Navigation, Commercial Exchange and the Problem of Long-Distance Control in England and the English East India Company, 1673-1755

Jason Grier

A Dissertation submitted to the Faculty of Graduate Studies in Partial Fulfilment of the Requirements for the Degree of Doctor of Philosophy

Graduate Program in Science and Technology Studies

York University

Toronto, Ontario

March 2018

Abstract

In this dissertation I address the related problems of expertise and long-distance control in the context of British navigation and the bureaucratic practices of the English East India Company. Expertise, in particular, is used as a framework from which I build outward to establish a stronger understanding of commercial trade, the circulation of knowledge and, most crucially, the place of the metropole. The first half of this dissertation introduces expertise and long-distances control and puts the concepts into historical context through the example of navigation between 1673 and 1755. Navigation is illustrative of the problem of expertise because it was a contentious subject at the time and, therefore, the contemporary debates can be followed. Expertise is a crucial problem because it directly addresses power and who controls knowledge. Thus, the question of navigational expertise ties directly to the problem of long-distance control. Therefore, my dissertation begins by moving outward from navigational instruction at the Royal Mathematical School to the practice of navigation on Edmond Halley's first *Paramore* voyage.

In the context of global commercial exchange, long-distance control became an increasing priority for those who sought to assert such control from a presumed centre onto agents around the globe. As such, the second half of the dissertation continues to follow actors further away from London with the setting moving to India and China where I contrast the idea of long-distance control with the reality. In practice the East India Company had little ability to impose itself on either its own employees or on the peoples with whom the Company wished to trade. Instead, the Company's efforts often drew attention to its ignorance of Asian trade and served to underline its weakness in the first part of the eighteenth century. The dissertation concludes by questioning the notion of the metropole and the periphery in the history of science and suggests an inversion of the traditional locations, with London now a periphery rather than centre, a state of affairs more in line with the situation at the time.

Acknowledgements

Larry Stewart introduced me to the history of science and nearly a decade later his influence continues to shape my approach. This dissertation would not exist without him. Ernie Hamm was the definition of an ideal supervisor. He provided support, advice and direction when needed while allowing me the freedom to sort my ideas out on my own. My dissertation committee of Bernie Lightman and Jamie Elwick carefully read multiple drafts of the dissertation and provided valuable feedback. Bernie was involved from the outset and has been a crucial source of support for the last six years. Jamie was a source of support and friendship throughout the doctoral process, but also deserves special recognition for stepping in to join my dissertation committee at a late stage and going above-and-beyond the call of duty. His careful reading and valuable interventions greatly strengthened the final product. More generally, his writing group helped to keep me on task.

Simon Schaffer has been invaluable to the development of this dissertation. As the external examiner his thoughtful and generous commentary of the thesis fundamentally clarified the ideas I had laboured to express. At the beginning of the research stage Simon enabled me to spend a year as a visiting student in the Department of the History and Philosophy of Science, Cambridge and the breadth and depth of his knowledge pointed me in critical directions when I was just figuring out what the project was. Margaret Schotte was exemplary as an examiner of the dissertation and her expert knowledge will continue to be critical as I continue forward in my academic career. Though they were not involved in the dissertation in any official capacity, Richard Dunn and Rebekah Higgitt offered much appreciated advice about the history of navigation. Richard Dunn was particularly generous with his time.

A great number of individuals at York University, the University of Cambridge, and the University of Saskatchewan and elsewhere have supported me over the years as teachers, colleagues, and friends. Julia Bewcyk, Amy Bewcyk, Dan Brielmaier, Susannah Brower, Angela Cope, Jennifer Gilchrist, Paul Greenham, Erin Grosjean, Edward Jones-Imhotep, Rich Jarrell, Eileen Kim, Nanna Lüders Kaalund, Kelly Ladd, Michael Laurentius, Hélène Mialet, Aryn Martin, Ali McMillan, Cam Murray, Elizabeth Neswald, Chris Phillips, Kristen Schranz, Efram Sera-Shriar, Joan Stiegerwald, Jeffrey Wajsberg, and Beth Watkins made my time Toronto more enjoyable and intellectually enriching. I would like to thank Leah Astbury, Toby Bryant, Jenny Bulstrode, Andrew Buskell, Margaret Carlyle, Charlotte Connelly, Seb Falk, Meira Gold, James Hull, Nick Jardine, Anna Jones, Francis Neary, Kathryn Schoefert, Andreas Sommer for making me feel welcome in Cambridge. In Saskatchewan, Gordon DesBrisay, Erika Dyck, Sheila Gibbons, Jim Handy, Simone Horwitz, Chris Kent, Frank Klaassen, Marc MacDonald, Lisa Smith, and Sharon Wright provided important support and friendship at the beginning of my academic ventures. Finally, I wish to thank my What If Sports friends, especially Justin Bender.

The librarians and archivists at the British Library; the Cambridge University Library; the Caird Library, National Maritime Museum; the London Metropolitan Library; the Pepys Library, Magdalene College; and the Whipple Library, Cambridge were unfailingly helpful and ensured their libraries were pleasant places in which to work. In Toronto the Scott, Steacie and Gerstein libraries enabled me to access the books I needed to complete my dissertation. I would also like to thank the Deer Park branch of the Toronto Public Library where much of this dissertation was written and the Toronto Public Library more generally for keeping me supplied in non-academic reading.

Financial support for my doctoral studies was provided by the Social Sciences and Humanities Research Council, Canada and York University. The support and benefits, both material and otherwise, provided by CUPE 3903 cannot be overstated and without which graduate school at York University might well have been untenable. Moreover, CUPE 3903 has been at the forefront of the resistance to the neoliberal corporatization of the university and has consistently sought to prevent the destruction of education at the hands of a short-sighted administration concerned only with increasing profits. I do not extend any credit or thanks to the administrators of York University who are actively dismantling the very aspects of the university that made it attractive to me in the first place. As I submit this dissertation in the midst of a work stoppage I can only hope they fail in their designs.

Sue Reeves opened her home to me in Cambridge. Linda Mead and Ian Feltham, meanwhile, made my frequent trips to London possible and pleasurable as they provided me with a home away from home. I cannot fully express how much I appreciate the home-cooked meals, the long discussions about the history, geography, and architecture of London, help navigating the city, and suggestions of sights to see and things to do.

My family has supported me throughout my long academic journey and in life more generally and I wish to thank my parents, Mike and Judy, my siblings Christopher, Callie, and Vanessa and my grandparents Roy and Ruth Grier and Scotty and Curly Wiltermuth.

Most importantly, Laura Mitchell has offered years of love and support even though she did not do any typing.

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List of Abbreviations

BL	British Library
CUL	Cambridge University Library
IOR	India Office Records, British Library
LMA	London Metropolitan Archives
Pepys	Pepysian Library, Magdalen College, Cambridge
RS	Royal Society

Note on Sources

In my transcriptions I have sought to adhere as closely as I was able to the spelling and grammar of my source material. Therefore, I have not normalized or modernized spellings or grammar within quotations and have maintained the original abbreviations. A partial exception is quotations from Pepys MS 2612 as the Admiralty had grammatical conventions unique to itself that are not easily transcribed, most notably the spelling of words such as “navigation” as navigacon with line over the c. In this instance, I have followed the convention adopted by the editors of John Flamsteed’s correspondence and maintained the spelling, but not reproducing the exact diacritic marks. When quoting from published edition of a manuscript I followed its transcription.

Introduction

When Robert Douglas arrived at Macau, China at the end of the seventeenth century, he was one representative of a much larger network that included the British Isles and Europe, the Americas, Africa, modern India, and China. Douglas is not famous. Though he kept a detailed journal of his time spent in China, it was not published. Besides the diary, he left behind only a few traces of his life and experiences with the English East India Company. Lesser known and obscure actors such as Robert Douglas are at the heart of this dissertation and have crucially shaped its argument. Rather than view the history of imperialism and science in the eighteenth century from a long lens, I have sought to focus closely on the actions of historical actors who provide a window into imperialism and globalization as it was practiced. Such an approach has consciously distanced the greater British world described in this dissertation from the one that would eventual come into being at the end of the eighteenth century. The English East India Company as a colonial power was not inevitable, or even the product of intentional policy by the Company's Directors; instead, it was the result of a complex network of individual actors whose actions were the product of self-interest and not imperial ambition. The goal of this dissertation is to understand the relationship between such self-interest and individual agency and the structures of power and modernity that emerged during the eighteenth century. The primary argument of this dissertation is that expertise is contingent, local and constantly contested. It is only by paying attention to specific contests of expertise that we can fully understand how knowledge is developed, transmitted and used.

The dissertation is divided into four chapters, each of which develops a specific historical example that is intended to make both a particular historiographic argument and extend the set of broader claims being made in this thesis. The approach has resulted in a rather wide-ranging dissertation that has traversed an ambitiously large terrain. This has necessitated working

through a significant amount of historiographic material; however, I contend that the breadth of focus taken in this thesis has served to enrich the arguments being made. Despite the range of material covered, the use of specific examples in each of the four chapters has ensured that the dissertation has remained historically grounded. The dissertation is divided into two sections. The first two chapters focus on navigational practice between 1673 and 1761, while the next two chapters discuss the English East India Company in the early eighteenth century from an institutional perspective and with an emphasis on bureaucracy. These two narratives are drawn together by the two related problems of expertise and long distance control. By subjecting expertise and long distance control to historical scrutiny, this dissertation aims to make a contribution to the understanding of how knowledge was produced, used and circulated. Moreover, my concern for imperialism and the history of science has pointed to some significant historiographical consequences. The goal of this introduction is to provide something of the historiographic and intellectual development of this dissertation in order to give context and form to the chapters that will follow.

Historiography

It might not seem immediately evident that this dissertation is a contribution to the history of the Enlightenment; however, the scholarship on the Enlightenment has been crucial to the shape the work has taken. Crucially, one of the foundational questions for the history of science and science and technology studies more broadly has been that of expertise. How is it defined, maintained and enforced? In other words, how does an expert become an expert? It was during the period known as the Enlightenment that "experts" came to be. Thus, the debates over expertise that I discuss in this dissertation had critical consequences for both the history of

science and the Enlightenment. This dissertation is a contribution to the history of the Enlightenment, then, because it addresses a central problem of the Enlightenment.

Indeed, as the Enlightenment and eighteenth-century natural philosophy so frequently overlapped both in terms of the people involved and the questions they sought to answer, it is almost surprising how thoroughly separated the study of the Enlightenment and eighteenth-century science were for much of the twentieth century. Partly this has been because both were long viewed as primarily to do with ideas. For many historians of science and historians of Enlightenment, it was *ideas* that drove the progress of history. It is in the scholarship on the Enlightenment that one finds bold statements on ideas as the drivers of history. Thus, according to Jonathan Israel, "Radical Enlightenment is the system of ideas that, historically, has principally shaped the Western World's most basic social and cultural values in the post-Christian age."[1]

Israel has drawn on a tradition that runs from Ernst Cassirer to Peter Gay and has regarded the Enlightenment as a coherent philosophical school. There were significant points of disagreement for the *philosophes*, but Gay saw synthesis as possible by viewing the *philosophes* as "a family of intellectuals united by a single style of thinking," which he saw as having been "a dialectal struggle for autonomy, an attempt to assimilate the two pasts they had inherited—Christian and pagan—to pit them against one another and thus to secure their independence." Accordingly, for Gay "the Enlightenment may be summed up in two words: criticism and power."[2] Gay did see the Enlightenment as essentially having an underlying ideology, however,

[1] Jonathan Israel, *A Revolution of the Mind: Radical Enlightenment and the Intellectual Origins of Modern Democracy* (Princeton: Princeton University Press, 2010), 8. However, the connection between the Enlightenment and secularization is tangential at best as mainstream secularization did not occur until well into the twentieth century (if it really happened at all), see Callum Brown, *The Death of Christian Britain: Understanding Secularisation 1800-2000* (London: Routledge, 2001).
[2] Peter Gay, *The Enlightenment: An Interpretation, Vol. I* (London: Wildwood House, 1970), *xii-xiii.*

as can be seen in his chosen subtitle "The Rise of Modern Paganism." For the Enlightenments twenty and twenty-first century defenders, it is in the Enlightenment that we find the origins of what are held up today as the "Western values" of liberalism. In sharp contrast to Gay's and Israel's embrace of the Enlightenment, Max Horkheimer and Theodor Adorno, writing in the shadow of Nazi Germany and Stalinist Russia, saw the Enlightenment and twentieth-century totalitarianism as inexorably linked.[3] Like Gay and Israel, Horkheimer and Adorno situated ideas at the heart of history.

The Enlightenment, however, has not always been understood as existing entirely within the confines of the history of ideas. *The Enlightenment in National Context*, edited by Roy Porter and Mikuláš Teich, and *Science and the Enlightenment* by Thomas Hankins (published in 1981 and 1985 respectively) did much to establish the Enlightenment within the broader social context of the eighteenth century. In doing so it was extracted from the history of ideas. In his review of *Science and the Enlightenment*, Jan Golinski pressed for an even more radical approach to the Enlightenment and the history of science and rejected any division between the two calling for historians to study science *in* the Enlightenment rather than science *and* the Enlightenment. As Golinski explained:

> To tell the parallel histories of independent disciplines would not have appeared an appropriate historiographical choice to the writers of the Enlightenment themselves. Their own historiographical and educational projects were dominated by the desire to see knowledge as an interconnected unity, and to understand the growth of the 'arts and sciences' in relation to the progress of their society as a whole. They perceived the scientific developments of their day as part of an overall process of cultural and social improvements, that of 'enlightenment' itself.[4]

[3] Max Horkheimer and Theodor Adorno, *Dialectics of Enlightenment: Philosophical Fragments*, edited by Gunzelin Schmid Noerr, translated by Edmund Jephcott (Stanford: Stanford University Press, 2002).
[4] Jan Golinski, "Science *in* the Enlightenment: Science and the Enlightenment," *History of Science* 24 (1986), 411. Golinski revisited the essay in 2011, see Golinski, "Science in the Enlightenment, Revisited," *History of Science* 49 (2011): 217-31.

The Enlightenment, then, cannot be viewed as a history of ideas divorced from the social context in which it took place. By drawing together the history of the Enlightenment and the history of science, historians have refocused attention on the participants of these histories actually did and rejected ideas as the primary driver of history.

Instead of teleology toward "Western liberal modernity," the historians of science and the Enlightenment who have followed Golinski's precepts have done much to situate the Enlightenment within its varying local contexts. In doing so, it might seem as though the Enlightenment would lose its explanatory strength; however, as William Clark, Jan Golinski and Simon Schaffer noted in the introduction to *Sciences in Enlightened Europe*:

> Creation of geographical hierarchies and the formation of local or regional identities have been shown to have been closely associated with participation in enlightened culture. Local studies, particularly of the areas of the European domain traditionally regarded as 'peripheral' to the Enlightenment, thus have the potential to reconfigure our sense of geography of the movement and its unity.[5]

Similarly, the increased focus on activities rather than ideas has greatly enhanced our understanding of the eighteenth-century intellectual world. As historians such as Mary Terrall and J.B. Shank have reminded us, Enlightenment figures were also participants in the political and social culture of their time and cannot be understood without full recognition of this reality.[6]

[5] William Clark, Jan Golinski and Simon Schaffer, "Introduction," *The Sciences in Enlightened Europe*, edited by Clark, Golinski, and Schaffer (Chicago: University of Chicago Press, 1999), 20.

[6] Mary Terrell, *The Man Who Flattened the Earth*: *Maupertuis and the Sciences in the Enlightenment* (Chicago: University of Chicago Press, 2002); J.B. Shank, *The Newton Wars and the Beginning of the French Enlightenment* (Chicago: University of Chicago Press, 2008). See also Jan Golinski, *Science as Public Culture: Chemistry and Enlightenment in Britain, 1760-1820* (Cambridge: Cambridge University Press, 1992); Larry Stewart, *The Rise of Public Science: Rhetoric, Technology, and Natural Philosophy in Newtonian Britain* (Cambridge: Cambridge University Press, 1992); Robert Drayton, *Nature's Government: Science, Imperial Britain, and the 'Improvement' of the World* (New Haven: Yale University Press, 2000); Lissa Roberts, Simon Schaffer and Peter Dear, eds., *The Mindful Hand: Inquiry and Invention from the Late Renaissance to Early Industrialisation* (Amsterdam: Koninkliijke Nederlandse Akademie van Wetenschappen, 2007).

The development of what has come to be regarded as modern science coincided with the European global expansion that occurred during the early-modern period.[7] The increasingly global European had a profound impact on how those involved and affected by the growing globalization perceived the world. For most, this expansion was experienced primarily through the introduction of new commodities; however, the introduction of new lands, peoples, and flora and fauna all helped to shape the way in which the world was understood by European intellectuals in the eighteenth century.[8] It is unsurprising, then, that botany has been the bridge between the histories of the Enlightenment, science and imperialism because it was the botanists more than anyone who were the active agents of enlightened imperialism in the eighteenth century.[9] Botany and collecting have been recognized as central elements to the enlightenment projects of classification and quantification.[10] A deterministic reading of the history of collecting would see it as a process by which the world was transported to Europe to be classified and, thereby, understood. However, despite the metropolitan scientists' claim to be the ultimate

[7] The role of global commerce has had particular recent currency, see Harold Cook, *Matters of Exchange: Commerce, Medicine, and Science in the Dutch Golden Age* (New Haven: Yale University Press, 2008).
[8] Julie Douthwaite, *The Wild Girl, Natural Man and the Monster: Dangerous Experiments in the Age of Enlightenment* (Chicago: University of Chicago, 2002); Alix Cooper, *Inventing the Indigenous: Local Knowledge and Natural History in Early Modern Europe* (Cambridge: Cambridge University Press, 2007); Emma Spary, *Eating the Enlightenment: Food and the Sciences in Paris, 1670-1760* (Chicago: University of Chicago Press, 2013).
[9] John Gascoigne, *Joseph Banks and the English Enlightenment: Useful Knowledge and Polite Culture* (Cambridge: Cambridge University Press, 1994); *Science in the Service of Empire: Joseph Banks, the British State and the Uses of Science in the Age of Revolution* (Cambridge: Cambridge University Press, 1998); Neil Safier, *Measuring the New World: Enlightenment Science and South America* (Chicago: University of Chicago Press, 2008); James Delbourgo and Nicholas Dew, eds., *Science and Empire in the Atlantic World* (London: Routledge, 2008); Daniela Bleichmar, *Visible Empire: Botanical Expeditions and Visual Culture in the Spanish Enlightenment* (Chicago: University of Chicago Press, 2012).
[10] Tore Frängsmyr, J.L. Heilbron, and Robin E. Rider, eds., *The Quantifying Spirit in the Eighteenth Century* (Berkeley: University of California Press, 1990); M. Norton Wise, ed., *The Values of Precision* (Princeton: Princeton University Press, 1995); Nicholas Jardine, James Secord, and Emma Spary, eds., *Cultures of Natural History* (Cambridge: Cambridge University Press, 1996) ; Richard Yeo, *Encyclopaedic Visions: Scientific Dictionaries and Enlightenment Culture* (Cambridge: Cambridge University Press, 2001); Horst Bredekamp, *The Lure of Antiquity and the Cult of the Machine: The Kunstkammer and the Evolution of Nature*, translated by Allison Brown (Princeton: M. Wiener Publishers 1995); Paula Findlen, *Possessing Nature: Museums, Collecting, and Scientific Culture in Early Modern Italy* (Berkeley: University of California Press, 1996); James Delbourgo, "Collecting Hans Sloane," in *From Books to Bezoars*, edited by Alison Walker, Arthur MacGregor, and Michael Hunter (London: British Library, 2013).

source of natural knowledge, in reality it was in the periphery and not the centre that this knowledge was best understood and put into practice. The centre was simply geographically too far removed from its sources.[11]

My aim, then, in this dissertation has been to follow an approach that emphasizes the local, contingent, messy reality that most closely corresponds to the actual experience of the eighteenth century. My interest is in what people actually did rather than to construct a broad narrative account of the time period. At the same time, however, by drawing strong connections between my localized examples and larger historiographic concerns situated within the scholarly context I briefly outlined in this introduction. In this section I have sought to clarify the general historiographical context; however, the dissertation is grounded on the more specific historiographic concern of expertise, which I will turn to in the next part of this introduction.

The Problem Defined

This dissertation is premised on two distinct, but related, problems: expertise and long-distance control. Expertise presents two problems. First of all, it is a terminological problem. The word did not enter English vocabulary until the latter half of the nineteenth century. For some historians, this renders it invalid as an analytical category for a work of history focused on the seventeenth and eighteenth centuries. Lorraine Daston and Peter Galison, for example, stressed in their study of objectivity that the existence of a concept that we would now call "objectivity" cannot be claimed for a historical period that predates the origin of the word "objectivity" in its modern usage.[12] As Leo Marx has shown in his study of the history of the word "technology"

[11] Ralph Kingston, "A Not-So Pacific Voyage: The 'Floating Laboratory' of Nicolas Baudin," *Endeavour* 31 (2007): 145-51; Natalie Zemon Davis, "Creole Languages and Their Uses: The Example of Colonial Suriname," *Historical Research* 82 (2009): 268-84; "Physicians, Healers, and Their Remedies in Colonial Suriname," *Canadian Bulletin of Medical History* 33 (2016): 3-34.

[12] For the argument that it is ahistorical to attribute categories not available to the actors being studies, see Quentin Skinner, "Meaning and Understanding in the History of Ideas," *History and Theory* 8 (1969): 3-53.

and its changing usage, such etymological concerns are significant and specificity cannot be discounted.[13] This is especially important in the case of a word like technology, which existed prior to its current definition, but whose usage was crucially different. As primary sources are more likely to use the word, it is necessary to be clear what they mean by it and how that meaning changes over time.

Ideally, then, one would stick to actors' categories. While there was not a perfect eighteenth century equivalent to technology, Leo Marx demonstrates that the word "mechanics" was used in roughly the same manner as we use technology today. Moreover, because what we understand as technology did not really exist prior to the rise of mass industrialization and the development of technological systems such as the railway and telegraph in the nineteenth century, the distinction between mechanics and technology is useful and important. Similarly, Daston and Galison argue that the development of the word "objectivity" is significant and marks an epistemological break because it demonstrates that it was only around the 1820s that objectivity took on it something like its modern definition. Such temporal specificity matters for Daston and Galison because they seek to locate the history of objectivity within the Kantian tradition.[14] Thus, objectivity as we understand it today cannot have preceded the emergence of Kantian philosophy in the nineteenth century. Though Daston and Galison argue that before the mid-nineteenth century there was not objectivity, but instead "truth-to-nature" and the trained judgment they describe came only after the advent of objectivity. Yet, an argument can be made that the essential aspects of what we understand as objectivity today existed before the word itself entered the English vocabulary. Daston and Galison, however, rejected this view because

[13] Leo Marx, "Technology: The Emergence of a Hazard Concept," *Technology and Culture* 51 (2010): 561-77.
[14] Loraine Daston and Peter Galison, *Objectivity* (New York: Zone Books, 2010), 30-31.

they regarded it as stemming "from an identification of science with objectivity *tout court*."[15] By sticking rigidly to their epistemological approach Daston and Galison wished to demonstrate that science can exist outside of objectivity. They sought to show that objectivity has a specific and precise meaning and, therefore, a history.

Like objectivity and technology, the word expertise did not enter the English vocabulary until the mid-nineteenth century. According to the *Oxford English Dictionary*, the first use of the word expertise did not occur until it was used by the popular Victorian novelist Charles Reade and the actor and playwright Dion Boucicault in the 1868 novel *Foul Play*.[16] In its modern usage, expertise describes extensive knowledge and/or technical skill in a particular subject or field. To be an expert is to have knowledge of the subject that goes beyond competence or even substantial skill and suggests a great understanding of the underlying theory. To have expertise is to have a deep knowledge of the how and why and not just the what of a given subject. Thus, an expert mechanic cannot just rebuild an engine, but also understands how engines work on a theoretical and scientific level. The argument here is basically claiming a distinction between knowing what to do and where the pieces fit based on learned experience and being able to figure out what to do and how to fit the pieces based on a greater knowledge of engines in general. Importantly, there is a tension to be seen in this very definition of expertise. It is not necessarily self-evident who is an expert. For instance, our imagined mechanic might not be able

[15] Daston and Galison, *Objectivity*, 28.

[16] "expertise, n.", *OED Online*. June 2017. Oxford University Press. http://www.oed.com.ezproxy.library.yorku.ca/view/Entry/66556?redirectedFrom=expertise& (accessed August 23, 2017). Reade was one of England's highest-paid novelists in the nineteenth century, but his work rapidly fell out of fashion until George Orwell observed in an essay that "Since Charles Reade's books are published in cheap editions one can assume that he still has his following, but it is unusual to meet anyone who has voluntarily read him," George Orwell, "Charles Reade," in *The Collected Essays, Journalism, and Letters of George Orwell, Vol. II*, edited by Sonia Orwell and Ian Angus (New York: Harcourt, Brace, and World, 1968), 34. Dion Boucicault's obituary in the *New York Times*, meanwhile, called him "the most conspicuous English dramatist of the 19th century," "Dion Boucicault," *The New York Times*, September 19, 1890. Like Reade, his reputation does not seem to have survived him.

to explain the scientific concepts that allow an engine to work, but that does not mean that they would not be able to figure out how to rebuild a type of engine they have not previously worked on because much of their past experience would be applicable to the new engine. Meanwhile, just because someone has spent years studying the theory of internal combustion engines but does not have practical experience with mechanical work does not mean that they would be better suited to repair an engine than the mechanic who has not.

Though Daston and Galison, among others, have argued against using terms outside of their historical context, there are good reasons for using the concept of expertise to frame my analysis. I justify using "expertise" for two reasons. Firstly, there is not an equivalent historical category that can be substituted. Secondly, I wish to use the term "expertise" in this thesis because it defines the problem at the centre of the dissertation. Expertise is an analytical tool that allows me to advance a theory—one that I would not be able to develop without the concept of expertise. Moreover, my use of expertise in this dissertation has a strong historiographic basis and builds on the work of the historian of science Eric Ash.[17] In his work, Ash has traced a shift between the sixteenth and eighteenth centuries from "experience" to "expertise." The traditional definition of *expert* indicated having a personal experience of something—"to be experienced." As an example, Ash noted a critic of Martin Frobisher who wrote that Andrew Dier, one of the mission's junior officers, was "so unexpert of the sea, as he was never further from England than

[17] Eric Ash, *Power, Knowledge, and Expertise in Elizabethan England* (Baltimore: The Johns Hopkins University Press, 2004). For other recent examples, see Eric Ash, ed., *Expertise and the Early Modern State, Osiris* 25 (2010); Ursula Klein, ed., "Artisanal-Scientific Experts in Eighteenth-Century France and Germany," special issue *Annals of Science* 69 (2012); Paola Bertucci and Olivier Courcelle, "Artisanal Knowledge, Expertise, and Patronage in Early Eighteenth-Century Paris: The *Société des Arts* (1728–36)," *Eighteenth-Century Studies* 48 (2015): 159-179. Michael Wintroub, meanwhile, uses the concept in his work on the sixteenth century, see Wintroub, *The Voyage of Thought: Navigating Knowledge Across the Sixteenth-Century World* (Cambridge: Cambridge University Press, 2017), Ch. 2.

France, and Ireland."[18] The comment was notable because it said nothing about Dier's knowledge or overall competence as a mariner in the areas where he had previously sailed, but rather was directed specifically toward his lack of experience in oceanic navigation. To be an expert, then, in the sixteenth century was to have considerable first-hand experience doing something. Someone who had sailed extensively would, therefore, be a greater expert than someone who had not even if the latter had a great deal more theoretical knowledge.

The central thesis of Ash's book is that this notion of expertise as grounded upon first-hand experience had begun to change. Accordingly, "it began to encompass not just experience but also *skill*, a more abstract and general term." Though skill often did imply experience, it was not necessarily the case. One did not necessarily have to have done something over and over to be able to do it well. Thus, expertise became an increasingly ambiguous term and hands-on experience was no longer a sufficient basis for expertise. Increased access to books created new avenues for learning; meanwhile, a craftsman might have been experienced, but lack the deep understanding needed to be considered an expert. It was on this distinction that the Royal Society was established. Indeed, one of its earliest planned projects was to undertake a history of the trades. Such a history was explicitly based on the presumption that the greater intellectual learning possessed by the Royal Society's *virtuosi* would enable them to acquire a deeper understanding of the trades than was possible for the unlearned, but highly experienced, craftsmen.[19] Robert Boyle argued that one of the great benefits to humanity that natural philosophy offered was that it might reform or improve the trades. Moreover, it was up to natural

[18] Ash, *Power, Knowledge, and Expertise*, 10. Cf. Peter Dear's discussion of the experience and experiment, Dear, "The Meanings of Experience," in *The Cambridge History of Science, vol. 3: Early Modern Science*, edited by Katherine Park and Lorraine Daston (Cambridge: Cambridge University Press, 2006).
[19] Walter Houghton, Jr., "The History of Trades: Its Relation to Seventeenth-Century Thought," *Journal of the History of Ideas* 2 (1941): 33-60; Kathleen Ochs, "The Royal Society of London's History of Trades Programme: An Early Episode in Applied Science," *Notes and Records of the Royal Society* 39 (1985): 129-58.

philosophers to provide such improvement because mechanics were "too familiar with their processes and unable to render effective accounts of experiments because 'some important circumstance'" was generally missing.[20] Boyle emphasized that studying trade practices would improve natural philosophy as those involved in the trades had developed and perfected their crafts over many years of experiment and had important knowledge that would benefit subjects that particularly interested Boyle such as chemistry and alchemy. Natural philosophers, however, had much to offer as well because they would be able to put craft practices into context and apply their deeper learning to understand not just what the methods were, but why.

Robert Boyle sought to draw a distinction between natural philosophy and commercial interests in which the natural philosopher was to be disinterested in base concerns. At the same time, however, English commerce was undergoing a significant expansion. According to Ash, this expansion resulted in a growing number of royal administrators and corporate investors who, in turn, relied on expert mediation in order to make decisions. Thus, a new profession of expert developed during the seventeenth century whereby these self-styled experts sold their "ability to translate their knowledge and skills into effective action."[21] Patrons were wealthy merchants, worldly statesmen, and educated courtiers; therefore, they were not inclined to associate with base and unlearned craftsmen. As a result, Ash has argued, they were attracted to individuals who were able to combine the highly literary style of humanist education with knowledgeable explanations of practical, useful skills. Thus, instead of "turning to common practitioners," these wealthy patrons "were an enthusiastic audience for the abstracted, text-based, theoretical version

[20] Robert Boyle, "Of the Usefulness of Experimental Philosophy, The Second Part," in *The Works of the Honorable Robert Boyle, vol. III* (London: Printed for W. Johnston, S. Crowder, T. Payne, G. Kearsley, J. Robson, B. White, T. Becket and P. A. De Hondt, T. Davies, T. Cadell, Robinson and Roberts, Richardson and Richardson, J. Knox, W. Woodfall, J. Johnson, and T. Evans, 1772), 403; Malcolm Oster, "The Scholar and the Craftsman Revisited: Robert Boyle as Aristocrat and Artisan," *Annals of Science* 49 (1992), 266.
[21] Ash, *Power, Knowledge and Expertise*, 11.

of expertise that began to flourish" in sixteenth-century England.[22] Ash's thesis, then, was that the increasingly centralized, bureaucratic forms of government and wealth led to a growing separation between practice and capital. As the scope of trade expanded, the size of investment and amount of regulation required also grew significantly. This meant that ventures were increasingly owned and financed by investors who were not local and did not have personal experience of the trade in question. Thus, they needed experts who were able to translate craft practice into a vocabulary that their genteel patrons were able to understand. In order to market themselves to patrons, such would-be experts needed to develop an entire vocabulary and literary genre from which to assert their authority. They needed to convince potential patrons that they possessed knowledge that unlearned practitioners did not.

Administrators' and investors' need for expert mediators points to the second core problem of expertise addressed by this dissertation. They were engaged in operations that were increasingly far removed geographically from where the administrators in question were located. As such, one of the principal problems for the development of modern capitalism was that of long-distance control. Merchants were engaging in commerce over ever longer distances and, therefore, relied more heavily than ever on agents to conduct their business on their behalf. Similarly, as the English government become more centralized it needed to be able to assert a greater degree of authority from its administrative centers. The new form of expertise described by Eric Ash was one of the crucial methods by which administrators attempted to establish long-distance control. Underlying the new expertise was an effort to transform who defined expertise. In doing so, the administrative state sought to wrench control over the trades from craft practitioners by re-defining expertise in a way that excluded the unlearned practitioners. If successful, it would then have enabled the administrative institutions to assert long-distance

[22] Ash, *Power, Knowledge, and Expertise*, 12.

control through their ability to regulate expertise. The sociologist of science John Law, in particular, has argued that new technologies of control were developed by western Europeans, beginning with the Portuguese in the fifteenth century. These new technologies of control, in turn, allowed for the rise of European hegemony from the sixteenth century onward.[23]

In this dissertation I argue that to a significant degree both the attempt to redefine expertise and to use it to establish long-distance control failed. The administrative state was never really able to impose the kind of regulatory power it desired. Moreover, the universal, text-based forms of expertise described by Eric Ash did not really win out nearly to the extent he suggests. While certainly there were plenty of instances where such experts were turned to for advice and put into positions of authority, they often failed. Andre Wakefield, in particular, has elegantly demonstrated the contradiction between the claims made by cameralists and the often very different results that occurred when these supposed experts on governing states and managing the economy were given administrative posts from which to put their expertise into practice.[24] Though many schemes were devised to establish long-distance control, the historical evidence suggests these efforts were largely unsuccessful.

Eric Ash's conception of expertise and John Law's theory of long-distance control both point to a related set of historical assumptions. These assumptions have been best articulated by John Brewer.[25] As military technology advanced and militaries grew in size and became more centralized, wars became increasingly expensive to fight. Because states needed an ever larger amount of money to fight wars, they had to devise new means of taxation in order to raise the

[23] John Law, "On Methods of Long-Distance Control: Vessels, Navigation, and the Portuguese Route to India," in *Power, Action, and Belief: A New Sociology of Knowledge?*, edited by John Law (London: Routledge, 1986).
[24] For example, see Andre Wakefield's discussion of the cameralist Johann van Justi's disastrous experience as Prussian Inspector of Mines, Glass, and Steel Works led to Justi's imprisonment in 1768, Wakefield, *The Disordered Police State: German Cameralism as Science and Practice* (Chicago: University of Chicago Press, 2009), Ch. 4, esp. pp. 108-11. See also, James Scott, *Seeing Like a State: How Certain Schemes to Improve the Human Condition Have Failed* (New Haven: Yale University Press, 1998), esp. ch. 1 and ch. 2.
[25] John Brewer, *The Sinews of Power: War, Money, and the English State, 1688-1783* (New York: Knopf, 1989).

revenues they required. Brewer's thesis, then, was that growing military costs created the need for a more centralized, administrative state in order to manage the fiscal demands created by the military. As the state acquired greater fiscal powers, the administrative apparatus continued to expand in kind and, therefore, ever further expansion of fiscal powers were demanded. At the centre of the fiscal-military state was the state bureaucracy. The rise of the fiscal-military state, then, directly resulted in the development of the expertise described by Eric Ash. Similarly, the military technologies that necessitated the fiscal-military state also served as important technologies of long-distance control for John Law. A strong reading of this historical progression would be to argue that the rise of modern, state militaries created the bureaucratic state in which the civil service was detached from court politics, which led to the power of the state to expand exponentially through the seventeenth and eighteenth centuries so that state power became increasingly ubiquitous and hegemonic. The technologies of power devised to fund the state's growing fiscal needs also enabled greater capacity for long-distance control and global trade, which, in turn, allowed the rise of European imperialism. By focusing on specific institutional examples such as the Royal Mathematical School or the English East India Company in some detail, my dissertation provides some much needed context to the broader claims made by Brewer, which do not necessarily refute his argument, but do bring into question the scope of the developments he described.

Underlying Brewer's teleology can be seen Michel Foucault's conception of power and his argument that during the seventeenth century there was a transition in the location of state power. Under monarchism the power of the state is embodied in the person of the monarch; therefore, power is centralized and visible. As the administrative advanced, monarchial power waned and power became increasingly diffuse, abstract and invisible. For Foucault, as power

became less visible it was not diminished. Indeed, because power was no longer embodied in a single person, it was much more difficult to challenge. Foucault's argument does not have much room for individual agency. Indeed, Foucault made this point explicitly in his argument that it is impossible for individuals to exist outside of the structures of power that govern our lives and that everyone is complicit in reinforcing such forces of control. At times, then, Foucault appears to present a nihilistic vision of the world, though his persistent involvement in direct political action from the later 1960s until the end of his life undermines an attempt to read Foucault as hopeless to the possibility of enacting political change.[26] Nonetheless, Foucault's terminology has been plagued by abstraction. For Foucault power is an omnipresent, impersonal social force that defies easy description; indeed, it is that obtuseness that gives power its strength to impose social norms on our day-to-day actions.[27] Power is powerful because it does not have an evident source. According to Foucault, "Power is everywhere; not because it embraces everything, but because it comes from everywhere."[28] Power, then, is disembodied and outside of human agency. Too close an adherence to Foucault creates the risk of becoming caught up in abstraction and losing track of what people actually did. Though people may have existed inside of insidious structures of power, it does not necessarily follow that they had no relative latitude within their daily lives to assert a degree of agency on their world. It is this juxtaposition of small acts of individual agency in defiance of overt efforts to impose institutional control that particularly

[26] See for example Foucault's participation in the radical French student movements after being hired as the head of the Philosophy Department in the newly established *Centre Expérimental de Vincennes* or the articles he wrote for the Italian newspaper *Corriere della sera* in support of the Iranian revolution after traveling to Tehran in 1978 and finding popular support for Islamism and opposition to the shah, Didier Eribon, *Michel Foucault*, translated by Betsy Wing (Cambridge, MA: Harvard University Press, 1991), 203-6; 281-5.

[27] "By power, I do not mean 'Power' as a group of institutions and mechanisms that ensure the subservience of the citizens of a given state. By power, I do not mean, either, a mode of subjugation which, in contrast to violence, has the form of the rule. Finally, I do not have in mind a general system of domination exerted by one group over another…these are only the terminal forms power takes. It seems to me that power must be understood in the first instance as the multiplicity of force relations immanent in the sphere in which they operate," Michel Foucault, *The History of Sexuality, Vol. I: An Introduction*, translated by Robert Hurley (New York: Vintage Books, 1980), 92.

[28] Foucault, *History of Sexuality*, 93.

interest me. While the technologies of surveillance and control that Foucault pointed to may have come into being between the early seventeenth and mid-eighteenth centuries, in many regards these efforts to impose control can be read as a sign of enduring institutional weakness.[29]

Chapters and Sources

In an effort to avoid the pitfalls I have outlined in this introduction, I have focused on specific incidents and emphasized individual actions and agency. My intention has been to combine historiographic breadth with fine-grained historical examples. What this has meant in practice has been to develop a set of examples situated within a specific historiographic context in which the historical material I have uncovered engages with the existing literature in a way that often serves to complicate or refine an existing narrative. In this final section I introduce the sources that I have used to advance my argument and establish the challenges and, more importantly, the opportunities that resulted from the sources I have chosen. Each of these sources has been selected because they are illustrative of aspects of my central argument.

The dissertation is divided into two parts and begins in London and works its way outward into the South Atlantic Ocean before finishing in India and China. It is not, however, a narrative of moving from the local to the global because the examples remain focused on the local regardless of the geographic context. Instead, I have sought to demonstrate the way in which local concerns, knowledge, and individual interests were key motivators of the actions taken by the different actors I discuss. This effort to uncover "ordinary" historical actors in the context of their daily work constituted the greatest archival challenge, but also offered the greatest opportunities. The sources I have used have primarily been institutional records, but I have not attempted to write institutional histories *per se*; instead, my objective has been to use

[29] See Theodore Porter, *Trust in Numbers*: *The Pursuit of Objectivity in Science and Public Life* (Princeton: Princeton University Press, 1995), Ch. 6.

these records to uncover the day-to-day practices within the institutions in question—namely the Royal Mathematical School and the English East India Company.

Chapter One is a detailed study of the Royal Mathematical School. My interest in this school began when I came across it in the correspondence of John Flamsteed. The school offered itself to me as a valuable source to explore because it correlated with my desire to avoid overly focusing on elite sources and actors and provided evidence from those operating below the level of elite science. The Royal Mathematical School sought to provide an education that combined knowledge of contemporary astronomy and mathematics with the practical skills needed for marine navigation. Because the school came into conflict with both experienced mariners (as a result of examinations carried out by Trinity House) and astronomers (due to Flamsteed's and Isaac Newton's involvement with the school), the institutional records offer valuable insight into existing tensions between different representatives of navigational expertise. Of the primary sources I have used, those of the Royal Mathematical School are the most straightforward. The material has been microfilmed and is now housed in the London Metropolitan Archive, having been moved there from its previous location in the Guildhall Library. As well, there are duplicates and additional manuscript material in the Pepys Library, Magdalen College, Cambridge as Samuel Pepys kept his own records during the period in which he was involved with the school. The Pepys records are the most complete and best organized; however, he left the school in 1683. Similarly, the period prior to the late 1690s is better recorded than the years after that. I have tried to give a longer picture of the school that extends through to the middle of the eighteenth century and gives more attention to the operation of the school under James Hodgson than previous accounts; however, it is not possible to provide as detailed an account as the early history allows due to the more limited records available.

One of the more interesting, but frustrating, set of records in the Royal Mathematical School archives is the apprenticeship lists. The school kept a record of every boy apprenticed to a ship captain, the name of the captain, and the name and destination of the ship. The survival of these lists means that we know where the students were going immediately after leaving Christ's Hospital, thus, I initially hoped was that I would be able to follow some of the mathematical boys to sea. In doing so, I might have been able to track them from the contests over expertise found in the Royal Mathematical School to their experiences and practice at sea and put the Mathematical School more concretely into context. The founding mission of the school was to improve navigation on English ships and the intention was to educate the boys in mathematics and navigation so as to provide a steady supply of skilled navigators to fulfill this objective. By following the boys to sea, then, I would be able to reconcile the intention with the reality and uncover to what degree the mathematical school succeeded in its mission. Unfortunately, however, the mathematical boys turned out to be highly elusive once outside of the institutional boundaries of Christ's Hospital and I had to turn to other sources to try to get a sense of how the conflicts over expertise I found in the Royal Mathematical School played out on English ships. The most straightforward example for my purposes was the dispute between Edmond Halley and his chief mate Edward Harrison and, thus, it was on that example that I based my second chapter.

