City: Lagos, 1760-1900* (2007).

British exploration in the nineteenth-century, particularly in Africa, has been the subject of another extensive literature connected to British imperial history. It is of secondary interest in this dissertation, as much of the exploration did not involve the Navy. For the most recent work on this subject, see Dane Kennedy, *The Last Blank Spaces* (2013), Heather J. Hoag, *Developing the Rivers of East and West Africa: An Environmental History* (2013), and David Lambert, *Mastering the Niger: James MacQueen's African Geography and the Struggle over Atlantic Slavery* (2013).

The history of British seapower and naval supremacy in the nineteenth century has been largely separated from British imperial history. Nonetheless, the Royal Navy and its control of the seas underpinned British global and imperial policy and activity. For the main works on this theme, see C.J. Bartlett, *Great Britain and Sea Power, 1815-1853* (1963), Bernard Semmel, *Liberalism and Naval Strategy: Ideology, Interest, and Sea Power During the Pax Britannica* (1986), Peter Padfield, *Maritime Power and the Struggle for Freedom: Naval Campaigns That Shaped the Modern World, 1788-1851* (2003), Paul M. Kennedy, *The Rise and Fall of British Naval Mastery*, 2nd Ed. (2006), and Barry Gough, *Pax Britannica: Ruling the Waves and Keeping the Peace Before Armageddon* (2014).

C.11 SCOTTISH ACTORS IN BRITAIN, THE EMPIRE, AND THE WORLD

There have been a variety of different geographic and thematic focuses of literature discussing the historical influence of Scots. For the broadest literature on Scots' achievements, see Duncan A. Bruce, *The Mark of the Scots: Their Astonishing Contributions to History, Science, Democracy, Literature, and the Arts* (1996), and Arthur Herman, *How the Scots Invented the Modern World: The True Story of How Western Europe's Poorest Nation Created Our World and Everything in It* (2001). For narratives emphasizing Scots as inventors, see Bill Fletcher, *Great Scottish Discoveries and Inventions* (1985), Alistair Fyfe, *Scottish Inventors* (1999), and Gary Smailes, *Scottish Inventors* (2011). For narratives of particular developments in the nineteenth century, see Robert D. Anderson, *Education and Opportunity in Victorian Scotland: Schools & Universities* (1983), and Graeme Morton, *Unionist Nationalism: Governing Urban Scotland, 1830-60* (1999).

From the 1970s onward, the role of Scots in the Atlantic during the early modern period has received significant attention. The eighteenth century has been the subject of the overwhelming majority of this literature. For overviews of the Scottish role in the formation of the Atlantic world and British Empire in the Atlantic, see Eric Richards, "Scotland and the Uses of the Atlantic Empire," in *Strangers Within the Realm: Cultural Margins of the First British Empire* (1991), Ned C. Landsman, ed., *Nation and Province in the First British Empire: Scotland and the Americas, 1600-1800* (2001), Douglas Hamilton, *Scotland, The Caribbean and the Atlantic World, 1750-1820* (2005), James Livesey, *Civil Society and Empire: Ireland and Scotland in the Eighteenth-Century Atlantic World* (2009), and Michael Morris, *Scotland and the Caribbean, c. 1740-1833: Atlantic Archipelagos* (2015).

For the theme of Scots' importance to the economic development of the Atlantic, see T.M. Devine, *The Tobacco Lords: A Study of the Tobacco Merchants of Glasgow and Their Trading Activities, c. 1740-90* (1975), and David Hancock, *Citizens of the World: London Merchants and the Integration of the British Atlantic Community, 1735-1785* (1995). For Scot's ties to slavery and antislavery also see, Charles Duncan Rice, *The Scots Abolitionists, 1833-1861* (1981), and Iain Whyte, *Scotland and the Abolition of Black Slavery, 1756-1838* (2006). For Scots and migration in the Atlantic, see Alan L. Karras, *Sojourners in the Sun: Scottish Migrants in Jamaica and the Chesapeake, 1740-1800* (1992), and Douglas Hamilton, "Transatlantic Ties:

Scottish Migration Networks in the Caribbean, 1750–1800," in *A Global Clan: Scottish Migrant Networks and Identity Since the Eighteenth Century* (2006).

A broader theme of Scottish migration throughout the world, but particularly in the Atlantic and to British settler colonies, has emerged since the 1980s. This literature has expanded the temporal focus from the eighteenth century forward to the late-twentieth century. For overviews on the subject, see T.M. Devine, ed., *Scottish Emigration and Scottish Society: Proceedings of the Scottish Historical Studies Seminar, University of Strathclyde 1990-1991* (1992), T.C. Smout, N.C. Landsman, and T.M. Devine, "Scottish Emigration in the Seventeenth and Eighteenth Centuries," in *Europeans on the Move: Studies on European Migration, 1500-1800* (1994), Marjory Harper, *Adventurers And Exiles: The Great Scottish Exodus* (2003), T.M. Devine, *To the Ends of the Earth: Scotland's Diaspora, 1750-2010* (2011), and Tanja Bueltmann, Andrew Hinson, and Graeme Morton, *The Scottish Diaspora* (2013).