While the first chapter primarily relied on manuscript sources, the second chapter made considerably more use of published primary sources as Edmond Halley's *Paramore* journals have been published along with a collection of supporting material such as correspondence between Halley and the Navy. Along with the edition of Halley's correspondence published in 1932 and his publications in the *Philosophical Transactions*, the *Paramore* journals make up a substantial portion of the extant Halley material. Halley lived a more active life than John

Flamsteed, his predecessor at the Royal Observatory, and he did not leave behind a significant papers. Though Halley's surviving correspondence is more limited and perhaps less revealing than Flamsteed's, whose letters devoted considerable attention to his multitude of disputes and grievances, Halley's active public life with the Royal Society and frequent contributions to the *Philosophical Transactions* ensure a clear picture of his activities and interests can be maintained. The *Paramore* journals are especially valuable for my purposes because they not only give a relatively detailed account of navigation as practiced on board the *Paramore*, but do so in the context of a dispute with his chief mate and navigator Edward Harrison. Moments of controversy are particularly useful sites of academic inquiry because they force the disputing parties to state their positions more clearly. Thus, activities that generally pass unremarked are entered into the record. The dispute between Halley and Harrison, therefore, is a particularly insightful episode in the history of navigation and the English Navy because it tells us a great deal about practice. This account of the first *Paramore* voyage follows the discussion of the Royal Mathematical School given in the first chapter because it builds upon the theme of expertise. While the Royal Mathematical School demonstrates the tensions created by the construction of expertise, the Halley/Harrison dispute displays the continuation of these disputes and the implication that debates over expertise had for the increasingly bureaucratized British state.

At the centre of the second chapter is the problem of long-distance control. A claim that has been made about the rise of European economic and political power and the eventual establishment of European imperial hegemony during the early-modern period was that Europeans developed superior technologies of long-distance control. I regard long-distance control to be a problem, however, because the historical record suggests that it was not ever

really achieved. I argue that the idea of long-distance control is intertwined with questions of expertise and, like expertise, was not settled. Rather than a powerful centre imposing its will over appendages around the world, global expansion and commerce was a constant contest of authority between a large and disparate collection of actors. Part Two builds on the themes of expertise and especially long-distance control developed in Part One while moving the geographic site to South Asia and the institutional context to the English East India Company. The shift to the East India Company began in part because the Company was by far the most frequent destination for mathematical boys. My original hope when I entered the East India Company archives in the British Library was that I would be able to trace some of the mathematical boys and uncover something of their lives after leaving the Royal Mathematical School. This hope did not work out in practice in part because the mathematical boys largely did not establish themselves in the upper echelons of society and, thereby, leave behind a significant record. Moreover, while I found a number of possible matches in the East India Company archives, I was not able to verify that they were the same people. Overall, then, I was not able to sustain a significant argument that continued the Royal Mathematical School directly; however, the East India Company records are an especially rich and vivid collection of material. Though I did not expand on the Royal Mathematical School in the way that I had originally planned, the East Indian archives had much to say on the problem of long-distance control.

The East India Company archives run into hundreds of thousands of pages and can be measured in miles on the British Library shelves. As such, the records can be overwhelming to work with, especially since the period for which I am interested has not been fully catalogued. The type of material available includes financial records for the Company's commercial transactions and employment records, official and private correspondence, and an assortment of

journals and logbooks and other miscellanea. While the records would become highly detailed during the British Raj and provide a wealth of information about the people who administered British India in the nineteenth and twentieth centuries, the records are considerably less detailed for the period covered by this dissertation. The correspondence, however, includes numerous illuminating episodes that provide insight into the regular operation of the East India Company. Unlike the other chapters, which focused primarily on a single example, I did not find an incident in the correspondence that provided enough depth for an entire chapter; instead, I used a set of illustrative examples from the period between 1690 and 1720. These examples taken from the Company's internal correspondence enabled me to piece together how its bureaucracy and administration actually worked. What these records make clear is that any strong claim for European long-distance control does not stand up to historical scrutiny.

The Board of Directors' influence over their agents was limited and the English East India Company was only one of several European trading companies operating in Asia. Moreover, the European trading companies were frequently in a subordinate position to local political and economic forces. The limitation of European influence is most clearly seen in the China trade where the Qing emperors were able to maintain strong regulation over the trade until well into the nineteenth century. Thus, like the first chapter, Chapter Three seeks to get inside of a specific institution in order to understand the individual motivations for those inside of it and to better understand the relationships between the different actors. In doing so, the objective is to establish an account of British commercial activities in South Asia that is not deterministic or read the history of the English East India Company backward from the establishment of the Company State at the end of the eighteenth century. The eventual rise of the Company State occurred due to specific decisions and actions and took place against significant resistance by

many involved. For the period around the beginning of the eighteenth century the East India Company not only did not have the means to establish a colonial regime, its directors, shareholders, and agents were largely uninterested in doing so. The Company's attempts to assert political control were directed primarily toward its own employees and focused principally strengthening its commercial interests.

The centrepiece of the fourth and final chapter is the journal of Robert Douglas, which he kept while conducting business for the East India Company in Canton at the turn of the eighteenth century. His journal is an invaluable source because it provides a detailed day-to-day account of his activities while in China and details clearly the challenges and limitations faced by the East India Company merchants. The second and third chapters challenged the idea of long-distance control and the fourth chapter builds on this foundation while situating the argument in the context of science studies accounts of the metropole and periphery. While Robert Douglas was not involved in any practices that would traditionally be regarded as part of the history of science, his journal still sheds much light on how marginal British merchants were at this time and, therefore, helps to undermine the idea of the metropole as a historiographic concept. What this means is that Douglas's journal is an invaluable source for the history of science because it gives a strong account of the situation on the ground. This, in turn, enables a better understanding of the knowledge practices available to curious Europeans in China in the eighteenth century. Douglas's journal brings the narrative trajectory of the dissertation to a conclusion.

Inasmuch as science and technology studies can be said to have a central question, the issue of expertise is it. This dissertation is a story of expertise. It is not, however, a story of how modern expertise came to be or how a single expertise came to dominate. Instead, I treat

expertise as a constantly contested issue and each chapter emphasizes a specific site in order to demonstrate how problems of expertise and control were experienced in a certain local context. All of these spaces were sites of contest for control and these struggles had important consequences. In drawing attention to some of these specific controversies over expertise, I have sought to contribute to the foundational problems of STS. While my examples are local and might seem narrow in their scope, such fine-grained investigations have significant consequences to the discipline as a whole because they demonstrate how things actually worked in practice and what people were actually doing. The development of expertise occurred in the context of commerce, bureaucracy and exploration. Yet, there was not a linear progression toward "modernity," nor was expertise ever a settled issue. It is important not to view history as overly determined or to read later developments, such as nineteenth-century science or the establishment of the British Raj, onto an earlier time period. It is through the investigation of specific historical examples such as presented in this dissertation that such historicity can be achieved.

PART ONE

London

During the eighteenth century there was a transition from the absolute monarchies that marked the post-feudal era to the modern democracy that began to emerge at the end of the century. This shift was eloquently described by Michel Foucault's classical episteme and its emphasis on categorization and taxonomy. That the classical episteme emerged in concert with capitalism and global trade is not a coincidence because capitalism necessitated the political reorganization of Europe. Two things occurred during this political reorganization. Firstly, there was a relocation of power from local, visible authorities (i.e. the lord), who derived their power from a monarch to a political arrangement whereby power was increasingly exercised by institutions and, therefore, was not embodied by specific individuals. This disembodiment of power both enabled and was a consequence of the way in which power was increasingly exercised over a greater distance. Nowhere is this more evident than in the emergence of global trade. In order for capitalism to function new means of establishing trust were needed; hence, the rise of expertise as a form of standardizing and credentialing experts in the service of the nascent bureaucratic state. The new expertise, in turn, enabled the establishment of long-distance control, which allowed for the formation of European economic and political hegemony. There is, however, a problem. The bureaucratic state, its experts and long-distance control are all largely idealizations that do not correspond to the historical record.

Samuel Pepys's reforms of the Royal Navy exemplify the move toward bureaucratic centralization. For instance, he established an examination for would-be officers. The purpose of this examination was to ensure a baseline of knowledge and competence across the officer corps of the navy. After Pepys the Admiralty continued to attempt related reforms such as efforts to employ teachers on board ships and to establish a naval academy. On the one hand, these efforts support the argument that there was a trend toward standardization and expertise during the

eighteenth century. On the other hand, none of these schemes were particularly successful and to a large extent the Navy continued to operate on its own terms. The vast majority of officers continued to bypass the naval academy and navigation largely followed older practices.

Both the Royal Mathematical School and the Halley/Harrison dispute demonstrate that the new form of bureaucratic expertise promoted by Samuel Pepys did not appear in a vacuum. Instead, there was already existing means of validating skill. What bureaucratic expertise sought to do was to redefine who had the authority to accredit someone as an expert. Thus, Pepys supported examinations and standardized education because it centralized expertise. Naval officers, however, recognized that such centralization undermined their authority and were largely able to maintain control on board their ships and within the fleet. The example of the Royal Mathematical School introduces the concept of expertise and demonstrates the terms of the debate. Essentially, I show an example of an attempt at defining and imposing expertise in a specific institution and some of the difficulties that were experienced. Meanwhile, the dispute between Halley and Harrison takes the concept of expertise and applies it to the problem of long-distance control. What this controversy further demonstrates is that expertise was not a settled question on board English Navy ships. Moreover, I want to establish the stakes involved, particularly for those for whom the new expertise looked to supplant. Edward Harrison's credibility was his experience, while Halley's authority was derived from his learned knowledge.

Part One, then, situates the dissertation and orients the theoretical concepts. The case study of the Royal Mathematical School centres the discussion in a specific, local context. In doing so, I ground the idea of expertise on a concrete example. Having done so, the next three chapters each aim to expand the scope of the dissertation to an increasingly global stage. The objective is to demonstrate how bureaucratic models of expertise were applied, with limited

success, when the institution in question spanned the globe. At the same time, the examples covered in Part Two will continue to emphasize specific, local contexts. Thus, I hope to show how the tensions around expertise and institutional authority played out on the ground and some implications of this for how we understand the history of science and imperialism in the eighteenth-century British world.

Chapter One
Defining Expertise: Navigational Pedagogy and the Royal Mathematical School at Christ's Hospital

When, in 1695, the governors of Christ's Hospital elected Samuel Newton to replace Edward Pagett as the mathematical master at the Royal Mathematical School, the Astronomer Royal, John Flamsteed, was not impressed. In a letter to Isaac Newton (no relation to Samuel), Flamsteed complained that the treasurer of the school—Nathaniel Hawes—had told him that "too much learning made their Masters proud. that the Youths were proud and troublesome to the seamen."[1] Thus, the school preferred Samuel Newton, who did not have a University education over John Caswell of Oxford and William Collins of Cambridge. As far as Flamsteed was concerned, the "methods of ordinary teachers of Navigation" would "ruin our schole."[2] When Newton finally resigned in 1708, Flamsteed gloated, "Mr Newton the math master at Christs Hospitall has resigned that is, is turned out for insufficiency and James Hodgson succeeds him and has been in that schoole ever since Christmas."[3]

The validity of Flamsteed's opinion of Samuel Newton is impossible to judge from the distance of three hundred years as the records are limited and generally heavily biased, especially as Flamsteed was friends with Caswell and had been close to Collins's father (the mathematician John Collins).[4] Not only that, despite Flamsteed's anger with the situation his information might

[1] John Flamsteed to Isaac Newton, 20 April, 1695, in *The Correspondence of John Flamsteed, The First Astronomer Royal, vol. 2 1682-1703,* compiled and edited by Eric Forbes and by Lesley Murdin and Frances Willmoth (Philadelphia: Institute of Physics Publishing, 1997), 582.
[2] Flamsteed to Newton, 21 March, 1694/5, *Flamsteed's Correspondence, vol 2,* 580.
[3] James Hodgson was Flamsteed's assistant between 1695 and 1702, during which time he was a member of Flamsteed's household. While Hodgson had moved out of Flamsteed's home after his indenture concluded in 1702, he maintained a close connection to Flamsteed, marrying Flamsteed's niece Anna (who also lived with Flamsteed). After leaving Flamsteed's employ in 1702 Hodgson moved to London where he worked as a mathematical lecturer and collaborated with Francis Hawksbee in a number of experiments. RGO 1/6, ff. 24r, 176r gives September 15, 1706 as the date of Hodgson's marriage to Anna. On Hodgson's career as a public lecturer see Larry Stewart, "Other Centres of Calculation, or, Where the Royal Society Didn't Count: Commerce, Coffee-Houses and Natural Philosophy in Early Modern London," *The British Journal for the History of Science* 32 (1999): 133-53.
[4] Though Flamsteed denied any favouritism toward Caswell claiming, "I am not so earnest to have him into the vacant place because he is my acquaintance but because I know he is able to discharge that businese fully and will

not have been the most accurate as the minutes for Christ's Hospital's Court of Governors regarding the election indicate that Caswell was not present when he was called for and Collins is not named at all in the list of candidates.[5] Moreover, while Flamsteed and Samuel Pepys both regarded Newton's predecessor Edward Pagett as having been a complete disaster, Hawes wrote to Pepys:

> We beleive we have substantial reasons to esteem Mr. Paget better then ordinarily qualified for his imployments & myself have good reason to esteeme him a Gentleman of soe much ingenuity & Constiense that he wil not, nay that he does not faile to aply those qualifications, for the most advtange & improvement of his schollars.[6]

It is necessary to remember Flamsteed was notoriously opinionated and his views should, therefore, be taken with a grain of salt. Certainly, one would not rely primarily on Flamsteed's opinion for a fair picture of the astronomer Edmond Halley, who Flamsteed developed a strong enmity toward and repeatedly attacked as a lazy drunk who stole other people's work.[7] Flamsteed's views, however, reflect the desire for naval reform held by many of his peers.

The leading advocate for naval reform in seventeenth-century England was the secretary to the Admiralty and famed diarist Samuel Pepys. While on one of the few sea voyages he would make in his life, Samuel Pepys was particularly keen to observe how navigation was practiced. What he saw, however, disturbed him as he regarded mariners as relying on little more than "looking-out" for the shore. Instead of possessing skills in mathematics, the use of navigational instruments and the making and reading of charts, Pepys proclaimed "the best navigator is the best looker-out" and that "stories are told of West Countrymen going home that they have lain

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conscientiously mind his duty being a person no less religious and honest then modest and skillful," John Flamsteed to Isaac Newton, 21 March, 1694/5, *Flamsteed's Correspondence,* 580.

[5] LMA CLC/210/B/001/M MS 1206/08, 361.

[6] Nathaniel Hawes to Samuel Pepys, April 24, 1694, BL Add MS 20732, ff. 14r-v.

[7] E.g. "The discourses Mr Halley has broacht and fomented relateing to my Not publishing my Observations signifie little: for the World knows him, his principles, and practice[s] and that all the dust he raises is onely by the help of our Young lewd gentlemen, whom he encourages in their vices, and they remunerate him by spreadeing his slanders," Flamsteed to T. Smith, 1 November, 1700, *Flamsteed's Correspondence, vol. 2*, 872.

by looking out for land 200 leagues off out."[8] It was this supposed anti-intellectualism that particularly concerned Pepys, as it stood in the way of the improvement of navigation:

> It is clear also that rather than show their differences, for fear of showing their mistakes, masters will conceal their differences and so let the charts forever remain as they are. Their only care now being to lie off in the night and make in in the day, when they think themselves drawing in towards any shore.[9]

In these two examples from Flamsteed and Pepys, a conflict is presented between navigation as an imprecise practice learned through experience and as a science dependent on book knowledge and skills that could be rendered universal.

The debate that took place around how navigation should be taught at the Royal Mathematical School indicates a dichotomy between navigation as practice (techne) and science (episteme). Royal Society elites such as Samuel Pepys, John Flamsteed and Isaac Newton viewed navigation as a sub-discipline of astronomy. From this perspective, the Royal Mathematical School offered an ideal opportunity to transform navigational practice into a standardized method that emphasized mathematical skill and universal knowledge over local experience and technical competence. Historians of science have seen an increasing standardization in the eighteenth century and argued that it was part of a general process of quantification that resulted from the increasing centralization required by state expansion, a process described in detail by the historian John Brewer and which will be discussed in more depth in Chapter Three.[10] The dispute between Nathaniel Hawes and John Flamsteed usefully articulates the tension that existed between those who represented the new administrative state and practitioners for whom the imposition of coordinated standards was an erosion of traditional

[8] Samuel Pepys, *The Tangier Papers of Samuel Pepys*, transcribed and edited by Edwin Chappell with W. Matthews (London: The Navy Records Society, 1935), 130, 235.
[9] Pepys, *Tangier Papers*, 127.
[10] Tore Frängsmyr J.L. Heilbron and Robin Rider, eds., *The Quantifying Spirit in the Eighteenth Century* (Berkeley: University of California Press, 1990); M. Norton Wise, ed., *The Values of Precision* (Princeton: Princeton University Press, 1995); John Brewer, *The Sinews of Power: War, Money, and the English State, 1688-1783* (New York: Knopf, 1989).

authority. By framing my account of the Royal Mathematical School around the problem of expertise in the context of centralization, this chapter demonstrates the connections between the local debates that took place in the school to the larger developments that were occurring in British society.

From Experience to Expertise? Navigation becomes Universal

The central problem at the heart of the debates at Christ's Hospital is one of expertise. As this chapter will demonstrate, expertise is not a straightforward concept. Instead, close attention to controversies over expertise demonstrate that expertise, like most problems, is a political one. The historian of science Eric Ash has sought to articulate the formation of expertise as a concept between the sixteenth and eighteenth centuries.[11] Ash has taken up the historian of mathematics, E.G.R. Taylor's thesis of an increasing mathematicization of the world during this period, in order to posit a transformation of the word "expert" in sixteenth-century England.[12] While it had traditionally meant "to have personal experience of something" it began "to encompass not just experience but also *skill*, a more abstract and general term." What this meant for Ash was that there came to be a distinction between experience—which was associated with localized artisanal knowledge—and expertise—which was associated with the more theory-based knowledge typically linked to science.[13]

One of the primary examples Ash used to make his argument was navigation, arguing that "perhaps the most important change in English navigational practice during the latter half of the sixteenth century was the introduction and further development of navigational technologies

[11] Eric Ash, *Power, Knowledge, and Expertise in Elizabethan England* (Baltimore: Johns Hopkins University Press, 2004).
[12] E.G.R. Taylor, *The Mathematical Practitioners of Tudor and Stuart England* (Cambridge: Cambridge University Press, 1954).
[13] Ash, *Power, Knowledge, and Expertise*, 10.

founded upon mathematics and astronomy."[14] While a pilot's knowledge was necessarily local in nature because it was learned through particular experience, expertise in navigational science meant that the navigator possessed a set of skills that were generalizable and able to be applied to any context. Unlike a traditional pilot, "a mathematical navigator could leave his familiar coasts and practice his art from any point on Earth" and, thus, "expertise was set loose from its local, empirical moorings."[15] As navigation became increasingly global in scale, according to Ash's argument, it was increasingly less important that one had local knowledge and more essential that a navigator possessed skills that would allow successful navigation regardless of whether or not one had previous experience in a particular locale. The distinction Ash draws between "experience" and "expertise" is helpful to how I have framed my discussion of the Royal Mathematical School; however, though it is certainly true that there was a proliferation of navigational technologies during the seventeenth and eighteenth centuries, Ash overstated the degree to which navigation transitioned from a local craft to a universal skill during this time period.

By Samuel Pepys's day, navigation was increasingly reliant upon instruments. The most common instruments included sextants, quadrants, telescopes and other astronomical instruments, the magnetic compass and tables and charts that relied on more advanced theoretical knowledge of the world. Despite this proliferation of instruments aboard ships, the primary means of navigation remained dead-reckoning.[16] Dead-reckoning was conducted by throwing a rope over the side of the ship in order to calculate the speed it was travelling. This speed was

[14] Ash, *Power, Knowledge and Expertise*, 89.
[15] Ash, *Power, Knowledge and Expertise*, 133.
[16] Taylor, *The Haven-Finding Art: A History of Navigation from Odysseus to Captain Cook* (London: Hollis & Carter, 1958); W.E. May, *A History of Marine Navigation* (Henley-on-Thames: G.T. Foulis & Co., 1973); J.A. Bennett, *The Divided Circle: A History of Instruments for Astronomy, Navigation and Surveying* (Oxford: Phaidon Christie's, 1987).

recorded along with the direction of the wind and the ship in an hourly log. In order to plot the location of the ship, the navigator would thus add up the logs in order to obtain an estimate of how far the ship had travelled and provide a reasonable estimate as to where they currently were. Dead-reckoning was not extremely precise, but it was generally adequate as most voyages had a fairly significant amount of leeway. The primary concern was simply to ensure that the ship was staying on course and to have a general idea as to when they ought to reach land again. While incidents of shipwreck or of ships becoming lost and wandering around the sea unable to find their intended port are dramatic, such episodes were quite uncommon and it is often unclear to what degree methods of navigation such as dead-reckoning ought to be blamed on the occasions where such disasters did occur.[17]

In writing about the history of the marine arts, it is not necessarily clear how the conversation should be framed in relation to the history of science. The Navy was not completely divorced from the scientific developments of the period. Historian of Naval Science Larrie Ferreiro has argued that "Naval architecture was developed and used by various navies, starting in the late 1600s, in response to a bureaucratic need by naval administrations for greater control over their constructors and for standardization of the ship design process." Nations such as France, Spain, Denmark and Sweden, where scientific naval architecture already had strong institutional development, were quick to incorporate ship theory because "in those navies, the development of ship theory coincided with—and was integrated into—the standardization and centralization of the design process during the 1700s." Britain and the Netherlands, on the other hand, offered little direct support for those working on ship theory. According to Ferreiro, this was because they had "already refined [their] bureaucracy and standardization rates before

[17] W.E. May, "The Last Voyage of Sir Clowdisley Shovel," *Journal of Navigation* 13 (1960): 324-32.

1720," which was well before ship theory had been fully developed.[18] In support of his institutional argument regarding the limited role of ship theory in eighteenth-century Britain, Ferreiro contrasted the situation of navigation in the same time period and in particular pointed to the establishment of the Longitude Prize in 1714.[19]

There certainly was a great deal of noise made in the eighteenth century about the need to improve navigation, but the situation from within navigational practice does not look significantly different from Ferreiro's depiction of ship construction. It was a skilled craft whose practitioners were highly trained professionals with a great deal of practical knowledge of arithmetic and geometry, but who lacked formal education and were often unable to read or write.[20] Ship constructors did not possess knowledge of ship theory because it "served no useful purpose for them." Rather, "they knew their business and built good ships."[21] Similarly, navigators on board ships did not need to know advanced mathematics or the latest developments in astronomical theory because neither served a useful purpose to the day-to-day practice of navigation. Indeed, the latest navigational theories were no more accurate than the long established conventions, which relied on dead reckoning and simple calculations to plot the

[18] Larrie Ferreiro, *Ships and Science: The Birth of Naval Architecture in the Scientific Revolution, 1600-1800* (Cambridge, MA: The MIT Press, 2007), 25-6. See also Simon Schaffer, "'The charter'd Thames': Naval Architecture and Experimental Spaces in Georgian Britain," in *The Mindful Hand: Inquiry and Invention from the Late Renaissance to Early Industrialisation*, edited by Lissa Roberts, Simon Schaffer and Peter Dear (Amsterdam: Koninklijke Nederlandse Akademie van Wetenschappen, 2007).

[19] Ferreiro, *Ships and Science*, 25-6, 138, 190. Cf. David McGee, Review of Larie Ferreiro, *Ships and Science: The Birth of Naval Architecture in the Scientific Revolution, 1600–1800*, *Isis* 99 (2008): 179-80; McGee, "Review of Larrie Ferreiro, *Ships and Science: The Birth of Naval Architecture in the Scientific Revolution, 1600-1800*," *Aestimatio: Critical Reviews in the History of Science* 3 (2006): 171-175. McGee particularly takes issue with Ferreiro's definition of naval architecture as the application of scientific theory to ship design, which is historically mistaken according to McGee because scientific theory had little bearing on changes to ship design. Indeed, Ferriero, too, admitted that the eighteenth-century naval science to which he has devoted the majority of his study was "useless" in that it was largely based on theories that would be later proven false, though Ferreiro took issue with McGee's assertion that naval science was never applied to actual ship building. For Ferreiro's response to McGee's negative review in *Aestimatio* see Ferreiro, "A Response to McGee on *Ships and Science*," *Aestimatio* 4 (2007): 8-12.

[20] Ferreiro, *Ships and Science*, 24-5.

[21] Ferreiro, *Ships and Science*, 25.

ship's course. Moreover, even once a reliable means of finding the longitude was established, it did not take hold with nearly the speed or conviction with which it has often been portrayed. Much like naval architecture, scientific navigation was promulgated in the context of institutional developments and was part of bureaucratic efforts to establish greater control over its periphery, an argument which will be made in more detail in a later chapter.

Larrie Ferreiro's argument points to the question of what is the relationship between artisanal practice and theory in the history of science, a concern that has long dogged the disciplines that have coalesced into what is now known as Science Studies.[22] It is not my intention to involve myself overly deeply with these debates; however, as this chapter draws heavily on work in the area, a brief summary of some of the arguments might be beneficial. The argument that science should be studied as part of, rather than separate from, public culture and that it can be understood in relation to economic history, was first raised by a number of Marxist scholars in the 1930s such as the Soviet scientist Boris Hessen and J.D. Bernal. Hessen's 1931 paper is particularly significant, though its value was not recognized until much later, for its contention that Isaac Newton's *Principia* was explicitly concerned with the industrial, political and economic issues of Newton's time.[23] Such materialist arguments engendered an immediate response by Western scientists like Michael Polanyi who regarded science as inseparable from liberal democratic values.

Polanyi was not so naïve as to reject out of hand that social factors helped to shape the course that science had taken, but he objected to the position that science should embrace the

[22] One of the key early contributions being Edgar Zilsel, "The Sociological Roots of Science," *American Journal of Sociology* 47 (1942): 544-62.
[23] Boris Hessen, "The Social and Economic Roots of Newton's *Principia*," in *The Social and Economic Roots of the Scientific Revolution: Texts by Boris Hessen and Henryk Grossmann*, edited by Giddeon Freudenthal and Petr McLaughlin (Dordrecht, NL: Springer 2009). On the impact of Hessen on the development of the history of science see Schaffer, "Newton at the Crossroads," *Radical Philosophy* (1984): 23-28.

kind of governmental control that was occurring in the Soviet Union. He recognized that scientists could not entirely escape external influence on their research, but argued that they should continue to try to strive toward a free pursuit of knowledge for its own sake. Science left free to pursue knowledge for its own sake would naturally progress in a way that would benefit society. If, on the other hand, it was subjected to government interference, the result would be the Soviet Union in which scientists were forced to conform to ideology at the expense of truth. For Polanyi, the Soviet model would necessarily lead to "disciples steeped in fanaticism" who "able to suppress their own scruples" would "wield the weapon of terror with sufficient effect." Such "party members educated in unscrupulous fanatiscism" was regarded by Polanyi as "an indispensable factor in the making and maintenance of the Totalitarian State."[24] The end result of Soviet science was not that it would achieve greater societal benefit, but that progress would be stifled as a result of political intervention. Moreover, in Stalinist Russia, such interference went beyond simple interference or the pursuit of a supposed "Soviet" science, to the deep political repression and frequent purges that took place in the Soviet Union during the 1930s (and of which Boris Hessen himself was a victim).[25]

Thus, in its first incarnation, the relationship between science and artisanal practice was embedded in deeply held ideological convictions and played out as part of arguments for and against liberal, democratic capitalism on the one side and Soviet-style Marxism on the other. With the advent of the Cold War, the issue became less prominent in Western discourse. More recently, however, historians of science have become more comfortable positioning science

[24] Michael Polanyi, "Rights and Duties of Science," in *Science, Economics and Philosophy: Selected Papers*, edited by R.T. Allen (New Brunswick: Transaction Publishers, 1997), 75-6; Polanyi, "The Growth of Thought in Society," *Economica* 8 (1941), 456.
[25] Polanyi, "Rights and Duties of Science," 76.

within public culture.[26] In one of the key clashes between new and old schools of thought, the notion that economic factors have a direct bearing on what science is produced again came to the fore. Unlike Hessen, however, this argument, first articulated at length by A.E. Musson and Eric Robinson, did not depend on a Marxist interpretation of the world. Instead, Musson and Robinson sought to demonstrate that eighteenth-century science and the Industrial Revolution were inseparable and neither could be adequately understood without reference to the other.[27] The Newton scholar A. Rupert Hall took issue with Musson and Robinson's thesis. In an article titled "What Did the Industrial Revolution Owe to Science?" he concluded that the two owed nothing to each other, or at least, very little.[28] Hall conceded the correspondence between eighteenth-century industrialists that Musson and Robinson had demonstrated, but rejected their conclusion that it proved industrial practice was significant to the history of science or science to that of industrialization. As Hall explained, James Watt's "acute interest" in natural philosophy did not lead "to commercial success."[29]

Explicitly demanding elsewhere that a clear division between science and technology be maintained, Hall proclaimed that "one need not be long misled by the vulgar sophism that would see Leonardo da Vinci's studies of artillery or Galileo's lessons in fortification as evidence that 'science' had been overtaken by novel military necessities."[30] Demarcation was to be maintained between 'high' and 'low' science; between the scientist-philosopher and the mechanic-artisan. A distinction that, as the historian of scientific instruments J.A. Bennett observed, "established the

[26] Jan Golinski, *Making Natural Knowledge: Constructivism and the History of Science, with a new Preface* (Chicago: University of Chicago Press, 2005).
[27] A.E. Musson and Eric Robinson, *Science and Technology in the Industrial Revolution* (Manchester: University of Manchester Press, 1969).
[28] A. Rupert Hall, "What Did the Industrial Revolution Owe to Science?" in *Historical Perspectives: Studies in English Thought and Society,* edited by Neil McKendrick (London: Europa Publications, 1974).
[29] Hall, "What Did the Industrial Revolution in Britain Owe to Science," 137.
[30] Hall, *The Revolution in Science, 1500-1750* (London: Longman, 1983), 22.

impossibility of the mechanics' realm seriously impinging on science."[31] Thus, Hall might have allowed for "the growing importance of the artisan and mechanic in the period" having "created a favourable climate for its wider practice, but not that such popular practices contributed to science itself."[32] However, maintaining a distinction between science and popular culture, as Roger Cooter and Stephen Pumfrey have explained, privileged elite science, marginalized other ways of knowing and obscured contests between and within classes.[33] Musson and Robinson's thesis has been taken to its logical extreme by the historian of science Margaret Jacob, who has argued that it was the scientific revolution that allowed the Industrial Revolution to take place in Britain, an argument that has been picked up and developed further by the economic historian Joel Mokyr.[34]

While Jacob and Mokyr have put forward the argument that science contributed directly and significantly to the development of industry in Britain during the eighteenth century, much scholarship has been devoted to the inverse proposition. Historians of science such as J.A. Bennett, Pamela Smith and Pamela Long have concentrated on reconstructing artisanal-mechanical practice. Such studies have put artisan methods under the microscope and subjected them to the kind of rigorous historical analysis as had previously been reserved for elite science.[35] The examination of artisanal practice within the context of the history of science and technology has served to further erode the easy distinction between science and technology

[31] J.A. Bennett, "The Mechanics' Philosophy and the Mechanical Philosophy." *History of Science* 24 (1986), 6.
[32] Roger Cooter and Stephen Pumfrey, "Separate Spheres and Public Places: Reflections of the History of Science Popularization and Science in Popular Culture." *History of Science* 32 (1994), 240.
[33] Cooter and Pumfrey, "Separate Spheres," 240.
[34] Margaret Jacob, *Scientific Culture and the Making of the Industrial West* (Oxford: Oxford University Press, 1997); Joel Mokyr, *The Gifts of Athena: Historical Origins of the Knowledge Economy* (Princeton: Princeton University Press, 2002); Mokyr, *The Enlightened Economy: An Economic History of Britain, 1700-1850* (New Haven: Yale University Press, 2009).
[35] J.A. Bennett, "The Mechanics' Philosophy;" Pamela Smith, *The Body of the Artisan: Art and Experience in the Scientific Revolution* (Chicago: University of Chicago Press, 2004); Pamela Long, *Openness, Secrecy, Authorship: Technical Arts and the Culture of Knowledge From Antiquity to the Renaissance* (Baltimore: Johns Hopkins University Press, 2001); Long, *Artisan/Practitioners and the Rise of the New Sciences, 1400-1600* (Corvalllis: Oregon State University Press, 2011).

demanded by Hall, especially in the period before 1700. Meanwhile, historians of alchemy and related cognates such as books of secrets and magic have demysticized the investigations of early-modern alchemists and their ilk and, in doing so, have made more coherent the rationality behind investigations that now seem arcane or even ridiculous.[36]

While Isaac Newton and Robert Boyle's enthusiasm for alchemy has long been known, it tended to be treated separately from their supposedly serious scientific work; however, it has become clear that the concepts and techniques Newton learned during his alchemical studies also played a role in his scientific thought.[37] Betty Jo Teeter Dobbs, in particular, argued that much Newton scholarship overly privileged his mathematical investigations over the many other areas of study to which he devoted his attention. In particular, she took issue with I. Bernard Cohen's thesis "that an essential part of Newton's methodology was deliberately" creating "mathematical models as a first step." Mathematics, she contended, was just one of his tools. Alchemy was another, equally important, aspect of his philosophical project.[38] Rather than a unified method,

[36] In his highly influential study of the seventeenth-century, Keith Thomas presented science as rational, mechanistic and developed separately from magic. Much of Thomas's argument has been challenged by more recent historiography. Keith Thomas, *Religion and the Decline of Magic: Studies in Popular Beliefs in Sixteenth and Seventeenth-Century England* (Oxford: Oxford University Press, 1971). Richard Kieckhefer's work has demonstrated that medieval magic was founded on rational principles; meanwhile, Eamon Duffy has challenged Thomas's representation of religion and magic by placing considerably more emphasis on the former and much less on the latter than Thomas had, see Richard Kieckhefer, "The Specific Rationality of Medieval Margic," *American Historical Review* 99 (1994): 813-36; Eamon Duffy, *The Stripping of the Altars: Traditional Religion in England, 1400–1580* (New Haven: Yale University Press, 1992). William Eamon and Frank Klaassen have confronted directly the connections between magic and related practices and the development of experimental philosophy in the early-modern period, see William Eamon, *Science and the Secrets of Nature: Books of Secrets in Medieval and Early Modern Europe* (Princeton: Princeton University Press, 1994); Frank Klaassen, "Ritual Invocation and Early Modern Science: The Skrying Experiments of Humphrey Gilbert," in *Invoking Angels: Theurgic Ideas and Practices, Thirteenth to Sixteenth Centuries*, edited by Claire Fanger (University Park: The Pennsylvania State University Press, 2012). As Jennifer Rampling has observed, alchemical practices were coherent and replicable procedures, even if they were often obfuscated by fanciful language, Rampling, "Transmuting Sericon: Alchemy as 'Practical Exegesis' in Early Modern England," *Osiris* 29 (2014), 20-1.

[37] Betty Jo Teeter Dobbs, *The Janus Faces of Genius: The Role of Alchemy in Newton's Thought* (Cambridge: University of Cambridge Press, 1991). In a related argument, Jed Buchwald and Mordechai Feingold have sought to demonstrate the intellectual consistency between how Newton conducted his experimental research and how he approached the study of chronology, see Buchwald and Feingold, *Newton and the Origin of Civilization* (Princeton: Princeton University Press, 2012).

[38] Dobbs, 6-7.

then, she sought to demonstrate the unity of his different pursuits from the standpoint of a single intellectual project: that of understanding how God works upon the universe.

The history of navigation has been caught up in these debates. Unlike alchemy, which until recently was often regarded as essentially an unproductive dead-end that had little bearing on the history of chemistry, navigation has been aligned with mathematical practice and that this relationship was solidified as the discipline became more dependent on increasingly advanced instruments between the fifteenth and nineteenth centuries. Though there were a reasonable number of textbooks on the art of navigation published in the sixteenth and seventeenth centuries, it remained something that one learned through doing. As commerce expanded and European powers became more globally-minded as a result, the length and variety of voyages at sea grew accordingly. This transformation in marine enterprise had obvious consequences with regard to navigation and seamanship. Samuel Pepys made such a claim when he observed that it was "generally confessed that the East Indies masters are the most knowing men in their navigations, as being from the consideration of their rich cargoes, and the length of their sailing."[39] While mariners had previously tended to stay close to the shore and stuck to routes they knew well, this was increasingly not the case as travel between Europe, the Americas and the Asia became ever more frequent. The new globalized world, therefore, has fitted neatly into the thesis of the mathematization of navigation, which was first articulated by E.G.R. Taylor. The history of the Royal Mathematical School and a close attention to navigation as practice, however, calls into question some of the core assumptions of this point-of-view.

The Royal Mathematical School in Historical Context

The Royal Mathematical School was established at Christ's Hospital in 1673 for the purpose of improving navigation at sea. The Mathematical School was first accorded

[39] Pepys, *Tangier Papers*, 127-8.

significance by the historian of education Nicholas Hans who regarded it as the first "modern" school as it focused on practical, technical education rather than the study of Latin, Greek and the classics. According to Hans, "Christ's Hospital served as a radiating centre for similar schools in France, Russia and Germany."[40] In support of this claim, he pointed in particular to a similar school started in France by Louis XIV in 1682 and to Peter I of Russia who had the Royal Mathematical School inspected while he was in England in 1698 and took two alumni of the back to Russia with him with the intention of establishing a similar school in Moscow.[41] That the Royal Mathematical School represented something new was crucial to Hans's argument; however, N. Pumley noted that Spain had been providing navigational instruction since 1502 and in France there had been a school for navigation at Dieppe since 1666, which according to Pumley led to the establishment of further schools under Louis XIV such as the one that Hans mentioned.[42] In their recently published history of the Royal Mathematical School, Nerida Ellerton and M.A. Clements have again made grand assertions about the import of the mathematical school. Similar to Hans, they have argued that the Royal Mathematical School "provided a model by which educational institutions at the school level could offer instruction to ordinary children in mathematics beyond arithmetic and elementary geometry" and that "Christ's Hospital's influence was fresh, extensive and international, and its example led to the creation of

[40] Nicholas Hans, *New Trends in Education in the Eighteenth Century* (London, Routledge, 1966), 214. More recently, Nerida Ellerton and M.A. Clements have made similar claims about the significance of the school in the formation of modern mathematical education, Nerida Ellerton and M.A. Clements, *Samuel Pepys, Isaac Newton, James Hodgson and the Beginnings of Secondary School Mathematics* (Cham: Springer, 2017) Cf. "The founding of the Royal Mathematical School at Christ's Hospital, although frequently mentioned in accounts of the efflorescence of early modern natural philosophy, was only a small factor in the growth of numeracy. The Royal Mathematical School was not considered a success by many, especially those most involved in it at the time, such as Samuel Pepys," Mordechai Levy-Eichel, "'Suitable to the Meanest Capacity': Mathematics, Navigation and Self-Education in the Early Modern British Atlantic," *Mariner's Mirror* 103 (2017), 452.

[41] Nicholas Hans, *New Trends in Education*, 214-5, 216. On Peter the Great's school see, Hans, "The Moscow School of Mathematics and Navigation (1701)," *Slavonic and East European Review* 73 (1951): 532-36.

[42] N. Pumley, "The Royal Mathematical School Within Christ's Hospital: The Early Years – Its aims and Achievements," *Vistas in Astronomy* 20 (1976), 52.

secondary school mathematics which were not to be found in schools before RMS was created."[43]

Though the School had begun with high expectations, Pumley's detailed account of the School's early struggles concluded by observing "the first 50 years of the King's foundation were not a great success." Pumley's pointed to Hodgson's arrival in 1708 and his half-century tenure as mathematical master as having stabilized the institution and having provided the secure and competent instruction needed while also securing greater connections between the School and other institutions such as the Royal Society and the Royal Observatory.[44] Thus, for Pumley, it was the combination of individual brilliance and the fortunate location of the School within the large and already well-known Christ's Hospital that ensured the School's survival and eventual success.[45] The fact that the School existed within Christ's Hospital, however, was the result of an interesting series of events that are rather telling about the haphazard development of the School and its status within English society.

In the seventeenth century, Christ's Hospital was a charity school that had begun as a foundling school in the middle of the previous century and had grown to have an average of about eight hundred male and female students. Located only a few minutes' walk north of St. Paul's Cathedral, Christ's Hospital was well-located geographically to be embedded in the social and political networks of London. It was, however, perennially short of money as it relied primarily on the combination of charity and income from properties that the school owned.

[43] Ellerton and Clements, *Samuel Pepys*, 8.
[44] Pumley, "The Royal Mathematical School," 57-8. Indeed, J.D. Davies has pointed out that existing schools in France were a crucial incentive behind the establishment of the Royal Mathematical School, see J.D. Davies, *Kings of the Sea: Charles II, James II and the Royal Navy* (Barnsley: Seaforth Publishing, 2017), 184.
[45] Being part of Christ's Hospital and having a royal patent were both significant factors in the maintenance of the Royal Mathematical School; however, the example of the mathematical school at Greenwich that was established by one of Flamsteed's former assistants, Tom Weston, demonstrates that it was possible for a school to be successful over a significant period of time without such institutional advantages. See Kim Sloan, "Thomas Weston," *Transactions of the Greenwich & Lewisham Antiquarian Society* 9 (1984): 313-33.

Charitable donations were a particularly unreliable source of income. One particularly difficult incident, the will of Richard Aldworth, played a crucial role in the history of the Royal Mathematical School at Christ's Hospital. Aldworth's 1646 will bequeathed his estate to Christ's Hospital. Though he died in March, 1648, the will was not proven until June 12, 1654.[46] As a result of the English Civil War and the resulting military dictatorship under Oliver Cromwell, Christ's Hospital did not receive the promised income. Once the monarchy was restored under Charles II in 1660, the treasurer of Christ's Hospital, Mr. Parrey, would spend the next decade petitioning the Crown and Parliament for the money the school was owed and had not received as a result of the "late Rebellion."[47]

The issue of Aldworth's bequest persisted through the entirety of the 1660s and it does not seem as though either Crown or Parliament was particularly concerned about bringing about a resolution. The Second Anglo-Dutch War, however, made the state of the English Navy and the quality of its seaman a major concern for a number of members of Charles II's inner circle.[48] It was perceived that "the trade of seaman is of much better credit in Holland & enjoys more privileges & encouragements all Europe over."[49] While Aldworth's bequest was not intended for the purposes of mathematical education or the improvement of the Navy, but, instead, was meant "to provide and ordaine a convenient Place and Receipt and Entertainment for other 40 poor Male children to be at his Cost educated in Reading, Writeing, Arithetic, and the Lattin Tongue."[50] The troublesome bequest was seized upon as a means of achieving just such an improvement. Thus, Aldworth's original bequest was allowed to fall into legal forfeiture and, in

[46] Pepys MS 2612, 103.
[47] Pepys MS 2612, 103-111.
[48] Rob Iliffe, "Mathematical Characters: Flamsteed and Christ's Hospital Royal Mathematical School," in *Flamsteed's Stars: New Work on the Life and Work of the First Astronomer Royal (1646-1719)*, edited by Frances Willmoth (Oxford: The Boydell Press, 1997), 121.
[49] Pepys, *Samuel Pepys's Naval Minutes,* edited by J.R. Tanner (London: The Navy Records Society, 1925), 134.
[50] Pepys MS 2612, 103.