For Scots in the global economy, see R.A. Cage, *The Scots Abroad: Labour, Capital, Enterprise, 1750-1914* (1985). For networks and identity, see Angela McCarthy, ed., *A Global Clan: Scottish Migrant Networks and Identity Since the Eighteenth Century* (2006). For intellectual migration, see Cairns Craig, "Empire of Intellect: The Scottish Enlightenment and Scotland's Intellectual Migration," in *Scotland and the British Empire* (2011). For return migration, see Marjory Harper, *Emigrant Homecomings: The Return Movements of Emigrants, 1600-2000* (2005).

The newest theme related to Scots in the British Empire and the world has focused on the subject of Scots as imperial actors. While this had been a part of the literature on Scots in the Atlantic, it has become a research focus in its own right. For Scotland and its importance to the British Empire, see T.M. Devine, *Scotland's Empire, 1600-1815* (2003), Michael Fry, *The Scottish Empire* (2002), John M. MacKenzie and T.M. Devine, eds., *Scotland and the British Empire* (2011), and Douglas Hamilton, "Scotland and the Eighteenth-Century Empire," in *The Oxford Handbook of Modern Scottish History* (2012).

For Scots as soldiers and sailors, see Andrew Mackillop, *More Fruitful Than the Soil: Army, Empire and the Scottish Highlands, 1715-1815* (2000), Edward M. Spiers, *The Scottish Soldier and Empire, 1854-1902* (2006), T.M. Devine, "Soldiers of Empire, 1750–1914," in *Scotland and the British Empire* (2011), and Brian Lavery, *Shield of Empire: The Royal Navy and Scotland* (2007).

For Scots' role in empire-building and its impact on Scotland, see Martha McLaren, *British India & British Scotland, 1780-1830: Career Building, Empire Building, and a Scottish School of Thought on Indian Governance* (2001), Esther Breitenbach, *Empire and Scottish Society: The Impact of Foreign Missions at Home, c. 1790 to c. 1914* (2009), and Tanja Bueltmann, *Scottish Ethnicity and the Making of New Zealand Society, 1850-1930* (2011).

C.12 THE AGE OF REFORM

The Age of Reform has been conceptualized as the period of political, economic and social transformation of British society from 1783 through 1870. A number of scholars over the course of the twentieth century and more recently have conceived of the Age of Reform broadly. They have argued that political, economic, social and cultural changes occurred within this turbulent but coherent period of British history. For the classical works on the subject, see Llewellyn Woodward, *The Age of Reform, 1815-1870*, 2nd Ed. (1962), and Asa Briggs, *The Age of Improvement, 1783-1867*, 2nd Ed. (2000). For a more recent volume stretching the boundaries of the Age of Reform as a concept, see Arthur Burns and Joanna Innes, eds., *Rethinking the Age of Reform: Britain 1780-1850* (2003).

A number of surveys of nineteenth-century British history have incorporated this narrative of fundamental change throughout British society. For a general selection, see Chris Williams, *A Companion to 19th-Century Britain* (2004), and Norman McCord and Bill Purdue, *British History 1815-1914*, 2nd Ed. (2007). For those focused on the economic and social history of the period, see Eric J. Evans, *The Forging of the Modern State: Early Industrial Britain, 1783-1870*, 3rd Ed. (2001), and Boyd Hilton, *A Mad, Bad, and Dangerous People?: England, 1783-1846* (2006). For considerations of the relative continuity and uncertainty of the period, see David Eastwood, "The Age of Uncertainty: Britain in the Early-Nineteenth Century," *Transactions of the Royal Historical Society* (1998), David Feldman and Jon Lawrence, eds., *Structures and Transformations in Modern British History* (2011), and P.J. Shinner, "Continuity in the Age of Reform: Freemen and the Persistence of the Old Order in Nineteenth-Century Grimsby," *Midland History* (2012).

Political reform has dominated the historiography on the Age of Reform. Parliamentary and electoral reform culminating in the 1832 Reform Act has long been a focus of analysis. For works that portray 1832 as a turning point for British political history, see John Cannon, *Parliamentary Reform 1640-1832* (1973), Michael J. Turner, *British Politics in An Age of Reform* (1999), Eric J. Evans, *Parliamentary Reform in Britain, c. 1770-1918* (2000), and Herbert Schlossberg, *The Silent Revolution and the Making of Victorian England* (2000). For the period leading up to the Reform Act, see Jennifer Mori, *Britain in the Age of the French Revolution, 1785-1820* (2000), Michael J. Turner, *The Age of Unease: Government and Reform in Britain, 1782-1832* (2000), and Eric J. Evans, *Britain Before the Reform Act: Politics and Society 1815-1832*, 2nd Ed. (New York: Pearson Longman, 2008). For the Reform Act itself and its direct effects, see John A. Phillips, *The Great Reform Bill in the Boroughs: English Electoral Behaviour, 1818-1841* (1992), and Robert Saunders, "The Rise of Democratic Discourse in the Reform Era: Britain in the 1830s and 1840s," in *Re-Imagining Democracy in the Age of Revolutions: America, France, Britain, Ireland, 1750-1850* (2013).