1673, the Royal Mathematical School was established at Christ's Hospital for the improvement of navigation and Charles II was "Entitled to y^{e} sole Foundershipp of this Institution." By this point, Aldworth's bequest was essentially irrelevant as the money now came from the Crown and the Royal Mathematical School's purpose was "wholly unregarded to y^{e} first purposes of Mr. Aldworth."[51]

The timing of the mathematical foundation at Christ's Hospital is notable for a couple reasons. That it came in the wake of the Second Anglo-Dutch War has already been noted. Both Charles II and his brother James, the Duke of York, were closely associated with the Navy, with James acting as its commander.[52] Unlike later British monarchs, both Charles and James had significant experience at sea and were skilled seamen. Thus, a project that purported to improve the quality of the Navy perhaps piqued their interest in a way that would not have been the case for other monarchs. The Anglo-Dutch War, moreover, was expensive and Charles II was embroiled, as was the case for most of his reign, in a battle with Parliament for more money. Finally, in 1672 Charles's Parliamentary adversaries had passed an Act that forced the King's Cabinet to publically take Protestant oaths. This act had been designed in order to force into the public the secret Catholics who were close to Charles II. Most significantly, Charles's brother James—the heir to the throne—was revealed to be Catholic.

All of this is important to the Royal Mathematical School insofar as the School appealed directly to Charles's vanity at a time when his authority was at particularly low ebb. As the foundations Royal patent put it:

> Know yee therefore, That wee being desirous to promote so pious & Publick a Work, of Our Especiall Grace, Certaine knowledge & meere Motion, Have Erected, founded, constituted, Ordained, appointed, & Established, and by the Present for Us, Our Heirs, & Successors, Doe Erect, found, constitute, Ordaine,

[51] Pepys MS 2612, 111.
[52] On the history of Charles II and James II's naval interests, see Davies, *Kings of the Sea*.

> appoint, & Establish a Mathematicall Schoole to be held from time to time and for ever continued within the said Hospitall called Christ=Hospitall.[53]

The King's power was being aggressively eroded by Parliament, in stark contrast to the situation in France where Louis XIV sat as the supreme exemplar of the absolute monarch. Furthermore, Charles II's legacy was under threat. Charles had no legitimate children and James was deeply unpopular due to his Catholicism. While in 1673 these issues were merely simmering in the background, they would explode by the end of the decade, with the exclusion crisis and then eventually the so-called Glorious Revolution of 1688 in which James II was deposed in favour of the Protestant William of Orange (who was married to one of James's daughters). Thus, a Royal Foundation at Christ's Hospital offered Charles a relatively inexpensive opportunity to build a legacy.

At the time, naval training was received on the job by boys who went to sea at a young age (typically twelve to fourteen, but younger was not uncommon), much like would have been the case in any of the trades. While intended to be trained as apprentices, the quality of the education varied widely. Moreover, unlike other trades, navigation did not unambiguously belong to the realm of artisanal mechanics. For example, in sixteenth-century Spain, University cosmographers successfully wrested control over navigation in the Spanish Navy from practicing pilots.[54] In seventeenth-century England, the connections between navigation, astronomy and mathematics were the area of contention. The Royal Mathematical School served the interests of those were aligned with the New Science of the Royal Society and who conceived of navigation as a subsect of astronomy. Thus, the RMS might be seen as explicitly representing what Eric Ash has regarded as the transition of navigation from a practice to an expert skill. The early history of

[53] Pepys MS 2612, 122.
[54] Alison Sandman, "Cosmographers vs. Pilots: Navigation, Cosmography, and the State in Early Modern Spain," PhD Diss. University of Wisconsin-Madison, 2001, Ch. 2; María M. Portuondo, *Secret Science: Spanish Cosmography and the New World* (Chicago: University of Chicago Press, 2009).

the School has tended to be from the perspective of the mathematization of navigation during the seventeenth century.[55] As such, many of the accounts of the early history of the School have been biased in favour of points-of-views such as expressed by John Flamsteed disapproving quotation of Nathaniel Hawes with which this chapter opened. That much of the literature has taken such a view is perhaps unsurprising considering the major accounts were written by the primary editor of Flamsteed's correspondence in biography of Jonas Moore (Frances Willmoth), a member of Christ's Hospital (Plumley) and a Newton scholar in an edited collection on Flamsteed (Rob Iliffe).[56] All of these accounts are excellent pieces of scholarship. They were; however, written with Flamsteed or Samuel Pepys as the starting point.[57]

The mathematization of navigation is only one possible approach to the study of the Royal Mathematical School. Another option is to consider its history in the context of the gentlemen/tarpaulin debate. One of the major narratives with regard to the English Navy in the seventeenth century was that there was a sharp divide between Gentleman and tarpaulin officers, meaning officers who achieved their rank as the result of their social status and connections versus those who rose through the ranks through merit. The essential claim of the gentleman/tarpaulin controversy was that the English Navy was being weakened by commands being given to aristocrats who did not have any experience at sea over highly skilled mariners who lacked such fortunate births. The degree to which such a division actually existed in reality has been challenged by historians of the British Navy as in practice it is often difficult to separate the supposed gentlemen from the so-called tarpaulins.[58] Interestingly, the officer corps of the

[55] E.G.R. Taylor, *The Mathematical Practitioners*, 118.
[56] Frances Willmoth, *Sir Jonas Moore: Practical Mathematics and Restoration Science* (Woodbridge, UK: Boydell Press, 1993).
[57] Despite the role Pepys's would claim for himself, recent histories have demonstrated that he did not play a role in the founding of the mathematical school, Davies, *Kings of the Sea*, 184.
[58] J.D. Davies, *Gentlemen and Tarpaulins: The Officers and Men of the Restoration Navy* (Oxford: Clarendon Press, 2001).

British Navy became increasingly genteel during the course of the eighteenth century, a development that does not seem to have negatively impacted the competency of the Navy. Moreover, social connections were crucial for advancement regardless of one's social class as promotions were meted out primarily through the fortunate association with a successful commander.[59]

The controversy, thus, to an extent, a strawman used by a number of individuals in the seventeenth century who wished to initiate reforms to the Navy and the most prominent of these reformers was Samuel Pepys. The British Naval historian J.D. Davies contested the importance that Pepys's opinions had been accorded by historians who studied the seventeenth-century Navy. According to Davies, because Pepys kept such extensive and well-organized records, and because his manuscripts were so conveniently located, historians ended up neglecting other significant sources such as the naval records now housed at Kew. This has led to the history of the English Navy during the seventeenth century to have been seen almost exclusively from the point-of-view of Pepys. While Pepys tended to flatter himself as to his importance—the prominence to which he gave himself as President of the Royal Society on the title page of Newton's *Principia* being one good example—Davies has demonstrated that Pepys was only one part of the larger Naval enterprise. Pepys's particular background meant he favoured what might be described as middle-class virtues. He had a marked preference for standardized education, examinations and preferred tarpaulin to gentlemen officers. Pepys was, however, an administrator. Though he had sought to educate himself on the subject of navigation upon joining the Naval Office and thus had read much of the literature on the subject, he had very little practical experience at sea.

[59] N.A.M. Rodger, *The Command of the Ocean: A Naval History of Britain, 1649-1815* (New York: W.W. Norton & Company, 2005), 115.

Due to Pepys's fastidious record-keeping, the interest in the School by figures such as Isaac Newton and John Flamsteed and a series of controversies regarding the competency of its schoolmasters and what sort of instruction its students ought to receive which dogged its early years, the material available for the period of 1673 to around 1700 are significantly greater than is the case for the eighteenth century. Thus, it is much easier to develop a detailed account of the School's first thirty years than it is for the thirty years that followed. The story of the early period of the Royal Mathematical School has been excellently told a number of times and, therefore, I will not give a more detailed narrative in this chapter. To summarize somewhat facetiously, the Royal Mathematical School was established in 1673 and went through a string of generally unsatisfactory schoolmasters until 1709 when Samuel Newton resigned and Flamsteed's former assistant James Hodgson was given the job. Hodgson then went on to hold the position until his death in 1755 during which time the School seems no longer to have been a source of public controversy. With the arrival of James Hodgson, the School finally had a qualified mathematical master and disrepute and poor instruction that had marked its early history has been regarded as a thing of the past. In what remains of this chapter, however, I seek to re-evaluate the early controversies, the Royal Mathematical School under James Hodgson and finally the place of the School within education and marine history.

Expertise Contested at the Royal Mathematical School

As was touched upon at the beginning of this chapter, the early years of the Royal Mathematical School were frequently turbulent and its management and teaching came under heavy criticism. After James Hodgson became mathematical master, however, such public criticism disappeared, which has generally been regarded as a sign that the school eventually achieved significant success. It is less clear to me, however, that the contrast between the largely

failed early years and the supposedly triumphant period after 1709 is entirely warranted. In this chapter I aim to demonstrate the ideological convictions that underlay the critiques made by Samuel Pepys, Isaac Newton and John Flamsteed in order to show that the early years of the school, while certainly troubled, were not necessarily as disastrous as has been claimed. Meanwhile, careful investigation of Christ's Hospital's institutional records has suggested to me that the School under James Hodgson was less stable than it appears from the outside. The school was caught between a number of different competing interest groups—sea captains, the Board of Governors, the school masters, the students, Newton and Flamsteed and the Navy itself to name a few—and these interests frequently did not align. Thus, the questions that have guided my study have been: How did the school operate on a day-to-day basis? And how does the Royal Mathematical School help to develop a better understanding of "expertise" in the period being covered by this dissertation? Essentially, who is an expert? How does one teach expertise? How can such expertise be accredited?

When the school was first established, it does not seem as though such questions were at the forefront of the minds of those involved. Indeed, Samuel Pepys's extensive records relating to the early years of the school indicate that significantly more time and effort was devoted to designing the badges the mathematical boys were to wear than to the selection of the first mathematical schoolmaster or the development of the curriculum. Curriculum, examinations and the system of apprenticeship were all sorted out on an ad hoc basis as the school's governors attempted to resolve unforeseen problems. One example of this was the "King's bounty," which was payment made to captains who took on one of the mathematical boys as an apprentice.

Essentially, the Crown provided the equivalent of the first three years of wages in exchange for agreeing to provide the boy in question with a seven year indenture at sea.[60]

Initially there was no such provision of funds to pay apprenticeship fees. The payment of an apprenticeship fee to the intended master was standard practice; however, the provision of payment was only set up after it was found to be inordinately difficult to obtain appropriate masters for boys who had completed their education and were considered ready to go to sea.[61] By August 21, 1675, fifteen boys had completed their education and passed an examination at Trinity House, but did not yet have a place on board a ship. The Governors expressed concern:

> For the future Welfare of those Boys as to pravaile with His Majesty to write effectually to the East India, Turky, Royall African, & Russia Company's to perswade them to establish an order in their Respective Courts. That y^{e} Commander of every Shipp, which they shall hire or imploy in their Severall Trades, may be by them oblidged to take one of those Boys, and such others as shall from time to time be fitted for ye sea, from this foundation, and constantly imployed by them in their Navigation.[62]

Though the School had been set up with the Navy in mind, the nation was not involved in a naval war when the first students were ready to go to sea. In response to the predicament, Pepys wrote letters to the East Indian, Russian, Turkey, African and Muscovian Companies imploring their assistance.[63]

The first mathematical master was a man by the name of John Leake. Leake had previous experience teaching mathematics and navigation. Unlike later schoolmasters, there is no record of Leake's application for the job, who his references were or if he had any competition for the position. The Court Records simply state, "Mr. Leake this Day first tendering his Service to be

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[60] The King's Bounty worked out to three payments of 12 pounds, 7 shillings. An ordinary seaman's wage at the time was 19 shillings/month for a thirteen month lunar year, Pepys MS 2612, 169.

[61] On the King's Bounty see Pepys MS 2612, 153, 165. On apprenticeships in England in the eighteenth century, see Malcolm Graham, *Oxford City Apprentices, 1697-1800,* Oxford Historical Society, New Series 31 (Oxford: Clarendon Press, 1987).

[62] Pepys MS 2612, 148-9.

[63] Pepys MS 2612, 166. No company by the name of the Muscovian Company was able to be found and thus the letter intended for it remained in Pepys's possession.

Master."[64] Similarly, he does not seem to have received many directions as to how and what specifically he was to teach. He was to instruct forty bluecoat boys and was given leave to take on another forty from outside the school to supplement his salary, which was set at £50 per year.[65] As for his manner of instruction, Leake promised:

> I will constantly & diligently attend upon y^{e} said forty Children of the New Royall Foundation from seven of the Clock in y^{e} morning with all diligence & Care teaching and instructing the said Scholars in the said Arts of Arithmetick and Navigation until it bee Eleven of y^{e} Clock; and from one of the Clock in y^{e} afternoon until Five of the Clock, or at such houres, days, & Times as y^{e} Governours shall thinke fitt to direct & appoint.[66]

He also agreed to take the boys to geometry lectures at Gresham College and to keep the books, globes, maps and instruments necessary for the teaching of navigation. It was not indicated if the school's governors expected any specific books to be used. A list of books owned by the school, however, suggests that its mathematical master and students had access to a fairly large number of navigational and mathematical texts.

Similarly, the school possessed an impressive collection of instruments.[67] As well, Jonas Moore was in the process of preparing a textbook for the Royal Mathematical Foundation's use, which would be completed principally by John Flamsteed after Moore's death. While it had aimed to be the primary mathematical textbook for the Mathematical School, it appears to have been unsatisfactory for those purposes and it does not seem to have been particularly used. Though there are not clear and consistent records as to what the students were taught, there is reasonable evidence as to what they were expected to know before they were considered ready to go to sea. Initially, there were not any plans for how the boys were to be certified; however, it

[64] Pepys MS 2612, 135.
[65] On the mathematical master's salary, Pepys MS 2612, 135; on the number of students and permission to take on external students, Pepys MS 2612, 141.
[66] Pepys MS 2612, 141-2.
[67] See "Inventory and Catalogue of the Bookes, Globes, Mapps, and other Instruments belonging to y^{e} Mathematicall Schoole in Christ's Hospitall London, deliver'd to D^{r} Robert Wood, 28th January 1680," MS 2612, 371-8.

was decided that the boys should be subjected to an external examination by the Masters at Trinity House in order to demonstrate their competence. Trinity House was made up of ship captains and was responsible for protecting the interests of sailors as well as the maintenance of lighthouses.

The first round of examinations occurred on August 21, 1675 with fifteen boys going down to Trinity House. As all fifteen passed, the performance of the mathematical boys seemed to be satisfactory. The letter sent from Trinity House to accompany the certifications stated:

> This comes to accompany y^{e} inclosed Certificates on Behalf of y^{e} poore Children concerned therein, in w^{ch} (as wee hope) wee have done them full rights, soe wee take this occasion of letting you know, That it is matter of very great content to us, to see His M$^{t's}$ Royall Institution (under yo^{r} Care) receive soe hopefull a Beginning as y^{e} Instances wee have met wth, Both of y^{e} ability & Industry of Mr Leake yo^{r} Mathematicall Schoole=m^{r} & y^{e} great Improvement of y^{e} Child^{n} under him has given us y^{e} knowledge of, in this first Office of Service wee have been called to, by you, assuring you, That in w^{t} ever else it shall fall within Our power to contribute towards y^{e} Advantage of this His M$^{t's}$ Foundation, & Benefitt of y^{e} poore Child^{n} interested in it, you shall find us most ready to doe y^{e} same.[68]

The letter went on to outline the aspects of navigation on which the boys were questioned:

> 1. The principles of Geometry with y^{e} practice theof in describing of lines, Angles, Paralells, Chords, Sines, Tangents, Secants, Triangles, and all sorts of plaine Geometricall Figures by a plaine Ruler and Compass.
>
> 2. The division and proportionall section of Lines the use of y^{e} Diagonall Scale, & y^{e} Rule of Three in Lines, with y^{e} dividing of y^{e} Circumference of a Circle, & y^{e} Description of ye scale of Chords, Houres, Rumbs & Longitude.
>
> 3. Decimall Arithmetick with y^{e} Composition & Extracon of y^{e} Square Roote
>
> 4. The Doctrine of y^{e} plaine straight lined Triangles wth y^{e} use of y^{e} Naturall Tables of Lynes, Tangents & Secants.

[68] Pepys MS 2612, 145

5. Propositions of y^{e} Julian Calendar with y^{e} Comon Rules for finding y^{e} Course of ye Sun, Moone & Tydes.

6. A general Rule for finding y^{e} Latitude by y^{e} Sun and fixed Starrs

7. Questions of plain sayling with y^{e} use of the plaine Sea Chart.

8. The use of Logarithms & Tables of Artificiall Lynes and Tangents.

9. The use of Gunter's Scale

10. The projecting of the Sphere in Circles or Globe on a plaine, Diverse ways, with y^{e} Rule of projecting all sorts of Mapps.[69]

Thus, the project was off to a good start and John Leake seemed to be a capable mathematical master. This state of affairs would not last long, however, and soon Leake's suitability began to be questioned.

While Leake was experienced as a mathematical teacher and clearly knew well enough what needed to be taught, he was elderly ("antient" according to one description in the minutes) and soon the physical strain of providing instruction from "7 of y^{e} Clock in y^{e} morning" until "11, & from one in ye afternoon till 5, except Holy-days" with only three weeks off during the year began to catch up with him.[70] The number of students the mathematical master was to teach was reduced to a maximum of ten from each cohort and the mathematical master was no longer allowed to take in external students to supplement his salary. In order to make up for this lost income, the mathematical master's salary was increased, rising from its initial £50 to £70. By 1680 it had been increased further to £100 pounds.[71] As well, Leake was allowed to hire an assistant so as to reduce the burden on himself. While these changes were intended to improve

[69] Pepys MS 2612, 146-7.
[70] Pepys MS 2612, 195, 180b.
[71] On prohibiting the mathematical master from outside teaching and the subsequent increase of his salary, see Pepys MS 2612, 418-9. On the mathematical master's salary in 1680/1, see Pepys MS 2612, 365.

the quality of instruction within the school, it remained unclear what Leake was expected to be teaching. Despite the positive outcome of the first set of examinations, in November, 1676 Leake requested more clarity in what was expected and that he be provided with "a Rule from y^{e} Worthy Members of Trinity House as to y^{e} Instructions of y^{e} Children hereafter, that be they may come qualify'd to their Examination."[72]

In response to Leake's request, it was decided that Pepys, who had recently become one of Christ's Hospital's governors, would provide Leake with a more defined set of expectations. Presumably Pepys did as instructed, however, no record seems to have been kept as to what, if any, further instructions Pepys might have given Leake regarding what the mathematical students were to be taught in preparation for the examination other than a timetable that Pepys's produced indicating the expected progression of students through the school (see Table 1 below). Those children who did not obtain the proficiency required by the age of sixteen were "Not to partake of the King's bounty, but to be placed forth to Trades as the other children of the Hospital be."[73] Despite this claim, in reality many students failed to receive their qualifications on the first attempt and were given time for further study and a second opportunity to take the examination rather than being put out of the mathematical school.[74] An investigation of the records of apprenticeships received by the mathematical students indicates that it was quite uncommon for a boy not to be apprenticed on board a ship and in the instances where such an apprenticeship did not occur, it was typically for reasons other than academic failure. While Pepys's plan seemed reasonable on paper, in practice his schedule was frequently too ambitious for students to maintain.

[72] Pepys MS 2612, 228.
[73] LMA CLC/210/B/001/M MS 12873/02, 32.
[74] The only mathematical boy I came across in the records as having been turned out of the school without being apprenticed was Richard Masters in 1703.

Pepys's description	Age	Length	Age at Completion
"Writeing school to prepare him for the Latine"	9	½ Year	9 ½
"The Latine School to understand Tully's Epistle or Erasmus Colloquy's"	9 ½	4 ½ Years	14
"The Writeing Schoole to finish his Writeing and Learne Arithmetick to the Rule of Three"	14	½ Year	14 ½
"The Mathematicall Schoole to be raised to a proficiency fitting him to be put forth as an Apprentice"	14 ½	1 ½ Years	16

Figure 1.1: Pepys's Plan for Student Progression (LMA CLC/210/B/001/M MS 12873/02, 31-2)

Nicholas Hans's principal claim regarding the Royal Mathematical School was to see it as an exemplar of a general trend in education during the eighteenth century.[75] For Hans, education transitioned from the traditional grammar schools to a more practical, technical education as Britain became increasingly industrial and urban. Hans made an important contribution to the historiography of education as his work sought to revise how grammar education in eighteenth-century England was viewed. The classic work on the subject had been done in the nineteenth century by Arthur Francis Leach, an All Soul's, Oxford Fellow and Principal, who was deeply prejudiced by his bias toward a classical education.[76] His view of

[75] Cf. Keith Thomas, "Numeracy in Early Modern England: The Prothero Lecture," *Transactions of the Royal Historical Society 37* (1987): 103-32.
[76] Richard Thompson, *Classics or Charity? The Dilemma of the Eighteenth Century Grammar School* (Manchester: Manchester University Press, 1971), vii. Brian Simon's argument that the English educational system was designed in the nineteenth century to keep the poor in their place is also instructive for understanding the context in which

what a proper education entailed led him to regard the eighteenth and nineteenth centuries as a period of decline as venerable grammar schools lost their previous vigour. As access to education increased, the emphasis became increasingly vocational and Latin and Greek went into sharp decline. For Leach this was a sign of decline, while Hans regarded it as a renewal.[77]

Leach and Hans, then, did not disagree that the old grammar schools had lost their place of primacy in English education; instead, where they differed was on if this was good or bad. Neither was particularly informed by statistics and a number of social historians beginning in the 1970s used more data-driven approaches to challenge many of the central assumptions held by both Leach and Hans.[78] Lawrence Stone, for instance, posited an education revolution in the seventeenth and eighteenth centuries that put into place the structures that allowed the development of the highly literate, urbanized, middle-class world of the nineteenth century.[79] Meanwhile, as O'Day observed, "the acceptance of Latin as the be all and end all of grammar school education was at odds with reality in many cases," even at its supposed peak in the seventeenth century.[80] David Cressy's study of literacy rates from the mid-sixteenth to mid-eighteenth centuries suggested that while literacy did increase during the period, it was "not

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Leach was working, see Brian Simon, *The Two Nations and the Educational Structure, 1780-1870* (London: Lawrence & Wishart, 1974), 366.

[77] Hans, *New Trends in Education*, 209.

[78] The most substantive critique coming from Joan Simon, see Simon, "Private Classical Schools in Eighteenth Century England: A Critique of Hans," *History of Education* 8 (1979): 179-91; *History of Education: Major Themes, Vol. II: Education and its Social Context,* edited by Roy Lowe (London: Routledge, 2000).

[79] Lawrence Stone, "Literacy and Education in England 1640-1900," *Past & Present* 42 (1969), 69-139; Rosemary O'Day questioned his basic premise and argued that change was much slower and more erratic than Stone would have it. For O'Day the developments at the end of the seventeenth century represented social 'cement' rather than agents of change, see O'Day, *Education and Society, 1500-1800* (London: Longman, 1982). W.A.L. Vincent, meanwhile, sought to demonstrate that the decline of education in the eighteenth century actually occurred in the Restoration Period, contending that changing needs, curricular rigidity and the low salaries of schoolmasters made endowed grammar schools unattractive to those with better options, Vincent, *The Grammar Schools: Their Continuing Tradition, 1660-1714* (London: John Murray, 1969).

[80] O'Day, *Education and Society*, 65. Similarly, David Cressy's work on literacy rates called into question the assumption that literacy was constantly rising between 1530 and 1730, Cressy, *Literacy and the Social Order: Reading and Writing in Tudor and Stuart England* (Cambridge, Cambridge University Press, 1980). His analysis of marriage records suggested that in the middle of the eighteenth century approximately 40% of men and 60% of women were unable to sign their name, p. 176

sudden or spectacular" and in the second half of the eighteenth century literacy stagnated.[81] Cressy emphasized that "literacy did not occur as a natural development at a particular stage of childhood, but depended on successful contact with a teacher, contact which for many children was frustrating, fleeting, or never happened at all."[82]

From a macroscopic perspective, then, Hans's thesis that education in England underwent a transformation from being focused on the classics and ancient languages with the intention of education a small middle-class for positions in the church to a more varied and dynamic education that had greater emphasis on the vernacular, mathematics and practical skills needed as England urbanized and the middle-class grew is not as clear-cut as he presumed. At a glance, however, the Royal Mathematical School does appear to fit his hypothesis as its primary objective was to find apprenticeships for its boys. Doing so would, hopefully, provide them with a profession and, therefore, ensure that they would be able to be self-supporting adults. Despite these stated assumptions, the make-up of the student body calls this somewhat into question. Richard Thompson's analysis of the occupations of the students' fathers found a significant change in social backgrounds for the students during the eighteenth century. While in 1700 Christ's Hospital was a charity school whose students were drawn from the lower classes, by 1800 the social background of its pupils had become decidedly middle-class.[83] Meanwhile, Rosemary O'Day pointed out that while Christ's Hospital was initially intended to take in fatherless and illegitimate children, it quickly closed its doors to them and limited itself to

[81] Cressy, *Literacy and the Social Order*, 176-7.
[82] Cressy, *Literacy and the Social Order,* 34. Cressy also argued that the growth of universities in late-seventeenth-century England meant there were more educated men than could be accommodated by Church employment. Thus, those who could not obtain a position in the Church turned to teaching. He does not speculate how much this increase in available school teachers might have contributed to improving literacy or whether the growth of new employment opportunities outside of the Church for university educated men as the British state took on its "modern" character in the eighteenth century might have negatively impacted education in the latter half of the century, pp. 168-9. Cf. Vincent, *The Grammar Schools*.
[83] Thompson, *Classics or Charity?*, 96.

children of freemen and citizens of London becoming "an institution caring for the domestic, responsible poor rather than the vagrant child."[84] The students in the seventeenth century, then, were those who could reasonably be expected to take up a trade, but whose family did not have the means to elevate the child without assistance.

The school abandoned its commitment to the lowest classes and the education received at Christ's Hospital was as much focused on moral and religious education as on teaching practical skills. The schoolmaster was expected to "see yo^{r} Child^{n} make Pray^{rs} & Supplicon to God both morning & Evening" and to "attend at Christ's Church upon yo^{r} Child^{n} every Lord's Day soe they may be kept in order during Prayers & Sermon-times."[85] As the children came to the school from the London poor, such moral instruction was deemed particularly essential so that they would be able to rise above the ignobility of their births. Sailors were frequently regarded as being morally questionable. For example, when Edmond Halley expected to succeed John Wallis as Savilian Professor of Astronomy at Oxford, Flamsteed sought to impinge upon Halley's character claiming, "now talks sweares and drinkes brandy like a sea captaine so that I much fear his own ill behaviour will deprive him of the advantage of this vacancy."[86] While such slanders by Flamsteed had little effect on Halley's career—he got the position and would later succeed Flamsteed as Astronomer Royal—it does demonstrate the concern held by many middle-class English that the Navy needed to be made more virtuous. It was believed that the introduction of youths who had received strong moral education and were inoculated by middle-class values from the moral dangers that came with going to sea would further serve to improve the moral character of the English Navy. Notably, the first requirement listed when replacing John Leake in 1677 was that the mathematical master was to "be a sober discreet & diligent Person, of good

[84] O'Day, *Education and Society*, 246.
[85] Pepys MS 2612, 180b.
[86] Flamsteed to Abraham Sharp, 18 December, 1703, *Flamsteed's Correspondence, vol. 3*, 47.

Life, Governm[t] & conversation."[87] In this regard, the tenure of the third mathematical master, Dr. Robert Wood, is particularly indicative of the importance of moral instruction in the minds of the school's governors.

The choice of Wood was controversial to begin with as he was an Oxford scholar who had neither practical experience with navigation or teaching youths. Though neither of the two previous mathematical masters, John Leake and Peter Perkins, had come from Oxford or Cambridge, the requirement that the mathematical master have strong enough Latin and Greek to continue the boys' education in those languages limited the available candidates.[88] The emphasis on Latin belies the view of Christ's Hospital as an exception to the norm. This expectation made it significantly more difficult for someone to be found from outside of the Universities. It was generally expected that a University mathematician would have the skill so as to be able to pick up the necessary navigational knowledge without significant difficulty. In contrast, someone who had practical experience in navigation, but lacked Latin could not be expected to learn Latin and Greek while also employed as the mathematical master. Robert Wood's abject failure as mathematical master severely challenged this belief.

Wood might have been a capable mathematician; however, he was not a good teacher. As mathematical master he was expected to put in long hours every day. When he was hired he promised not to employ an assistant, which had been an issue previously with Leake because the school's governors were not able to vet an assistant to ensure they met expectations.[89] Moreover, the position of mathematical master was already difficult to fill because the salary did not

[87] Pepys MS 2612, 233.
[88] Pepys MS 2612, 233.
[89] Pepys MS 2612, 421.

correspond with the expectations and requirements.[90] Wood failed to live up to these obligations. A few months after Wood was hired, the general state of the Royal Mathematical School was reviewed and the mathematical students questioned to see how well they were progressing. The review was not positive as the examiner deemed "that y^{e} said Children have been neglected, for that they might have learned more in a month's time, then what most of them have been doing since Christmas last." Furthermore, "some of y^{e} Children, & upon examinacon y^{e} Child^{n} were found to be very deficient in answering to what y^{e} Dr. what said he has taught them, & particularly in y^{e} Doctrine of y^{e} Globe."[91] Not only were the students not being taught at an adequate rate, but they did not even remember what they were supposed to have been taught. When the committee called Wood in to explain himself, he admitted that due to poor health he had not always been able to attend to the students as much as was expected, though he "constanty employ'd a man to look after them." The committee was not satisfied and resolved "y^{t} they would meet every first Thursday in y^{e} Month to inspect wheth^{r} he was performing his Duty or not, & what progress y^{e} Child^{n} make in their Learning und^{r} his care."[92]

Though the governors had resolved to keep a closer eye on Wood, the situation does not seem to have improved. Samuel Pepys met with members of Trinity House regarding the mathematical boys and reported back to Christ's Hospital "they have of late found y^{e} Boys very deficient in their Arithmetick & have complain'd of It & other Defects to their very Masters."[93] One of the principal reasons why Wood had been hired was due to his faculties in Latin; yet, the mathematical students' Latin fared no better than their mathematics and Wood was noted to have

[90] The mathematical master at Christ's Hospital, however, was better paid than was typical for school teachers of the period. The typical salary was £30-40 and £100 was at the high end of salaries, see Richard Thompson, *Classics or Charity?*, 31. Vincent gave £20-30 as typical in the Restoration period and noted that such salaries put teaching on par with lower paid clergy, shopkeepers, tradesmen and artisan and above common seamen (£20), labourers (£15), and common soldiers (£14), Vincent, *The Grammar Schools,* 102, 170-1.
[91] Pepys MS 2612, 385-6.
[92] Pepys MS 2612, 386.
[93] Pepys MS 2612, 392.

been entirely neglectful in that area.[94] The man whom Wood had hired to assist him with the boys was a particular concern. Despite all the promises Wood had made to the governors that he would attend to his responsibilities, it was alleged that "y^{e} Doctor never teaches any of them himselfe...this even when some of them (& particularly Guy) have gone to his Closett on purpose to be inform'd by him."[95] Similarly, Wood did not look over the students' books, except on one occasion when there had been complains of some boys tearing their books. Even then, "wth out examining their Bookes himselfe, but committing it to some of y^{e} Elder Boys, he sent for a Bealde & caused to whip those that were found guilty."[96]

Instead of teaching the mathematical students, Wood seems to have kept himself in his rooms and left the teaching and discipline to Hudson, the usher he had hired. Unfortunately, this man was "One for whom they have noe reverence, he being an idle drunken fellow, having at times come to them plainly in Drink, setting them ill Examples in y^{e} slovenliness of his Dress; lodgeing in an Ale-house," spending all of his money on drink and mistreating the boys. The situation meant that "they have learned y^{e} most part of what the know from y^{e} upper Boys & not from their Mast^{r} nor Hadson; save a little of sphericall Triangles, w^{ch} they say y^{e} Trinity House told them they were taught wrong, & y^{t} they must untaught it againe."[97] Meanwhile the boys were "ungovernable" and took "great liberty in spending their time at Schoole, even to y^{e} playing at Football there. As alsoe takeing their owne hours of going into y^{e} Schoole & leaving it."[98] This was contrasted to the governing of the boys under Leake and Perkins, who it was claimed had understood the rules and carried out their duties satisfactorily.

[94] Pepys MS 2612, 505-6.
[95] Pepys MS 2612, 409.
[96] Pepys MS 2612, 410.
[97] Pepys MS 2612, 410.
[98] Pepys MS 2612, 412.

Robert Wood was clearly not a good teacher, but he was not the only problem. It remained unclear to everyone involved what the students ought to be taught. While Jonas Moore had laboured to prepare a mathematical textbook for use in the school, a committee deemed it necessary that the book be "inspected into, & so much thereof taken out as is necessary for y^{e} instrucon of y^{e} Math Child^{n} in their Learning."[99] Because there was no set curriculum, it was difficult to establish what the students should be expected to know. Pepys had drafted a schedule for how the mathematical boys were to progress through the school; however, it was not particularly specific. Similarly, there was a disconnect between what the different mathematical masters taught and what the examiners from Trinity House expected the students to know. Moreover, the efficacy of sending to the boys to Trinity House to be tested is not clear. While "upon Examination, how to judge whether a Boy answers and works right or wrong," because they were not involved with any of the day-to-day instruction and "through want of use and overlooking their Books they are not themselves best fitted for Examining y^{e} Children."[100] The decentralization of education meant there were significant differences in the standards of education and even within institutions disagreements regarding the selection of new masters, the criteria and who should make the appointment were frequent. Thus, such problems were not confined to Christ's Hospital, but were frequently faced by endowed grammar schools of the period.[101]

The fundamental problem at the heart of the Royal Mathematical School's early difficulties was not the competency, or the lack thereof, of its early educators, but the vagueness of its remit. The School was established in order to teach boys mathematics in order to improve navigation at sea, but what this entailed or how it was to be executed was not planned in

[99] Pepys MS 2612, 386.
[100] Pepys MS 2612, 392.
[101] Vincent, *The Grammar Schools,* 184-8 and Ch. 8.

advance. This meant that the early mathematical schoolmasters were left to sort things out on their own. In 1677, following the tenure of John Leake, Samuel Pepys presented the governors of Christ's Hospital with a long report outlining the School's current shortcomings. In this report Pepys made it rather clear the extent to which the School had been set-up and then operated on an ad hoc basis. According to Pepys, while the first set of boys had been exemplary, the School had already begun a rapid decline and "it is complained of by the Gentlemen of the Trinity House universally and others" that the most recent students were "beneath the first sett of Our Boys were raised to."[102] It was not only their mathematical skills that were not up to par, but "though some of them appear entred toward a good hand, yet they are few, and those not able in y^{e} fairest of their writing to writte true English." Meanwhile, their Latin was so poor that "Wee found them as Ignorant of Latine as if they had never learned a word of it, or been acquainted with any one Rule towards it."[103]

The problems were not limited to the Mathematical School as "even they that were presented to us the Other day by the Gram^{r} Mast^{r} to bee advanced to the Mathematicall Schoole knew not how to put a sentence of ten words of the plainest English into true Latine."[104] Indeed, the mathematical master was not the only position the school had difficulty filling adequately. For instance, the grammar and catechism master Mr. Mansfield was fired in 1682 for failing to fulfill his duties and he was not the only such example of one of the non-mathematical masters being removed from his duties.[105] However, the Mathematical School was funded by the Crown,

[102] Pepys MS 2612, 249.
[103] Pepys MS 2612, 249.
[104] Pepys MS 2612, 249.
[105] Pepys MS 2612, 461. Mansfield had previously been warned to improve his performance telling him that "if for y^{e} time to come he did not better look to y^{e} schoole and Children under his care as Gramer Maister & Cattechist, they would report to y^{e} Court, that he is no fitt person for y^{e} Employment," Pepys MS 2612, 390. In another example, in 1695 there was a report on the current state of the different schools indicated the "corruption" and deficiencies found in the writing school and the inadequacy of the current writing master John Smith. As a result of the examination, Smith resigned, see LMA CLC/210/B/001/M MS 1206/08, 390-2.

had a Royal patent and had higher ambitions for its students than was the case for most of the ordinary students. This meant that the Mathematical School was held up to greater external scrutiny than was the case for the rest of Christ's Hospital. Many of the difficulties the School dealt with are perhaps more reflective of the general problems inherent in running a school in seventeenth and eighteenth-century England than specifically with the poor governance of Christ's Hospital itself.

When Samuel Newton was hired in 1694, it marked a change in direction for the Mathematical School. Though the first two mathematical masters had not come from the Universities, the next two—Dr. Robert Wood and Edward Pagett had. The preference for a University educated mathematical schoolmaster was due to the desire to have someone versed in theoretical mathematics and skilled in Latin; however, Pagett's hiring after the disaster that had been Wood's tenure caused an immediate rift. Samuel Pepys, in particular, was incensed. He had concluded that the emphasis on Latin was misguided and a principal problem with the mathematical masters the School had hired up to that point was that they lacked experience at sea.

Wood's incompetence as a teacher made it particularly clear to Pepys that a University man was especially ill-suited for the role. Having submitted his view to the Christ's Hospital governors, Pepys was then obligated to be away from London when Wood's replacement was to be chosen. Upon his return, he found the School had overlooked candidates with practical experience in favour of another University educated mathematician who had no practical experience either at sea or as a teacher.[106] For Pepys, this was nearly the last straw. He found his

[106] The candidates were Edward Pagett, Fellow of Trinity College, Cambridge; Richard Norris, mathematician and mariner; Reeves Williams, mathematician and mariner; Thomas Street, mathematicians; George Fairfax, mathematicians, Pepys MS 2612, 531.

advice repeatedly ignored and ultimately resigned from his position as governor and recused himself of any further responsibility:

> Memorandum – That from my Despaires long since conceived & frequently in this Collection mentioned of any satisfactory successe to this Foundation from y^{e} Methods of it's then management, & being therein dayly confirmed by my observations of y^{e} still greater inproficiencyes of it's Children at theyr Examinations at ye Trinity House, I persisted in my first withdrawing myself from ye Care thereof, to the time of the Generall Dissolution of the Government both of the Hospitalls & City. Nor though rechosen thereinto by the succeeding Commission of his Majesty's, bearing the date of 26th of October 1683 (which GOD prosper) can I yet finde any Encouragement to the reengaging myself in any new Charge therein.[107]

He would continue to abstain from involvement for the next decade, only to be spurred back into action around the election of Samuel Newton in 1695, by which time he no longer held his position at the Navy.

When John Evelyn visited Christ's Hospital in 1687 he was very impressed. He described the school enthusiastically in his diary:

> I went this evening to see the order of the boys and children at Christ's Hospital. There were neere 800 boys and girls so decently clad, cleanly lodg'd, so wholesomely fed, so admirably taught, some the mathematics, especialy the forty of the late King's foundation, that I was delighted to see the progresse some little youths of 13 and 14 yeares of age had made.[108]

Yet, as we have seen, those more closely involved with the school's operations were less satisfied with its condition. The tenures of Edward Pagett and Samuel Newton saw Christ's Hospital endure some of its most sustained crises. In particular, toward the end of the 1690s, Christ's Hospital's finances were in such disarray that it was unable to take new students for

[107] Pepys MS 2612, 722. The last few years had been trying for Pepys as he had spent two years locked up in the Tower of London on suspicion of treason due to his close association with Charles II and James. After James II was deposed in 1688 Pepys lost much of his political capital and suspicion of Jacobite sympathies dogged Pepys for the last few years of his life.

[108] John Evelyn, 10 March, 1686-87, *The Diary of John Evelyn, ESQ., F.R.S., to which are added a selection from his familiar letters and the private correspondence between King Charles I and Sir Edward Nicholas and between Sir Edward Hyde (Afterwards Earl of Clarendon) and Sir Richard Browne, edited from the general MSS. by William Bray, with a Life of the Author and a New Preface by Henry B. Wheatley, vol. III* (London: Bickers and Son, 1906), 34.

couple years.[109] Such pressing concerns as well as the general political climate of the time might in some part explain why both Pagett and Newton were each able to persist in their posts for well over a decade despite repeated accusations of incompetence and failure. Pagett, furthermore, benefitted from a seemingly positive relationship with influential figures within Christ's Hospital. While Pepys held him in low regard, the treasurer Nathaniel Hawes was much more positive:

> We beleive we have substantial reasons to esteem Mr. Pagett better than ordinarily qualified for his imployments & myself have good reason to esteeme him a Gentleman of soe much ingenuity & Constiense that he wil not, nay that he does not faile to apply those qualifications, for the most advtange & improvement of his schollars.[110]

Significantly, it was not Pagett's qualifications as a teacher that ultimately led to his undoing, but his persistent poor health that had led him to be absent from his post for the last two years of his employment, a situation that did not seem to be likely to improve as Pagett had requested further absence in order to recover his health, which the Court of Governors rejected in the hopes that "by his constant attendanse and diligense he will retrieve what hath bin found amisse."[111]

When Pagett was hired, Samuel Pepys had pointed to Pagett's obvious shortcoming—that he had not been to sea—and there was an attempt to address this. The mathematical committee suggested he be given leave to go to sea and gain some practical experience shortly after he was hired and Pagett would make similar requests later on.[112] Pagett's request points to one of the more obvious challenges the school faced: the mathematical boys were expected to learn navigation without the opportunity to obtain direct experience. It was a problem recognized

[109] Pepys wrote a number of reports regarding the finances of Christ's Hospital, see LMA CLC/210/B/001/M MS 1206/08, 527-8; 609-12; 613-39. In gratitude, the governors made him treasurer on March 22, 1698/9, 646.
[110] Nathaniel Hawes to Samuel Pepys, April 24, 1694, BL Add. MS 20732, f. 14r-v.
[111] William Parrey to Samuel Pepys, August 9, 1694, BL Add MS 20732, f. 31r.
[112] LMA CLC/210/B/001/M MS 1206/06, 431. The Navy, similarly recognizing the problem that the great majority of teachers of navigation seldom went to sea themselves added £20 per annum to midshipmen's pay to any willing to go to sea and undertake the duties of schoolmaster, Dickinson, *Educating the Royal Navy*, 13.

from the outset, Pepys for instance noted: that "the Foundation of Christ-Hospital, as it is now set for the teaching the children all they are to be taught before they go to sea to have any practice, will never do the business it is designed for, their masters being generally very ignorant themselves."[113] Despite the awareness of the problem, the school struggled to find a way to resolve it. While some plans were made to send Pagett to sea for experience, there is no evidence that these plans were ever acted upon. As well, the amount of skill he would have been able to obtain during twenty days at sea would have been rather limited. It does; however, suggest that he took his position seriously and was diligent in carrying out his duties while his health still permitted despite how he was represented by Flamsteed. Such efforts may have endeared him to Hawes and the other governors; however, it did not assure the quality of his instruction.

The relationship between the mathematical masters, the governors of Christ's Hospital and the masters at Trinity House, moreover, was troublesome as the examiners provided by Trinity House and the mathematical masters frequently clashed. Robert Wood, Edward Pagett and Samuel Newton all claimed that the examiners were prejudiced against them and that it was this bias, rather than the quality of instruction, that led to their pupils' frequent failures when examined. For example, Trinity House noted that Wood complained, "Of Discouragem^{t} in y^{e} execucon of his Employm^{t} from our Witholding to grant Certificates in approval of y^{e} proficiencies of some of y^{e} Children of the said schoole whom he has under his Hand reported to be duely qualified in y^{e} severall Points of y^{e} Arts of Navigacon & science of Arithmetick."[114] Unsurprisingly, they denied any prejudice against him and "that we are so far from being conscious of any personal disregard to y^{e} s^{d} Doctor, or inclinacon to y^{e} giving him y^{e} least discouragement in y^{e} well performance of his Duty, that we have ever endeavoured to give >to<

[113] Pepys, *Tangier Papers*, 115.
[114] Pepys MS 2612, 449.

all that have been in his Place before him." Moreover, they claimed that out of tenderness toward the poor children, they had "sometimes been prevailed with to grant our Certificates even in cases where we should rather have forborne them, had we been disposed y^{e} exercising any strickness of serverity therein."[115]

Wood, however, continued to view the situation differently. When he resigned, he gave "finding a Tide elsewhere stronger against me then I am able to stemme" as the reason.[116] When pressed by the governors, Wood assured them that he was not referring to them, who had always treated him with kindness, but rather:

> It was at y^{e} Trinity House that those Gentlemen refus'd to sign such Certificates as was sent to from y^{e} Governours of this House of y^{r} Children's abilities in order to their being plac'd forth to sea service that he had often in vain, and to y^{e} loss of a great deale of time attended them about y^{e} same, not only to his & of y^{e} Children's great discouragement but also as he conceived, of good Maisters, who would have taken y^{s} Children.[117]

The children themselves also complained of being ill-treated by Richard Norris who they claimed had refused to give a good account of their examinations while the questions they were asked were unfair and unexpected. In response the mathematical committee told the children to follow the instructions of Pagett as the committee had found to be a "learned and able Mathematician whatever Mr. Norris said to the contrary." Furthermore, it was promised "that the Court [of Governors] would take care that they should receive no discouragem^{t} at the Trinity house when they were sent thither for their Examination." The committee went on to note they had "put to Mr. Norris his unwarrantable proceedings of Endeavour to set the said Children against their Master at his very first Entrance upon his worke."[118] As independent audits of the students also frequently found shortfalls in their education, the tendency to blame Trinity House

[115] Pepys MS 2612, 449-50.
[116] Pepys MS 2612, 445.
[117] Pepys MS 2612, 460.
[118] LMA CLC/210/B/001/M MS 1206/06, 378.

was likely motivated by self-preservation; however, it is clear that Trinity House was frequently obstructionist and the relationship fractious. Norris, in particular, was likely unfavourable to Pagett because he had also been one of the candidates for the position of mathematical master and resented Pagett for being given the job for which he believed himself to be more qualified.[119] Indeed, Norris was so antagonistic toward Pagett's pupils that it was suggested it was "wholly inexpedient" that Norris continue to examine the boys.[120] The removal of Norris as examiner, however, did not resolve the problems as the examiners continued to find the boys to be insufficient in learning.[121]

The tensions continued after Pagett resigned. While Pagett's difficulties might have been brought on by personal antagonisms, in the 1690 there were different, significant reasons why members of Trinity House might have been biased against the Royal Mathematical School. The principal reason was the change in the political situation following the 1688 revolution. This caused problems for the Royal Mathematical School being the School was closely associated with Charles II and James II. The fallout of such a political association became evident when Samuel Pepys, who was particularly close to James II and had High Church leanings, returned to involvement in the school around 1694.[122] The political situation of the Anglican Church was certainly one of the factors that led Flamsteed to dislike Nathaniel Hawes whom he described in a letter to Isaac Newton as, "a stiffe formall Churchman, and a freind of those who dissent from the present establishment."[123] Like Pagett, Samuel Newton almost immediately ran into difficulties with Trinity House and went so far as to resign from his position proclaiming that

[119] Pepys MS 2612, 531.
[120] Pepys MS 2612, 688.
[121] Pepys MS 2612, 690.
[122] According to N.A.M. Rodger, the status of the Admiralty collapsed after 1689, Rodger, *Command of the Ocean*, 183.
[123] Flamsteed to Newton, 27 April, 1695, *Flamsteed's Correspondenc, vol. II*, 589.

opposition from Sir Matthew Andrews, Joseph Lane and Mr. Midgley made it impossible for him to carry out his duties, though a few months later he successfully petitioned to have his job back.[124] Newton's resignation followed a December 15, 1695 report from Trinity House saying "taking them together, they are…the worst set of Boyes we doe remember to have any at any time come to us."[125]

By 1695 Samuel Pepys had not been involved with the school for over a decade, but at this point he began to take an interest again. Pepys wrote to Matthew Andrews to ask about the progress of the mathematical boys; however, his inquiries were rebuffed. Pepys did not take the slight well and wrote to Andrews that "I have a great deal to say to you which you will bee sorry for, at our next meeting."[126] Pepys went on to request that Andrews speak to the masters of two boys who had been recently bound to a captain that the boys might be sent to Pepys so that he could better gauge the situation. Andrews agreed to do so and concurred with Pepys's view that the present lack of learning by the children at the Mathematical School was due to Pagett's absences over the previous two years. While the first set of boys sent to Trinity House by Newton to be tested performed very poorly, Pepys, at least, did not see Newton as particularly to blame. Upon Newton's election he noted that Newton had been recommended to him and he had "no reason of doubting his being a learned & virtuous man; but on y^{e} contrary have much ground of expecting far great fruit from him than wee either had or could ever expect from Mr. Pagett's method of Management." Even though Newton did not have direct experience as at sea, he had spent several years teaching mathematics at Yarmouth and, therefore, at least "been in y^{e} way of seeing & conversing more with the People & Business of Navigation."[127] Shortly later, Pepys

[124] LMA CLC/210/B/001/M MS 1206/08, 393, 414.
[125] LMA CLC/210/B/001/M MS 1206/08, 402.
[126] Pepys to Sir Matthew Andrews, November 9, 1694, BL Add. MS 20732, f. 31r.
[127] Pepys to Aungier, April 14, 1695, BL Add. MS 20732, f. 99v-100r.

met with Newton in person and "as so farr as my short Conversation wth him can warrant it, I have mighty hope of seeing the Roy^{ll} Foundation recover through y^{e} Industry, Practice, & Sobriety of this Gent^{m}."[128]

Pepys's impression of Newton, thus, was quite different from that of John Flamsteed, for whom the election of Newton to replace Pagett was a further sign of the incompetent management at the School. The difference between how Pepys and Flamsteed regarded Newton had little to do with whether or not Newton was a competent teacher of navigation, and much more to do with how they believed navigation was best taught. Pepys, as he had written in 1682, thought the most important thing was that the mathematics master be someone who had actual experience with navigation and, thus, would be able to teach the actual practice of navigation. As one of the leading astronomers in the world, Flamsteed had a different view. It was not practice that he regarded as most important, but a more advanced understanding of mathematics and astronomy that was crucial if navigation was to be advanced. A significant difference that must be recognized here is that Pepys was primarily concerned that navigators aboard naval ships would be competent in executing their duties; Flamsteed, on the other hand, was more interested in the theoretical advancement of navigation as a discipline. It was this same bias that led Isaac Newton to disregard the improvement of mechanical marine timekeepers as solving the longitude because such a method would only enable a navigator to keep the longitude, it would not aid in the finding of it.[129]

After Newton returned to the School following his initial resignation, he seems to have applied himself diligently enough though the pupils continued to have gaps in their knowledge,

[128] BL Add. MS. 20732, f. 114r.
[129] Newton to Burchett, ? October, 1721, *Correspondence of Isaac Newton, vol 7*, edited by Henry Turnbull, A. Rupert Hall and Laura Tilling (Cambridge: Cambridge University Press, 1979), 172; Similarly, see Sharp to Flamsteed, 8 March, 1714/15, *Flamsteed's Correspondence, vol 3*, 727.

they were now judged that "they may be capable of entering into a practice of the Art of Navigation, and being put out apprentices."[130] While this was not the most enthusiastic endorsement, it was really all that was required of the boys. They were, after all, going to sea not as ready navigators, but as apprentices. Newton's time as mathematical master was not without difficulties and he never seems to have been able to teach his students to the full satisfaction of the masters at Trinity House; however, for significant portions of his time in charge he was at least able to execute his duties well enough for what was needed. Much the same can be said of Edward Pagett. The harsh assessment of their tenures is in part because of controversies at the beginning and end of their time as mathematical master while ignoring the more placid periods in between. Pagett, in particular, was undone more by ill-health than anything to do with his teaching. Similarly, Robert Wood's failures coincided with significant family tragedies. His two children were intended to live with him at Christ's Hospital; however, his daughter almost immediately fell ill and had to return to the country. His son continued to reside with him, but, too, became sick and died after two months. His wife was hit hard by the death of her child as "thereupon Grief & some Friends prevailed with his Wife to retire ag^{ne} into y^{e} Country."[131] While Wood and his wife intended for the family to return to London in the future, as smallpox was endemic at the time, his wife and remaining child continued to live in the country. It should not be surprising that Wood found himself unable to attend to his duties with the fullness of heart and mind in such circumstances and instead kept to his rooms while leaving an usher in charge.

The poor results by the mathematical boys when examined was not the only major charge against the various instructors as they, unsurprisingly, also frequently had difficulty maintaining discipline of their charge of fourteen to sixteen year old boys. Poor discipline and irreligion was

[130] LMA CLC/210/B/001/M MS 1206/08, 482.
[131] Pepys MS 2612, 433-4.

one of the principal charges against Wood; however, the most significant incident occurred while Samuel Newton was mathematical master. A group of seven boys left the school without leave and went to visit one of the recently apprenticed boys on board his ship and proceeded to get drunk and unruly. Furthermore, three of the boys had gone to a public house and even worse one of them had participated in a lottery and lost two shillings. They did not return to the school until after bedtime. As a result of this incident, the governors decided to remove the boys' badges in front of the whole school as punishment and then it was later decided to add expulsion to the previous punishment. However, a short time later five of the boys had their badges restored and despite the supposed expulsion, all seven of the boys were eventually apprenticed out.[132]

Though Wood and Newton received more attention for the indiscipline of the students, it is not clear that the other teachers faired particularly better. For instance, while Peter Perkins is generally regarded as having been an effective teacher, in large part likely because he worked closely with Flamsteed on a number of experiments and died relatively soon after receiving the position and without a protracted illness. This combination meant that he did not have time for the school to go into 'decline' and then Flamsteed continued to support Perkins's reputation for the next thirty years.[133] Perkins, however, too found the boys difficult to manage at times. For example, a boy named Richard Wilkins was so troublesome that Perkins went before the Court of Governors to complain that Wilkins was refusing to do his lessons and had persuaded a number of his classmates to join him in his rebellion.[134] Meanwhile, during the tenure of James Hodgson, a group of mathematical boys were called before the court due to "Rude and indecent

[132] LMA CLC/210/B/001/M MS 1206/08, 705-9, 716; LMA CLC/210/B/001/M MS 1208/09, 7.
[133] One of Flamsteed's accusations against Edmond Halley was that Halley, who had acquired Perkins's papers after his death, had stolen a number of Perkins ideas, which was largely why Flamsteed continued to discuss Perkins so frequently in his correspondence.
[134] Pepys MS 2612, 337. Notably, Wilkins does not appear on the register of apprentices.

behaviour towards Mr. Mountfort the Gramar Master at the time of Catchchise."[135] Indeed, in his history of Christ's Hospital, E.H. Pierce noted the mathematical students had an unruly reputation that lasted until the nineteenth century.[136]

When the Royal Mathematical School was established, its founders were primarily concerned with the Navy. It was presumed that the mathematical students would be apprenticed aboard naval ships and begin a career in naval service. In a long discourse he wrote Christ's Hospital's governors in 1677, Samuel Pepys expressed particularly high ambitions:

> His Maj[tie] designe a Nursery for persons of Art & such as may bee able to serve him & their Country, not by Rote & uncertainty, but with Method & Theory, able to inform and correct others, and this not barely as ordinary Seamen unfit for any other service then what is strictly confined with the Conduct of a ship, But as persons fitted (in faire writing Accounts and Language) to serve him in any negotiation at sea or in forrein parts, to treate with forrein Governors, To reside, as Consuls, To keep acc[ts] as Purs[rs], Clercks, or Other officers of the Navy, to serve as secretary, to Admiralls, & as they shall rise to it bee qualified for the Executing of duties of Commanders themselves, with an advantage of being able to draw or dictate Orders, Letters, Instructions, Articles of Treaty, and other works of Secretaries and Negotiation beyond what the ordinary Educaon of bare Tarpawling can ever arrive at.[137]

The alumni of the Royal Mathematical School never achieved Pepys's lofty dreams. The quality of their education might not have met Pepys's satisfaction, but it was not the instruction that prevented the children from reaching such status. British society was deeply defined by class and the Navy was no different. Social connections were paramount for one's ability to advance. According to Nicholas Rodger, "the most prominent social pattern in the Navy was not birth but connection."[138] As the Navy was "physical embodiment of England's political and religious freedom," and because Naval captains were often called upon to fill diplomatic functions, it

[135] LMA CLC/210/B/001/M MS 1206/10, 12.
[136] E.H. Pearce, *Annals of Christ's Hospital* (London: Hugh Rees, 1908), 128.
[137] Pepys MS 2612, 248-9. The full discourse runs some twenty-nine handwritten pages in Pepys's records.
[138] Rodger, *The Command of the Ocean*, 115.

became increasingly imperative that officers were drawn from the class of educated gentlemen and would, therefore, be comfortable in such social settings.[139]

If they did not reach Pepys's ideal, it is also unclear whether the more modest ambition of supplying the Navy with a sober, educated and competent compliment of navigators was attained either. Certainly, in its early days it was found to be very difficult to place boys on board ships. It was only after a fund was initiated to provide a payment to captains who took a boy as an apprentice that this difficulty became alleviated. While they were now able to find masters for the mathematical boys, these masters often did not live up to expectations. Indeed, the provision of money meant that those who took boys as apprentices had their motivations questioned. As Pepys put it, "these Children are sometimes put to Masters w^{ch} these Gentlem declare they would not put a Footman to, as having either no skill to examine them & then their Learning is lost, or are indigent & take y^{e} Boys onely for their Money."[140]

The Navy had been the intended destination; however, the Navy was not particularly in need of the boys until the early eighteenth century. Thus, the vast majority were apprenticed into merchant service. The East Indies was the most common destination for the mathematical students with the Caribbean, Virginia and the 'The Streights' (Straits of Gibraltar) as next three most frequent.[141] As it was put in Christ's Hospital's committee book in 1690, "the chief source of foreign service for our boys came from the East India Company, who were long the Hospital's 'tenants at a very low rate.'"[142] The East India Company might have taken the most boys, but was only one of places where mathematical students found employment. Christ's Hospital kept

[139] Rodger, *Command of the Ocean*, 183.
[140] Pepys MS 2612, 392.
[141] Considering the 53 ships traveling to Jamaica, Barbados, and the West Indies and a further 27 to Virginia, there is likely a connection between the Royal Mathematical Boys and the trans-Atlantic slave trade that could be further explored.
[142] Quoted in Pearce, *Annals of Christ's Hospital*, 283.

relatively detailed accounts of to whom the different boys were apprenticed (see Figure 1.2 below), which show that the mathematical students were widely dispersed amongst English ships. The proliferation of mathematical boys throughout the maritime world lends some credence to the assumption that the school was well-known and regarded.

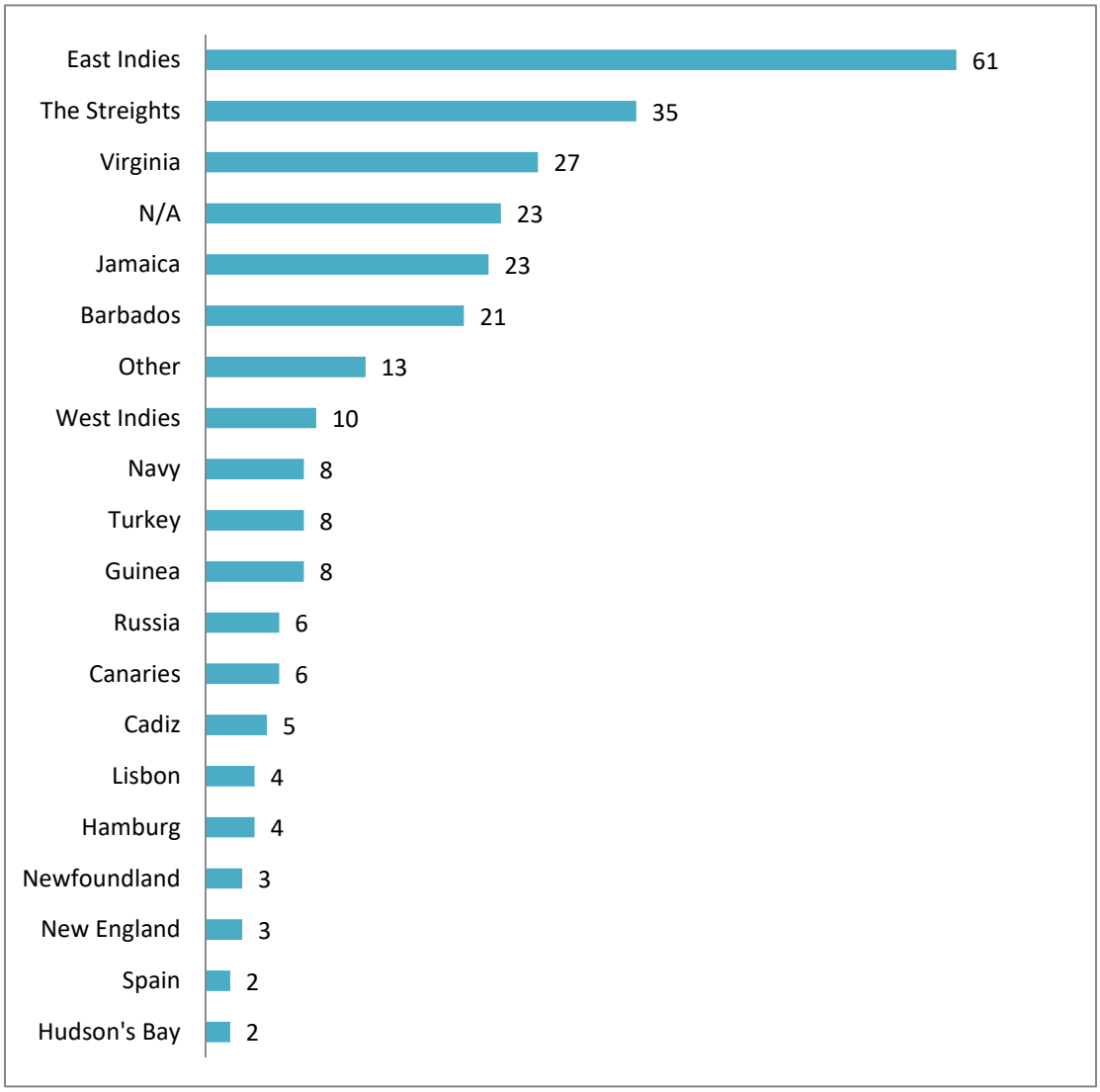

Figure 1.2: Destinations of Ships at Time of Apprenticeship, 1675-1702 (LMA CLC/210/F/014/MS12875)

Such a perspective can be seen in Harry Dickinson's account of naval education in the eighteenth and nineteenth centuries. Dickinson sought to challenge a standard view that on board schoolmasters were of little importance and that they were far more common than had typically

been believed. The position of schoolmaster was created in 1702 and added £20 a year to a midshipman's pay; however, it had generally been held that few took the position until F.B. Sullivan's analysis of the Trinity House and Admiralty records between counted 394 individuals who served as ship's teachers between 1712 and 1824.[143] Allowing for gaps and unofficial teaching, Dickinson suggests a figure of 500-600 to be closer to the actual number.[144] This number is significant; however, it was spread out over the years between 1702 and 1824. Considering that the number of seamen in the English Navy grew from 33,000 in 1702 to 47,000 between 1709-11 and had approximately 150 ships in service, the number of school teachers aboard naval ships remained quite small.[145] Furthermore, it is unclear how useful their teaching was. For example, Captain John Cremer's memory of his onboard education was highly negative saying "Wee all Leant to write, Read, Arrithmatick, and began Lattin," but while all their "inclinations was for to learne Navigation, which was out of our Master's knowledge. As for Lattin I mortally hated it."[146] That said, Cremer did obtain a reasonable level of literacy in English at least.

Certainly, the number was well below what had been hoped. While the position had been created in 1702, until 1720 most vacancy remained unfilled. The Order of Council wanted ninety schoolmasters at any time, but the average between 1713 and 1720 was only twenty-five and after 1720 the numbers fell off significantly.[147] Thus, while Dickinson has pointed to the Royal

[143] F.B. Sullivan, "The Naval Schoolmaster During the Eighteenth Century and the Early Nineteenth Century," *Mariner's Mirror* 62 (1976), 311.
[144] H.W. Dickinson, *Educating the Royal Navy: Eighteenth and Nineteenth-Century Education for Officers* (London: Routledge, 2007), 13; 18.
[145] Rodger, *Command of the Ocean*, 208.
[146] John Cremer, *Ramblin' Jack: The Journal of Captain John Cremer, 1700-1774*, transcribed by R. Reynell Bellamy (London: Jonathan Cape, 1936), 46; 49-50.
[147] Dickinson, *Educating the Royal Navy*, 19. While Dickinson's objective is to demonstrate that institutional systems of education were more prominent sources of naval education than had previously been believed, he was forced to admit that it was only a small part of a broader scheme. Even after the opening of the Portsmouth Naval

Mathematical School as a major source of schoolmasters, it was clearly not the principal destination for most considering the school put over five hundred students into marine service between 1675 and 1732 alone. Though Dickinson has demonstrated that organized education was significantly more available in the Royal Navy than had been typically believed, he concluded that naval education remained generally informal and subsumed by a system of patronage that was fiercely guarded by officers.[148] Even after the opening in 1733 of the Portsmouth Naval Academy, under the direction of William Haseldon (a product of Christ's Hospital), as many as ninety-eight percent of officers bypassed the Academy and continued to proceed directly to sea through family connections.[149]

Unfortunately, it has not been possible to this point to follow the mathematical students after they left the Royal Mathematical School and began their indentures. The vast majority did not obtain any fame and I have been unable to find records of more than a handful as adults. There is an asymmetry between the prominence accorded to the Royal Mathematical School and its actual results. The apparent obscurity of the mathematical boys upon leaving the school undermines the view put forward by Ellerton and Clements that the Royal Mathematical School played a defining role in the development of mathematical education. In particular, Ellerton and Clements point to James Hodgson as the key figure in the history of secondary school mathematics.[150]

In its early years much attention was paid to the incompetence of its instructors and the dismal results of its students; however, after James Hodgson became mathematical master in 1709 such complaints largely ceased. Perhaps this was due to his greater abilities as an

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Academy in 1733 the vast majority of officers—Dickinson estimates as much as ninety-eight percent--continued to proceed directly to sea through family connections and, therefore, bypassed the Academy, p. 39.

[148] Dickinson, *Educating the Royal Navy*, 45.

[149] Dickinson, *Educating the Royal Navy*, 33; 39.

[150] Ellerton and Clements, *Samuel Pepys*, 47, 82.

instructor. More important, however, was his social prominence in fashionable London. Unlike Wood, Pagett or Newton, Hodgson was a member of the Royal Society and frequently attended their meetings as well as being a regular in London Coffeehouses. Hodgson's credentials were further bolstered by collaborations with Frances Hawksbee and contributions to the *Philosophical Transactions.* Furthermore, he was Christopher Wren's nephew, a former assistant to the Astronomer Royal John Flamsteed and was married to Flamsteed's niece.

Hodgson, thus, was inherently in a much stronger position than previous mathematical masters had been. Hodgson's credentials were strong as he had spent several years in London as a lecturer of experimental philosophy as well as having been Flamsteed's assistant, though, like all the previous mathematical masters he too lacked experience at sea. Furthermore, he was a member of the Royal Society and a regular in London's coffeehouses. Finally, the idea that the school should hire one of Flamsteed's assistants for the job had been around for a while. Abraham Sharp, had been previously solicited for the position by Edmond Halley amongst others, which Sharp declined because he "had no inclination for so laborious a confinement, being better pleased with an easier though less advantageous employment."[151] Sharp's response points to inherent difficulty faced by the school in that the most capable candidates for the job were likely to have better alternatives available to them.[152] Halley, for example, aside from being wealthy enough not to need a job, especially one as demanding as schoolmaster at Christ's

[151] Abraham Sharp to Flamsteed, April 12, 1709, in *Life and Correspondence of Abraham Sharp, the Yorkshire Mathematician and Astronomer, and Assistant of Flamsteed, with Memorials of His Family and Associated Families*, edited by William Cudworth (London: Sampson, Low, Marston, Searle, and Rivington Ltd., 1889), 97.
[152] Sharp ultimately left London in 1694 and returned to his family home in Bradford where he managed his family's affairs after his father's death. As a result he was isolated from English intellectual life, relying on his correspondence with Flamsteed and irregular deliveries of the *Philosophical Transactions* to keep him informed on the latest developments. It seems that it was this isolation that led to Sharp reviving contact with Flamsteed in the first place and serving as one of Flamsteed's calculators. Though Sharp became Flamsteed's closest friend during the last twenty years of Flamsteed's life, Flamsteed seemed not to think so much of him while Sharp was his assistant and Sharp had left Flamsteed's employ suddenly and acrimoniously in order to take a better paid job in London.

Hospital, would become Savilian Professor of Geometry at Oxford after John Wallis's death 1702. Similarly, the Oxford mathematician John Caswell had put his name in for the job in 1695 he did not turn up for the interview, perhaps because he concluded he had better prospects if he stayed in Oxford.[153] At any rate, Caswell, too, would later become a Savilian Professor (in Astronomy) at Oxford succeeding David Gregory in 1709.

After the tumult of the first thirty years, the Royal Mathematical School certainly appears to have been far more stable and effective under Hodgson, which has generally led to the assumption that the early mathematical schoolmasters were principally to blame for the difficulties faced by the school. Elleteron and Clements have put the argument most directly, arguing that "it was Hodgson who vindicated the faith of Samuel Pepys in the possible viability of the radical model that RMS's creation, in 1673, represented."[154] E.G.R. Taylor, however, suggested a somewhat different interpretation for the change in the school's fortunes after Hodgson's appointment. Rather than Hodgson being significantly more competent, she argued that it "was due in part to the change that had taken place in the status of mathematics," a position that aligns well with Nicholas Hans's thesis.[155] Based on my investigation of the available institutional documents, it seems clear to me that, while the school became significantly more stable from the perspective of the continuity of its leadership, it continued to be plagued with difficulties. For example, the curriculum remained undefined and a matter of debate as late as 1729. In 1725, having already held the position for fifteen years, Hodgson

[153] LMA CLC/210/B/001/M MS 1206/08, 361.
[154] Ellerton and Clements, *Samuel Pepys*, 49.
[155] Taylor, *Mathematical Practitioners*, 118. Cf. D.W. Waters, *The Art of Navigation in England in Elizabethan and Early Stuart Times* (New Haven: Yale University Press, 1958), 340.

presented his two volume system of mathematics to be used by the mathematical students.[156] Hodgson's scheme, however, was apparently overly ambitious for the school's needs.

As had consistently been the case for previous mathematical masters, Hodgson found it difficult to move the students through the mathematical school on schedule. Thus, the mathematical committee developed its own scheme of learning to serve as "a means to prevent the excessive ages which the Boys of that ffoundation are apt to Arrive," which was approved on March 20th, 1728/29 and Hodgson was ordered to follow the new system:

> 1st. Vulgar and Decimal ffractions with the Extraction of the Square and Cube Roots
>
> 2nd. The Usefull Methods for finding the Golden number, Epact, Moons Age time of His Southing, as also the time of High Water in any Ports.
>
> 3d. The Principalls of Geometry in the Delineation or Construction of such Problems as are usefull and necessary in the following Articles.
>
> 4th. Plain and Sphereical Trigonometry Geometrically, Arithmetically, Instrumentally performed in all the various cases of Rectangular & oblique Angular Triangles.
>
> 5th. The use of the Globes Celestial and Terrestiall.
>
> 6th. Spherical Triangles applyed to the Solution of such Problems in Astronomy as are necessary for finding the Suns Amplitude Azimuth Latitute of the [illegible] and Hour of the Day and Night.
>
> 7th. Plain Sailing namely the working of Traverses, the Solution of all Plain Saleing Questions Geometrically Arithmetically and Instrumentally with the Application of Plain Triangles to Oblique Sailing and the Doctrine of Currents.

[156] LMA CLC/210/B/001/M MS 1206/10, 128.

8th. Mercators Sailing to be don in all Respects as Plain Saleing in Article the Sixth.

9th. The use of Instruments proper for observing the Altitude Amplitude and Azimuth of the Sun and fixed Stars such as the Quadrant, cross staff and Azimuth or Amplitude Compass with the use of the observations thus made in finding the Latitude the Ships is in and the variation of the Compass.

10th. The Construction and use of the Plain and Mercators Sea Charts.[157]

The rejection of Hodgson's system in favour of this revised system points to a continuing tension between the mathematical school as being principally concerned with teaching practical skills versus one which emphasized mathematical theory.[158] This conflict was at the heart of John Flamsteed's criticism of the school. For Flamsteed, advanced mathematics and astronomy were crucial training because he hoped for the school to serve a role in the advancement of navigation as a science. Advanced mathematics and astronomy did not serve a purpose for navigational practice at the time, but were necessary for the development of astronomical theories needed for navigation to become more accurate. Foremost, this meant solving the longitude problem, but from a more immediate point-of-view was also necessary for the improvement of charts and maps as most of the ones in common use had significant inaccuracies. In many cases the latitude and longitude were not even known, which rendered the ability to find the ability to find the longitude at sea rather irrelevant.[159]

Conclusion

[157] LMA CLC/210/B/001/M MS 1206/10, 238-9.
[158] Cf. Ellerton and Clements analysis of Hodgson's curriculum, based primarily on his 1723 mathematical textbook. Published in two volumes and weighing in at over 1000 pages, Ellerton and Clements regard it as demonstrating the depth and weight of the instruction provided by Hodgson, see Ellerton and Clements, *Samuel Pepys*, 130-36.
[159] Edmond Halley, "An Advertisement to Astronomers, of the Advantages that may accrue from the Observation of the Moon's frequent Appulses to the Hyades, during the Three next ensuing Years," *Philosophical Transactions* 30 (1717), 692.

The Royal Mathematical School was viewed by Nicolas Hans and more recently by Ellerton and Clements as representing a crucial shift in English education toward increasingly vocational and practical and the School has been cited as playing a key role in navigation in the eighteenth century. I would suggest, however, that it should be associated more closely with questions of charity, morality and regard for the poor in seventeenth and eighteenth-century England.[160] A great number of influential members of London's community of natural philosophers took an active interest in the Royal Mathematical School. Edmund Halley, Isaac Newton, John Flamsteed and Samuel Pepys all appear in the court minutes as having been school governors. Newton, Halley, Flamsteed and Hooke were all enlisted at one point or another to fulfill duties such as carrying out audits of the school.

Following Hodgson's death in 1755, a number of the mathematical masters had connections with important institutions of the day. For example, Hodgson's immediate successor, John Robertson resigned from the position in order to take up the post of headmaster at the Portsmouth Naval Academy. Williams Dawes, meanwhile, had traveled to Botany Bay with the support of the Board of Longitude in order to carry out nautical and astronomical observations. Finally, William Wales had preceded his appointment in 1775 by observing the transit of Venus in 1769 from Hudson's Bay and serving as the astronomer aboard the *Resolution* during James Cook's second voyage. These later mathematical masters demonstrate that the school was eventually able to attract the kind of mathematical master Pepys had desired; however, it remains less clear to what extent these men, experienced in navigation and knowledgeable of astronomy and mathematics as they were, serve as a demonstration that the school was a training ground for the improvement of English navigation. Indeed, in a society that

[160] Jeremy Schmidt, "Charity and the Government of the Poor in the English Charity-School Movement, circa 1700-1730," *Journal of British Studies* 49 (2010): 774-800.

did not provide social welfare and in which many aspiring members of the professional classes were in a constantly tenuous position, an institution such as the Royal Mathematical School might be better understood as another means of patronage.

This chapter has provided a lengthy treatment of the Royal Mathematical School because the school has a rather unique position in the history of navigation and astronomy in early-modern Britain. Though I am cautious about according the school a significant role in the actual development or even practice of navigation during the eighteenth century, the discussions around the school and controversies that it faced are highly instructive. One of the major themes that unite the different chapters of this thesis is that of institutional practice. I am particularly concerned to understand the contradictions between agency and actions within an institution versus expectations and the perspective toward the given institution from those on the immediate outside. In the next chapter, I will move from this single example of the navigational pedagogy to an account of the actual practice of navigation from the point-of-view of long-distance control. Thus, in keeping with the preceding discussion of the Royal Mathematical School, my analysis of eighteenth-century navigation will seek to place it within an institutional setting and focus on the tensions between navigation as a day-to-day practice versus the institutional needs of navigation as Britain became increasingly a naval, imperial and commercial power.

Chapter Two
Expertise in Practice: Navigation and the Problem of Long-Distance Control

In his journal the British Naval officer and future Baron of Longford Edward Pakenham described the 1758 wreck of the *Lichfield*, which he had witnessed from the *Dunkirk*:

> We thought we saw Land, but could hardly believe so as we were so far distant by our Reckoning, but in a few minutes as it grew lighter we found it really was the Land…If it had been dark a quarter of an hour longer, it would have been impossible for any ship in the Fleet to have escaped.[1]

For Pakenham the accident was a clear result of navigational failure, which he demonstrated in the chart he drew to plot their error (see Figure 2.1).[2] While "most People seemd to impute this error to the indraught of the Streights, if it was to that onely it must be much greater than is generally supposed;" Pakenham was "apprehensive that we were not sufficiently accurate in determining the variation of the Compass, an omission that is too common, and that we did not allow west variation enough."[3] The imprecision of navigation in the eighteenth century has long been recognized by historians as a significant problem in marine history and more recently to the histories of science and technology. Yet, it is less clear mariners in the eighteenth century regarded such limitations and imprecision to have been as significant as is commonly presumed to outsiders.

[1] "Journal, Vol I., of the of HMS DUNKIRK, NEPTUNE, TERROR, BLENHEIM, ROMNEY, Storeship, CROWN, BONETTA, SHEERNESS, AMERICA, ALEXANDER, 28 Mar 1758-Jun 1779," 28 November, 1758, Caird PAK/1, f. 27.
[2] Pakenham's chart can be found in PAK/1, opposite f. 28. The image in this dissertation was provided by Richard Dunn.
[3] PAK/1, f. 28.

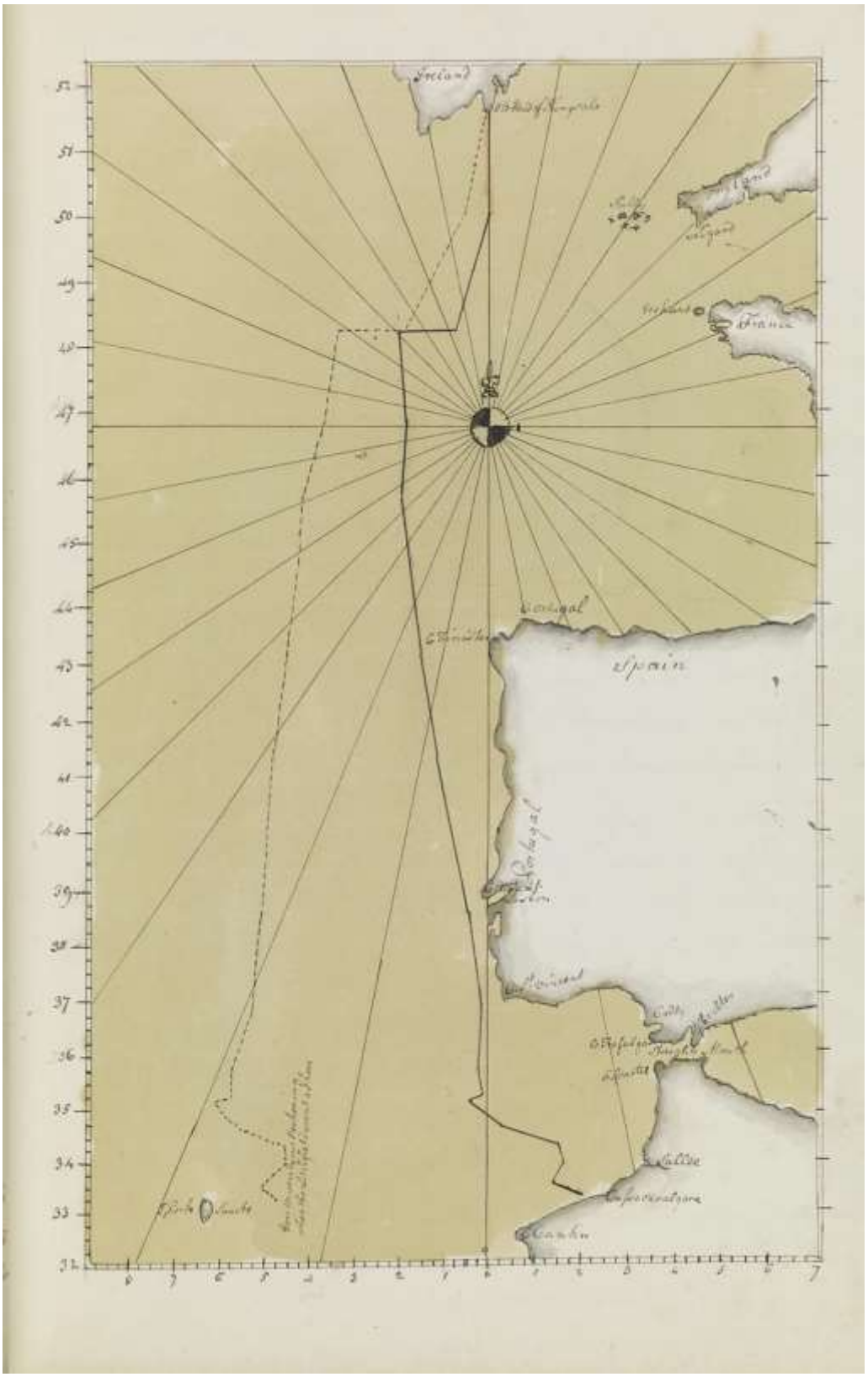

Figure 2.1: Edward Pakenham's Chart of the Lichfield Accident

When Samuel Pepys traveled by sea to the Tangiers in 1683, he was shocked by the crudity of navigational techniques and described them as doing little more than keeping watch for land.[4] The reality, however, was that standard practice, which involved a combination of dead-reckoning and the use of a variety of increasingly sophisticated instruments was far more effective than detractors would have had it.[5] Moreover, methods that depended on greater mathematical and theoretical knowledge were no more accurate at the time and were very labourious and difficult to execute even on land. Responding to a query about the means by which the longitude problem would be solved, Isaac Newton noted that he had never met a ship captain who found the problem to be a grave concern. Moreover, in one of his draft replies, Newton wryly observed that he had never been to sea "& therefore my opinion is not much to be relied on."[6]

In this chapter, I seek to build upon the principles outlined in the first chapter in order to re-position the practice of navigation in the eighteenth century, and debates which surrounded it, as part of a larger narrative regarding the problem of long-distance control. That bureaucrats like Pepys, the Parliamentarians who established the Longitude Prize and astronomers such as John Flamsteed regarded navigation as a problem that needed to be solved, while practicing navigators largely did not is telling. Even more telling, I would argue, is the way in which the practical day-to-day reality of doing navigation has been obscured by a heroic account of the overcoming of the inability to find the longitude at sea to the salvation of mariners world over. My aim is to emphasize the practice of navigation rather than the innovations of astronomical science and to

[4] Samuel Pepys, *The Tangier Papers of Samuel Pepys*, transcribed and edited by Edwin Chappell with W. Matthews (London: The Navy Records Society, 1935), 127, 130, 235.
[5] J.A. Bennett, *The Divided Circle: A History of Instruments for Astronomy, Navigation and Surveying* (London: Phaidon, 1987), 58.
[6] Isaac Newton, "Papers on Finding the Longitude at Sea," ULC MS Add.3972, f. 41r. Available online at https://cudl.lib.cam.ac.uk/view/MS-ADD-03972/81.

put debates such as the longitude problem into the context of the British state and the commercial economy of the early eighteenth century.

As I discussed in the introduction to Part One, capitalism and global trade necessitated the further development of commercial technologies that could operate over long-distances. Thus, at the same time that experimental philosophy was developing new methods of establishing credibility, merchants were dealing with the same set of problems, but on a larger scale: how does one define credibility and assert authority over distance and outside of immediate personal experience?[7] Navigation, as seen most clearly with the longitude problem, is fundamental to understanding the imperial bureaucratic view of the world. Long-distance control was an ideal that was never even close to being achieved; however, its pursuit would profoundly shape the way in which knowledge was produced, consumed and circulated. In the case of navigation, I argue that it was the challenge of long-distance control that made the longitude problem a *cause celebre* of the eighteenth century. In this chapter I engage with the specific dispute over authority between Edmond Halley and his first mate Edward Harrison for the purpose of taking the problem of expertise discussed in the previous chapter and demonstrating how these tensions played out in practice on board English ships.

The Problem of Long-Distance Control

In a 1986 article, the sociologist of science John Law wrote that:

> Columbus's discovery of the New World in 1492, when taken with the arrival of heavily armed Portuguese vessels in the Indian Ocean in 1498, clearly marks an important turning point in the balance of power between Europe and the rest of

[7] On the question of credibility in the new science see Steven Shapin and Simon Schaffer, *Leviathan and the Air-Pump: Hobbes, Boyle, and the Experimental Life* (Princeton: Princeton University Press, 1985); Shapin, *A Social History of Truth: Civility and Science in Seventeenth-Century England* (Chicago: University of Chicago Press, 1994); Barbara Shapiro, *Probability and Certainty in Seventeenth-Century England: A Study of the Relationships Between Natural Science, Religion, History, Law, and Literature* (Princeton: Princeton University Press, 1983); *A Culture of Fact: England, 1550-1720* (Ithaca: Cornell University Press, 1999). On the same problem in commerce and the relationship between commerce and science, see Harold Cook, *Matters of Exchange: Commerce, Medicine, and Science in the Dutch Golden Age* (New Haven: Yale University Press, 2007).