The development of the early British political party system, with the Whigs and Tories opposing each other, has also been the subject of extended analysis. For political organization and parties, see D.A. Hamer, *The Politics of Electoral Pressure: A Study in the History of Victorian Reform Agitations* (1977), Eric J. Evans, *Political Parties in Britain, 1783-1867* (1985), Peter Mandler, *Aristocratic Government in the Age of Reform: Whigs and Liberals, 1830-1852* (1990), Jonathan Parry, *The Rise and Fall of Liberal Government in Victorian Britain* (1993), James Vernon, *Politics and the People: A Study in English Political Culture, 1815-1867*

(1993), T.A. Jenkins, *Parliament, Party, and Politics in Victorian Britain* (1996), and Philip Salmon, *Electoral Reform at Work: Local Politics and National Parties, 1832-1841* (2002).

For Whigs and their role in political reform, see Richard Brent, *Liberal Anglican Politics: Whiggery, Religion, and Reform, 1830-1841* (1987), Ian Newbould, *Whiggery and Reform, 1830-41: The Politics of Government* (1990), and William Anthony Hay, *The Whig Revival, 1808-1830* (2004). For radicalism and reform, see J.R. Dinwiddy, *Radicalism and Reform in Britain, 1780-1850* (1992), and Edward Royle, *Revolutionary Britannia?: Reflections on the Threat of Revolution in Britain, 1789-1848* (2000).

Separate bodies of work have also noted the growth of the British government and the state apparatus, and the role of Parliament in this new system. For a selection, see Daniel Norman Chester, *The English Administrative System, 1780-1870* (1981), Anthony Brundage, *England's "Prussian Minister": Edwin Chadwick and the Politics of Government Growth, 1832-1854* (1988), and Peter Jupp, *The Governing of Britain, 1688–1848: The Executive, Parliament and the People* (2006).

The literature on the economic transformation of British society has been the subject of its own historiography dominated by industrialization. While this conversation has remained somewhat separated from the Age of Reform, these economic developments and their social ramifications drove the political agitation and reform traditionally associated with the Age of Reform. For economic historical surveys of the early nineteenth century, see Norman Gash, *Aristocracy and People: Britain, 1815-1865* (1979), Michael Sanderson, *Education, Economic Change and Society in England, 1780-1870*, 2nd Ed. (1991), and Martin J. Daunton, *Progress and Poverty: An Economic and Social History of Britain, 1700-1850* (1995).

For a selection on population and the debate over the standard of living during the era of the Industrial Revolution, see E.A. Wrigley and R.S. Schofield, *The Population History of England 1541-1871* (1981), Colin Pooley and Jean Turnbull, *Migration And Mobility In Britain Since The Eighteenth Century* (1998), Arthur J. Taylor, *The Standard of Living in Britain in the Industrial Revolution* (1975), and Stanley L. Engerman, "Reflections on 'The Standard of Living Debate': New Arguments and New Evidence," in *Capitalism in Context: Essays on Economic Development and Cultural Change in Honor of R.M. Hartwell* (1994).

For a selection on Industrialization, see Seymour A. Broadbridge, *Studies in Railway Expansion and the Capital Market in England, 1825-1873* (1970), Hugh Cunningham, *Leisure in the Industrial Revolution, c. 1780-c. 1880* (1980), E.A. Wrigley, *Continuity, Chance and Change: The Character of the Industrial Revolution in England* (1988), Pat Hudson, ed., *Regions and Industries: A Perspective on the Industrial Revolution in Britain* (1989), Donald Cardwell, *The Development of Science and Technology in Nineteenth-Century Britain: The Importance of Manchester*, ed. Richard L. Hills (2003), and Christine MacLeod, *Heroes of Invention: Technology, Liberalism and British Identity, 1750-1914* (2007).

The social and cultural transformation of British society during the early nineteenth century has been the subject of extensive scholarship discussing a variety of themes. It has often been considered as separate from the Age of Reform. Nonetheless, the social upheaval and change occurring in British society underpinned political, economic and social reform. The social transformation also reflected the intended and unintended effects of political and economic policies and reforms. For a selection of broader surveys that demonstrate the diversity of the social changes occurring during this period, see John Roach, *Social Reform in England, 1780-*

1880 (1978), John Belchem, *Industrialization and the Working Class: The English Experience, 1750-1900* (1990), Harold Perkin, *The Origins of Modern English Society*, 2nd Ed. (2002), and Edward Royle, *Modern Britain: A Social History, 1750-2011*, 3rd Ed. (2012).

Class formation has been one of the long-term themes of study in British social history. During this period, the working, professional and middle classes emerged as distinct and coherent societal forces with their own identities, agency, and agendas. For general narratives of class formation and relations in this period, see Patricia Hollis, *Class and Conflict in Nineteenth-Century England, 1815-1850* (1973), R.J. Morris, *Class and Class Consciousness in the Industrial Revolution, 1780-1850* (1979), Alastair J. Reid, *Social Classes and Social Relations in Britain 1850-1914* (1995), and David Cannadine, *The Rise and Fall of Class in Britain* (1999).

For the working class, see E.P. Thompson, *The Making of the English Working Class* (1964), and John Rule, *The Labouring Classes in Early Industrial England, 1750-1850* (1986). For the professional class, see W.J. Reader, *Professional Men: The Rise of the Professional Classes in Nineteenth-Century England* (1966), and Penelope J. Corfield, *Power and the Professions in Britain, 1700-1850* (1995). For the middle class, see Leonore Davidoff and Catherine Hall, *Family Fortunes: Men and Women of the English Middle Class 1780–1850* (1987), and Dror Wahrman, *Imagining the Middle Class: The Political Representation of Class in Britain, c. 1780-1840* (1995). For the propertied class, see W.D. Rubinstein, *Men of Property: The Very Wealthy in Britain Since the Industrial Revolution*, 2nd Ed. (2006).

Urbanization, poverty, social conditions, and reform are themes connected to industrialization and class formation that have received significant attention in their own right. For urbanization, see James Walvin, *English Urban Life, 1776-1851* (1984), E.A. Wrigley, *People, Cities, and Wealth: The Transformation of Traditional Society* (1987), and Mark Girouard, *The English Town: A History of Urban Life* (1990). For poverty, see Gertrude Himmelfarb, *The Idea of Poverty: England in the Early Industrial Age* (1984), and Martin J. Daunton, *Progress and Poverty: An Economic and Social History of Britain, 1700-1850* (1995). For social reform, see Edward Royle and James Walvin, *English Radicals and Reformers, 1760-1848* (1982), and Lynn Hollen Lees, *The Solidarities of Strangers: The English Poor Laws and the People, 1700-1948* (1998).

Public health and medicine has been a theme connected to urbanization and poverty. For people's and working class health, see F.B. Smith, *The People's Health, 1830-1910* (1979), and James C. Reilly, *Sick, Not Dead: The Health of British Workingmen during the Mortality Decline* (1997). For medicine during the Industrial Revolution, see Ivan Waddington, *The Medical Profession in the Industrial Revolution* (1984), John V. Pickstone, *Medicine and Industrial Society: A History of Hospital Development in Manchester and Its Region, 1752-1946* (1985), Hilary Marland, *Medicine and Society in Wakefield and Huddersfield 1780-1870* (1987), and Rebecca Vickers, *Industrial Age Medicine* (2013).

Beyond these developments directly connected to economic and class development, there were also a variety of developments related to civil society and culture. These contributed to the political and social reform occurring in British society, and the expansion of governmental reach. The theme of religion and morality has occupied significant historiographical attention. In particular, the rise of the evangelical and humanitarian movements has been seen as a formative development that had far-reaching consequences for British society. For surveys of the impact of evangelicalism, see Boyd Hilton, *The Age of Atonement: The Influence of Evangelicalism on Social and Economic Thought, 1785-1865* (1986), John Wolffe, *The Protestant Crusade in Great*

Britain, 1829-1860 (1991), and Herbert Schlossberg, *The Silent Revolution and the Making of Victorian England* (2000). For the development of religion, morality and reform, see also K.D.M. Snell and Paul S. Ell, *Rival Jerusalems: The Geography of Victorian Religion* (2000), M.J.D. Roberts, *Making English Morals: Voluntary Association and Moral Reform in England, 1787–1886* (2004), and Felicity James and Ian Inkster, eds., *Religious Dissent and the Aikin-Barbauld Circle, 1740-1860* (2011).

One particular theme that was heavily influenced by religious and moral reforming impulses was education. While universal education did not emerge until the late nineteenth century, access to education, literacy, university education, and working-class education expanded throughout the century. For surveys of education, see Brian Simon, *The Two Nations and the Educational Structure, 1780-1870* (1960), John Hurt, *Education in Evolution: Church, State, Society and Popular Education, 1800-1870* (1971), Michael Sanderson, *Education, Economic Change and Society in England, 1780-1870*, 2nd Ed. (1991), Joseph Ben-David, *Centers of Learning: Britain, France, Germany, United States*, New Ed. (1992), and W.B. Stephens, *Education in Britain, 1750-1914* (1998).

For universities and intellectuals, see Robert D. Anderson, *Universities and Elites in Britain Since 1800* (1992), and William C. Lubenow, *Liberal Intellectuals and Public Culture in Modern Britain, 1815-1914: Making Words Flesh* (2010). For Scottish education especially, see Robert D Anderson, *Education and Opportunity in Victorian Scotland: Schools & Universities* (1983), and Robert D. Anderson, *Education and the Scottish People, 1750-1918* (1995). For literacy, see W.B. Stephens, *Education, Literacy and Society, 1830-70: The Geography of Diversity in Provincial England* (1987). For working-class education, see D.G. Paz, *The Politics of Working-Class Education in Britain, 1830-50* (1980), and Neil J. Smelser, *Social Paralysis and Social Change: British Working-Class Education in the Nineteenth Century* (1991).

On the other hand, the supposed problem of crime, and organized policing also emerged in this period. Debates over these issues were heavily colored by religious, moral, and social sentiments. For a selection on this theme, see David Taylor, *The New Police in Nineteenth-Century England: Crime, Conflict and Control* (1997), Elaine A. Reynolds, *Before the Bobbies: The Night Watch and Police Reform in Metropolitan London, 1720-1830* (1998), David Philips and Robert D. Storch, *Policing Provincial England, 1829-1856: The Politics of Reform* (1999), and Clive Emsley, *Crime and Society in England: 1750-1900*, 4th Ed. (2010).