> the world. From that moment onwards until the very recent past the rest of the world has been under European control and domination.[8]

Law argued that Portugual's success—and European domination more generally—was due to it successfully managing long distance control and, therefore, created the conditions that made imperialism possible. Law's view was consistent with Actor-Network Theory, of which he has been a key proponent, and the parallels between Law's argument in this article and Bruno Latour's model of centres of calculation as presented in *Science in Action* are clear. From the perspective of a historian, however, Law's claims are problematic. Europe was neither economically or politically hegemonic prior to the late eighteenth century.[9]

The third and fourth chapters of this dissertation will use some key examples from the English East India Company to demonstrate that the historical evidence does not support Law's representation of Europe as a hegemonic power. Rather, the records indicate the weakness of the European position in the East at the time period being covered by this dissertation. It is my argument that an investigation of the archives of the English East India Company shows that the kind of metropolitan conceptions of the production and transfer of knowledge at the heart of Law and Latour's Actor-Network Theory is untenable in terms of European globalization prior to the latter eighteenth century. Due to Law's focus on the example of navigation, his argument is particularly significant for this chapter. Law wished to demonstrate a sociological theory and his evidence is macroscopic in scope. In contrast, this chapter takes a more microscopic approach and seeks to understand how navigation was executed on a day-to-day basis.

[8] John Law, "On Methods of Long-Distance Control: Vessels, Navigation, and the Portuguese Route to India," in *Power, Action, and Belief: A New Sociology of Knowledge?,* edited by John Law (London: Routledge, 1986), 234.
[9] Andre Gunder Frank, *Reorient: Global Economy in the Asian Age* (Berkeley: University of California Press, 1998).

Navigation as Practice

Navigation in the seventeenth and eighteenth centuries was a site of contested expertise. Practicing navigators were not educated or elite. Navigators filled a necessary function, but their practice was not necessarily imbued with theoretical ambitions. As Margaret Schotte has argued, "navigators could be framed as authorities but were more frequently disdained due to their low status."[10] While the traditional practices of navigation have not always been accorded respect, they were indispensable to successful marine travel. I attempt to keep in mind the daily practice of navigation because doing so points to other possibilities for early-modern expertise; possibilities that challenge the tendency to emphasize elite education and privilege those who attained a greater social status. In this chapter I seek to offer an alternative account of the dispute between the Edmond Halley and his chief-mate Edward Harrison during Halley's first *Paramore* voyage at the end of the seventeenth century. Instead of a fight between a ship captain and an insubordinate and jealous officer stirring up mutiny, which was how Halley presented the incident, I read the affair as being fundamentally to do with the contested nature of expertise and very real threats to Harrison's claims to authority. That Harrison is remembered almost entirely according to Halley's assessment of the man is telling about how expertise has been framed in science and technology studies.

The controversy is valuable in this context because of both the way in which it illuminates issues of control and social order on board ships and because it was specifically about what constituted good navigational practice. Halley, moreover, is interesting in relation to the idea of the mundane daily practice because he was at the forefront of English astronomy and natural philosophy as a former protégé of the Astronomer Royal John Flamsteed—though the

[10] Margaret Schotte, "Expert Records: Nautical Logbooks from Columbus to Cook," *Information & Culture* 48 (2013), 285.

two had fallen out around 1686—and close associate with Isaac Newton. Most significantly, the first *Paramore* voyage was explicitly conceived with the hope of improving navigation as Halley sought to complete an accurate chart of the variation of the compass. In the final part of the chapter I will return to the question of long-distance control with which the chapter opened and use the notion of the mundane daily practice of navigation. The example of navigation given in this chapter is intended to provide a robust pushback to John Law's theory of long-distance control in order to suggest a more historically grounded account that more accurately fits the reality of the early eighteenth century.

While logbooks were used to track the position of the ship that was only one of several purposes for which they were kept. The information entered into them varied, as did the way in which they were structured. Though the Navy increasingly standardized logbooks as the eighteenth-century progressed, they were often quite variable in practice and appearance.[11] They necessarily recorded the same basic information. Most significantly were the regular record of the ship's speed as measured by the log-line, the direction the ship was traveling, the direction of the wind and current. This information was used to estimate the current location of the ship by adding up the measurements of how the ship's speed and off-setting that number with countervailing circumstances. Navigation was not the only purpose of logbooks as they also contained regular observations of the weather, accounts of disciplinary actions taken against crew members, the status of the rations on board the ship and any replenishing that was carried out, other ships they met, any illnesses and deaths during the voyage, and a great deal of other

[11] Margaret Schotte has noted that "Navigators often demonstrated a preference for narrative over number, neatly but firmly disregarding the lines in their preruled company logbooks. If they acqueisced to a certain degree of naval discipline by producing the required journal, they nonetheless circumvented administrative demands for epistemic uniformity," Schotte, "Expert Records," 296.

valuable historical information.[12] Thus, the logbook was not simply a tool for navigation, but was a complete record of the voyage. Indeed, as the accounts of punishments carried out on the ship makes clear, the logbook served an important disciplinary role. One of the arguments of this chapter is that all of the data entered in the logbook served a disciplinary purpose. Indeed, the logbook was a crucial tool in the effort by the centre to impose long-distance control against an

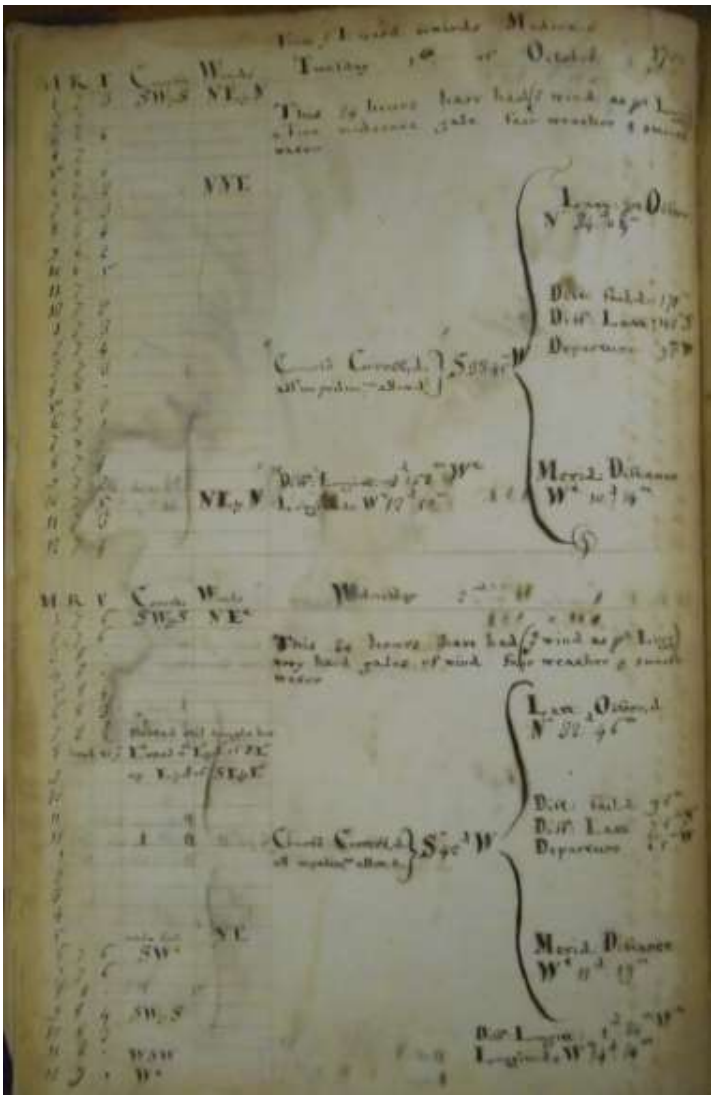

Figure 2.2: Journal for the *Rising Eagle*, 17 Sep 1700-8 Jul 1702
IOR/L/MAR/A/CXLVIII, f. 4v

[12] On logbooks as a source for climate data, see Dennis Wheeler, "Understanding Seventeenth-Century Ships' Logbooks: An Exercise in Historical Climatology," *Journal for Maritime Research* 6 (2004): 21-36; Dennis Wheeler and Ricardo García-Herrera, "Ships' Logbooks in Climatological Research: Reflections and Prospects," *Annals of the New York Academy of Science* 1146 (2008): 1-15.

intransigent periphery. Thus, organizations such as the navy or the English East India Company explicitly required their crews to keep detailed records of every voyage, which were to be handed in upon the ship's return to England.

The logbook was only one of a litany of paperwork, much of which was not only tedious to keep, but frequently irrelevant as far as the captains were concerned. As J.D. Davies has observed, the Navy Board required regular muster books to be sent to London and did not make exceptions even when doing so was physically impossible. In her history of the early-modern logbook, Margaret Schotte argued "New centralized institutions allowed authorities to shape—and to exploit—the logbook for their own interests."[13] Detailed accounts were demanded so as to demonstrate that the captain was following orders. Yet, in practice ship captains were frequently able to circumvent such strictures. Though the failure to comply with these strictures resulted in the withholding of pay, "captains frequently resisted and claimed they had 'lost' the required paperwork in various natural disasters or that they had never received the instructions or necessary books."[14] Global sea travel was a complex web of overlapping and frequently contradictory hierarchies of power.

Thus, individual actors within the Admiralty were in conflict with each other, the Admiralty was in conflict with Parliament, individual captains were in conflict with the naval administration and the Admiralty and crews were in conflict with their officers. In this frequently messy environment, then, paperwork was intended to serve a necessary function of rendering transparent events that occurred outside of geographical and temporal control of the administration. In immediate terms, the naval administration or the East India Company could do little to insure their instructions were carried out by their agents. By demanding detailed records,

[13] Schotte, "Expert Records," 294.
[14] J.D. Davies, *Gentlemen and Tarpaulins: The Officers and Men of the Restoration Navy* (Oxford: Clarendon Press, 1991), 44. See also Schotte, "Expert Records," 294.

however, they were theoretically able to retain a degree of control. It is important to recognize that such institutions were not monoliths and represented a number of conflicting interests. Moreover, there was significant latitude for resistance and mariners frequently exercised their power. The example of the *Paramore* voyages of Edmond Halley usefully demonstrates many of the themes and arguments that have been made in the first section of this chapter while drawing the conversation into a broader account of the relationships between navigation and astronomy and between natural philosophy and the modern nation-state as described by John Brewer and Michel Foucault.[15]

The *Paramore* Voyages

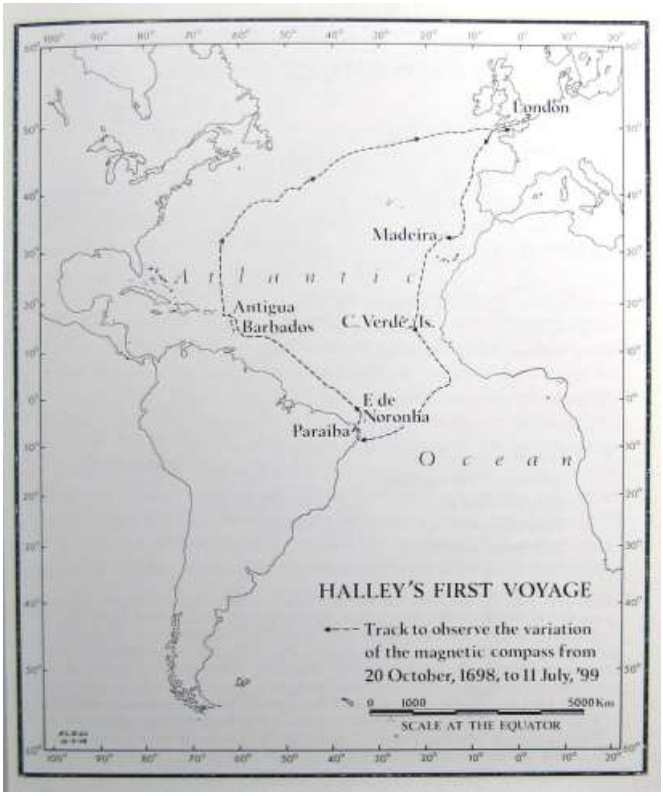

Figure 2.3: Map of Halley's first Paramore Voyage, in *The Three Voyages of Edmond Halley in the Paramore, 1698-1701*, edited by Norman J.W. Thrower (London: The Hakluyt Society, 1981).

[15] John Brewer, *The Sinews of Power: War, Money, and the English State, 1688-1783* (London: Unwin Hyman, 1989); Michel Foucault, *Discipline and Punish: The Birth of the Prison*, translated by Alan Sheridan (New York: Vintage Books, 1977).

In 1693 Edmond Halley and Benjamin Middleton proposed to the Navy Board that they would:

> Undertake a Voyage, wherein he [Middleton] proposes to incompass the whole Globe from East to West, in order to the describeing and laying downe in their true Positions, Such Coasts, Ports and Islands, as the Weather will permit to some of which possibly Advantageous Trade may be found. And to endeavour to get full information of the Nature of the Variation of the Compasse over the whole Earth, as Likewise to experiment what may be expected from Severall Methods proposed for discovereing the Longitude at Sea.[16]

Halley was young, ambitious, skilled in astronomy and mathematics and well-connected as a member of the Royal Society and close associate of Isaac Newton, for whom Halley had just seen the *Principia* through the press. Moreover, unlike other leading English astronomers such as Newton or the Astronomer Royal John Flamsteed, Halley had first-hand experience with the sea as he had left Oxford in 1676 to travel to the South Sea and produce a map of the Southern Stars. Middleton, too, was a fellow of the Royal Society. His father had been Colonel Thomas Middleton, who had managed the dockyards at Portsmouth and Chatham and was a friend of Samuel Pepys.[17] The project was approved and a ship, named the *Paramore*, began to be prepared for his use, but its ambitions would quickly be diminished from circumnavigating the globe to a voyage only to the South Atlantic. Ultimately, Halley would make three voyages aboard the *Paramore* between 1698 and 1701. The first two voyages were to the South Atlantic and resulted in Halley's chart of magnetic variation, while the third remained closer to home as Halley surveyed the Channel and produced a tidal chart that would not be superseded for over a century. Thus, the third voyage was an unqualified success. The first two, however, were rather more controversial.

[16] "Admiralty Orders to the Navy Board," July 12, 1693, *The Three Voyages of Edmond Halley in the* Paramore, *1698-1701*, edited by Norman J.W. Thrower (London: The Hakluyt Society, 1981), 252.
[17] Alan Cook, *Edmond Halley: Charting the Heavens and the Seas* (Oxford: Clarendon Press, 1998), 261.

The problems began for Halley from the outset and centred on the officers he had been provided by the Navy. As Alan Cook has pointed out, Halley was in a difficult situation as commander of the *Paramore* because his status was ambiguous. Halley had significant knowledge of seamanship due to his voyage to the South Sea, his hydrographic surveys of the Thames and the coast of West Sussex and his experiments with the diving bell and diving suit. He did not, however, have any experience in command. Thus, Cook argued that while John Flamsteed would denigrate Halley as drinking and swearing like a sailor because "he no doubt had the landsman's idea of him as a tarpaulin," his lieutenant "despised him for his ignorance of nautical terms" and "saw him as a gentleman commander."[18] The weakness of Halley's position was further compounded by the ambiguity of his rank. After he had completed the three voyages and retired from seamanship to take up a professorship at Oxford, Halley was treated as a non-active naval officer holding the rank of captain. When Queen Anne sent him to the continent for a diplomatic mission in the early 1700s, he was introduced as colonel, which was regarded as the equivalent rank as captain. Yet, his rank during his actual voyages is less clear and if he had been given a formal rank it was not one earned through experience. As Greg Dening has shown with the example of Captain Bligh, such ambiguities in status and rank could serve to create and exacerbate tensions on board a ship and to undermine the authority of the ship's commander. Dening argued that the issue with Bligh's language was not that it was obscene, but "that Bligh's bad language was the ambiguous language of his command."[19] Certainly, Halley's relationship with his officers was not strong when he set out on his first voyage in October, 1698.

Halley recognized the potential conflicts before the *Paramore* had even left England. Having immediately hit bad weather, the *Paramore* quickly showed itself to be leaky and he

[18] Cook, *Edmond Halley*, 259-60.
[19] Greg Dening, *Mr. Bligh's Bad Language: Passion, Power and Theatre on the Bounty* (Cambridge: Cambridge University Press, 1992), 61.

noted in his journal that he found the crew to be weak.[20] He wrote to the Admiralty to ask for an additional five sailors, but his request was denied.[21] Instead, the leaks were patched up and Halley left English waters in early December. As the *Paramore* ventured further from home, the tensions between Halley and his officers began to manifest themselves more strongly. In particular, Halley and his lieutenant and navigator Edward Harrison found themselves at loggerheads. Harrison had written a short book on navigation a few years earlier, for which Halley had written a highly critical, though anonymously published, review. Alan Cook dismissively summarized Harrison's book as "scientifically and technically…poor, second-hand and ill-digested. It is shot through with aspersions on mathematicians, the manner is aggressive, and it shows a deep inferiority complex."[22] Though Halley did not realise his lieutenant was the same Edward Harrison until after they had returned to England, it is not entirely surprising that the two would come into conflict.

Both Halley and Harrison made observations and plotted the *Paramore's* location on a daily basis. As Flamsteed received a copy of Harrison's journal and recorded his observations, Alan Cook was able compare Harrison's observations with Halley's. Halley and Harrison had good agreement on latitude and magnetic variation; however, on the longitude they diverged substantially. The differing observations point to the unreliability of navigation at the time. It was not uncommon for multiple members of the crew to make regular independent observations and to plot the ship's location on a daily basis. Moreover, it was not unusual for these observations to disagree or for the disagreement to be known. For example William Ratcliffe, the chief mate of the East India Company ship the *Loyal Bliss*, noted the divergence between his own calculations and those of the board as to the ship's longitude writing that he found himself

[20] *Voyages of Edmond Halley*, 89.
[21] Burchett to Halley, October 15, 1698, in *Voyages of Edmond Halley*, 270.
[22] Cook, *Edmond Halley*, 264.

to be "6" to y^{e} west of y^{e} board."[23] While Ratcliffe continued to record his own observations where they disagreed with the log line, he does not appear in his journal to have been either surprised or concerned about the deviations. Halley and Harrison did not demonstrate the same equanimity. On April 2, 1699, Halley recorded that:

> We were so farr to the Southward, that we could Scarce see the Island bareing NNW. my Lieuten^{t}. then haveing the Watch clapt upon a wind, pretending that we ought to goe to Windward of the Island, and about the North end of it, whereas the Road is at the most Southerly part almost. he persisted in this Course, which was Contrary to my orders given overnight, and to all sence and reason, till I came upon Deck; when he was so farr from excusing it, that he pretended to justifie it; not without reflecting Language.[24]

Ratcliffe had noted the difference between his own calculations and those of the ship's log, but he did not challenge the course. Ratcliffe was on board an East India Company vessel that was following a prescribed and regular passage that had been undoubtedly experienced many times before by the ship's commander, while this was Halley's first real voyage away from the English coast. There was, however, more going on. Halley's justification for his role as commander of the vessel and for the voyage as a whole was directly tied to his supposed expertise as an astronomer and mathematician and his familiarity with the latest navigational practices and theories. Meanwhile, Harrison's position on the *Paramore* was expressly tied to his experience as a navigator. Thus, their disagreement over the course of the ship was tied directly to the status of each aboard the ship.

The example of Ratcliffe suggests that in normal circumstances one set of observations would be accepted for the purpose of the voyage. If the principal objective was simply to get from one place to another, then the exact location at a given time was not particularly imperative. Halley, however, was producing a chart of magnetic variation. If the chart was to have any value,

[23] "Loyal Bliss: Journal William Ratcliffe, Chief Mate," March 20, 1709, IOR/L/MAR/B/121A, unpaginated.
[24] *Voyages of Edmond Halley*, 106.

it was essential that he could prove himself able to plot his location accurately. As well, according to his instructions, he was to test the different methods of navigation. The problem was that Halley's observations made at sea were not accurate. Indeed, his judgment was so far off that it was notable even considering the unreliability of navigation at the time. On March 5, 1699 Halley was able to make an observation of an eclipse of the moon, with which he concluded their current longitude to be 36° West of London. This observation differed notably from the longitude he had derived through latitude and dead reckoning, which gave their location as being 26° West.[25] Halley had previously observed the lunar position at sea on February 17 when they were close to the island of Fernando Loronho and just off the coast of Brazil. Thus, Halley had erred by 100 miles in 220.[26] Such an incident was hardly likely to convince the already difficult Harrison of Halley's expertise or that Halley's judgment ought to be regarded as superior to his own.

Such a significant error was not an isolated event during the first *Paramore* voyage. In June Halley recorded that he found "by my reckoning that I am 48 Leag^{s}. before the Shipp." He attributed this discrepancy to "the shortness of our Logg line, the halfe Minute glass being full Measure."[27] Dead reckoning was not expected to be especially accurate and errors and deviations amongst observations were common. The objective of navigation was not to know precisely where one was at a given time, but to know close enough so as not result in tragedy. Halley's mistakes are notable partly because of their magnitude, but also because of who he was and the scientific objectives that justified his voyage in the first place. As Cook has pointed out, such frequent and significant errors in Halley's reckoning raises serious questions about his magnetic

[25] *Voyages of Edmond Halley*, 103; Cook, *Edmond Halley*, 273.
[26] Cook, *Edmond Halley*, 273.
[27] *Voyages of Edmond Halley*, 113.

chart.[28] More immediately for Halley, there was a correspondence between his inability to keep an accurate location and the insubordination of his officers. Harrison, in particular, had pretentions of expertise, as demonstrated by his book on navigation. According to his account, he had served on six previous ships and had found the state of navigation in the Navy to be sorely lacking.[29] Thus, Harrison was unlikely to respond to Halley's errors with equanimity. Halley, meanwhile, as a gentleman, Fellow of the Royal Society and highly regarded astronomer was not likely to regard Harrison's interventions as positive. Their differences turned out to be irreconcilable and by April Halley, "finding it absolutely necessary to change some of my officers," decided to return to England early in order to do so.[30]

Upon his arrival in England, Halley attempted to court martial Edward Harrison. As Halley put it in his explanation to the Admiralty:

> A further motive to hasten my return was the unreasonable carriage of my Mate and Lieutenant, who because perhaps I have not the whole Sea Directly so perfect as he, has for a long time made it his business to represent me, to the whole Shipps company, as a person wholy unqualified for the command their Lopps have given me, and declaring that he was sent on board here because their Lopps knew my insufficiency. Your Honour knew that my dislike of my Warrant Officers made me Petition their Lopps that my Mate might have the Commison of Lieutenant, therby the better to keep them in obedience, but with a quite contrary effect it has only served to animate him to attempt upon my Authority, and in order therto side with the said officers against me. On the fifth of this month he was pleased so grosly to affront me, as to tell me before my Officers and Seamen on Deck, and afterwards owned it under his hand, that I was not only uncapable to take charge of the Pink, but even of a Longboat; upon which I desired him to keep his Cabbin for that night, and for the future I would take the charge of the Shipp my self, to shew him his mistake: and accordingly I have wacht in his steed ever since, and brought the Shipp well home from near the banks of Newfound Land, without the least assistance from him. The many abuses of this nature I have received from him, has very sensibly toucht me, and made my voyage very displeasing and uneasy to me, nor can I imagine the cause of it, having endeavoured all I could to oblige him, but in vain. I take it that he envys me my

[28] Cook, *Edmond Halley,* 273.
[29] Edward Harrison, *Idea Longitudinis: Being, a brief Defininition of the best known Axioms For finding the Longitude, or a more Rational Discovery thereof, than hath been herefore Published* (London, 1696),
[30] *Voyages of Edmond Halley*, 109.

> command and conveniencies on board, disdaining to be under one that has not served in the fleet as long as himself, but however it be I am sure their Lopps will think this intolerable usage, from one ought to be as my right hand, and by his example my Warrant Officers have not used me much Better; so that if I may hope to proceed again I must entreat their Lopps to give me others in their room.[31]

The Admiralty acknowledged Halley's complaint and instigated a court martial upon the *Paramore*'s arrival in the Downes.[32] The Court Martials Enquiry, however, concluded that:

> Halley has produced nothing to prove y^{t} y^{e} said Officers have at any time disobey'd or denyed his Command thô there may have been some grumbling among them as there is generally in Small Vessels under such Circumstances & therefore y^{e} Court does Accquitt y^{e} S^{d} L^{t} Harrison & the other Officers of his Maj^{ties} Pink y^{e} Paramour of this Matter giving them a Severe reprimand for y^{e} Same.[33]

While Halley found Harrison's behaviour to severely compromise his position, the Admiralty interpreted the officer's actions as merely grumbling. Thus, Harrison and his co-conspirators were reprimanded, but the court martial demanded by Halley was denied.

Halley was not impressed with the result of the inquest. As he complained to the Secretary of the Admiralty, Josiah Burchett:

> Yesterday at the Court Martiall I fully proved all that I had complained of against my Lieutenant and Officers, but the Court insisting upon my proof of actuall disobedience to command, which I had not charged them with, but only with abusive language and disrespect, they were pleased only to reprimand them, and in their report have very tenderly styled the abuses I suffered from them, to have been only some grumblings such as usually happen on board small Shipps. My Lieutenant has now declared that I had signally disobliged him, in the character I gave their Lopps of his Book, about 4 years since, which therfor, I know to be the cuase of all his spight and malice to me, and it was my very hard fortune to have him joined with me, with this prejudice against me. Howsoever their Lopps may resent it, I am sure that never any man was so used by a Lieutenant as I have been, during the whole term of the Voiage, nor could I any wais help my self when abroad.[34]

[31] Halley to Burchett, June 23, 1699, in *Voyages of Edmond Halley*, 281-2.
[32] *Voyages of Edmond Halley*, 283.
[33] *Voyages of Edmond Halley*, 286.
[34] Halley to Burchett, July 4, 1699, in *Voyages of Edmond Halley*, 287.

This was the first time that Halley mentioned Harrison's book. It appears that it was only at this point that he learned that the Edward Harrison who had written the book he had reviewed harshly a few years previously was the same Edward Harrison as had been his disagreeable first mate. Halley was, therefore, able to explain Harrison's behaviour as having been the result of resentment. Such an explanation, however, does not address the root of Halley and Harrison's original dispute—that is the views expressed by Harrison in his book and the response by Halley in his review. Moreover, regardless of cause, the incident is telling with regard to the problem of control and the relationship between control and expertise. The central claim of the remainder of this chapter will be to establish a correlation between the language and development of navigation as a science during the eighteenth century in opposition to navigation as an art or practice as had previously been the case and the rise of the centralized, bureaucratic control over long distances that was needed for the formation of global imperialism.

Expertise Contested at Sea

Harrison's attitudes are clearly spelled out in the preface to his book:

> Some Years ago, I presented a few Lines concerning this Art, to a Nobleman, or Person of Quality, which Lines he little understood, and less regarded; which one of my Friends understanding well compared to casting Pearl before Swine. I have been informed of one who pretended to find the Longitude, and requiring a Gratuity, was sent to Mr. _____ to have his Approbation; I think they might as well sent him to a been Rob'd; I Discoursed this Art with some Fellows of the R.S. whom I found too much aiming at their peculiar Advantage; therefore I resolved to appear on the Publick Stage in Print.[35]

Halley fit the description of both a "Person of Quality" and a fellow of the Royal Society and Harrison might not have been inclined to view him favorably even if he had not negatively reviewed his book, though he did rely heavily on Halley as a source. The dispute between Harrison and Halley, thus, can be seen as part of the gentlemen/tarpaulin debates that were

[35] Edward Harrison, *Idea Longitudinis*, Preface.

ongoing at the time. As explained in the previous chapter, the debate featured a division between those who believed the English Navy was best served by genteel captains versus those who preferred the Navy's officers to be made up of men of common stock who achieved their rank not through birth and connections, but on the strength of experience and merit. Before his death, the sociologist Norbert Elias was developing a thesis which argued that it was this very tension between genteel and tarpaulin officers that allowed for the English Navy's fantastic rise from near irrelevance in the early seventeenth century to the world's dominate sea power only one hundred years later. As Elias put it, "only the rivalry between the two socially divergent groups could result in a fusion of military and nautical skills, or, in other words, the sociogenesis of the naval officer."[36] While the historian of the seventeenth-century British Navy J.D. Davies has argued that the gentlemen/tarpaulin debate was largely a rhetorical invention of reformist bureaucrats such as Samuel Pepys, the Halley/Harrison dispute demonstrates that such tensions were a reality on board ships.[37]

In the example of Christ's Hospital discussed in the previous chapter, John Flamsteed condemned the education provided to the mathematical boys in part because the school failed to teach the level of mathematics and astronomy that would lead to the advance of navigation. For Flamsteed, the fundamental problem regarding navigation was theoretical. Essentially, navigators lacked the mathematical and astronomical competence. Navigation would, therefore, remain problematically imprecise unless the longitude was solved at an astronomical level and navigators in the English Navy possessed the level of mathematical skill required to carry out the difficult calculations necessary after an astronomical observation has been taken. Harrison, too, considered the quality of navigators in the English Navy to be deeply deficient, but on

[36] Norbert Elias, *The Genesis of the Naval Profession*, edited by René Muelker and Stephen Mennell (Dublin: University College Dublin Press, 2007), 3.
[37] Davies, *Gentlemen and Tarpaulins*, 2.

importantly different grounds. Their problem was not that they were poorly instructed in mathematics, but that they were deficient in the practical skills obtained through experience. "It troubles me to think what Ignorant Persons are *Masters* of Ships," wrote Harrison in his discussion of magnetic variation, which he followed up with a couple anecdotes to illustrate the great ignorance he had found regarding the use of compasses for navigation.[38] According to Harrison, he had "belong'd this War to Six several Rates in the Navy, and never saw an *Azimuth Compass* Aboard any of them."[39] Most ships were not lost due to the inability to find the longitude; rather, they were lost as a result of accidents such as storms. While Harrison regarded there to be significant deficiencies on board Naval ships, in most cases experience made up for ignorance regarding technical matters.[40] Thus, as well as Halley knew his mathematics and astronomy, Harrison found him to be deeply lacking when it came to technical matters that could only be mastered through long experience at sea. From Halley's point-of-view, Harrison undermined him out of envy that Halley had been given the command despite having much less experience at sea than Harrison, which was evinced by Halley's ignorance of nautical terms.[41]

Halley represented the technocratic elite. Well-bred, well-educated and well-connected, he was a perfect representative of the rising bourgeoisie who were increasingly coming to the fore as England urbanized, its governance became more centralized and bureaucratic and its economy more market-based and capitalist. The crux of the gentlemen/tarpaulin debate, from the perspective of those who supported the tarpaulins, was that well-bred, but ignorant, gentlemen would receive commands on the basis of their social class and family connections and would

[38] Harrison, *Idea Longitudinis*, 30. Cf. Davies for whom such arguments beg the question of if the captains were so bad, how did the English fleet perform so well against the best commanded fleet of the age—the Dutch—in two wars and in 1692 defeat the best designed naval force, Louis XIV's new French fleet?, Davies, *Gentlemen and Tarpaulin*, 34-5.
[39] Harrison, *Idea Longitudinis*, 32.
[40] Harrison, *Idea Longitudinis*, 43.
[41] Halley to Burchett, June 23, 1699, *Voyages of Edmond Halley*, 282; Cook, *Edmond Halley*, 260.

lead their men into disaster as a result of their ignorance of seamanship. Halley was obviously not ignorant since his astronomical skill was widely recognized and he had a reasonable amount of marine experience. His threat was not really that he might bring his ship to ruin as a result of a lack of knowledge. Rather, I would argue that Halley challenged the order of things and threatened the internal structure of the naval hierarchy. It was this same tension between experience as local knowledge of a set of skills gained through experience and expertise as possession of universal knowledge that could be applied as a tool that could be applied in any specific circumstance that was seen in the tensions surrounding the Royal Mathematical School.[42]

The mathematical boys were meant to be exemplars of bourgeois values (literate in both the vernacular and in Latin and Greek, well-spoken, versed in the classics and—most importantly—pious and devout) as well as skilled mathematicians and capable navigators. Thus, they represented a belief that education and a middle-class morality was more important than practical experience and seniority. Indeed, these were points emphasized by Samuel Pepys when he presented his vision of what the Royal Mathematical School's goals ought to be:

> Persons fitted (in faire writing Accounts and Language) to serve him in any negotiation at sea or in forrein parts, to treate with forrein Governors, To reside, as Consuls, To keep acc^{ts} as Purs^{rs}, Clercks, or Other officers of the Navy, to serve as secretary, to Admiralls, & as they shall rise to it bee qualified for the Executing of duties of Commanders themselves, with an advantage of being able to draw or dictate Orders, Letters, Instructions, Articles of Treaty, and other works of Secretaries and Negotiation beyond what the ordinary Educaon of bare Tarpawling can ever arrive at.[43]

In other words, what was under threat was control over who was allowed to define expertise. As the Navy became increasingly bureaucratized, it was ever more difficult for its seamen to

[42] D.W. Waters argued that there was a clear distinction between "pilotage" and "oceanic navigation" with the former depending primarily on experience and the latter being "fundamentally scientific," see D.W. Waters, *The Art of Navigation in England in Elizabethan and Early Stuart Times* (New Haven: Yale University Press, 1958), 5.
[43] Pepys MS 2612, p. 249.

maintain their trade as autonomous and defined according to their rules rather than those imposed by civil servants who were ignorant of practical matters relating to the sea and whose concerns were rather more logistical.

One of the guiding hypotheses of this dissertation is that a centralized, bureaucratic state necessarily requires the creation of a standardized definition of expertise that can be controlled by the centralized institutions through specialized education or training.[44] This argument can be found to some degree in Theodore Porter's study of the relationship between numeracy, statistics and trust in the institutions of nineteenth and twentieth century France and the United States. Porter emphasized that reliance on statistics represents institutional weakness rather than strength. For example, the French military engineers resisted standardization successfully because their status as experts was already secure and to concede the ability to define what constituted such expertise would have resulted in undermining their authority.[45] In contrast, disciplines whose position is weaker are more likely to use numbers and externally validated standards of expertise in an effort to strengthen their position. Scholars of the professions have argued that a fundamental characteristic of a profession is that it is self-regulating. As the sociologist Terence Johnson put it, "a profession is not, then, an occupation, but a means of controlling an occupation."[46] In reference to the recent trend of non-academic, ex-politicians being hired as university presidents for political reasons, Mark Paschal has argued that such

[44] The relationship between the formation of a global commercial economy, centralized and bureaucratic government, and expertise will be developed further in Chapter 3.
[45] Theodore Porter, *Trust in Numbers*: *The Pursuit of Objectivity in Science and Public Life* (Princeton: Princeton University Press, 1995), Ch. 6. See also John Carson, *The Measure of Merit: Talents, Intelligence, and Inequality in the French and American Republics, 1750-1940* (Princeton: Princeton University Press, 2006).
[46] Terence Johnson, *Professions and Power* (Hong Kong: The MacMillan Press, 1972), 45. See also Eliot Freidson, *Professional Powers: A Study of the Institutionalization of Formal Knowledge* (Chicago: The University of Chicago Press, 1986).

encroachment by outsiders is a threat to the professional autonomy of the academy.[47] Yet, both Theodore Porter and this chapter demonstrate that the regulatory boundaries are often fuzzy and contested. Thus, professionalization has much to do with class and power.[48]

Halley did not represent a radical change in terms of how he actually practiced navigation. He continued to rely primarily on dead reckoning. While he was more knowledgeable about astronomical theory and practice, the evidence of his difficulty keeping an accurate longitude makes it clear that he was not a better navigator than his contemporaries. What he did represent, however, is an externally validated expert who threatened to undermine the existing structure of accrediting authority as a navigator. This was not a new threat. Samuel Pepys had spent his entire career at the Admiralty trying to impose standard definitions of expertise; hence, his instigation of an examination for would-be officers in 1677 and his continuous efforts to improve naval education. Unfortunately, there does not appear to be any existing copies of Halley's review of *Idea Longitudinis*, though there is a surviving review by Richard Waller of another of Harrison's papers from a couple years earlier in which Waller concluded by saying "I see nothing in the Paper but what is better explained in the places I have above quoted."[49] As Kate Morant has pointed out, Harrison's chapter on magnetic variation opens with lines copied almost word-for-word from an article on the same subject that Halley had published a decade earlier. Halley's 1683 article opened:

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[47] Mark Paschal, "Towards a History of the Professional: On the Class Composition of the Research University," *Viewpoint Magazine* 3 (September 17, 2013), https://www.viewpointmag.com/2013/09/27/towards-a-history-of-the-professional-on-the-class-composition-of-the-research-university/ <retrieved August 28, 2017>.

[48] This relationship between expertise and class and power is especially clear in Michael Wintroub's observation that "Though expertise in the early modern period was associated with specialized knowledge and skill, it was also associated with cunning, deception and social climbing," Michael Wintroub, *The Voyage of Thought: Navigating Knowledge Across the Sixteenth-Century World* (Cambridge: Cambridge University Press, 2017), 72.

[49] Richard Waller to Hans Sloane, December 4, 1699, Royal Society, EL/W3/68, quoted by Kate Morant. See the discussion of Harrison by Kate Morant on her blog in the entry "Harrison's book," *Halley's Log*, July 10, 2013, https://halleyslog.wordpress.com/2013/07/10/harrisons-book/ <retrieved November 14, 2016>.

> The Variation of the Compass (by which I mean the deflection of the Magnetical Needle from the true Meridian) is of that great concernment in the Art of Navigation that the neglect thereof, does little less than render useless one of the noblest Inventions mankind ever yet attained to.[50]

Harrison's chapter, meanwhile, began:

> The *Variation* of the Compass (by which I mean the deflection of the Needle, from the true Meridian) is of that great concernment in the Art of Navigation, that the neglect thereof does little less then render useless, one of the noblest Inventions Mankind ever attain'd to.[51]

Setting aside the plagiarism, Harrison devoted his efforts primarily to describing the general problems that existed, but offered very little by way of solutions as his book did not contain much that could not have been found elsewhere. Perhaps even worse, he provided nothing by way of technical explanation. Harrison may have believed that navigation was learned primarily through experience; therefore, it was not particularly useful to provide the specific details of how to carry out particular practices. Rather, the important thing was to establish institutional and cultural barriers that Harrison believed to be impeding navigation in the English Navy. It might have simply been, however, down to Harrison lacking the technical expertise necessary to explain such issues at a detailed level and, similarly, did not possess the financial resources to publish a longer book that such additional material would have required. Ultimately, then, Harrison's short book tells its reader a great deal more about Harrison's character than it does about navigation in the late seventeenth century.

The dispute between Halley and Harrison was motivated in part by the tensions that I have been describing; however, it must be recognized that the situation was more complex. Harrison's book was not a defence of the status quo. Indeed, he justified his writing it by claiming endemic incompetence and ignorance in the English Navy. Meanwhile, Halley does not

[50] Edmond Halley, "A Theory of the Variation of the Magnetical COMPASS," *Philosophical Transactions* 13 (January, 1683), 208.
[51] Harrison, *Idea Longitudinis*, 26.

appear to have been interested in challenging established naval practices or its existing hierarchical structures. However, his productions of a map of magnetic variation and an improved tidal chart were part of an ongoing effort to establish a centralized, 'scientific' vision of the world. As has been shown by scholars such as Matthew Edney and Benjamin Schmidt, such ambitions would come to be integral to the imperial project.[52] Harrison presented himself in grand terms (comparing himself to Columbus for example), but his book was of little practical value and was instead primarily a failed attempt at self-promotion. Scholars such as Morant and Cook who have commented on Harrison's book have generally concluded that Harrison was a vainglorious man who nursed a grudge against Halley for reviewing his book poorly. I do not dispute much of this reading; however, I hope that in placing the matter into the context of the gentlemen/tarpaulin debates and concurrent changes in how expertise was understood and defined, I have provided a more nuanced consideration of the controversy than has typically been the case. A central approach of this dissertation is to consider debates such as the gentlemen/tarpaulin one in relation to the larger societal transformations that were occurring as English governance became increasingly centralized and the economy globalized and capitalistic. The next section of this chapter will turn to the example of the Board of Longitude and the search for a solution to the longitude problem in order to push this claim further.

[52] Matthew Edney, *Mapping an Empire: The Geographic Construction of British India, 1765-1843* (Chicago: University of Chicago Press, 1997); Benjamin Schmidt, *Inventing Exoticism: Geography, Globalism, and Europe's Early Modern World* (Philadelphia: University of Pennsylvania Press, 2015). See also Laura Hostetler, "Contending Cartographic Claims? The Qing Empire in Manchu, Chinese, and European Maps," in *The Imperial Map: Cartography and the Mastery of Empire,* edited by James Akerman (Chicago: University of Chicago Press, 2009) and Richard Smith, *Mapping China and Managing the World: Culture, Cartography and Cosmology in Late Imperial Times* (London: Routledge, 2013).

The Longitude Problem and the Problem of Expertise

Figure 2.4: William Hogarth, A Rake's Progress, Plate 7

In his famous series of eight paintings, Hogarth depicted the decline and fall of Tom Rakewell. In the seventh plate, Rakewell is shown incarcerated in the Fleet debtor's prison and beginning to go mad, with his madness indicated by the presence of a telescope (a reference to the Longitude prize) and an alchemy experiment in the background.

Finding the longitude at sea was the defining limitation to navigation at the beginning of the eighteenth century. The latitude—that is, how far north or south you are—is relatively straightforwardly determined from the height of the sun in the sky. The longitude—how far east or west you are—lacks a natural reference point like the equator and is significantly more

difficult to ascertain. Indeed, many regarded finding the longitude at sea with any certitude to be as impossible as perpetual motion machines and the search for a method to be every bit as foolish, as can be seen in the reference to the longitude in William Hogarth's famous work "A Rake's Progress." (Figure 2.4)[53] While a workable method to find the longitude at sea might have been widely regarded as a fool's errand, there were three methods that were theoretical solutions to the problem. The first was the lunar method. The lunar method relies on the quick movement of the moon across the sky as it will move about half a degree in one hour. Thus, a navigator could measure the angle between the moon and another body. In theory, this method can be used to compare against a known time (e.g. Greenwich Time) for that observation. Knowing both Greenwich and local time would then allow the longitude to be calculated. The second method involved observing Jupiter's four brightest moons in order to determine the time and calculate the longitude. The third method was the timekeeping method. Instead of requiring precise astronomical observations and difficult calculations, the timekeeping method involved carrying on board the ship a timepiece set to the exact time of a location where the longitude is known. As the degree of longitude corresponds to a unit of time (a minute of time equals a minute of distance and a degree an hour), all one needs to do is determine the time at the current location and calculate the difference compared to the time shown on the clock.

All three of these methods were faced with significant problems that rendered them deeply unreliable at best prior to the mid-eighteenth century. The lunar-distance method required three things in order to be possible: an accurate star catalogue, instruments capable of making the angular measurements required with the precision required, and, finally, the ability to predict the

[53] On satirical depictions of the longitude, see Katy Barrett, "The Wanton Line: Hogarth and the Public Life of Longitude," PhD. Diss. University of Cambridge, 2013. See also, Owen Gingerich, "Cranks and Opportunists: 'Nutty' Solutions to the Longitude Problem," in *The Quest for Longitude: Proceedings of the Longitude Symposium*, edited by W.J.H. Andrewes (Cambridge, MA: Collection of Historical Scientific Instruments, 1996).

motions of the sun and moon several years in advance. At the time Newton wrote his letter none of these ingredients were in place; however, Flamsteed's star catalogue would partly satisfied the first and John Hadley's reflecting quadrant meant the second requirement was satisfied in the 1730s. The third would not be solved until Tobias Mayer's lunar tables were sent to the Admiralty in 1755 and, then eventually tested conclusively by Nevil Maskelyne in 1761 that the problem was effectively solved.[54] As Derek Howse pointed out, Maskelyne was not the first to successfully use the lunar-distance method at sea as the Abbé Nicolas-Louis de Lacaille had made such observations on his voyage from the Cape of Good Hope to France in 1753-54; however, Maskelyne became the Astronomer Royal in 1765 and was able to use his position in support of publicizing the lunar-distance method and, most importantly, making it viable for use by navigators.[55] Thus, Maskelyne devoted much of the Royal Observatory's resources to the continued production of the necessary predictions and employed a large number of computers to carry out the difficult calculations needed.[56] The result of this effort was the *Nautical Almanac*, which was published annually from 1767 onward.