These political, economic, social and cultural changes contributed to a broader redefinition of Britons' identities during the Age of Reform. While class formation and consciousness is one example, national and gender identities also underwent significant change during this period. For the redefinition of British national identity and the place of Scotland and the four nations, see Anand C. Chitnis, *The Scottish Enlightenment & Early Victorian English Society* (1986), Lawrence Brockliss and David Eastwood, eds., *A Union of Multiple Identities: The British Isles, c. 1750-c. 1850* (1997), John F. McCaffrey, *Scotland in the Nineteenth Century* (1998), Linda Colley, *Britons: Forging the Nation, 1707-1837*, 2nd Ed. (2005), and Gordon Pentland, *Radicalism, Reform and National Identity in Scotland, 1820-1833* (2008).

For changing gender roles in the family, workplace and society, see Leonore Davidoff and Catherine Hall, *Family Fortunes: Men and Women of the English Middle Class 1780–1850* (1987), Anna Clark, *The Struggle for the Breeches: Gender and the Making of the British Working Class* (1995), and John Tosh, *A Man's Place: Masculinity and the Middle-Class Home in Victorian England* (1999). For shifts in attitudes toward sexuality, see Michael Mason, *The*

Making of Victorian Sexual Attitudes (1994), and Michael Mason, *The Making of Victorian Sexuality* (1994).

C.13 COLLECTIVE BIOGRAPHY AND PROSOPOGRAPHY

Collective biography and prosopography have been methodological and conceptual inspirations for this dissertation. British medical and imperial history have employed these methods, producing a number of examples and models. For collective biography, see M. Anne Crowther and Marguerite W. Dupree, *Medical Lives in the Age of Surgical Revolution* (2007), and David Lambert and Alan Lester, *Colonial Lives Across the British Empire: Imperial Careering in the Long Nineteenth Century* (2006). For a rich example of prosopography, see Christine MacLeod and Alessandro Nuvolari, "'The Ingenious Crowd': A Critical Prosopography of British Inventors, 1650-1850," *Journal of Economic History* (2005).

Army surgeons have been the focus of several biographical and prosopographical studies. For the biographical example, see Lisa M. Rosner, *The Most Beautiful Man in Existence: The Scandalous Life of Alexander Lesassier* (1999). For the prosopographical ones, see N.D. Lankford, "The Victorian Medical Profession and Military Practice: Army Doctors and National Origins," *Bulletin of the History of Medicine* (1980), S.H. Brown, "British Army Surgeons Commissioned 1840-1909 with West Indian/West African Service: A Prosopographical Evaluation.," *Medical History* (1993), and Marcus Ackroyd, *et al*., *Advancing with the Army: Medicine, the Professions and Social Mobility in the British Isles 1790-1850* (2006).

For the two examples on naval surgeons, see Lawrence Brockliss, John Cardwell, and Michael Moss, *Nelson's Surgeon: William Beatty, Naval Medicine, and the Battle of Trafalgar* (2005), and John Cardwell, "Royal Navy Surgeons, 1793-1815: A Collective Biography," in *Health and Medicine at Sea, 1700-1900* (2009).

For methodological guides, see K.S.B. Keats-Rohan, ed., *Prosopography Approaches and Applications: A Handbook* (2007), Gideon Cohen, Andrew Flinn, and Kevin Morgan, "Towards a Mixed Method Social History: Combining Quantitative and Qualitative Methods in the Study of Collective Biography," in *Prosopography Approaches and Applications: A Handbook* (2007), and Daniel I. Greenstein, "Multi-Sourced and Integrated Databases for the Prosopographer," in *History and Computing*, vol. 3 (1990).

C.14 PROFESSIONALIZATION

The historical and sociological understanding of professions has been an extensive subject for research for decades. While it has given scholars a general narrative for professional development, the theory remains difficult to apply to focused historical studies. Historical research on the development of professions has proved more helpful as a general model.

For the studies most helpful to this project, see Penelope J. Corfield, *Power and the Professions in Britain, 1700-1850* (1995), and Lawrence Brockliss, “The Professions and National Identity,” in *A Union of Multiple Identities: The British Isles, c. 1750-c. 1850* (1997). For additional case studies, see Noel Parry and José Parry, *The Rise of the Medical Profession: A Study of Collective Social Mobility* (1976), and Gerald L. Geison, *Professions and the French State, 1700-1900* (1984).

For more general and classical historical studies of professions, see W.J. Reader, *Professional Men: The Rise of the Professional Classes in Nineteenth-Century England* (1966), Harold Perkin, *The Rise of Professional Society: England Since 1880*, New Ed. (2002), and Michael Burrage and Rolf Torstendahl, *Professions in Theory and History: Rethinking the Study of the Professions* (1990).

For a selection of works on the sociological theory of professions and the issues involved, see Wilbert E. Moore, *The Professions: Roles and Rules: Roles and Rules* (1970), Robert Dingwall and Philip Lewis, *The Sociology of the Professions: Lawyers, Doctors, and Others* (1983), Michael Burrage and Rolf Torstendahl, *The Formation of Professions: Knowledge, State and Strategy* (1990), and Keith M. Macdonald, *The Sociology of the Professions* (1995). For a more Marxist analysis, see Magali Sarfatti Larson, *The Rise of Professionalism: A Sociological Analysis* (1977), and Magali Sarfatti Larson, *The Rise of Professionalism: Monopolies of Competence and Sheltered Markets*, New Ed. (2013).

C.15 CONCEPTUAL APPROACHES TO THE RISE OF SCIENCE

Historians and historians of science and medicine have employed numerous theoretical conceptions of the development of science, particularly in relation the emergence of “modern” science in the nineteenth century. The social constructionist view of science that emerged from the 1970s onward remains influential in current historiography. For examples related to the history of science, Bruno Latour and Steve Woolgar, *Laboratory Life: The Construction of Scientific Facts* (1979, repr., 1986), and Bruno Latour, *Science in Action: How to Follow Scientists and Engineers Through Society* (1987). For the history of medicine, see Peter Wright and Andrew Treacher, *The Problem of Medical Knowledge: Examining the Social Construction of Medicine* (1982), and Frank Huisman and John Harley Warner, eds. *Locating Medical History: The Stories and Their Meanings* (2006), part III.

Recent work has attempted to expand the scope of conceptions of science to match the explanatory breadth and power of Thomas Kuhn’s theory of paradigm shifts and scientific change. See Thomas S. Kuhn, *The Structure of Scientific Revolutions*, 4th Ed. (2012), Thomas S. Kuhn, *The Essential Tension: Selected Studies in Scientific Tradition and Change* (1977), Erich Von Dietze, *Paradigms Explained: Rethinking Thomas Kuhn’s Philosophy of Science* (2001), and Edwin H.-C. Hung, *Beyond Kuhn: Scientific Explanation, Theory Structure, Incommensurability, and Physical Necessity* (2006).

The work attempting to apply the conception of Humboldtian Science has represented part of this effort. Humboldtian Science’s emphasis on field research and the natural world has allowed historians to ground the changes occurring in the nineteenth century in both conception and practice. This theory has emphasized the importance of colonial and natural historical science. See Susan Faye Cannon, *Science in Culture: The Early Victorian Period* (1978), Malcolm Nicolson, "Alexander von Humboldt, Humboldtian Science and the Origins of the Study of Vegetation," *History of Science* (1987), W.H. Brock, "Humboldt and the British: A Note on the Character of British Science," *Annals of Science* (1993), Michael Dettelbach, "Humboldtian Science," in *Cultures of Natural History* (1996), Nicholaas A. Rupke, "Humboldtian Medicine," *Medical History* (July 1996), and Andreas W. Daum, "Science, Politics, and Religion: Humboldtian Thinking and the Transformations of Civil Society in Germany, 1830-1870," *Osiris* (2002). For another view of the importance of nature to science's conception and approaches, see Goethian Science. For examples, see Henri Bortoft, *The Wholeness of Nature: Goethe's Way Toward a Science of Conscious Participation in Nature* (1996), and David Seamon and Arthur Zajonc, *Goethe's Way of Science: A Phenomenology of Nature* (1998).

Another strand of historiography has considered the conceptual and methodological scope of nineteenth-century science. For one influential view, see the narrative of analytical science described in John V. Pickstone, "Museological Science? The Place of the Analytical/ Comparative in Nineteenth-Century Science, Technology and Medicine," *History of Science* (1994), and John V. Pickstone, *Ways of Knowing: A New History of Science, Technology and Medicine* (2000). For examples of work debating the boundaries of scientific fields and practices, and the extent of universality, see John Harley Warner, "The History of Science and the Sciences of Medicine," *Osiris* (1995), David Clifford et al., eds., *Repositioning Victorian Sciences: Shifting Centres in Nineteenth-Century Scientific Thinking* (2006), and Simon Schaffer, "Indiscipline and Interdisciplines: Some Exotic Genealogies of Modern Knowledge," 2010, http://www.hse.ru/data/2011/11/13/1272007743/Schaffer.2010.Indiscipline_and_interdisciplines.pdf.

The most influential conception of science for this dissertation has been empirical and observation science. This has been grounded in considerations of how scientists operationalized and applied the increasingly sophisticated philosophy of empirical approaches in practice. For one direct consideration in medicine, see Mark W. Weatherall, "Making Medicine Scientific: Empiricism, Rationality, and Quackery in Mid-Victorian Britain," *Social History of Medicine* (1996). For a selection on the broader subject of British empiricism in the eighteenth and nineteenth centuries, see Stephen Priest, *The British Empiricists: Hobbes to Ayer* (1990), Miriam Solomon, *Social Empiricism* (2001), and Peter Garratt, *Victorian Empiricism: Self, Knowledge, and Reality in Ruskin, Bain, Lewes, Spencer, and George Eliot* (2010).