The second method was the only one that was practical for finding the longitude while on land and, thus, was the one used by astronomers such as Flamsteed or Halley; however, because of the limitations of chromatic lenses, a twenty foot telescope was needed in order for it to be powerful enough to observe Jupiter's moons. It was impossible to make an accurate observation

[54] Providing such lunar observations was the principal objective of the Royal Observatory under Edmond Halley; however, by the time he became Astronomer Royal in 1719 he was over sixty years old and his observations ultimately were neither accurate nor regular enough to be of significant use, see RGO 2/18, f. 25

[55] Derek Howse, "The Lunar Distance Method of Measuring Longitude," in *The Quest for Longitude*, 154. See also, Guy Boistel, "From Lacaille to Laland: French Work on Lunar Distances, Nautical Ephemerides and Lunar Tables, 1742-85" and John Gascoigne, "Navigating the Pacific from Bougainville to Dumont d'Urville: French Approaches to Determining Longitude, 1766-1840," both in *Navigational Enterprises in Europe and its Empires, 1730-1850*, edited by Richard Dunn and Rebekah Higgit (London: Palgrave Macmillan, 2015).

[56] On the painstaking difficulty of the necessary calculations and the human labour involved, see Mary Croarken, "Human Computers in Eighteenth- and Nineteenth-Century Britain," in *The Oxford Handbook of the History of Mathematics*, edited by Eleanor Robson and Jacqueline Stedall (Oxford: Oxford University Press, 2009).

with a telescope of such length while at sea considering the constant motion of the ship. Finally, the third method can only be relied on if the clock in question is very accurate. Even the best mechanical clocks at the time were not particularly good at keeping the time and their performance was further challenged by the conditions on board a ship as air pressure, salt water and rough treatment from the crew, weather and waves all conspired to make the task of keeping the time quite difficult. As any time lost resulted in a corresponding misrepresentation of the longitude, reliance on a clock was likely to result in a very unreliable longitude. As the example of the magnetic variation shows, other methods were proposed and investigated; however, they generally proved to be even less successful than the existing methods. Thus, the most reliable means of navigation remained the same as had been used for a number of centuries: dead-reckoning.

Dead reckoning involved carrying a length of rope on board the ship with a series of knots tied at established intervals. The rope would be tossed overboard and a period of time measured through the use of an hour glass while someone counted the number of knots that passed over the side of the ship. By this method, sailors were able to approximate the speed of the ship. The speed, wind strength and direction and the direction the ship was traveling were recorded at regular intervals and from there an estimate of how far they had travelled in a given day was made. Dead reckoning is not particularly reliable if one needs to know precisely where one is, but it was generally adequate for getting to the intended destination.[57] As well, the knowledge of experienced seamen and the ability to determine the latitude meant that generally navigators knew where they were well enough that in normal conditions the ship was unlikely to run aground and usually did not get hopelessly lost. In the instances where such significant

[57] On dead reckoning, see J.A. Bennett, *Navigation: A Very Short Introduction* (Oxford: Oxford University Press, 2017), Ch. 4.

failures of navigation did occur, there were often circumstances such as bad weather or gross incompetence that would not have been solved by there being a solution to the longitude problem.[58]

For reasons that are unclear, in 1714 the British Parliament established the Longitude Prize which promised to reward anyone who solved the longitude problem to a close enough degree of accuracy would be rewarded a prize of £20,000. The creation of the prize has generally been attributed to the Cloudesley Shovell disaster of 1707 in which a fleet of naval ships under the admiral's command ran aground and some 3000 sailors were lost and to the publication of a pamphlet by William Whiston and Humphrey Ditton in 1714 in which they suggested a method of finding the longitude.[59] Whiston certainly was aggressive at self-promotion and quite possibly lobbied for the creation of a prize, which he could then claim for himself (Ditton died in 1714).[60] However, Whiston was a known heretic who had lost his position as Lucasian Professor at Cambridge due to his public anti-Trinitarianism and millenarianism. These controversies had led to Newton disavowing Whiston, whom he had previously chosen to be his successor at Cambridge, and left Whiston a rather isolated figure for the rest of his life.[61] It seems unlikely, then, that Whiston would have possessed the political clout to get such a significant prize established by Parliament. Moreover, Whiston and Ditton's solution was deeply impractical and

[58] For example, the infamous Cloudesley Shovel disaster occurred at night and in bad weather (though W.E. May disagreed that the weather was poor). While a better method of finding the longitude would likely have made those on board the ships more aware of how close they were to the Scilly Islands, it is not clear that the lack of the longitude was the primary cause of the disaster. For analysis of the Shovel disaster see: W.E. May, "The Last Voyage of Sir Clowdisley Shovel," *Journal of Navigation* 13 (1960): 324-32.

[59] William Whiston and Humphrey Ditton, *A New Method for Discovering the Longitude Both at Sea and Land, Humbly Proposed to the Consideration of the Publick* (London: Printed for John Phillips, 1714).

[60] After Ditton's death his widow petitioned the Court for financial assistance as she had four children to care for, three of whom had been born while Ditton was mathematical master at the New Mathematical School. The court decided to provide a house allowance of two shillings and six pence per week for the two youngest children, LMA CLC/201/B/001/M 1208/09, 470, 562.

[61] See Stephen Snobelen, "William Whiston: Natural Philosopher, Prophet, Primitive Christian," PhD Diss. University of Cambridge, 2000, 109-10, 280; Larry Stewart and Snobelen, "Making Newton Easy: William Whiston in Cambridge and London," in *From Newton to Hawking: A History of Cambridge University's Lucasian Professors of Mathematics*, edited by Kevin Knox and Richard Noakes (Cambridge: Cambridge University Press, 2003).

generally subjected to mockery as can be seen by the references to it in the correspondence between John Flamsteed and his former assistant Abraham Sharp. This was because what they proposed was that a network of ships be set up along the coasts which would then fire cannons at prescribed times so that sailors would be able to see the fire of the cannons and hear the explosions and thus be able to determine how close they were to shore. While such a system might have been of some merit for marking the coasts of England, it did not actually address the problem of finding the longitude.

The mystery of the longitude prize is further compounded by the fact that no one affected particularly seems to have wanted it. The Act which created the prize also established a set of commissioners who were to adjudicate submissions and determine when and if the prize was to be awarded. These commissioners were men drawn from logical sources such as the mathematical professors at Oxford and Cambridge, the astronomer royal at Greenwich as well as from the admiralty. Those who were named commissioners do not seem to have been asked before being named. Certainly, Flamsteed and Newton both found the whole thing to be an annoying waste of their time and Flamsteed devoted most of his efforts as a commissioner to convincing those who came to him with schemes to leave him alone. Newton was consulted before the Longitude Act was passed, but does not seem to have been listened to since he had little interest in the prize and did not regard finding the longitude at sea to be particularly important. Newton's opinion on the matter can be seen in an unsent draft of a letter written in 1721 in reply to the secretary of the admiralty Josiah Burchett regarding the solutions to the longitude problem in which Newton concluded with "But the chairman of the Committee of the

House of Commons being a seaman represented that they did not want the longitude, & so far as I can observe the seamen are generally of that opinion."[62]

For Newton, the longitude was an astronomical problem that was not particularly pressing and the longitude prize mostly resulted in him being irritated by people like Burchett. Even if navigation could be perfected, the maps and charts on which mariners depended were both highly incomplete and frequently inaccurate. As Edmond Halley noted, "it would be needless to enquire exactly what Longitude a Ship is in when that of the Port to which she is bound is still unknown."[63] The records of the Board of Longitude indicate that it was not regarded as a particularly pressing or serious endeavour in its early years. According to the historian Alexi Baker, the commissioners did not meet until 1737, by which time nearly all of the original commissioners named in the Longitude Act were dead. Baker has argued that in reality the Board of Longitude was invented by Nevil Maskelyne, Astronomer Royal from 1765 to 1811, for the purpose of re-establishing the Royal Observatory as the centre of astronomy in Britain and that he used the Board to consolidate and strengthen his own personal power.[64]

It is not clear what the longitude problem even actually was because the answer to that question depended on personal interests. The most basic purpose of navigation is that it enables one to arrive at one's intended destination safely and efficiently. Thus, improving navigation had potential commercial benefits. Indeed, the commercial implications of finding the longitude were emphasized in the Longitude Act itself, which noted that "such a Discovery would be of

[62] CUL Add. 3972, f. 40.
[63] Halley, "An Advertisement to Astronomers, of the Advantages that may accrue from the Observation of the Moon's frequent Appulses to the Hyades, during the Three next ensuing Years," *Philosophical Transactions* 30 (1717), 692.
[64] Alexi Baker, "'Humble Servants', 'Loving Friends', and Nevil Maskelyne's Invention of the Board of Longitude," in *Maskelyne: Astronomer Royal,* edited by Rebekah Higgitt (London: Robert Hale, 2014).

particular Advantage to the Trade of Great Britain."[65] For astronomers such as Newton or Flamsteed that did not address the crucial problem. As Flamsteed noted to Sharp regarding Whiston and Ditton's proposal, they "tend onely to finding the distance of a ship at sea from any mark or coast from whence they can see the fire and hear the noyce of a gun shot at 12 a clock at night" thus "their proposal sinkes *from finding of the longitude* to finding of the distance of the ship from a seamark."[66] To which Sharp responded by opining that "some considerable part" of the longitude prize ought to be given to Flamsteed "enabling you to carry on and compleat your laudable designes which will undoubtedly more effectively contribute to the obtaining the Longitude universally than any thing the best of these petty projectors have or can offer."[67] Meanwhile, Newton wrote to Burchett that the longitude:

> Is not to be found at sea by any method by wch it cannot be found at land. And it is not yet found at land by watch-work. The method of finding it at land must be improved before it be fit for sea. A good Watch may serve to keep a recconing at Sea for some days & to know the time of a celestial Observ[at]ion: & for this end a good Jewel watch may suffice till a better sort of Watch can be found out. *But when the Longitude at sea is once lost, it cannot be found again by any watch*. By Astronomy it may be found at land without erring a quarter of a degree & by this method the longitude of the Harbours in ye world may be settled.[68]

Both Flamsteed and Newton, thus, saw a distinction between *finding the longitude* and *keeping the longitude*. Finding the longitude implied, as Sharp notes, a universal method that can be executed anywhere on the globe. More importantly, it meant finding the longitude when the longitude was lost or not already known. Keeping the longitude, on the other hand, required only that the ability to maintain a longitude that had already found. Thus, Newton disregarded timekeeping as a real solution to the problem and pronounced that improvement for finding the longitude "must be made at land, not by Watchmakers or teachers of Navigation or people that

[65] "Acts of Parliament and awards," RGO 14/1, f. 21r. Available online at http://cudl.lib.cam.ac.uk/view/MS-RGO-00014-00001/21.
[66] Flamsteed to Sharp, 31 August, 1714, *Flamsteed's Correspondence, vol 3*, 701.
[67] Sharp to Flamsteed, 8 March, 1714/15, *Flamsteed's Correspondence, vol 3*, 727.
[68] Newton to Burchett, ? October, 1721, *Correspondence of Isaac Newton, vol. 7*, 172. Emphasis added.

know not how to find the Longitude at land, but by ablest Astronomers."[69] Finally, Edmond Halley observed that the coordinates for a great number of ports had not yet been calculated, which rendered the question of finding the longitude at sea rather moot.[70]

Simon Schaffer has noted a dichotomy between "interest" and "curiosity." The former points toward "the importance of economic, military, and political factors" while the latter "is often used to describe the scientific motives at work in the voyages of the late eighteenth century and after."[71] In other words, interest connotes the words monetary definition as it relates to investment and finance. Curiosity, on the other hand, maintains an air of dispassionate observation in which the curious is not motivated by expected reward. The longitude prize stood in sharp contrast to such ideals.[72] The longitude problem, however, points to a different, though related, tension. In rejecting the timekeeping method as failing to solve the problem because it only kept the longitude and did not give the navigator the means to find it again should it become lost, Newton represented a view which prioritized universal knowledge.

Yet, from a practical standpoint, seamen were unlikely to be concerned about the distinctions between finding the longitude and keeping it as long as they were able to better get to where they were going. Sailors were indifferent or even antagonistic to efforts to solve the longitude problem because the solutions did not seem to promise to improve the day-to-day art of navigation. One of the principal groups of people who were invested in the longitude problem were the projectors who hoped to get rich off their schemes to solve it and it has often been these

[69] Newton to Burchett, ? October, 1721, *Correspondence of Isaac Newton, vol 7*, 172.
[70] Halley, "An Advertisement to Astronomers," 692.
[71] Simon Schaffer, "Visions of Empire: Afterward," in *Visions of Empire: Voyages, Botany, and Representations of Nature*, edited by David Philip Miller and Peter Hanns Reill (Cambridge: Cambridge University Press, 1996), 335-6.
[72] Not that the ideal ever conformed to reality, as the career of Robert Hooke demonstrates with particular clarity, see Rob Iliffe, "'In the Warehouse': Privacy, Property and Priority in the Early Royal Society," *History of Science* 30 (1992): 29-68; "Material Doubts: Hooke, Artisan Culture and the Exchange of Information in 1670s London," *The British Journal for the History of Science* 28 (1995): 285-318.

individuals who have received the most attention.[73] Such a focus, however, leaves unaddressed the question of why was the longitude prize offered in the first place? Nobody involved in the navy or astronomy seemed particularly to want it and the person for whom there is the most extant evidence of lobbying for such a prize is the outcast heretic William Whiston. There was, however, another interested party who would have found the need to solve the longitude problem to be at least somewhat pressing: the growing managerial class of professional civil servants and bureaucrats. By solving the longitude the definition of navigational expertise would be, theoretically, removed from the possession of seamen into the hands of these same bureaucrats. Knowledge, then, would be centralized and standardized so that it would both conform to a clear set of rules and would be able to be managed and tracked from a central location.

The historian of the seventeenth-century English Navy, J.D. Davies, has observed how much popular perception of the Navy has been dominated by Samuel Pepys.[74] Pepys is one of the earliest representatives of the bourgeois, professional class of civil servants who would become increasingly important as the governance shifted from the cult of the monarch to its modern, more insidious form as famously described by Michel Foucault.[75] Pepys was characterized by his obsession with rules and procedure, his pursuit of self-improvement (for example his efforts to teach himself mathematics or his long involvement with the Royal Society) and, perhaps most significantly, his enthusiasm regarding examinations.[76] Davies has noted that these characteristics are demonstrative of Pepys's upbringing and social class. It is notable, and perhaps surprising, that it was the gentlemen officers who were regarded as having the corrupting effect on the Navy as they were portrayed as "vicious, arrogant, 'gentlemen' who

[73] See Larry Stewart, *Rise of Public Science: Rhetoric, Technology, and Natural Philosophy in Newtonian Britain* (Cambridge: Cambridge University Press, 1992), Ch. 6 "The Longitudinarians."
[74] Davies, *Gentlemen and Tarpaulins*, 2; 44-9.
[75] Michel Foucault, *Discipline and Punish.*
[76] Claire Tomalin, *Samuel Pepys: The Unequalled Self* (New York: Vintage Books, 2003), 246-53.

brought into the fleet such vices as drinking, swearing, whoring, and effeminate clothing" and supplanting the "rough, brave, tarpaulin captains."[77] It is important to remember that Pepys was thoroughly middle-class, Cambridge educated and a life-long civil servant. In other words, the standards of behaviour and understanding of credibility he sought to impose on the Royal Navy were products of his social milieu. Davies's thesis was that Pepys, due to the significant amount of well-organized and easily accessed material that he left behind and because of his charismatic voice both in the archive and his famous diaries, had caused historians to neglect other sources of naval history that, it turns out, challenge Pepys's authority. Thus, Davies rejected the gentlemen/tarpaulin debate as overplayed with regard to naval history.

The tension between gentlemen and tarpaulins may have been overemphasized in terms of naval practice; however, it was a significant early skirmish in the battle between practice and expertise. The dispute was not over whether the navy was best served by gentlemen officers or officers who earned their status through years of experience, but over management.[78] What the reformers such as Pepys sought to do was to take away from the mariners the authority to define expertise by redefining it in a narrower, standardized manner that obscured the role played by social factors. Thus, Pepys theoretically sided with the tarpaulins over the gentlemen in that he argued naval officers ought to achieve their rank through merit, which could only be obtained through experience. However, as an advocate of examinations and in his support of the Royal Mathematical School, he attempted to put into place structures that would undermine the existing naval hierarchy in favour of practices that would strengthen the power of the Admiralty office at the expense of the officers. The central tension, then, for the Royal Navy as Britain grew into an imperial power was that of how best to wield command over such vast distances? As a later

[77] Davies, *Gentlemen and Tarpaulins*, 34.
[78] On this point, see Schotte, "Expert Records," 294-99.

chapter will argue with the example of the English East India Company, the tension was between attempts to exert power from the metropole over actors in the so-called periphery. The issues that dominated scholarly concerns regarding navigation are, I believe, particularly instructive relating to these larger issues in imperialism.

The popular historian Dava Sobel subtitled her hagiography of John Harrison "The True Story of a Lone Genius Who Solved the Greatest Scientific Problem of His Time," a heroic assessment that is not entirely borne out by the historical evidence.[79] As Katy Barrett has observed, "Harrison could be presented as a genius, but he could also be presented as a projector, or worse as a madman, as, precisely, our longitude lunatic."[80] In her best-selling popular history Sobel took the side of Harrison and assigned to Nevil Maskelyne the role of villain. Historians of science have tended, especially in recent years (in explicit response to Sobel's book), to be more sympathetic toward Maskelyne and more critical of Harrison.[81] Harrison first came to the attention of Halley around 1730 and it was due to his first timekeeper that the first meeting of what became the Board of Longitude was held in 1737; however, it took him another thirty years of labour to perfect his chronometer to where it satisfied both his and the Longitude Act's qualifications. Yet, even the final version did not officially receive the prize, though Harrison was eventually given money the more or less equalled the £20,000. As Rebekah Higgit has pointed out, rather than being completely unsupported and at odds with the elites of the Board of Longitude, Harrison was in fact given unprecedented levels of financial support.[82] For Sobel,

[79] On challenging Harrison's legacy, see Rebekah Higgit, "Challenging Tropes: Genius, Heroic Invention, and the Longitude Problem in the Museum," *Isis* 108 (2017): 371-80.
[80] Barrett, "The Wanton Line," 134.
[81] For recent examples coming out of the Board of Longitude Project, see Higgitt and Richard Dunn, "Introduction," in *Navigational Enterprises in Europe and Its Empires.* See also Higgitt, ed., *Maskelyne: Astronomer Royal* (London: Robert Hale, 2014); Richard Dunn and Rebekah Higgitt, eds., *Finding Longitude: How Ships, Clocks and Stars Helped Solve the Longitude Problem* (Glasgow: Collins, 2014) and Barrett, "The Wanton Line." See also Bennett, *Navigation*, Chs. 4 and 5.
[82] Higgit, "Challenging Tropes," 374.

Maskelyne's antipathy toward awarding the prize to Harrison is what defines Maskelyne of the villain in the story. Certainly Maskelyne was motivated in part by the recognition that if the prize was awarded the Board of Longitude would cease to have its primary purpose. As Flamsteed and Newton both argued, however, there was a reasonable case to be made that the time-keeping method did not actually solve the longitude problem since if the time was lost the navigators would not be able to regain the longitude without resorting to an astronomical approach. Thus, rather than bringing about the end of the Board, Maskelyne was able to expand the scope of the Board.[83] In order to improve the usage of the lunar distance method, in 1767 the *Nautical Almanac* was established and Maskelyne devoted significant resources toward its annual production, including the employment of a number of human computers who were tasked with completing the difficult calculations required.[84]

Long-Distance Control in Practice

At the beginning of this chapter, I introduced a classic article by John Law to serve as a provocation for what would follow. Law presented Portuguese expansion in the fifteenth and sixteenth centuries as a case-study for the network approach to science and technology studies that was being pioneered at the time by scholars such as Bruno Latour, Michel Callon and Law. Law argued for an approach that stressed heterogeneity, complexity and interrelation and the role of conflict for solving problems. The problem Law wished to solve was what made Portuguese expansion successful in the sixteenth century and European imperialism more generally? The answer, for Law, was technological. The Portuguese prevailed over their non-European adversary because they had technological advantages. European ships, built for northern

[83] Alexi Baker, "'Humble servants,'" in *Maskelyne: Astronomer Royal*.
[84] Croarken, "Providing Longitude For All," *Journal for Maritime Research* 4 (2002): 106-26; "Tabulating the Heavens: Computing the Nautical Almanac in 18th-Century England," *IEEE Annals of the History of the History of Computing* 25 (2003): 48-61; "Human Computers in Eighteenth-and nineteenth-century Britain;"; "Nevil Maskelyne and His Human Computers," in *Maskelyne: Astronomer Royal*.

climates, were more durable. European guns were more devastating. Finally, when Portuguese mariners set out into open water they were confronted with the need to improve navigational techniques if such trans-oceanic voyages were to be viable as regular endeavours. Thus, navigation became more technical and the instruments used more advanced. Moreover, navigation was transformed from a practice that was inherently local in context to that of a universal science. In other words, before the Europeans began to make voyages across the Atlantic and around the south of Africa and into the Indian Sea, ships tended to follow coasts and stay close to land. Thus, navigation operated primarily in terms of know-how and experience. Rather than needing to know astronomy or mathematics, a good navigator relied on knowledge of things such as the coasts, currents or weather—that is, local knowledge gained through experience.

The crucial assumption upon which Law's argument was built was that a transition from tacit knowledge to something more rigorous and universal happened. While Law accepted that it was imperfect and that the new method of navigation was difficult for most mariners and not fully understood by many, including Christopher Columbus, he contended that the end result was the creation of a new social group: the astronomical navigator.[85] The new astronomical methods of navigation are seen by Law as more advanced and superior when the navigator possessed the proper skill. As this chapter has hopefully demonstrated, the reality was rather less teleological. Navigation remained highly dependent on the local context and continued to depend primarily on non-astronomical methods such as dead-reckoning for the entire period from the Portuguese in

[85] John Law, "Technology and Heterogeneous Engineering: The Case of Portuguese Expansion," in *The Social Construction of Technological Systems: New Directions in the Sociology and History of Technology, anniversary edition,* edited by Wiebe Bijker, Thomas Hughes and Trevor Pinch (Cambridge, MA: The MIT Press, 2012), 119-20.

the fifteenth century right through into the nineteenth.[86] Moreover, historians such as Alison Sandman have convincingly shown that the transition toward the astronomical navigator, inasmuch as it occurred, had more to do with political contests between pilots and cosmographers as it did with technological superiority.[87]

While Law acknowledged the merits of the social constructivist approach, he did not take politics into account or investigate his actors within historical context. Sandman, on the other hand, did just this and in considerable detail. Thus, what was for Law primarily a story of broad contests leading toward technological innovation was, to Sandman, a complex tale of power struggles between actual people. According to Law, "when success is achieved, it is obvious" because "If one arrives at one's port of destination (or for that matter runs aground on the reefs of Cape Bojador), the success (or failure) of the enterprise is readily apparent to all."[88] The work of Sandman suggests that this is not actually true. Most of the time one did arrive at one's destination regardless of what navigational methods were used and when one did not it was not necessarily readily apparent why one failed. As the example of Halley shows, the most advanced methods of navigation were not necessarily the most accurate. As Halley also demonstrates, despite making catastrophic errors in which he was over one hundred miles out in his reckoning, he made the circuit to the South Atlantic, up the American coast to Newfoundland and back to London without any problems. Indeed, he specifically pointed to how he had brought his crew back in unusually good health when he made his case for a second voyage.[89]

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[86] For example, while the chronometer has been heralded as solving the longitude problem, its uptake was extremely slow and limited, especially in the British Navy, see W.E. May and Derek Howse, "How the Chronometer Went to Sea," *Vistas in Astronomy* 20 (1976), 135.
[87] Alison Sandman, "Cosmographers vs. Pilots: Navigation, Cosmography, and the State in Early Modern Spain," PhD Diss. University of Wisconsin-Madison, 2001, Ch. 2.
[88] Law, "Technology and Heterogeneous Engineering," 120.
[89] Halley to Burchett, *Voyages of Edmond Halley*, 281; Halley to Burchett, *Voyages of Edmond Halley*, 287.

The argument made by Sandman, and by this chapter, is supported by the work of Theodore Porter. As Porter has contended, disciplinary authority relies heavily on social power. Thus, the Spanish cosmographers described by Sandman triumphed because they possessed social advantages that the less educated pilots did not. Porter illustrated his argument with the contrasting examples of Corps des Ponts in nineteenth-century France and cost-benefit analysis in twentieth-century American army engineering. Pressures such as public responsibility and local political debate would "inspire a monumental attempt to reduce cost-benefit analysis to firm rules" in the American army; however, this never occurred with the Corps des Ponts. Unlike the Americans:

> The Ponts engineers never had to pretend that calculation was simply a matter of following unambiguous rules. Given the institutional autonomy and elite standing of their Corps, it was quite inconceivable that these engineers could have been deprived of the ability to exercise discretion.[90]

In other words, reliance on externally validated numbers is a sign of disciplinary weakness. A given discipline does not necessarily establish its authority on the basis of its actual competence so much as a result of winning a political struggle in which competence is only one of the factors under consideration and, moreover, can often be defined in contradicting ways.

As Sandman has argued, elite tools serve as instruments of power. As she explained, the cosmographers "used their nascent power over the tools used by the pilots—the charts, astrolabes, regiments, cross-staffs, and compasses—to try to control the behavior of the pilots at sea."[91] Such attempts at imposing long-distance control are typically resisted and in the example of navigation such resistance was largely successful. In his study of British naval education in the eighteenth and nineteenth centuries, Harry Dickinson showed that persistent attempts to

[90] Porter, *Trust in Numbers,* 115.
[91] Sandman, "Cosmographers vs. Pilots," 162.

create a standardized, centralized naval academy to train officers consistently failed.[92] The example of the dispute between Edmond Halley and Edward Harrison illuminates some of the tensions between elite technocratic preferences and established practice; moreover, the lenient judgement by the courts martial initiated by Halley against his officers is a significant reminder that the Royal Navy, as an institution, was also engaged in the same political struggle. Indeed, the push toward technological and navigational standards was a move that would have undermined the Navy's ability to govern itself and came at a time when the Navy was already engaged in a struggle with Parliament to maintain its political status and relevance after the Glorious Revolution in 1688.

Conclusion

In this chapter, I have sought to discuss navigation with the emphasis on how it was actually practiced in the early eighteenth century and without over-reliance on theoretical developments. In particular, I have resisted a narration that placed the solution to the longitude problem at the heart of the story. As was discussed at length in the first chapter, one of the ways in which the history of early-modern navigation has been told has been through the lens of mathematization. The longitude, thus, can be read as the central problem of early-modern navigation. It was the inability to find the longitude that prevented navigation from becoming 'modern' because such technical limitations enabled navigators to continue to rely on 'primitive' techniques such as dead-reckoning. Yet, the practice of navigation in the eighteenth century fails to provide clear support for such a straightforward teleology. Indeed, an investigation of the founding myth of the Longitude Prize itself offers a different story. W.E. May's study of the surviving logbooks from the Cloudesley Shovell disaster questioned nearly every one of the

[92] Ironically, he did so while largely attempting to make essentially the opposite argument and demonstrate the significant resilience of continuation of such naval academies in contrast to a historiography that had largely regarded them to have been entirely irrelevant.

basic premises upon which the myth rested. Most significantly, May suggests that the want of the longitude was not the cause of the accident.

While the logbooks demonstrate a significant degree of variation in their measurements, the variation in longitude was not the specific problem. Instead, due to the inconsistencies found in the navigational texts available, the expected location of the Isles of Scilly varied importantly depending on which charts were being used. As the charts were not graduated for longitude, recourse had to be made to the latitude and longitude tables available in navigational manuals; however, the manuals differed among themselves in important ways. For instance, the prime meridian was not the same in every book. Moreover, the officers frequently had the wrong latitudes, which could be accurately measured. May's argument was that the accident was not entirely the product of poor navigation, rather "the errors in longitudes in the accepted text-books must have introduced a danger just as great as any errors in reckoning the longitude."[93] This revision of the Shovell disaster points to the wide range of challenges still faced by navigation in 1707. Longitude was but one of these difficulties and sailors themselves did not actually regard it as being the most significant problem to be addressed. Though the Shovell disaster tends to be told as directly leading to the establishment of the Longitude Prize seven years later, the link between the two events is tenuous at best.

Much like in the previous chapter, I have found the story of navigational practice to be one of a tension arising over the concept of expertise. How was expertise to be defined and who was best to provide accreditation? Thus, it is a story of the contest of power between those who practiced navigation and those who wished to reform marine practice to better suit what they perceived as the modern world. Navigation, then, is part of the broader story of the rise of capitalism, the bureaucratic state and the birth of the modern world. It is a story of capitalism

[93] May, "The Last Voyage," 331.

because navigation rose to greater prominence as Europe began to expand its economic reach around the globe. Indeed, it is the need to improve and protect trade that the Longitude Act points to in support of the prize. The forces of capital should not be viewed in a deterministic way. While not discounting the significance of extra-human forces in history, this dissertation seeks to recognize and support individual agency. The first two chapters of this thesis have used the example of navigation around the turn of the eighteenth century in order to discuss disputes over the notion of expertise and to introduce the problem of long-distance control. The final two chapters will turn from navigation to the English East India Company in order to continue to pursue the theme of long-distance control and the contradictions between individual self-interest and the institutions of the state and commerce.

PART TWO

India and China

In Part One I demonstrated that "expertise" and "long-distance control" were both interrelated and contested in the seventeenth and eighteenth centuries. As such, we cannot view the history of the seventeenth century as part of a progression toward a quantitative expertise in support of strong administrative control in the eighteenth century. Such a position risks obscuring the existence of alternative forms of expertise and knowledge practices and reducing the significance of these alternatives. The contested reality of expertise and the severely limited quality of long-distance control have consequences for the history of science and empire in the eighteenth century. The problematic nature of expertise has to be taken into account when addressing the production and diffusion of knowledge. Science studies have often privileged the perspective of science in its historical accounts. What this has meant, in practice, is that there is built-in teleology and an assumption that scientific methods and knowledge are more modern and, therefore, better. At the core of this has been the *post facto* imposition of asymmetrical power relationships that favour Euro-American knowledge practices. The argument of Part Two is that much of our understanding of European and non-European power relations has been coloured by nineteenth-century imperialism. Thus, I have sought to develop the two chapters in Part Two from a perspective that does not read backward from the establishment of the English East India Company as a colonial power at the end of the eighteenth century and, instead, emphasizes the practices within the Company during the first part of the century.

By connecting the history of expertise in Britain to the early endeavours of the East India Company, this dissertation offers a fresh perspective on science and imperialism and the history of the Company in the eighteenth century. In Chapter Three I will take up the issue of the East India Company as a bureaucratic institution. Bureaucracy is significant because paperwork has been regarded as one of the crucial features of the Company's history and to the establishment of

British rule in India. Through an examination of the surviving correspondence, what I aim to show is that the Company's paperwork practices were neither consistently followed nor part of a direct progression toward bureaucratic control. Indeed, long-distance control from the Company's headquarters in London to its operations in Asia did not meaningfully exist at the beginning of the eighteenth century. The lack of long-distance control has purchase for science and technology studies because it challenges the notion of centres of calculation and brings into question the standard view of the metropole and periphery.

Thus, the third chapter makes an argument against a deterministic approach to the history of the East India Company that takes for granted what the Company would eventually become after 1780 and the fourth and final chapter of this dissertation builds on this claim while putting it directly into the context of the scholarly discussion about centres of calculation and the circulation of knowledge. While the Company extended its power throughout the eighteenth century, its position was never uncontested or hegemonic. Instead, the bureaucratic practices such as paperwork and expertise served, and continue to serve, as a means of masking British weakness rather than as demonstrations of strength. In order to understand how knowledge circulated, we need to have a clear picture of the relationships between Europeans and non-Europeans and between institutions such as the East India Company, on the one hand, and the Qing administration on the other. It is necessary that we understand these relationships and power dynamics so that our history does not become over-determined. If the history of science is to be global we cannot presume the outcome or allow the success of science to erase alternative practices.

Chapter Three
Bureaucratic Practice: Institutional Knowledge, Local Practice and the Problem of Long-Distance Control

In a 1692 memorandum to the President of the English East India Company's Bombay factory, Bartholomew Harris, his assistant John Vaux expressed his dissatisfaction with his current status.[1] The point of contention was over the use of the Company's horses. Vaux wrote that he was "given to understand that neith^{r} my self nor others shall have y^{e} use of either Coach or Horse without comming first to ask [Harris's] leave" and wished to inquire "know wheth^{r} you pay for Coaches or Horses or the Comp^{a}." If the horses belonged to Harris, Vaux assured him that he would trouble Harris no further; however, if they were the Company's horses, then Vaux believed he had "as much right to make use of a Coach in my Station as a great many that eates the Comp^{as} bread."[2]

Upon establishing that the horses were, indeed, paid for by the East India Company and not by Harris, Vaux sought to press the matter further. He followed up his initial inquiry by asking whether Harris was familiar with the customs of the factory in Surat and, "if not I shall acquaint you in all Sincerity."[3] Vaux proceeded to explain that he had investigated the established customs regarding the use of horses and had been "well assured & inform'd is otherways managed then formerly by the knowledge of men of ancienter standing then your Hon^{r} or I am" that his understanding of the situation was correct. [4] Harris, Vaux contended, was violating the established conventions of the East India Company in Surat with his insistence on maintaining direct control over who used the horses and when. At this point, Vaux had finally

[1] Bartholomew Harris was technically President at Bombay 1690-94. The East India Company shifted its main holdings from Surat to Bombay in 1687; however, due to plague and cholera the move did not actually take place until 1708 so Harris and Vaux both were based in Surat, see Jerry Dupont, *The Common Law Abroad: Constitutional and Legal Legacy of the British Empire* (Littleton, CO: F.B. Rothman Publications, 2001), 564.
[2] John Vaux to Bartholomew Harris, June, 1692, IOR/E/3/49, f. 82r.
[3] Vaux to Harris, June, 1692, IOR/E/3/49, f. 83r.
[4] Vaux to Harris, June, 1692, IOR/E/3/49, f. 84r.

gone too far and Harris was forced to assert his authority. Harris rejected Vaux's appeal to the authority of men "ancienter" than Harris informing Vaux that "As to w^{t} you wrote me last night of yo^{r} being informed by those of ancienter standing then I about y^{e} Customs & Rules of y^{e} factory, I know of none y^{t} can pretend to it except one, who is not one of y^{e} Comp^{as} Serv^{ts}." Harris assured Vaux that there had been no change in policy and that "there has been as worthy second as yo^{r} selfe formerly in place y^{t} did acquist in y^{e} same." Moreover, while Vaux had presented the complaint as if he had been denied access to the horses and carriage, Harris denied this had been the case. Harris insisted he "never will deny you Horse or Coach when yo^{r} Occassions require it if mine does not."

> Far from having been deprived use of them, Harris observed, instead, that:
>
> Its very strange to me y^{t} you should write me abot y^{e} Horses & Coaches & at y^{e} same time they were both up & Imployed with both or Wives & another Councillers wife Madm Aleyn & one of ye Concsell & Minister & you yor self had taken Physick so by Consequence cod not go abroad & I would not goe so y^{t} if or Wifes are accomadated in y^{t} manner there needs noe such grumbling so y^{t} you cannot appear to me any otherways but a design to Quarrell.[5]

The incident, as Harris saw it, had nothing to do with Vaux's use of the Company's horses. Rather, Harris interpreted Vaux's complaint and subsequent letters as an attempt by Vaux to undermine his authority in order to supplant him as governor. Particularly telling regarding Vaux's intentions is that on two separate occasions he "granted" Harris permission to register his letters in the Company's consultation book "that our R^{t} Hon^{ble} Masters may be judges of the case" and that the issue be in "the publick view."[6] In doing so, Vaux sought to take the dispute out of the private sphere and put the Company's bureaucratic practices to work for him. The controversy has much to say about the operations of the East India Company due not only to its concern with rules and rights versus power and control, but also with individuals acting outside

[5] Harris to Vaux, June 25, 1692, IOR/E/3/49, f. 85r-v.
[6] IOR/E/3/49, f. 83r; IOR/E/3/49, f. 84r.

of their supposed limitations. While bureaucracy is often regarded in hegemonic terms and represented in terms of its impenetrability, in this chapter I seek to attend to the concept of bureaucracy from the inside rather than the outside. Moreover, I wish to pay particular attention to individual action within a functioning bureaucracy and not to regard it as a depersonalized monolith. Monolithic interpretations of bureaucracy have epistemic value; however, a bureaucracy remains made up of people. Though the bureaucracy presented restraints to human agency, I argue that its structures also offer opportunities for the individual actors who comprise it to advance their self-interests. A bureaucracy might appear from the outside as an impenetrable glacier inexorably advancing; however, the internal view shows, instead, a complex web of actors who often possess competing interests and concerns.

In Part One I showed how debates over expertise played out on-the-ground and how this challenges some conceptions of long-distance control in the context of the English Navy. These issues become even more pertinent when we move our view further afield from London. In this chapter I use the questions raised regarding long-distance control to investigate and better understand the administrative practices of the English East India Company and to put the development of the Company's institutional and imperial practices in a historical context. The vast bureaucracy that developed under Company rule (1757-1868) and formed the basis of the British Raj (1858-1947) was not in place in the early eighteenth century. Though the Company did maintain extensive correspondence and promulgated considerable records, the detail and organization of the paperwork was inconsistent and decentralized circa 1700 compared to what it became. Much of the history of the English East India Company has focused on the period after 1780 when its bureaucratic power had been firmly established. This emphasis on the later period risks the danger of an over-determined historical trajectory toward Company rule. In an effort to

counter this teleology I am approaching the paperwork practices of the East India Company in the late seventeenth and early eighteenth centuries without reference to the vast intelligence network that later developed; instead, I focus on how individuals within the Company used paperwork to further their own interests. In doing so I further challenge the concept of long-distance control that was introduced in the previous chapter and demonstrate its weakness in the East India Company.

Bureaucracy and Historical Considerations

There was a correlation between the rise of capitalism and the scientific fact because, as Harold Cook has argued, capitalism spurred the development of consensus and restricted practitioners' attention to empirically verified facts. At the same time, however, commercial networks not only provided the infrastructure for long-distance scientific exchange, they shaped how it was done.[7] Dániel Margócsy, meanwhile, has questioned some of Cook's argument and contended that "mercantile capitalism only enabled the development of a unified infrastructure for circulating facts, images, and material objects."[8] While the infrastructure of global capitalism was crucial for scientific exchange, it was developed for commercial reasons and was executed primarily by merchants whose principal interest was trade and not scientific knowledge. Thus, this chapter seeks to understand the infrastructure of the English East India Company from the perspective of institutional practices of the Company's servants in India. Because global trade and scientific exchange were closely interrelated, a better understanding of how global commerce functioned in practice enables greater knowledge of the role played by the non-European world in the history of eighteenth-century science.

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[7] Harold Cook, *Matters of Exchange: Commerce, Medicine, and Science in the Dutch Golden Age* (New Haven: Yale University Press, 2007). Cf. Mary Poovey, *A History of the Modern Fact: Problems of Knowledge in the Sciences of Wealth and Society* (Chicago: University of Chicago Press, 1998).

[8] Dániel Margócsy, *Commercial Visions: Science, Trade, and Visual Culture in the Dutch Golden Age* (Chicago: University of Chicago Press, 2014), 15, 17.

The historian John Brewer has presented a compelling argument relating eighteenth-century military developments to the formation of the centralized, bureaucratic nation-state.[9] Essentially, through the seventeenth and eighteenth centuries, European warfare underwent significant changes as technology advanced and the scale of warfare grew. These transformations meant that decentralized, feudal military structures were no longer suitable and the central state increasingly claimed a monopoly on the capacity to execute warfare. What this also meant was that, with wars becoming increasing large in scale, they also became ever more expensive to carry out. Thus, not only were feudal structures insufficient as a means of ordering warfare, but such institutions were also inadequate to support financially the needs of the state. Thus, according to Brewer, the changing needs of the military led to the formation of the modern fiscal state. Brewer sought to show how the British state in the eighteenth century, in order to support its growing military needs, came up with new means of raising revenue in the form of increasingly complex forms of taxation such as the customs and excise. Unlike previous taxes, these new taxes required the centralized, bureaucratic institutions. Thus, in order to raise the revenue needed to carry out wars, bureaucratic institutions were formed, which in turn fed into the continued expansion of the British military and, thus, the perpetuation of new, larger and ever more powerful state institutions.

Michel Foucault viewed history through the lens of power and saw the modern episteme as one in which state power shifted from a public performance to private and insidious.[10] Such a

[9] John Brewer, *The Sinews of Power*. D.A. Washbrook has told a rather similar narrative about the relationship between an increasingly expensive military apparatus and the formation of a new fiscal state in eighteenth-century India, see D.A. Washbrook, "Progress and Problems: South Asian Economic and Social History, c. 1720-1860," *Modern Asian Studies* 22 (1988): 57-96.

[10] Michael Foucault, *Discipline and Punish*, brilliantly illustrates Foucault's thesis in its opening chapter which contrasts a public execution of Damiens the regicide in 1757 to the facelessness of Léon Faucher's rules "for the House of young prisoners in Paris." As Foucault put it, "We have, then, a public execution and a time-table," Michel Foucault, *Discipline and Punish: The Birth of the Prison*, translated by Alan Sheridan (New York: Vintage Books, 1977), 3-7.

concept of history, thus, has tended to regard the state in hegemonic terms. In keeping with such a point-of-view, Brewer's approach was telescopic in scope and, therefore, he did not provide close analysis of the institutions so important to his story. Doing so would not necessarily have negated Brewer's claims, but it would seem to complicate the picture considerably. He presented a picture of eighteenth-century Britain that assumed coherence within the instruments of the British state that did not exist at the time. Indeed, studies of Britain's institutions in the twentieth century have demonstrated that such coherence has never been obtained.[11] In his detailed investigation of the history of the customs and excise in Britain between the seventeenth and nineteenth centuries, the historian of science, William Ashworth has shown the difficult reality of the institutions involved.[12] The history of the fiscal state turns out to be both messier than Brewer would seem to imply and less straightforward in its development. A significant limitation of Foucault's conception of power is that he left very little room for human agency. What Ashworth's study has shown is the possibility of agency and the ways in which it affected the institutional history. Thus, while Brewer's work has a lot to recommend it, he did not fully capture the experiences to be found within the institutions that made up his fiscal-military state.