Beyond Pickstone's conception of analysis and Cannon's theory of Humboldtian Science, there are a number of other models discussing empirical science. For the work devoted to these considerations, see Lorraine Daston and Elizabeth Lunbeck, eds., *Histories of Scientific Observation* (2011). For works with references that discuss the roles of empirical observation in scientific practice, see Richard Yeo, *Defining Science: William Whewell, Natural Knowledge and Public Debate in Early Victorian Britain* (1993), Thomas F. Gieryn, *Cultural Boundaries of Science: Credibility on the Line* (1999), Jim Endersby, *Imperial Nature: Joseph Hooker and the Practices of Victorian Science* (2008), Francisco J. Ayala, "Darwin and the Scientific Method," *Proceedings of the National Academy of Sciences* (2009), David Aubin, Charlotte Bigg, and H. Otto Sibum, eds., *The Heavens on Earth: Observatories and Astronomy in Nineteenth-Century Science and Culture* (2010), James Brooke-Smith, "'A Great Empire Falling to Pieces':

Coleridge, Herschel, and Whewell on the Poetics of Unitary Knowledge," *Configurations* (2012), and Mary Terrall, *Catching Nature in the Act: Réaumur and the Practice of Natural History in the Eighteenth Century* (2014).

Most directly relevant for this project, the history of medicine has long considered the relevance of empirical medicine as a conception. For works devoted to considerations of empirical medicine, see John Harley Warner, "Therapeutic Explanation and the Edinburgh Bloodletting Controversy: Two Perspectives on the Medical Meaning of Science in the Mid-Nineteenth Century," *Medical History* (1980), Ulrich Tröhler, "'To Improve the Evidence of Medicine': Arithmetic Observation in Clinical Medicine in the Eighteenth and Early Nineteenth Centuries," *History and Philosophy of the Life Sciences* (1988), John Harley Warner, *Against the Spirit of System: The French Impulse in Nineteenth-Century American Medicine*, Paperback Ed. (2003), Mark Harrison, *Medicine in an Age of Commerce and Empire* (2010), and José A. López Cerezo, "Dimensions of Clinical Observation in the Origins of Scientific Medicine," in *New Methodological Perspectives on Observation and Experimentation in Science* (2010).

For more works considering the role of empirical, observational practices in medicine, see Michel Foucault, *The Birth of the Clinic: An Archaeology of Medical Perception*, trans. A.M. Sheriden (1973), Jacalyn Duffin, *History of Medicine: A Scandalously Short Introduction* (1999), Andrew Cunningham and Perry Williams, eds., *The Laboratory Revolution in Medicine* (2002), George Weisz, "The Emergence of Medical Specialization in the Nineteenth Century," *Bulletin of the History of Medicine* (2003), Geoffrey L. Hudson, *British Military and Naval Medicine, 1600-1830* (2007), Daniel R. Headrick, *Power Over Peoples: Technology, Environments, and Western Imperialism, 1400 to the Present* (2010), and Erica Charters, *Disease, War, and the Imperial State: The Welfare of the British Armed Forces during the Seven Years' War* (2014).

APPENDIX D

INTER ALIA LISTS OF BRITISH MEDICAL JOURNAL ARTICLES

A sustained outpouring of articles discussing service conditions and dynamics within the naval medical service appeared in British medical journals and popular newspapers, and drove a reform movement among naval surgeons and within the medical profession. Under the direction of founding editor, Radical MP, and surgeon Thomas Wakley, *The Lancet* became the champion of naval medical officers' cause. Naval surgeons gained the forum and space to voice their concerns regarding their status, pay, treatment, and working conditions within the Navy, and produced a sustained critique of the Admiralty's resistance to instituting professional reforms. The case of naval Assistant Surgeons became the *cause célèbre*. Advocates of reform succeeded in drawing out connections between the particularly arduous conditions that naval Assistant Surgeons faced, and the medical service's morale, recruitment dynamics, and professional competence. This appendix focuses on themes related to the movement for naval medical reform that have received less consideration in previous works, which have emphasized the Assistant Surgeons' case and the general complaints of medical officers.[1]

[1] For the previous discussions, see McLean, Penn, "Burnett," and Harrison "Important Subject." Beyond *The Lancet*, articles also appeared in the *Association Medical Journal*, *British Medical Journal*, *London Journal of Medicine*, *London Medical Gazette*, *Provincial Medical and Surgical Journal*, and *The United Service Magazine*.

D.1 ARTICLES ON SIR WILLIAM BURNETT'S LEADERSHIP

A Subscriber, *The Lancet* 16, no. 417 (Aug. 27, 1831): 703.

James Scott, *The Lancet* 16, no. 418 (Sept. 3, 1831): 732–33.

Justus, *The Lancet* 16, no. 419 (Sept. 10, 1831): 759–62.

An Assistant, *The Lancet* 16, no. 420 (Sept. 17, 1831): 797–978.

A Subscriber, *The Lancet* 16, no. 420 (Sept. 17, 1831): 798.

James Scott, *The Lancet* 16, no. 421 (Sept. 24, 1831): 829–31.

Chiron, *The Lancet* 17, no. 423 (Oct. 8, 1831): 44–45.

One of the Taxed, *The Lancet* 17, no. 423 (Oct. 8, 1831): 43–44.

Courtney, *The Lancet* 17, no. 423 (Oct. 8, 1831): 45.

D.2 ARTICLES ON MANPOWER, RECRUITMENT AND QUALIFICATIONS

An Old Naval Surgeon, *The Lancet* 51, no. 1271 (Jan. 8, 1848): 52.