Such attention to the role of people can also been seen in Andre Wakefield's account of cameralism in the Germanic states during the eighteenth century. Responding to a seminal work by Marc Raeff, Wakefield refused to take the cameralist theorists at their word and instead

[11] For example, work presently being done on the history of British telecommunication and postal technologies being carried out as part of a collaborative research project by doctoral students at the University of Manchester, University College, London and the University of Leeds, https://postofficeresearch.wordpress.com/ and "National Life Stories: An Oral History of the Electricity Supply Industry in the UK" hosted by the British Library, https://www.bl.uk/projects/national-life-stories-an-oral-history-of-the-electricity-supply-industry-in-the-uk.
[12] William Ashworth, *Customs and Excise: Trade, Production and Consumption in England, 1640-1845* (Oxford: Oxford University Press, 2003).

looked at what they had actually done.[13] Instead of Raeff's well-ordered police state, Wakefield found that the cameralists, on the occasions when they were put into positions of power, frequently failed to live up to their ideals. Cameralism, it turned out, was rather more successful in theory than practice. Raeff saw cameralism as representing the "authorities' conscious desire to transform society," which "resulted in the development of administrative and legal tools that, in turn, displayed their own inherent dynamic."[14] The end result being the formation of a "well-ordered police state" in Western and Central Europe that "not only brought about great material and cultural progress but also stimulated and strengthened individual initiative, enterprise and rational or critical constructivist features of intellectual life."[15] Raeff relied "almost exclusively on ordnances and laws that were actually implemented" and, in doing so, assumed that they were enforced.[16] Wakefield, on the other hand, did not assume that any of these laws were actually enforced and went beyond the ordnances and laws themselves to investigate their actual implementation.[17] What he learned was, in fact, they frequently were not. Thus, Brewer has offered a valuable means to think about relationships between the major events of eighteenth-century British history and the formation of the modern, British state, while Ashworth and Wakefield provide excellent examples from which to move from Brewer's telescopic perspective to the microscopic while still maintaining a larger historiographic concern.

As the example of John Vaux has shown, bureaucratic systems of paperwork suggest the possibility of empowering individual action within the bureaucracy. Vaux's case also demonstrates limitations to such agency. Taking the example of French institutions leading up to,

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[13] Andre Wakefield, *The Disordered Police State: German Cameralism as Science and Practice* (Chicago: University of Chicago Press, 2009); Marc Raeff, *The Well-Ordered Police State: Social and Institutional Change Through Law in the Germanies and Russia, 1600-1800* (New Haven: Yale University Press, 1983).
[14] Raeff, *Well-Ordered Police State*, 4.
[15] Raeff, *Well-Ordered Police State*, 250.
[16] Raeff, *Well-Ordered Police State*, 9-10.
[17] Wakefield, *Disordered Police State,* 15.

during and after the French Revolution, Ben Kafka has developed such themes. Paperwork, Kafka argues, is unpredictable and "this unpredictability is frustrating," with the result being that "modern political thought was both founded and confounded by its encounters with paperwork."[18] According to Kafka, it had the ability to "defer and displace the object of power." While, in one of Kafka's examples, the chief of the General Police Bureau, Augustin Lejeune might not have intentionally slowed down the pace of political violence or halt it altogether by burying the paperwork itself, Kafka argues that he could have. As Kafka explains, Lejeune, "seems to have realized, if only belatedly, that the proliferation of documents and details presented opportunities for resistance, as well as for compliance."[19] While paperwork and bureaucracy might be used to resist power, it also can serve to stymie individual ambition, as Kafka shows in another example of Edme-Etienne Morizot's attempts to get back his job as a clerk in the Ministry of Finance after he was replaced in September of 1788.[20] Morizot was told he had lost the job due to financial problems in the administration. The financial problems did, indeed, exist; however, they were not actually the reason Morizot lost his job. When Morizot pressed, his supervisors admitted that the reason they had given had been a lie. Morizot had not been let go to cut costs. In fact, he had been replaced by the son-in-law of the king's aunt's chambermaid. Morizot had lost his job for a more straightforwardly human reason: he was impossible to get along with. In response, Morizot decided to sue. As an experienced civil servant who understood how the system worked and knew from whom to get favours and how to ask for them, he had every reason to expect to recover his position. Instead, he would fail miserably. All the actors involved in the incident accepted the legitimacy of his complaint, yet he found himself forced to wander from one clerk to another producing seemingly endless

[18] Ben Kafka, *The Demon of Writing: Powers and Failures of Paperwork* (New York: Zone Books, 2012), 10.
[19] Kafka, *Demon of Writing,* 67.
[20] Kafka, *Demon of Writing,* Ch. 1.

paperwork. What Morizot wanted was "to petition deputies the way he had once petitioned the king, but they could no more decide his case on their own initiative than they could cure his scrofula by touch…What he needed was the right signature on the proper letterhead."[21] According to Ben Kafka, it was not a coincidence that Morizot's case occurred when it did—as the *ancien régime* was about to collapse. As Kafka put it, "a world of privilege was becoming a world of rights; the personal state was becoming the personnel state."[22]

In his classic study of the Newcastle papers and the English electoral machine in mid-eighteenth century, Lewis Namier re-evaluated a political system remembered primarily for its rotten boroughs, the ubiquity of graft, quid pro quo patronage appointments and general corruption.[23] All of these charges certainly did accurately describe English politics at the time; however, Namier argued that, rather than being an inhibition, such so-called corruption in fact was what enabled the whole system. As representative democracy, the English government was sorely lacking; however, what it did offer was opportunities for a class of educated professionals. Corruptions such as patronage positions and the so-called secret service money, "was more jobbery, stupidity and human charity about it than bribery." In absence of organized social welfare, it provided one measure of protection for members of the tenuous middle-class. In turn, these would-be bourgeoisie worked to maintain the system that actively disenfranchised them and which disregarded the "moral and uplifting of the electorate" in favour of the crass collection of seats and hence political power for those who commanded them.[24]

Thus, as Namier, Kafka, Wakefield and Ashworth all demonstrate, "bureaucracies" serve a multitude of purposes. While the electoral machine and the cynical alliances of parliamentary

[21] Kafka, *Demon of Writing*, 31.
[22] Kafka, *Demon of Writing*, 32.
[23] Lewis Namier, *The Structure of Politics at the Accession of George III, vol. I* (London: MacMillan and Company, 1929).
[24] Namier, *The Structure of Politics*, 164.

politics in eighteenth-century Britain emphatically did not serve the interests of the vast majority of the populace, they did what they was intended to do, which was to advance the interests of the bourgeoisie and to protect those who belonged to the system. As Wakefield observed, the cameralists he "knew" were "not very well behaved." Instead of being models of the ideal civil servant, in practice "they lied, connived, cheated and embezzled." At the same time, however, "they also painted beautiful pictures of well-ordered police states." These well-ordered police states were creations of the cameralists in order to address a need specific to the cameralists: "their lives depended upon it."[25] The cameralists needed to make money and projecting their expertise and the fashionableness of their knowledge was a means for them to do so. Wakefield, thus, reminds us of the mundane motivations upon which history rests. Though he wrote about the German speaking states, while this dissertation looks at the English, his insights into the nature of bureaucracy and statecraft are transferable. Rather than any kind of clear trajectory toward a strong, centralized state the history of institutions in eighteenth-century Britain is more accurately understood as a series of self-interested actions taken by a large number of individuals over the course of a century. To the degree that these actions led to the expansion of such institutions, it can hardly be a great surprise as such reification and growth was obviously in the interests of its agents.

Paperwork was at the heart of the enterprise of the English East India Company and the British colonialism that grew out of it in the nineteenth century. Indeed, the Company's employees were called writers for a reason. The Company did not only generate great wealth for select members of its service, but also great, massive reams of papers. Its archive in the bowels of the British Library is measure literally in miles and comprises of millions of documents. The geographer Miles Ogborn has regarded this emphasis on paperwork as the technology that

[25] Wakefield, *Disordered Police State*, 141.

allowed the Company to maintain a centralized authority that ensured the directives in London were executed thousands of miles away in Southeast Asia. Ogborn made much of the letters sent on ships and argued that "these letters and the writing that traveled alongside them were a vital part of making the relationships necessary to establish a global network."[26] Yet, the degree to which the Company was ever able to dictate orders to its distant operations is somewhat unclear. As Jon Wilson has put it, "The British used paper as a surrogate for authority."[27] Certainly in the period covered by this dissertation the Company's influence from London was quite limited. Moreover, the paperwork and archival practices that define much of how the East India Company and the later India and Colonial offices have been understood were much less clearly defined circa 1700.

From an epistemological standpoint, bureaucracy is a product of the nineteenth century. The word bureaucracy was first used by Vincent de Gournay (1712-1759) and entered the public domain in the July, 1764 issue of *Correpondence littéraire*, but it was not for another fifty years that it widely entered the literary domain.[28] According to Martin Albrow, the concept was principally a product of the nineteenth century and presumed a continental phenomenon.[29] It has been indicated that it was the collapse of the *ancien régime* at the French Revolution and the reformulation of the French state that followed that really brought bureaucracy to the fore. Locating bureaucracy as a nineteenth-century epistemological concept has obvious limitations. It

[26] Miles Ogborn, *Indian Ink: Script and Print in the Making of the English East India Company* (Chicago: University of Chicago Press, 2007), 39. Moreover, the obsession with paperwork was not unique to the English East India Company. For example, compare this description of Spanish imperialism: "It's not that Spain didn't encourage record keeping and paperwork. On the contrary, the Spanish empire floated on ink. To a far greater degree than any of their imperial rivals, Spaniards were obsessed with legalisms. Spain sent not just warriors, priests, and would-be aristocrats across the Atlantic, but a legion of scriveners and notaries to create one of the most comprehensive bureaucratic edifices in world history," Greg Grandin, *The Empire of Necessity: Slavery, Freedom, and Deception in the New World* (New York: Metropolitan Books, 2014), 98.
[27] Jon Wilson, *The Chaos of Empire: The British Raj and the Conquest of India* (New York: PublicAffairs, 2016), 6.
[28] Martin Albrow, *Bureaucracy* (London: Pall Mall Press, 1970), 16; Kafka, 77. The credit is given to de Gourney by Baron Grimm and Diderot in Grimm and Diderot, *Correspondence littéraire, Philosophique et Critique, 1753-69, 1813 edition*, Vol. 4, 146.
[29] Albrow, *Bureaucracy*, 16.

arguably fails to recognize the well-developed court bureaucracies that predate the French Revolution by several centuries and the growth of the centralized fiscal-military states from the mid-seventeenth century onward, especially in England and France.[30] These structures could be regarded, however, as proto-bureaucratic and, moreover, that such structures existed does not mean that bureaucracy had been developed as a concept. More problematic to locating bureaucracy as a category of inquiry only beginning in the nineteenth century is cameralism, on which there was an extensive literature before the term bureaucracy had even been coined. While Albrow regarded bureaucracy as essentially Germanic in its construction, most of the classic references prior to Weber appear to be French.[31] Partly to blame has been the tendency to write the intellectual history of eighteenth-century Europe so that Germanic history has been separated from that of Britain and France.[32] Such segmentation has meant that German history has often been treated as less relevant to intellectual history and as having made little contribution to what has been regarded as the Enlightenment, which remains associated with the French *philosophes* of the mid-eighteenth century despite the best efforts of many specialists on the subject.[33]

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[30] On paperwork in France during the reign of Louis XIV, see John Rule and Ben Trotter, *A World of Paper: Louis XIV, Colbert de Turcy, and the Rise of the Information State* (Montreal: McGill-Queen's University Press, 2014).
[31] Albrow, *Bureaucracy*, 16.
[32] Such emphasis on France being most evident in Ernst Cassirer, *The Philosophy of the Enlightenment,* translated by Fritz C. A. Koelln and James P. Pettegrove (Princeton: Princeton University Press, 1951) and Peter Gay, *The Enlightenment: An Interpretation* (New York: Knopft, 1966-69). Roy Porter and Roy Porter and Mikuláš Teich, *The Enlightenment in National Context* (Cambridge: University of Cambridge Press, 1981) sought to widen the field of inquiry by recognizing that the Enlightenment occurred outside of the France of Voltaire, Diderot and Rousseau and the Germany of Immanuel Kant. The approach taken by Porter and Teich was limited by its focus on national context, which was not always the most effective model in an era where national boundaries were less defined than they have since become. William Clark, Jan Golinski and Simon Schaffer, eds., *The Sciences in Enlightened Europe* (Chicago: University of Chicago Press, 1999) has provided an essential update to Porter and Teich that has built on the national context approach while developing sophisticated historiographical responses to the criticisms leveled at Porter and Teich. See also, Kostas Gavroglu, ed., *The Sciences in the European Periphery During the Enlightenment* (Dordrecht: Kluwer Academic Publishers, 1999); Richard Butterwick, Simon Davies and Gabriel Sánchez Espinosa, eds., *Peripheries of the Enlightenment* (Oxford: Voltaire Foundation, 2008).
[33] The repudiation of the segmentation of the history of the Enlightenment into national contexts and the emphasis on the French Enlightenment was at the core of Jonathan Israel's ambitious three volume history of the Enlightenment. Fundamental to Israel's approach was that historians of the subject must be cognizant of developments and intellectual movement from a global perspective. For Israel, the history of the subject could not be treated with justice if one confined one's attention to a single region. Israel's account offered a genealogy of the

The bureaucracy has been a common target in literature and film. While Franz Kafka's depictions are the most famous and enduring, bureaucratic stereotypes are a frequent trope in film and literature. A good example can be seen in the dystopia envisioned by Terry Gilliam in his film *Brazil.* To be a bureaucracy is to be large, obtuse, anonymous, and bewildering to the outsider. Such institutions are compartmentalized so that every task has its own department and each department operates as a fiefdom looking to defend itself against the encroachment of the other organs of the bureaucracy. As a structure, bureaucratic departments are often seen as having a primary objective of expansion, entrenchment and self-protection. From an operative perspective, then, efficiency and governance would not be the most significant concerns for the bureaucracy; indeed, an efficient, productive system might even be counter-productive to its aims.

While the modern state has been regarded as possessing a monopoly of force; the bureaucracy's greatest power lies in its monopoly over access to information. As the sociologist Norbert Elias observed, "The society of what we call the modern age is characterized, above all in the West, by a certain level of monopolization."[34] The accusation at the core of much of the negative portrayals of bureaucracy has been to blame it for red tape, inefficiency and to assert it as resulting in a significant cost due to a loss of productivity caused by bureaucratic inertia and interference. Though the bureaucracies of the real world do not reach the extremes of those described by Terry Gilliam or Franz Kafka, anyone who has had to negotiate the labyrinth of

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Enlightenment, the origins of which he placed in the mid-seventeenth-century Netherlands rather than Newtonian England or France. Ultimately, however, at times it feels as though Israel's massive works exist primarily to insert Spinoza into the standard narrative of what the Enlightenment was and to assert an even greater role for the Enlightenment in how the history of the eighteenth century ought to be written, Israel, *Radical Enlightenment: Philosophy and the Making of Modernity, 1650-1750* (Oxford: Oxford University Press, 2001).

[34] Norbert Elias, *The Civilizing Process: The History of Manners and State Formation and Civilization*, translated by Edmund Jephcott (Oxford: Blackwell, 1978), 345. Elias described the process by which such monopolization comes about in *State Formation and Civilization*, Ch. 2, "On the Sociogenesis of the State."

government or university bureaucracies can likely see a reflection of their own experiences. However, to define bureaucracy in such terms is a caricature.

What has been parodied as an absurd rigidity and opaqueness was rather regarded by Max Weber as giving it an inherent efficiency. Indeed, when Weber regarded the bureaucracy as emblematically modern he did not see this as pejorative.[35] Moreover, it pretends the bureaucracy to be an autonomous entity and gives it anthropomorphic qualities that actually serve to further erase the agency of its component parts. As John Rule and Ben Trotter put it in their study of French bureaucracy in the seventeenth century, "bureaucracies are organizational structures that can appear as machines, but in truth they are at most machine-*like* and are always made up of humans."[36] The multi-headed hydra of modern democracy might seem intentionally impenetrable; however, it is also a guardian of expertise as it allows talented individuals to develop significant specialist skills without which modern governance and corporate capitalism would not be able to function in its current form.

Taking the modern research university as his subject, the historian of science and the Enlightenment William Clark traced the development of the academic from the medieval to modern in order to cast light on bureaucratization and commodification—"the twin engines of rationalization and the disenchantment of the world."[37] The English East India Company was part of the same historical process that Clark described. While it was organized into segmented, specialized departments that were structured in what was nominally a hierarchical form and

[35] As Albrow noted, it was Weber's disregard for "problems of efficiency" that was the most "novel, unique and, for later commentators, disturbing feature" of his account of bureaucracy, Albrow, *Bureaucracy*, 66.
[36] Rule and Trotter, *A World of Paper*, 93. See also Leo Marx's observation regarding the tendency to "invest technology with the power to initiate change:" "By treating these inanimate objects—machines—as causal agents, we divert attention from the human (especially socioeconomic and political) relations responsible for precipitating this social change," Marx, "Technology: The Emergence of a Hazardous Concept," *Technology and Culture* 51 (2010), 577.
[37] William Clark, *Academic Charisma and the Origins of the Research University* (Chicago: University of Chicago Press, 2006), 3.

propagated a great deal of paperwork, the Company was both too small at the management level and too linear in its chain of command to be fully regarded as bureaucratic. Unlike, for instance, Colbert in France, the English East India Company often lacked strong leadership figures in London. What this meant in practice was that strong personalities in its foreign outposts were able to dominate much of the Company's operations during the eighteenth century.[38] Clark's argument centered on the concept of academic charisma because it allowed him to push his argument beyond a narrative that supposed the oral and traditional was superseded by the rational and the visible in the formation of the modern order.

As the East India Company, too, was part of the formation of the modern order, the tension between orality and textuality needs to be recognized. The Company was not a bureaucracy *per se* in the period in which this dissertation covers, but it would have to become one for the colonial project to succeed. It is crucial to keep in mind that establishing the Company as an imperial power in India was not an intended goal for most of its directors and the expansion of the Company as a political power in India was driven by the personal interests of charismatic Company representatives in India. The Company's concerns were divided between the Company as a commercial enterprise and the more individualistic interests of private members who were looking to expand their own personal political power. These tensions played a crucial role in the development of the English East India Company during the eighteenth century.

East India Company Practice

Despite its best efforts to establish institutional controls and to direct its affairs from London, Company employees had considerable ability to take independent action due to the

[38] G.J. Bryant, *The Emergence of British Power in India 1600-1784: A Grand Strategic Interpretation* (Woodbridge, UK: The Boydell Press, 2013).

weakness of institutional authority. The English East India Company did seek to strengthen its control over distant agents. For example, there was considerable emphasis on the maintenance of detailed records of the individual accounts for each factory and there was an extensive chain of communication. In theory, the governing bodies at each factory were required to provide regular and detailed accounts of their activities and were not to take action outside of their established purview or against the Company's best interests. On the other hand, these records not always orderly or maintained and the chain of communication did not necessarily mean a successful chain of command. It was not always easily established what the best interests of the Company meant. Furthermore, the Directors only received reports after-the-fact because the communication times involved made it impossible for the Directors to intervene in decisions in real time. Similarly, the transition from the oral to the paperwork and archive represented by the East India Company implies a permanence that does not entirely stand up to the historical record.

The structure of the East India Company was nominally hierarchical. In London the Company was managed by the Court of Directors. In India there were three Company outposts, called factories, each of which was responsible for the trade in its specific region. These factories were located at Madras (Fort St. George), Bombay and Calcutta (Fort William) (see Figure 3.1).[39] Bombay and Calcutta were in the north, closer to the centre of power for the Mughal Empire. The two factories, thus, gave the Company access to the Empire, but, because they were so close to it, also meant that the Mughal Empire was able to regulate the English traders. Madras, on the other hand, was on the southern fringe of the Empire, which gave the Company greater operational freedom. At each factory the Company appointed a council of traders, which was headed by a president. Thus, the factory bureaucracy was known as a presidency. Prior to

[39] Madras is now called Chennai, Bombay is the present day Mumbai, and Calcutta is Kolkata.

Figure 3.1: Map of the East India Company Factories
(Uwe Dedering CC BY-SA 3.0. Annotated by Author)

the middle of the eighteenth century, each presidency was functionally distinct and administratively none were responsible for the others. Indeed, they were more often in competition with each other than then in cooperation. Of the three presidencies, Madras was considered to be the principal one due to its beneficial geography, which was also noted by the

French who followed the English example and established a factory of their own a few miles from Fort St. George.[40]

In principle there was a clear chain of command. The Court of Directors chose the councils and picked the president and sent detailed instructions they expected their chosen governing bodies to execute. In practice, however, there were complications. To begin with, the presidencies frequently operated with relative autonomy and the high mortality rate of English traders in India meant that the man acting as president was frequently not actually the man who had been chosen for that role. Furthermore, as the example of John Vaux demonstrates, the relationships within the presidencies were often complicated and subject to negotiation between the various actors. As well, the actual structure of the Company itself contained a large number of interested actors whose location in the hierarchy is not easily defined. For instance, it is not entirely clear where the shareholders fit in the general scheme, nor where those whose relationship with the Company was more tenuous—for instance, ship's captains and their crews or supercargoes like Robert Douglas. The fate of these individuals was closely tied to the Company, but they lacked the same degree of institutional support compared to those based in established factories. Moreover, this schema does not take at all take into account native actors. European trade in Southeast Asia involved European marine enterprises plugging themselves into networks of trade that already existed prior to their arrival. Thus, there were established structures for trade and the European trading companies such as the East India Company constantly had to negotiate their place in the system.

As the political situation was complicated and India was not a homogenous political entity, this meant that the different European nations involved in the region needed to establish

[40] Matthew Edney, *Mapping an Empire: The Geographical Construction of British India, 1765-1843* (Chicago: University of Chicago Press, 1997), 4.

and maintain a number of relationships. Moreover, the different political factions meant that one was necessarily coopted into local political rivalries.[41] The instability of these relationships can be seen by the frequent revolts against the Company. James Pound described one such incident in a letter to John Flamsteed:

> On the third of March last about the dead time of night, our black Soliders at Condore set upon us with fire and sword, and killed our Governour with about twenty others as they endeavoured to come out of their Houses which were set on fire…I with 10 more made our escape from Condore by getting aboard a small sloop, we had scarce cloths to cover our nakedness, having no time to take cloths or any thing else out of our Houses; we leap'd out of our beds with the surprize of the fire, and did not think any thing of villainy; but soon found that we were beset with a worse enemy than the fire; the Governour was both shot, and stabb'd with a poysond Cress, amany others had the same fate, it was done by Macassars which were entertained as Soliders in our Service. The Fort was intirely burnt to the Ground; My house was a little without it, and I did not see it fired so Long as I was in sight of it. In so great a surprize we who escaped having neither Arms nor force to make any resistance could think of nothing but saving our lives; so that my Money, Goods, Books, Papers, Instruments, Cloths etc were all left behind and I never expect to see any of it more: but I am just now setting out from hence in the Caesar for Condore to see if there be any more English who escaped, or any Goods to be recovered.[42]

Finally, indigenous actors were not only engaged with the East India Company from the outside; they were frequently employed by the Company itself. As British hegemony developed in the course of the eighteenth century its reliance on locals only increased.[43]

While the post-colonial perspective has resulted in the view of colonial activity as necessarily antagonistic to those upon whom it was imposed, the process was less straightforward. Indigenous actors were frequently complicit in colonial enterprises. As well, the British did not necessarily go into regions like Southeast Asia with the intention of establishing a

[41] Such political plays were also used in efforts to undermine European rivals. For example, the English responded to the Dutch construction of a large stone fortress on the island of Banda in 1609 by fomenting an anti-Dutch uprising, Jonathan Israel, *Dutch Primacy in World Trade, 1585-1740* (Oxford: Clarendon Press, 1989), 104.
[42] James Pound to John Flamsteed, 7 July, 1705 in *Flamsteed's Correspondence, vol III*, 180. On Indian insurgencies see Ranajit Guha, *Elementary Aspects of Peasant Insurgency in Colonial India* (Oxford: Oxford University Press, 1984).
[43] Kapil Raj, *Relocating Modern Science*: *Circulation and the Construction of Knowledge in South Asia and Europe, 1650-1900* (Basingstoke: Palgrave Macmillan, 2007).

colony. Colonies were expensive, difficult to maintain and required a significant investment in personnel and infrastructure. The system of establishing factories at strategic locations was a careful balance between more transient modes of trade where Company merchants arrived on a Company ship and departed when the ship did, as was the situation in China where the political situation was more homogenous, versus the establishment of full colonies. Factories allowed the Company to maintain a continual presence, which gave employees the opportunity to ingratiate themselves into the local culture and meant they were less dependent on immediate circumstances when conducting trade. The Indian subcontinent had an established and well-developed model of credit.[44] The addition of Europeans to the trade led to the expansion of these credit systems, but it did not result in a fundamental reorganization of what was already in place.

The presumed hierarchy of the English East India Company has been preserved in its archive; however, the Company archive is a nineteenth-century construct. Though the Company generated massive amounts of paperwork and engaged in correspondence that spanned the globe, it did so in a rather haphazard fashion. The clean categories into which the Company's papers are organized today were only put into place at the very end of the Company's existence and often do not entirely stand up to close inspection. Much of the surviving correspondence can be found scattered and repeated in multiple series and what was preserved as opposed to what was not at times appears arbitrary. For example, despite Company mandates that its agents keep journals, there are actually very few surviving examples. While there are many more available logbooks or journals from ships, again only a very small portion of voyages left behind a written record. As keeping a log was essential for navigation, it is unlikely that any of the ships did not keep a logbook; however, many may not have submitted theirs to the Company at the end of the

[44] Barbara Metcalf and Thomas Metcalf, *A Concise History of Modern India, Third Edition* (Cambridge: Cambridge University Press, 2012), 39; Alexander Clavet, *Dutch and Chinese Merchants in Java: Colonial Relationships in Trade and Finance, 1800-1942* (Leiden: Brill, 2014), 7.

voyage. The Company did not have an official librarian or archivist before the nineteenth century and, therefore, did not maintain any reflective record of its archival practices.[45] Essentially, the archive was kept for practical and not historical purposes. Employees of the Company used the preserve of papers and records as a daily reference and not as a coherent narrative of the Company's history. It is not a coincidence that the best maintained and most complete records are the Company accounts.

The official correspondence of the Company was often formulaic and composed primarily of copying out the same basic set of instructions. In between the many repetitive letters listing orders from the Directors, however, are records of the dynamic relationships that made up the East India Company. The surviving private correspondence of the East India Company makes clear the power struggles and bitter rivalries that existed within its ranks. An example of this can be seen in the angry response by one member of the Company to another Company member by the name of Edward Hurst, in which he pronounced that he had "perused your false malicious and absurd Epistle which you are pleased to terme a Protest against me."[46] Hurst, it would seem, had placed the author under the risk of being reported to the government as a pirate, a charge which he protested strongly against. Such a charge was not only damaging to himself, he argued, but also to the English East India Company and he sought to protect the Company from the damages that might accrue due to Hurst's charge. Indeed, while Hurst had accused him of stealing pepper that belonged to Hurst, the aggrieved author, instead, asserted that in fact he had bought said pepper in the Company name and it was rather Hurst who had sought to steal it. By responding to Hurst's accusations, he was attempting to insulate himself from the charges

[45] Martin Moir, *A General Guide to the India Office Records* (London: The British Library, 1988), xi-xii.
[46] Samuel Cr___ to Edward Hurst, September 29, 1702, IOR/E/3/64, item 8026 (volume is unpaginated). The author of the letter's signature is too illegible to interpret and the archive volume in which it is located is not catalogued by individual item. Thus, I am unable to identify the author of the letter by name. I have not yet found the letter to which he was responding.

and, moreover, to reverse them. Though paperwork was seldom quite as dramatic as this incident, it frequently served the role of self-justification and to protect the writer against possible future accusations of misdoing. The journal kept by Robert Douglas during his 1698-1700 voyage to China (discussed in detail in Chapter Four) is a good example of this.

Douglas had been ordered by the directors of the Company "to keep a Dyary or Journall of all your Transactions as exact as you can to be produced by yourself, & in Case of your mortality, by your Successors, who are to continue the same dureing the whole voyage."[47] The journal, as has been shown, went considerably beyond simply providing an account of Douglas's transactions and also supplied an extensive record of his day-to-day dealings and the actions he attempted to undertake on behalf of the Company. In this regard, the journal was not intended by Douglas only for the benefit of a possible successor should he die or for the purpose of regular record keeping such as was the case with account books. While it did serve both of those functions, it significantly also provided Douglas with the opportunity for self-justification and to explain his actions at length. Thus, though in a very different context than the letter to Hurst, it too had the function of protection against possible incriminations. One of the obvious benefits of bureaucratic anonymity, from the perspective of a member of the bureaucracy, is that it insulates against the consequences of mistakes. The English East India Company employees, on the other hand, were typically isolated and held responsible for the consequences of their actions. The chain-of-command was generally short and direct and the individual actors relatively clear.

The use of paperwork for the purpose of discipline has been recognized and is especially clear in the case of journals and logbooks kept by officers aboard ships. The considerable record-keeping demanded by the East India Company served to benefit future voyages by communicating the hard-earned knowledge gained on earlier expeditions. An example of this is

[47] Instructions to Robert Douglas, Supercargo of the *Macclesfield*, January 21, 1699, IOR/E/3/94, f. 45v.

seen in the use of John Ovington's publication *A Voyage to Surat*, which the directors of the Company frequently referred to as a valuable source.[48] For instance, in the instructions to the supercargoes aboard the *Discovery* in 1700 was included "some directions concerning the Trade of Mocha in a printed book entitled *A Voyage to Surat* by Mr Ovington, which wee have caused to be transcribed and are here inclosed, not knowing whether you have seen y^{e} book."[49] While Douglas's journal might have been useful for such a purpose, I do not have evidence that it ever was.[50] Moreover, the printed *Voyage to Surat* was principally a work of travel writing. Thus, Ovington's work emphasized the usual themes of the genre describing the local political structures, cultures, peoples and geographies rather than the day-to-day dealings found in unedited journals. As was common, Ovington included significant material from other sources and did not clearly delineate when he went outside his personal experiences.[51]

Voyage to Surat was intended to be instructive to those traveling to the East and was not especially an account of John Ovington; however, many of the books written by world travelers were much more clearly intended to aggrandize the adventures of the author.[52] Global seafaring was difficult and dangerous, which made it inherently romantic and attractive for literature. More importantly for the argument of this chapter, the rules of behaviour were ill-defined and its

[48] John Ovington, *A Voyage to Suratt in the Year 1689* (London: Printed for Jacob Jonson, 1696). Ovington's book was first published in 1690.
[49] "Instructions to John Evans and Abraham Jackson, Supercargoes of the *Discovery*, bound for Mocha," IOR/E/3/94, f. 120r.
[50] Margaret Schotte has noted that logbooks were similarly mandated with at least partly an eye to be used as a reference resource, but in practice were very rarely consulted, Schotte, "Expert Records: Nautical Logbooks from Columbus to Cook," *Information & Culture* 48 (2013), 304.
[51] For a detailed discussion of the way in which books such as Ovington's were compiled, published and then put into use by the East India Company, see Anna Winterbottom, "Producing and Using the *Historical Relation of Ceylon*: Robert Knox, the East India Company and the Royal Society," *British Journal for the History of Science* 42 (2009): 515-38. For further accounts of the publishing industry and travel literature see, Kees Boterbloem, *The Fiction and Reality of Jan Struys* (Houndsmills, Basingstoke: Palgrave Macmillan, 2008) and Benjamin Schmidt, *Inventing Exoticism: Geography, Globalism, and Europe's Early Modern World* (Philadelphia: University of Pennsylvania Press, 2015).
[52] E.g. Woodes Rogers, *A Cruising Voyage Round the World*, with an introduction and notes by G.E. Manwaring (London: Cassell and Company, 1928).

activity was carried out at a great distance from supervision and at considerable expense. Because of the expenses involved, the demands placed on those in positions of authority were extremely high. The distances, however, meant that the expectations and realities were in constant conflict. Thus, those who made the voyages on behalf of the East India Company were constantly forced to armour themselves against likely disappointment. And, as the example of John Vaux shows, the tensions within the Company meant that one was also at risk of having one's position undermined by ambitious underlings.

Between 1698 and 1709 the situation was particularly confusing due to an Act of Parliament that saw the original East India Company lose its monopoly on the India trade and the formation of a new company. The reason for this was due to considerable concerns regarding the management of the original company and the real worry that the East India Company was on the verge of collapse and the East India trade would thus be lost. The loss of the monopoly meant that for the decade that followed there operated in Southeast Asia two companies, known as the Old and New companies. The situation was reflective of the belief that England's place in world trade was in decline. Though it was, ultimately, the Dutch who would decline, in the late 1690s the Dutch were seen to have "miserably lessened us in all Trades in the World, not secured to us by Laws, or by some natural advantage which over-ballanceth the disproportion of our Interest of Money."[53] To make things extra difficult, it was frequently unclear even for those involved as to which company one was working for or to whom goods belonged. Meanwhile, the fierce competition created both new opportunities and problems for Company employees in the East. Ultimately the situation was resolved by the two companies being merged in 1709 back into a

[53] Josiah Child, *A new discourse of trade wherein is recommended several weighty points relating to companies of merchants. The act of navigation. Naturalization of strangers. And our woollen manufactures. The ballance of trade. And the nature of plantations, and their consequences in relation to the kingdom, determining controversies, relating to maritime affairs, and for a law for transferrance of bills of debts, are humbly offered* (London: printed, and sold by Sam. Crouch, Tho. Horne, and Jos. Hindmarsh in Cornhill, 1694), preface.

single company known as the United English East India Company, but prior to that return of the monopoly the state of affairs were one of considerable turmoil. The decisions made by the presidents of the Company's factories were often subjected to intense scrutiny; however, the instable situation the Companies found themselves in at the beginning of the eighteenth century added a new risk that one might be accused of being an agent for the other company. An example of this can be found in the case of William Tillard.

Tillard had been the second in command as well as the warehouse keeper at Fort St. George until the death of John Pitt resulted in his promotion.[54] The Company soon expressed concern that it had "been very ill used by Mr. Tillard and others in the matter of the Bills of Exchange drawn on you for the Payment of Your Debt to the Black Merchants."[55] Tillard and his associates at Fort St. George had used Company money to pay off debts. When the Directors wrote to Duke Faunce and Philip Baker (a steward and accountant respectively) in an attempt to learn more details as to what had actually occurred, the two men denied any particular knowledge explaining they had been "at that time being 270 Miles from Fort St. George at a Place abandon'd by all English but ourselves."[56] While they defended Tillard as having sought to act in the Company's best interests, they suggested he had been forced to rely on unscrupulous advisers:

> Those with whom he was necessitated to Consult made their advantage of his necessity, advising more for their own private Interest then for the Good of the Company, and here is a Braeham belonging to the Company yet with a small matter of Instruction knows how to dress up a Grievance to the best advantage, and express himself in proper English, as may be seen by the Merchants last Petitition Deliver'd the United Councell against the New Company, which Philip

[54] *Records of Fort St. George: Despatches from England, 1701-1705, Vols. 12-13* (Madras: Printed by the Superintendent, Government Press, 1925), 74. Tillard had been in India since 1698 on a salary of £60.
[55] "Letter from Duke Faunce and Philip Baker, Fort St. George, to the Company, September 11, 1706," *Despatches to England, 1701-1711* (Madras: Printed by the Superintendent, Government Press, 1925), 46.
[56] "Letter from Duke Faunces and Philip Baker, September 11, 1706, *Despatches to England,* 47.

> Baker saw render'd into English by him very lately, a Copy of which We Suppose Your Honours have from the United Councell.[57]

Though Faunce and Baker claimed to know nothing of the actual affair, they were quick to speculate that private speculators had taken advantage of the Company. In order to resolve an immediately pressing problem regarding debt owed to local merchants:

> We may imaginarily infer from the Gentlemens advanceing their own Money for Payment of so dangerous a Debt as they gave it out to be, and to serve those they all along held to be their Enemies, (whom yet they wont afford a good word) from which We may reasonably Conclude some Siniste[r] Interest to be the Indueing Motive, that Put them upon doing the New Company Such a Signal Service (as they are pleas'd to term it) in Paying their Debt, saving their Credit, and Runing the Risque of their own money, in which if they had perceiv'd the least Danger, Wee are fully Perswaded but lightly Affect them.[58]

One possible motivation for the whole affair, it was suggested, was an effort to undermine the New Company's credit.[59] As trade in India was deeply dependent upon credit, if the New Company were to lose its reputation, its ability to carry out business would be significantly impaired. This was acknowledged by eighteenth-century commentators such as Charles Davenport who wrote:

> Of all beings that have existence only in the minds of men, nothing is more fantastical and nice than Credit; it is never to be forced; it hangs upon *opinion*; it depends upon our passions of hope and fear; it comes many times unsought for, and often goes away without reason; and when once lost, is hardly to be quite recovered.[60]

As the historian John Brewer has pithily put it, "credit was a matter of confidence and confidence was a matter of opinion."[61]

Private merchants had to "give out money before hand" when buying goods, while the East India Company preferred to buy entirely on contract, which lowered costs and protected the

[57] "Letter from Duke Faunce and Philip Baker, Fort St. George, to the Company, September 11, 1706," *Despatches to England*, 47.
[58] "Letter from Duke Faunce and Philip Baker, September 11, 1706," *Despatches to England*, 46.
[59] "Letter from Duke Faunce and Philip Baker, September 11, 1706," *Despatches to England*, 47.
[60] Charles Davenport, quoted by Brewer, *Sinews of Power*, 187.
[61] Brewer, *Sinews of Power*, 187.

Company from bad debts.[62] The involvement of speculators in the management of the Company's debt seemed ripe for abuse. The complicated state of affairs that saw the English East India Company divided in two while continuing to compete against a spate of foreign interests meant that the state of the New Company's credit was of particular importance. Indeed, when the two Companies merged back into a single enterprise, it was emphasized that "When the Old Company will expire like unto a dead man to use your own phrase and therefore the King of England has ordered you his Consull to tell the Governours of Suratt they are to pay their debts before their servants depart this Empire."[63]

It was imperative that the Company be on a firm foundation and the Old Company depart with its credit good. The trouble William Tillard found himself in was due to his predecessor having agreed to prices:

> At such extravagant rates, that after their arryvall, and the company had paid the Freights & high Customes for them, most of the said Goods would not sell for more mony then what he has charged them at in the Invoyces for their first cost, whereby the Company have lost an incredible Sume of mony, and could not avoyd suspecting there was an understanding underhand betwixt out Presid[t]: & those Merch[ts].[64]

The Company had originally sent two men (surnames Fraser and Wright) to assist Tillard with adjusting the Account Books in order to clarify what the new Company owed to the merchants of Metchlepatam and Maddapollam.[65] Tillard had requested advice on multiple occasions and had told the governor and council at Fort St. George that he had been offered a considerable loan on

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[62] "Abstract of General Letter from Fort St George to the Company, November 5, 1703, received, October 11, 1704, via Suratt. Signed by Thomas Pitt, William Fraser, Thomas Wright, Thomas Marshall, John Meverall," *Despatches to England*, 7.
[63] IOR/E/3/58, item 7205, f. 3 (volume unpaginated).
[64] "Despatch From the Company to Fort St. George. London, March 2, 1706," *Despatches from England, Vol. 15, 1706-1710* (Madras: Printed by the Superintendent, Government Press, 1927), 87.
[65] "The Consultation and Diary Booke of Thomas Pitt, Esq[r]. Governour and President &c[a]. Council their Proceedings, and Transactions in the Affairs of the R[t]. Hon[ble]. United English East India Company in the Presidency of the Coast of Choromandell &c. Begun p[mo]. January 1705-1706," *Records of Fort St. George*: *Diary and Consultation Book, 1706* (Madras: Printed by the Superintendent Government Press, 1929), 1.

his New Company Bills of Exchange at the rate of 10 shilling and 6 pence. He expressed concern at this point in time that the debt owed by the new Company was considerably bigger than he believed the Company expected. In the aftermath the council stated that at this point they had advised him to leave the debt for Metchlepatam unpaid until it had been thoroughly investigated by the Company. Furthermore, they had told him to return to England on the *Dutchess*, bringing with him all books and papers so that "they may clearly see how the Debt arrised."

The Directors soon claimed, however, that Tillard had allowed the "Black Merch[ts]: all their demands with Interest thereon, without makeing the least enquiry into the extortant prizes or frauds committed in Piscashes Dustores or any other wayes."[66] In paying off these debts, Tillard had valued the bills of exchange as being ten shillings and six pence when at the time in London they were actually worth only nine shillings. In the meantime, the debts to the "black merchants" had been renegotiated at a rate of sixty to seventy percent of what had originally been owed. The council at Fort St. George believed the reaction from London was due to a lack of information. The Directors had responded thus because "it plainly appears that when they wrott that Letter, they knew little or nothing of their great Debt on this Coast, or they would never have wrott so doubtfully of it." Thus, the council was confident that once Tillard arrived in England with the account books it would be seen that they would "expect that no considerable part of the Debt remaining be pay'd till their farther orders, which we may depend on they will send by next shipping." [67] That was essentially what the Directors decided after Tillard arrived in London and was able to explain the situation in person.