William Burnett, and George Burrows, *The Lancet* 51, no. 1272 (Jan. 15, 1848): 80.

Anon, *London Journal of Medicine* 2, no. 14 (Feb. 1850): 215.

An Assistant Surgeon, R.N., of More Than Three Years' Standing, *The Lancet* 61, no. 1541 (Mar. 12, 1853): 257.

Frederick James Brown, *The Lancet* 61, no. 1548 (Apr. 30, 1853): 417.

Roderick Random, *The Lancet* 61, no. 1553 (June 4, 1853): 527.

Anon, *The Lancet* 61, no. 1556 (June 25, 1853): 586.

Anon, *The Lancet* 62, no. 1560 (July 23, 1853): 85–86.

Assistant-Surgeon, R.N., *The Lancet* 62, no. 1575 (Nov. 5, 1853): 438.

Anon, *The Lancet* 62, no. 1564 (Sept. 24, 1853): 284.

Anon, *Association Medical Journal* 2, no. 57 (Feb. 3, 1854): 97.

Anon, *Association Medical Journal* 2, no. 66 (Apr. 7, 1854): 305–306.

Verax, letter to the editor, *The Times*, (Apr. 4, 1854).

Z., *The Lancet* 63, no. 1597 (Apr. 8, 1854): 404–406.

Medicus, letter to the editor, The Times (May 19, 1854).

M.D., *The Lancet* 63, no. 1603 (May 20, 1854): 556–557.

H.B., letter to the editor, *The Times* (May 24, 1854).

Anon, *The Lancet* 64, no. 1620 (Sept. 16, 1854): 232.

Anon., *Association Medical Journal* 2, no. 97 (Nov. 10, 1854): 1008–1009.

Anon., *Association Medical Journal* 3, no. 112 (Feb. 23, 1855): 196.

Anon, *Association Medical Journal* 3, no. 118 (Apr. 6, 1855): 210–211.

O., letter to the editor, *The Times* (Apr. 19, 1855).

W., *The Lancet* 65, no. 1654 (May 12, 1855): 498.

Anon, *Association Medical Journal* 3, no. 126 (June 1, 1855): 505.

Anon, *The Lancet* 66, no. 1672 (Sept. 15, 1855): 246.

Underpaid, R.N., *The Lancet* 68, no. 1726 (Sept. 27, 1856): 367.

Navy, *The Lancet* 68, no. 1734 (Nov. 22, 1856): 581.

Just Discontent, *The Lancet* 66, no. 1682 (Nov. 24, 1855): 507.

Navy, *The Lancet* 68, no. 1734 (Nov. 22, 1856): 581.

Blighted Life, *The Lancet* 69, no. 1764 (June 20, 1857): 642.

D.3 ARTICLES ON THE REFORM MOVEMENT & STUDENT BOYCOTT

Anon, *The Lancet* 53, no. 1330 (Feb. 24, 1849): 216.

Anon, *The Lancet* 53, no. 1338 (Apr. 21, 1849): 436.

An Assistant-Surgeon R.N., *The Lancet* 53, no. 1334 (Mar. 24, 1849): 325–326.

Anon, *The Lancet* 65, no. 1647 (Mar. 24, 1855): 324–28.

Anon, *London Journal of Medicine* 1, no. 6 (June 1849): 598–599.

Anon, *The Lancet* 53, no. 1348 (May 5, 1849): 488.

M.D., *The Lancet* 63, no. 1599 (Apr. 22, 1854): 458–459.

Henry F. Hanxwell, and Joseph Allen, *The Lancet* 65, no. 1644 (Mar. 3, 1855): 248.

Anon, *The Lancet* 65, no. 1645 (Mar. 10, 1855): 269–270.

George Webster, *Association Medical Journal* 3, no. 114 (Mar. 9, 1855): 238–239.

Henry Marshall, *The Lancet* 65, no. 1646 (Mar. 17, 1855): 299.

Anon, *Association Medical Journal* 3, no. 116 (Mar. 23, 1855): 269.

Anon, *Association Medical Journal* 3, no. 116 (Mar. 23, 1855): 285–286.

Anon, *Association Medical Journal* 3, no. 116 (Mar. 23, 1855): 284–285.

Anon, *The Lancet* 65, no. 1647 (Mar. 24, 1855): 324–328.

F.D., Fletcher, and R. Fryer, *The Lancet* 65, no. 1647 (Mar. 24, 1855): 328.

Anon, *Association Medical Journal* 3, no. 123 (May 11, 1855): 450–451.

T. Holmes, *The Lancet* 65, no. 1656 (May 26, 1855): 545.

D.I.G.H., *The Lancet* 78, no. 1989 (Oct. 12, 1861): 358–59.

D.4 ARTICLES WARNING STUDENTS AGAINST NAVAL SERVICE

An Assistant Surgeon in the Navy, *The Lancet* 8, no. 199 (June 23, 1827): 382–383.

Anon, *The Lancet* 53, no. 1330 (Feb. 24, 1849): 216.

John Argyll Robertson, *The Lancet* 53, no. 1333 (Mar. 17, 1849): 297–298.

M.R.C.S., R.N., *The Lancet* 53, no. 1336 (Apr. 7, 1849): 384.

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