The entire incident came down to two related issues, the debt owed to the merchants and the loan that had been offered to Tillard in order to pay the original debt. While the debt was

[66] "Despatch From the Company to Fort St. George. London, March 2, 1706," *Despatches from England, Vol. 15*, 88.
[67] *Diary and Consultation Book, 1706*, 2.

much greater than the Directors had expected because Pitt had supposedly purchased goods for greatly inflated prices, it was ultimately resolved by renegotiating the debt with the merchants to something more in line with what the Company regarded as reasonable. The question of the loan was a different problem because it resulted with those who had underwritten Tillard's original scheme involving the sale of bills of exchange in order to cover the debts claiming to own bonds worth more than what was due to the merchants. Such a situation was a threat to the stability of the New Company's credit. Moreover, it was a threat to the value of the Bills of Exchange as it left the Company owing bonds that exceeded assets and debts. The Company survived the affair without any noticeable effect; however, the example of the bursting of the South Sea Bubble a decade later demonstrates an extreme example of the possible consequences of such situations.[68]

The incident demonstrates a number of this dissertation's themes. Tillard, who had not been specifically chosen for a governing position at Fort St. George was still able to take considerable unilateral action when he found himself so empowered after the death of the Company's chosen president. The Directors of the Company were quite limited in their ability to affect the ongoing affairs in India and were frequently forced to respond retroactively after actions had already been taken. Despite the level of recordkeeping demanded, in this instance, the Directors lacked the information necessary to understand what had taken place. What they knew was that Tillard had drawn substantially upon the bills of exchange in order to pay debts that seemed out of line with standard practice. They were only able to come to a final resolution

[68] John Carswell, *The South Sea Bubble, revised edition* (London: Alan Sutton, 1993); Cf. Julian Hoppit, "The Myths of the South Sea Bubble," *Transactions of the Royal Historical Society*, Sixth Series 12 (2002): 141-65. Hoppit questions the way in which the South Sea Bubble has been mythologized by historians, arguing that the bubble is accorded an outsized place in the psyche of the history of the eighteenth century when the actual facts are examined. In Hoppit's view, the bubble was seized upon for its value to the political rivalries at the time, but the actual collapse was not as large or traumatic as historians have assumed. See also Anne Goldgar's account of the Dutch Tulip bubble in the 1630s and 1640s, Goldgar, *Tulipmania: Money, Honor and Knowledge in the Dutch Golden Age* (Chicago: University of Chicago Press, 2007). Cf. Peter Garber, *Famous First Bubbles: The Fundamentals of Early Manias* (Cambridge, MA: The MIT Press, 2001).

of the affair after Tillard had returned to England two years later and was able to answer their questions directly. While the Company's bonds derived their value from the assurance that they were to be paid out on demand, in this instance the Company refused to pay bonds they believed to be either fraudulent or more than they "justly" owed.[69] As a final side note, Duke Faunce would himself be dismissed by the Company along with a man named John Bridge a few years later when they refused to be responsible for a Mr. Berlue's perquisites while he was away from the factory, preferring, instead, to be suspended and discharged.[70]

Harold Cook has argued there was a direct relationship between the rise of global commercial exchange and the birth of the scientific fact because the kind of large-scale and long distance trade carried out by joint stock companies like the East India Companies required credit on a scale that went beyond what could be managed by local networks. Cook contended that Dutch capitalism spurred the development of consensus in science by restricting practitioners' attention to empirically verified facts.[71] In order to carry out trade on a global scale and with commodities that were not locally familiar, a new vocabulary for commerce had to be developed. The new vocabulary of global exchange, according to Cook, allowed for unfamiliar goods to be described in a language that allowed for them to be compared to commodities that were known by Europeans and thereby given a value. Cook has presented a highly compelling argument for the development of global exchange in the European context, but the way the English East India Company operated within India does complicate the picture somewhat. Much of the English East India Company's operation relied on the cultivation of interrelated local networks in its many

[69] "Despatch From the Company to Fort St. George. London, April 26, 1706," *Despatches from England, Vol. 15*, 94.
[70] "Abstract of General Letter from Fort St. George to the Company, November 23, 1709," *Records of Fort St. George*, 113.
[71] Cook, *Matters of Exchange*; Cf. Dániel Margócsy, *Commercial Visions: Science, Trade and Visual Culture in the Dutch Golden Age* (Chicago: University of Chicago Press, 2014), 15.

places of operation and on the actions undertaken by employees who were significantly empowered to act on the Company's behalf. The history of the Company in South Asia, therefore, had less to do with classification or the mathematization of nature though the flood of new commodities and ideas from hitherto little or unknown parts of the globe may have had such a result in Europe.[72]

The outgoing correspondence by the directors of the English East India Company was substantially made up of detailed orders to those in positions of responsibility such as the captains, supercargoes and presidents of the various factories. These instructions were both exhaustively detailed and repetitive as essentially the same orders were copied out over and over again. To take one example, supercargoes were instructed on what they were to buy, at what price and how much. The orders did not stop there, however, as they also were informed how the ship was to be laden in order to protect the newly purchased goods. For instance, Robert Douglas was told:

> In packing up your Raw Silks, observe you putt first a Wadd of Cotton over the whole Bale or parcel of Silk & dry paper next and then oyld paper over that and then your matts, which is to avoid the damageing or discoloring the Silks w^{ch} will happen if the oyld Cloth be next to it, but pack it rather in chests then Bales.

Meanwhile, regarding tea he was to "be sure that all the wood used for making your Cases & Tubbs be well seasoned & made of such Stuff as will not prejudice the Tea."[73] The long return trip placed the expensive cargo at considerable risk of damage and, therefore, it was important that proper procedure be followed. Presumably, however, crews experienced in the voyages to China and India were well familiar with how to laden the ship correctly. Such orders, thus, might be understood not as giving needed instruction, but providing officers with a means of

[72] On the relationship between global trade and the mathematization of nature in Europe see, Richard Hadden, *On the Shoulders of Merchants: Exchange and the Mathematical Conception of Nature in Early Modern Europe* (Albany: State University of New York Press, 1994); Dániel Margócsy, *Commercial Visions*. For the situation in India see, Kapil Raj, *Relocating Modern Science*.
[73] IOR/E/3/94, f. 44v.

disciplining their crews. An example of using the Company's directives for the purpose of discipline can be found when Douglas wrangled with his assistant regarding the keeping of accounts as per Company requirements:

> I offered Mr Strong two of y^{e} Company Books w^{ch} he refused to accept of, I told him it was his Bussiness as he was Second to me, to keep them, but he denyed y^{t} it was his businesse & refused to keepe them, I told him he must answer it to y^{e} Court of Directors for I designed to keepe an exact acco^{t} of all things in my owne Journall. att last when he had better Considered of it he came and told me y^{t} he was willing to keepe y^{m} butt till our Goods were all delivered he coud not doe any thing exactly therefore he wanted some wast books to keepe ruffe daughts, till they could be entred fare in y^{e} other Books y^{t} y^{r} might be no blotts.[74]

By including such written instructions, the directors gave their chosen officers a point of reference upon which to base orders to their subordinates that they might otherwise have been unable to enforce.[75]

The inclusion of written orders such as "you are not to touch at Batavia either outward or homeward bound" would not be enough to compel submission when the crew of the *Rising Eagle* found the supply of water at risk of falling short if the ship did not stop at Batavia to resupply.[76] While Douglas made the case that his orders explicitly forbade landing at Batavia for any reason, the crew refused to continue further without the issue of water being resolved and Douglas was forced to relent.[77] The incident provides one of the more clear examples of Douglas using his journal in order to justify his actions as he clearly failed to follow the direct order of his superiors. Thus, he was careful to make clear that he had advocated the Company's position and had only relented when it became clear there was no other alternative. It also calls attention to the dynamics aboard ships. Though hierarchical in nature and authoritarian to a degree, the crew, in fact, had significant power due to the constant shortage of able seamen—which meant that

[74] IOR//L/MAR/A/CXXIII, p. 72.
[75] Such use can also be seen in John Vaux's requests for a copy of his orders from the East India Company for use in his dispute with Bartholomew Harris.
[76] IOR/E/3/94, f. 45r.
[77] IOR/L/MAR/A/CXXIII, p. 8.

capable crew members were always able to abandon their current ship for another when in port, and frequently did—along with the threat of mutiny if the situation became particularly untenable.

The journal of John Cremer (self-styled as Captain Ramblin' Jack) has numerous examples of the negotiating power possessed by capable seamen as he was able to move from ship to ship with relative ease.[78] As Nicholas Rodger has put it, "Men joined a King's ship or a merchant's ship as opportunity or preference suggested, and they moved easily from one to another."[79] Though it is generally assumed that mutineers were swiftly prosecuted and hanged, Greg Dening has shown that this view is due to the attention being primarily given to the more extreme cases. In practice the Navy was often more tolerant of considerable insubordination and even mutinous behaviour depending on the situation.[80] It is this reality of life aboard at sea that underlies Douglas's account of the affair even if he does not explicitly discuss the danger. The Company's written directives were evidently of greater influence for those in positions of greater responsibility as they were the ones who would have to make an account of their actions. Company employees such as Douglas depended upon the favour of the Company's directors for their future well-being, which was not the case for common sailors who were always able to move to another ship. The ease by which sailors were able to leave their current ship can be seen when Douglas noted after three members of the crew ran away after the *Macclesfield* arrived in

[78] John Cremer, *Ramblin' Jack: The Journal of Captain John Cremer, 1700-1774*, transcribed by R. Reynell Bellamy (London: Jonathan Cape, 1936). N.A.M. Rodger supports this point, describing the sea as a "highly mobile profession," N.A.M. Rodger, *The Wooden World: An Anatomy of the Georgian Navy* (London: William Collins, 1986), 200.
[79] Rodger, *The Wooden World*, 113.
[80] Greg Dening, *Mr Bligh's Bad Language: Passion, Power and Theatre on the Bounty* (Cambridge: Cambridge University Press, 1994), 145-6.

Macau that "just nine" had done so since the beginning of the voyage: two at Madera, four at Batavia and now three at Macau.[81]

The "Nabobs," (from the term *Nawab,* which was the title given to provincial governors in the Mughal empire), that is Indiamen who accumulated tremendous fortunes while in India, did not really exist until around the 1750s onward; however, there was still plenty of opportunity for private enterprise.[82] Such trade was not opposed by the East India Company, though it did attempt to assert some control over private trade by its employees. The chance to participate in potentially lucrative private trade was one of the things that made India service attractive for would-be members of the bourgeoisie whose prospects were otherwise limited. This private trade did not damage the Company's enterprise because it maintained a monopoly over the sale of goods imported to England from Southeast Asia. As the century progressed, however, India service became increasingly associated with corruption and greed as men like Warren Hastings obtained enormous wealth via "gifts" from local luminaries in the course of administrating the Company's interests. These Nabobs then increased their notoriety by pouring the new riches in an effort to establish a bloc in Parliament favourable to their interests.

While the Nabob controversies did not begin until the 1760s, private trade was never without contention. This was due, in part, to the way in which such practices displayed the tensions between the disparate institutions that made up the British state. As compelling as John Brewer's narrative of the formation of the fiscal-military state might be, the institutions upon which his argument rests were often in direct competition with each other. As William Ashworth has shown, this was particularly the situation when it came to customs and excise. Importers,

[81] IOR/L/MAR/A/CXXIII, p. 52.
[82] On Nabobs see, Samuel Foote, *The Nabob; A Comedy in Three Acts* (Dublin: Printed by W. Kidd for the Company of Booksellers, 1778); Tillman W. Nechtman , *Nabobs: Empire and Identity in Eighteenth-Century Britain* (Cambridge: Cambridge University Press, 2010).

small and independent and giant corporations such as the East India Company alike were united in their efforts at avoiding paying taxes. The East India Company, with its important connections and powerful shareholders, often did this by influencing Parliament to create exceptions for it, the most significant and long-lasting of these being the case of tea imported by the Company. Smaller traders were forced to rely on different means; namely, trickery and smuggling.

Members of the English East India Company were not above such efforts at trickery and smuggling. For instance, a customs officer by the name of John Snow accused the captain and mates of the East India Company ship the *Caesar* of having:

> Taken out goods belonging to the Honorable united East India Company and showed them in other parts of the Said Ship and put into the hold a Large quantity of Bales of Coffee belonging to themselves and that these were private Scuttles made on purpose for the Conveying the said Bales of Coffee out of the Hold in order to cary it a shore without payment of His majesties Customs or the Honorable Company their dues.[83]

The *Caesar* was hardly an isolated case. Snow made similar charges against the crew of the *Townshend,* the *Drake* and the *Devonshire*.[84] For his trouble, the captain of the *Townshend* Philip Worth paid a fee of £78.15.0 to resolve the situation.[85] William Ashworth has gone so far as to argue that the ingenuity required for the evasion of taxes and fees were in fact a significant driver of technological improvement.[86] Such incidents point to the competing interests within and between commerce, the state and the ancillaries of the government and the many individual actors involved. While John Snow may have been dutifully performing his job, there was

[83] "John Snow at the Customs House to the Court relating to coffee smuggled on board the *Caesar* ," March 27, 1723, IOR/E/1/14, ff. 152r-153v.
[84] "John Snow to the Court reporting on Captain Philip Worth of the *Townshend* and Captain William Westerbane of the *Drake* who allowed goods to be taken from on board their vessels whilst at sea," IOR/E/1/14, f. 290r; "John Snow to the Court complaining that Captain Lawrence Prince knowingly ran goods from on board the *Devonshire* whilst at sea," September 4, 1723, IOR/E/1/14, ff. 323r-325v.
[85] "Captain Philip Worth to the Court concerning goods unshipped from the *Townshend* which the Barons of the Exchequer had allowed him to compound with John Snow," November 27, 1723, IOR/E/1/14 ff. 445r-446v.
[86] Ashworth, "The Intersection of Industry and State in Eighteenth-Century Britain," in *The Mindful Hand: Inquiry and Invention From the Late Renaissance to Early Industrialization,* edited by Lissa Roberts, Simon Schaffer and Peter Dear (Amsterdam: Koninkliijke Nederlandse Akademie van Wetenschappen, 2007).

obvious opportunity for corruption by customs officers. Bribes were not the only means by which some attempted to benefit from uncovering clandestine trade. For example, in 1710 Josiah Cliffe of London wrote to the East India Company to demand a reward for having uncovered and revealed such activity the previous year.[87] The problem of customs fees was not limited to England either as the East India Company was in regular conflict with local officials on the other side of the trade as well. The customs imposed in, for instance, China were portrayed by those on the English side of the trade as examples of Chinese corruption and as part of the unfair tactics employed by Chinese merchants against European merchants.[88] For instance, John Ovington noted in *Voyage to Suratt*, "Bartholomew Harris has urged to me often this case, that he thought it no Injustice to evade the payment of as much Customs for the English goods as they were injur'd in them above two and a half per Cent by the Mogul."[89]

In 1700 the Company's position was more tenuous and its riches much more of a promise than a reality. Thus, it had to tread particularly carefully. Britain did not yet have a large market for tea and it was only after decades of effort by the East India Company that tea would take its place at the centre of English culture and be seen as an essential commodity.[90] Meanwhile, pepper was not actually a financially viable good by the middle of the eighteenth century, yet the Company continued to buy it in large quantities and ship it back to England because it provided a

[87] "Josiah Cliffe in London to the East India Company requesting a reward for discovering clandestine trade," September 22, 1710, IOR/E/1/2, ff. 158r-159v.
[88] Portrayals of the Chinese character as being inherently dishonest were common, e.g. "The Chinese are Subtle, & must be dealt with accordingly" and "Be cautious in your Agreements, & Trust neither Silver nor Goods without Security, as is the usuall Way in that Country." IOR/E/3/94, ff. 44r-v.
[89] John Ovington, *A Voyage to Suratt* , 150.
[90] Erika Rappaport, *A Thirst For Empire: How Tea Shaped the Modern World* (Princeton: Princeton University Press, 2017). Brian Cowan has made a similar point regarding coffee, "Coffee did not automatically find a place in the British economy simply because overseas merchants developed the capacity to buy it abroad and bring it back to Britain for sale at an affordable price. A market for the commodity had to be created; consumer demand for it had to be stimulated," Brian Cowan, *The Social Life of Coffee: The Emergence of the British Coffeehouse* (New Haven: Yale University Press, 2005), 15.

necessary ballast to stabilize their ships as they made the long, dangerous voyage.[91] Even goods that were in demand were not without controversy. The importation of goods from India and China were not regarded by all as a good thing. The demand for silks was an immediate concern for English cloth manufactures and merchants, especially since global trade had not managed to secure the hoped for new markets for English woolens. Thus, there were regular efforts to limit or even ban the importation of silks, such as an Act of Parliament that sought to outlaw the wearing of wrought silk.[92] Global trade may have played a crucial role, as the economic historian Jan de Vries has shown, in creating the conditions that allowed modern capitalism and industry to develop, but it did so at considerable cost to those who depended on the models that had come before.[93] Though the benefits of globalism have come to be taken as an article of faith by modern economics, the tension between the global and the local remains unresolved.

Conclusion

In 1694 the president of the English East India Company, Josiah Child, published a treatise on trade.[94] The primary aim of his book, unsurprisingly, was to promote the growth of trade as essential for the good of the nation. Child anticipated the rise of the fiscal state arguing for low interest rates and available credit in order to advance England's position in the world.[95] In making such an argument, Child was hardly alone as John Locke and Daniel Defoe also both favorably addressed the question of trade and the Bank of England was established in 1695 with

[91] K.N. Chaudhuri, *The Trading World of Asia and the English East India Company, 1660-1760* (Cambridge: Cambridge University Press, 1978), 313.
[92] "The House of Commons who is now sitting have resolved to prohibit the wearing of all wrought silks from India & China," Letter to Allen Catchpole and the rest of the Council in China, February 2, 1700, IOR/E/3/94, f. 84r.
[93] Jan de Vries, "The Industrial Revolution and the Industrious Revolution," *Journal of Economic History* 54 (1994): 249-70. See also Robert Brenner, *Merchants and Revolution: Commercial Change, Political Conflict, and London's Overseas Traders, 1550-1653* (London: Verso, 2003), and Martha Howell, *Commerce Before Capitalism in Europe, 1300-1600* (Cambridge: Cambridge University Press, 2010).
[94] Child, *A New Discourse on Trade* (1694).
[95] The advantage to Dutch merchants that lower interest rates in Holland accorded them was widely recognized from the beginning of the seventeenth century, see Jonathan Israel, *Dutch Primacy in World Trade*, 78-9.

such concerns specifically in mind.[96] All looked to the Dutch as the model the English ought to be following. Defoe enviously termed the Dutch "*the Carryers of the World*, the middle Persons in Trade, the Factors and Brokers of Europe" who "supply'd from all Parts of the World, that they may supply all the World again."[97] If England was to become a leading power in the world, it was believed that it would have to address its institutional weaknesses.

Yet, the example of the English East India Company challenges the assumption that long-distance control was necessary for global trade. The case of John Vaux that opened the chapter is one example of how the East India Company was not only unable to attain long-distance control, but did not even manage local control within its administration. William Ashworth's example of the hydrometer is another telling example of the limitations of institutional authority and expertise. In the mid-eighteenth century the excise commissioned the instrument maker John Clarke to design an instrument—the hydrometer—to provide a quantified measurement of the alcohol content contained in spirits. This measurement was intended to resolve disputes between the excise and distillers because spirits were taxed according to their alcohol content. Thus, distillers and merchants were motivated to misrepresent their spirits in order to reduce their taxes and the hydrometer was intended as an objective mechanism to prevent disputes. While the hydrometer was widely adopted, distillers continued to find new methods of adulteration in order to evade the excise.[98] The institutions of state and trade, both public and private, were intertwined with the knowledge practices seen at the Royal Society and in the *Philosophical*

[96] On the Bank of England and the financial revolution in England, see P.G.M. Dickson, *The Financial Revolution in England: A Study in the Development of Public Credit, 1688-1756* (London: Macmillan, 1967); Brewer, *Sinews of Power*, Ch. 4, especially pp. 114-26.
[97] Daniel Defoe, *A Plan of the English Commerce: Being a Compleat Prospect of the Trade of This Nation, as Well the Home Trade as the Foreign* (London: Printed for Charles Rivington, 1728), 192.
[98] Ashworth, "The Intersection of Industry and State," 367-71. For an account of the lengths that brewers went to adulterate their products for commercial gain, see James Sumner, *Brewing Science, Technology and Print, 1700-1880* (London: Pickering & Chatto, 2013).

Transactions.[99] As Harold Cook has argued, knowledge production and commercial practices existed within the same spheres and one cannot be fully understood without recognition of the other.[100] At the same time, however, the institutions were composed of complex social relations and competing sets of self-interests.

That the origins of modern science and industrialization occurred in the context of global expansion and imperialism is not a coincidence. The complex web of relationships between the imperial, capitalist world and the history of science has been recognized by a great many historians. While the East India Company and the India trade has been afforded a great deal of attention by historians of science, the Company as an institution remains less explored. The principal goal of this chapter has been to bring the institutional imperatives into the conversation. Joint-stock trade companies, especially the East India Company, and the British Navy were crucial to the history of science in the eighteenth and nineteenth centuries; however, the advancement of science was never their primary concern. The interests of natural philosophy and natural history often overlapped with those of the East India Company and the Navy enough that the two were able to be of mutual benefit. Obvious examples of such cooperation can be seen in the improvement of navigation during the eighteenth century or the many voyages of discovery. Edmond Halley was given a naval rank, ship and crew with which to lead three scientific voyages in the 1690s. Similarly, James Cook's explorations are remembered for their scientific endeavours and, like Halley, were done at the Navy's behest and with its ships. However, in both of these examples, there was actually considerable tension between naval priorities and those of natural philosophy and natural history. In perhaps the most dramatic example, Greg Dening has

[99] Thomas Sprat, *History of the Royal Society*, edited with critical apparatus by Jackson I. Cope and Harold Whitmore Jones (London: Routledge & Kegan Paul, 1959 [1667]), 87-8; James Tully, *An Approach to Political Philosophy: Locke in Contexts* (Cambridge: Cambridge University Press), 140-1.
[100] Cook, *Matters of Exchange*, 5-6.

argued that it was partly William Bligh's obsequiousness to Joseph Banks and the demands of natural history was one of the major grievances that led to the infamous mutiny on the *Bounty*.[101] Though the results were less extreme, the relationship between Banks and Cook was also a tense one and ultimately prevented Banks from directly participating in Cook's later voyages.[102]

This chapter, then, has sought to tease apart bureaucratic and institutional concerns from the interests of the actors who made up the English East India Company. The thesis has been that the tensions that existed between rival actors within the Company and the contradictions that define the Company's history played an essential role in the way in which knowledge practices happened in the eighteenth century. Global expansion irrevocably changed the way in which Europeans viewed the world; however, their perspective was altered less in philosophical terms than in commercial ones. Benjamin Schmidt has argued that the concept of the exotic was invented principally for the benefit of commercial interests. Exotic geography, as he explained, was intended mainly to sell books.[103] Historians of natural history, similarly, have acknowledged the way in which the commodification of nature, global commerce and the history of science were intertwined. The East India Company was a leading participant in this process because if it was to be viable and profitable it needed markets for its products.

Yet, as this chapter has shown, on a day-to-day basis, the employees of the Company tended to be taken up rather more with self-interests. I hope to have shown something of the messiness with which the East India Company developed; I also hope to have begun to articulate something of an argument regarding the circulation of knowledge. Knowledge is produced and circulated in a wide variety of contexts. Moreover, its transmission is not always symmetrical.

[101] Dening, *Mr. Bligh's Bad Language*, 66.
[102] John Gascoigne, *Joseph Banks and the English Enlightenment: Useful Knowledge and Polite Culture* (Cambridge: Cambridge University Press, 1994), 9
[103] Schmidt, *Inventing Exoticism,* 227.

Indeed, I would argue that the power dynamics in the circulation of knowledge is almost always asymmetrical. Yet, as examples provided in this dissertation hopefully demonstrate, the imbalance is not always in the direction one would assume. In the case of the East India Company, the institutional power would seem to lie with those directing the Company from London; however, frequently limitations in communication and access to knowledge greatly undermined the intended hierarchy. My intention here is not to make any grand claims regarding the circulation of knowledge, but to place a greater emphasis on knowledge as practice. Ultimately, knowledge is intended to be used. The focus of this dissertation is to understand a set of knowledge practices. The question is less how was knowledge produced and more how was knowledge used and what tension existed between lay use of knowledge and elite conceptions of knowledge?

The concern of Andre Wakefield has been to write a history of German cameralism that looked forward from the perspective of his historical actors and not backward from the point-of-view of the present. In doing so, his aim was to "make the 'rise of the modern state' seem a little less inevitable and a little less monolithic."[104] Imperialism, capitalism and global trade are defining features of what is understood as the modern world. The modern world in which we live, however, was not inevitable. More crucially for the purposes of this project, it was not obvious from the perspective of the eighteenth century. The directors of the English East India Company did not intend to create a colonial power. The rise of British imperialism in Southeast Asia was the result of a series of events and decisions often made for reasons of self-interest by increasingly powerful Company administrators. In this chapter, I have provided a handful of examples that are particularly demonstrative of the contradictions of the English East India Company as an institution in the early eighteenth century. Considering the magnitude of its

[104] Wakefield, *Disordered Police State*, 23.

operations and the severe limitations of its resources, the English East India Company was an impressive achievement. It was also, however, frequently chaotic and disorderly and seldom able to achieve its goals to the extent that its directors hoped. Its eventual hegemony at the end of the century is a testament to persistence. Why its directors, its shareholders and the politicians who supported it continued to persist in the endeavour, and why the English company succeeded in ways that others such as the Dutch, the French or the Portuguese did not remains unclear to me. The Company state was not inevitable or remotely likely seeming at the turn of the eighteenth century; therefore, the questions I have raised here are crucial to understanding the English East India Company and suggest that the eighteenth century is as important for historians of the Company as the nineteenth century. In this chapter, I have not attempted to answer such questions. Rather, my aim has simply been to insist that they be asked.

Chapter Four
London as the Periphery: The English Experience in Canton c. 1700

Eighteenth-century Europeans accepted as a matter of fact that China was in a state of stagnation. David Hume explained this stagnation by pointing to China's homogeneity and insularity:

> In CHINA there seems to be a pretty considerable stock of politeness and science, which, in the course of so many centuries, might naturally be expected to ripen into something more perfect and finished, than what has yet arisen from them. But CHINA is one vast empire, speaking one language, governed by one law, and sympathizing in the same manners. The authority of any teacher, such as CONFUCIOUS, was propagated easily from one corner of the empire to another. None had courage to resist the torrent of popular opinion. And posterity were not bold enough to dispute what had been universally received by their ancestors. This seems to be one natural reason, why the sciences have made so slow a progress in that mighty empire.[1]

Hume, therefore, maintained a worldview that managed to be both parochial and globalist at once. Europe was accepted as the natural center of the world, which was explicated by Europeans' role in global trade. Unlike the insular Chinese who closed their empire off to outsiders, the cosmopolitan Europeans had spread across the globe and to great benefit. Yet, as this chapter will show, Europe's global influence was still limited, especially when viewed from the perspective of economic history. Britain had not yet become the industrial powerhouse it would develop into by the nineteenth century and its manufactured goods were of little interest to merchants in China.[2] When historians have written about the metropole and the periphery, it has traditionally been taken for granted that the metropole was Euro-American and the periphery

[1] David Hume, "Of the Rise and Progress of the Arts and Sciences," *Essays and Treatises on Several Subjects* (London: Printed for A. Millar, in the Strand and A. Kincaid and A. Donaldson at Edinburgh, 1758), 76.
[2] The Chinese were similarly unimpressed with English natural philosophical instruments, see Larry Stewart, "The Spectacle of Experiment: Instruments of Circulation, From Dumfries to Calcutta and Back," in *The Circulation of Knowledge Between Britain, India and China: The Early-Modern World to the Twentieth Century*, edited by Bernard Lightman, Gordon McOuat, and Larry Stewart (Leiden: Brill, 2013), 30-1; Simon Schaffer, "Instruments as Cargo in the China Trade," *History of Science* 44 (2006): 217-46, e.g. "While the British officials judged the Chinese infantile because they did not or could not comprehend the instruments' meanings, so Chinese officials also saw the British tribute-bearing delegation as children, because they brought nothing but gaudy ephemera, "Schaffer, 219.

everywhere else that came under nineteenth-century imperial domination. In this chapter, I argue that this is because we have taken Hume's point-of-view. From the perspective of the Chinese, it was China and not Europe that was at the center of the world.[3] As historians of economics and South Asia have shown, the Asian case is actually quite strong. The metropole and periphery can readily be inverted.

Underlying this inversion of the traditional metropole and periphery is that there was a loose relationship between the directors managing the Company's affairs from London and its so-called servants in Asia. A particularly acute example of this looseness can be seen in some of the correspondence of the East India Company captain Benjamin Brangwin. Writing from Surat, Brangwin was faced with an acute lack of information and wrote to his acquaintance Edward Owen at Gomeroon (Persia) for help. Brangwin pleaded for an update, stating that he "cannot imagine w^{t}'^{s} become of Sir Josiah Child & Sir Thomas Cook not finding y^{e} names mentioned; neither can I perceive how or who are y^{e} mangers of y^{e} Comp^{a} at present; if you know any thing pray inform me."[4]

It is, perhaps, unsurprising to learn that agents of the Company located in distant outposts found it difficult to keep abreast with news from home. However, to regard places like Surat, Bombay, Calcutta or Canton as simply distant outposts cut off from the metropole of London is to misunderstand the situation. The Company directors were arguably even more ill-informed of what was happening at the so-called periphery than those in that periphery were as to the goings on in England. A letter typically took six months to travel from India to England, its content

[3] Laura Hostetler, "Contending Cartographic Claims?: The Qing Empire in Manchu, Chinese and European Maps," in *The Imperial Map: Cartography and the Mastery of Empire*, edited by James Akerman (Chicago: University of Chicago Press, 2009); Richard Smith, "Mapping China's World: Cultural Cartography in Late Imperial China," *Mapping Chia and Managing the World: Culture, Cartography and Cosmology in Late Imperial Times* (London: Routledge, 2013).
[4] Benjamin Brangwin to Edward Owen, 29 May, 1696, IOR/E/3/52, f. 64r.

largely obsolete by the time it arrived. Thus, the Court of Directors in London were really only nominally managing the operations of the Company. Rather than a centralized hierarchy in which decisions were made at the centre and diffused outward to the far-flung "outposts," the Company depended heavily on its individual representatives in its distant factories for much of the management of its affairs.

The weakness of its organizational structure explains why it was obsessed with paperwork and record keeping. The consequences of bad management at the periphery could be severe. For example, when Charles Fleetwood replaced John Sowden at Benkulen it was because Sowden's governance had been so bad as to occasion "an actuall warr and distruction of the Town and Frightning away the Inhabitants and trade."[5] Other Company employees, however, lost their jobs for a much more mundane, but not unrelated, reason: the failure to supply the directors in London adequately with reports. Rather than existing at the centre of global exchange, London was simply one of a great number of nodes in a complicated network. As was shown in the previous chapter, the directors of the English East India Company were highly circumscribed in their ability to influence economic and political activity over long distances.

In this chapter, then, I have two objectives. As the quotation from David Hume points toward, the key conceit of Newtonian science was the claim that it produced universal knowledge and, correspondingly, that it was the only method by which such universal knowledge could be reliably obtained. This universalism was developed over the course of the eighteenth century and played a pivotal role in nineteenth and twentieth-century justifications of imperialism. Moreover, eighteenth-century assumptions remain embedded in twenty-first century historiography. The first objective of this chapter, then, is to begin to address this historiographic

[5] "Commission and instructions to Charles Fleetwood and Council for affairs at Benkulen, Madras," 21 September, 1691, IOR/E/3/49, f. 35r.

problem. One expression of it has been the various proposals for how knowledge circulates. On the one hand there is Bruno Latour's concept of centres of calculation—which makes explicit use of a metropole and periphery model of the world, while others in science and technology studies have proposed a more egalitarian circulation of knowledge.[6] While greater efforts have been made to make the history of science less Eurocentric, the primacy of science itself remains mostly unchallenged. In order to begin to develop a historicized understanding of the relationship between scientific universalism and the metropole, the first section of this chapter puts the metropole into historiographic context.

Global exploration and commerce were important reference points as the new science developed and matured between the seventeenth and nineteenth centuries. History of science, too, has recognized the significant role played by global commerce in shaping science during the eighteenth century.[7] The European trading companies were at the centre of this expanding world trade. Thus, it is unsurprising that this trade has been increasingly recognized as having played a key part in the history of science.[8] The tendency, however, has been to focus on those individuals

[6] E.g. Fa-ti Fan, *British Naturalists in Qing China: Science, Empire, and Cultural Encounter* (Cambridge, MA: Harvard University Press, 2004); Bernard Lightman, Gordon McOuat and Larry Stewart, eds. *The Circulation of Knowledge Between Britain, India and China*.

[7] E.g. Larry Stewart, *The Rise of Public Science: Rhetoric, Technology, and Natural Philosophy in Newtonian Britain, 1660-1750* (Cambridge: Cambridge University Press, 1992); Simon Schaffer, "The Consuming Flame: Electrical Showmen and Tory Mystics in the World of Goods," in *Consumption and the World of Goods*, edited by John Brewer and Roy Porter (London: Routledge, 1993); Pamela Smith and Paula Findlen, eds. *Merchants and Marvels: Commerce, Science and Art in the Early Modern World* (London: Routledge, 2002); William Ashworth, *Customs and Excise: Trade, Production, and Consumption in England, 1640-1845* (Oxford: Oxford University Press, 2003); "The Intersection of Industry and the State in Eighteenth-Century Britain," in *The Mindful Hand: Inquiry and Invention From the Late Renaissance to Early Industrialisation*, edited by Lissa Roberts, Simon Schaffer and Peter Dear (Amsterdam: Koninklijke Nederlandse Akademie van Wetenschappen, 2007); Harold Cook, *Matters of Exchange: Commerce, Medicine, and Science in the Dutch Golden Age* (New Haven: Yale University Press, 2007); Benjamin Schmidt, *Inventing Exoticism: Geography, Globalism, and Europe's Early Modern World* (Philadelphia: University of Pennsylvania Press, 2015).

[8] Deepak Kumar, ed. *Science and Empires: Essays in Indian Context, 1700-1947* (New Delhi: Wiley Eastern 1991); Satpal Sangwan, *Science, Technology and Colonisation: An Indian Experience, 1757-1857* (New Delhi: Anamika Prakashan, 1991); Kapil Raj, *Relocating Modern Science: Circulation and the Construction of Knowledge in South Asia and Europe, 1650-1900* (New York: Palgrave Macmillan, 2007); Miles Ogborn, *Indian Ink: Script and Print in the Making of the English East India Company* (Chicago: University of Chicago Press, 2007); Schaffer, "Newton on the Beach: The Information Order of *Principia Mathematica*," *History of Science* 47 (2009): 243-76; Vinita

who were doing what can be recognizably described as science. Yet, the vast majority of the trading companies' activities were devoted to just what their names suggest: trade. In that spirit, the second part of the chapter is devoted to understanding the experience of European-Chinese trade circa 1700 by following the story of the English East India Company supercargo for the *Macclesfield* Robert Douglas as he struggled to execute his duties in Canton (Guangzhou). Douglas was not involved in any scientific enterprises. Nor was he a central figure in the history of the East India Company. He left to posterity little other than the journal he kept while in China. Yet, his story can tell us much that is of value to the history of science because it is very illustrative of the commercial relationship between European and Chinese merchants.

His journal is a valuable source because it demonstrates many of these key themes that have been the focus of investigations of the European imperial project. Though Douglas is an obscure figure who has been largely forgotten by history, he serves as an invaluable exemplar of global exchange and is useful as a type case. Douglas was the supercargo for the English East India Company ship the Macclesfield during a trading voyage to China at the turn of the seventeenth century. As supercargo, Douglas was responsible for selling the English goods the ship carried with it on its outward voyage and for purchasing the Chinese products desired in Europe. As such, he was given a detailed list of instructions by the Company, but also had relatively substantial latitude to carry out his role while he was in China. Though the Company sought to define the terms of the exchanges to be made and impose prices favourable to the Company, in practice the Company's representatives were significantly constrained by the realities of the marketplace. The purpose of the Douglas case study is to demonstrate a more complex account of centres and peripheries. Rather than presuming the metropole to be

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Damodaran, Anna Winterbottom, and Alan Lester, eds., *The East India Company and the Natural World* (Houndsmills, Basingstoke: Palgrave Macmillan, 2015); Anna Winterbottom, *Hybrid Knowledge in the Early East India Company World* (Houndsmills, Basingstoke: Palgrave Macmillan, 2016).

European and the periphery to be the rest of the world, in this chapter I advocate for a plurality of metropoles and peripheries. From the context of trade, at least, in 1700 Canton can be regarded as a metropole and London as a periphery.

The Metropole and the Periphery

Examples such as Benjamin Brangwin demonstrate the difficulty of asserting the existence of *the* metropole and *the* periphery. The metropole was original conceived to describe the British Empire. One of the more straightforward illustrations of the idea of the metropole can be found in a promotional scheme devised by the Empire Marketing Board in 1927.[9] The Empire Marketing Board requested and received from the Master of the Royal Household the very recipe for the Christmas pudding that the Royal family would be eating with their Christmas dinner. Beside each ingredient listed in the recipe was listed the location in the empire from which the ingredient originated. Thus, the Empire Christmas Pudding perfectly embodies the notion of the metropole. As the centre or home territory of the colonial empire, the metropole was understood as determining the character of the rest of the empire. While the ingredients for the Empire Pudding come from around the globe, once in the metropole they were transformed into the most English of dishes. While historians of science have increasingly taken a broader view of their subject, a concept similar to the metropole has formed the foundation of how science has come to be understood. Perhaps the most explicit and developed model of the metropole and periphery in science studies can be found in Bruno Latour's concept of "centres of calculation"; hence, Latour serves as the provocation for this chapter.

[9] Kaori O'Connor, "The King's Christmas Pudding: Globalization, Recipes, and the Commodities of the Empire," *Journal of Global History* 4 (2009): 127-55; Felicity Barnes, "Bringing Another Empire Alive? The Empire Marketing Board and the Construction of Dominion Identity, 1926-33," *Journal of Imperial and Commonwealth History* 42 (2014): 61-85.

By centre of calculation, Latour argued that scientific knowledge is produced at a centre of political power (the metropole) and then disseminated outward from there to the periphery. He illustrated his concept of centres of calculation by discussing Jean-François de Galaup, comte de La Pérouse's expedition on *L'Astrolabe* to an area of land in the East Pacific that was named "Segelien" or "Sakhalin" in Lapérouse's travel books.[10] This land was controversial in Europe when Lapérouse landed there on July 17, 1787 because no one in Europe knew if it was an island or a peninsula. It was to resolve such disputes that had led to Lapérouse being commissioned by Louis XVI to produce a map of the Pacific. Latour described how when the French arrived they sought geographic knowledge from the natives. An older Chinese man drew a map in the sand and demonstrated with gestures the size of the straight that divided Sakhalin from the Chinese mainland.[11] As the tide threatened to erase this map, another Chinese man took Lapérouse's notebook and sketched out another map in which he used little marks to signify a day's travel by canoe and, therefore, indicate scale. Latour notes that the islanders were less successful at communicating to the French the depth of the straight because they had little understanding of the ship's draught. Having received such helpful knowledge, Lapérouse decided to leave the next morning to see the straight for himself; however, fog, winds, and bad weather all conspired to prevent him from sighting the straight. Thus, months later when they arrived at Kamchatka, he had still not seen the straight. Instead, the French used the geographic knowledge received from the Chinese in order to conclude that Sakhalin was, indeed, an island and a young officer by the name of De Lesseps was asked by Lapérouse to carry the maps, notebooks, and astronomical

[10] Bruno Latour, *Science in Action: How to Follow Scientists and Engineers Through Society* (Cambridge, MA: Harvard University Press, 1987), 215-6.

[11] "Chinese" was how Latour identified the indigenous peoples of Sakhalin. As he also used "savages," Latour's word-choices are rather problematic, a point on which he has been criticized by a number of scholars. For example, see Steven Shapin, "Placing the View from Nowhere: Historical and Sociological Problems in the Location of Science," *Transactions of the Institute of British Geographers* 23 (1998), 7.

bearings the expedition and gathered over the previous two years back to Versailles where it could be assimilated into the corpus of geographic knowledge.

Latour wrote that Lapérouse rushed to learn as much from the natives as he could and described their culture, politics, and economics. His naturalists gathered specimens, took notes, and made astronomical observations. All of this was done in a single day's observations. This rush to collect as much knowledge as possible as quickly as possible is at the centre of what Latour regarded as the point of the story: "If they were interested in the island could they not stay longer? No, because they are not so much interested in this place as they are in bringing this place *back* first to their ship, and second to Versailles."[12] Data is collected at the periphery, but, Latour implies, it is only at the European metropole that such data can be transformed from a collection of facts into scientific knowledge. That is, it is in the metropole that natural knowledge is assimilated into the systemic body of universal knowledge of Western science. The role played by the Chinese in Latour's account was only to provide unsystematised information that Lapérouse could then send back to Versailles. It was only after knowledge had been made scientific in the European centre that it could be transmitted back out into the periphery. The relationship between the periphery and the metropole is clear.

Yet, the conception that knowledge is produced in the Euro-American metropole and then transferred to the periphery does not hold up to historical scrutiny.[13] For instance, Michael

[12] Latour, *Science in Action*, 217.

[13] David Philip Miller has found Latour's ideas to be productive for his study of Joseph Banks, see David Philip Miller, "Joseph Banks, Empire and 'Centres of Calculation' in Late Hanoverian London," in *Visions of Empire: Voyages, Botany and Representations of Nature*, edited by David Philip Miller and Peter Hanns Reill (Cambridge: Cambridge University Press, 1996), while other historians of science of have lodged a number of criticisms such as that Latour's model denies agency to the periphery in the making of science and that Latour assumes that instruments can work equally well in any context, see Kapil Raj, *Relocating Modern Science* and Graeme Gooday, "Instrumentation and Interpretation: Managing and Representing the Working Environments of Victorian Experimental Science," in *Victorian Science in Context*, edited by Bernard Lightman (Chicago: University of Chicago Press, 1997), 411. On the difficulty of replicating experiments, see Otto Sibum, "Reworking the Mechanical Value of Heat: Instruments of Precision and Gestures of Accuracy in Early Victorian England," *Studies*

Bravo's analysis of Lapérouse's expedition found a very different account than what Latour had given. While Latour presented the encounter between Lapérouse as a one-off event and represented it as an example of the cycles of accumulation and calculation that allowed the West to gain and maintain its mastery over the world, Bravo's adherence to the historical details resisted such unambiguous interpretations. As Lapérouse was, in fact, in Sakhalin waters for seven weeks, his party participated in a number of exchanges with the locals. Thus, Lapérouse was much more dependent on the locals than Latour's account of the same event would lead one to believe.[14]

Latour's work is a continuation of a longstanding historical problem regarding the role of the "East" and the "West" in the development of science and technology. An illustration of the controversies that have arisen can be found in the contrasting views between the Joseph Needham and Herbert Butterfield circa 1949. In *The Origins of Modern Science*, Butterfield framed his inquiry around why modern science originated in Europe and not somewhere else.[15] It was his thesis that the Scientific Revolution was the result of Renaissance scholars rediscovering ancient mathematics that had been lost in the "Dark Ages." While Butterfield accepted that experimental work was done in the medieval period, he contended they lacked the necessary mathematical tools for the accumulation of knowledge necessary for the Scientific Revolution. As he put it, "Without the achievements of the mathematicians, the scientific revolution, as we

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in History and Philosophy of Science Part A 26 (1995): 73-106; Harry Collins, "The TEA Set: Tacit Knowledge and Scientific Networks," *Science Studies* 4 (1974): 165-185.

[14] Michael Bravo, "Ethnographic Navigation and the Geographic Gift," in *Geography and Enlightenment*, edited by David Livingston and Charles Withers (Chicago: University of Chicago Press, 1999). See also, Simon Schaffer, "'On Seeing Me Write:' Inscription Devices in the South Seas," *Representations* 97 (2007): 90-122.

[15] Herbert Butterfield, *The Origins of Modern Science, 1300-1800* (London: G. Bell and Sons, 1949); Cf. Nicholas Jardine, "Whigs and stories: Herbert Butterfield and the historiography of science," *History of Science* 41 (2003): 125-40. Steven Shapin has notably challenged the very notion of the Scientific Revolution, Shapin, *The Scientific Revolution* (Chicago: University of Chicago Press, 1996). For a defence of the Scientific Revolution as a historical category see H. Floris Cohen, *The Scientific Revolution: A Historiographical Inquiry* (Chicago: University of Chicago Press, 1994); *The Rise of Modern Science Explained: A Comparative History* (Cambridge: Cambridge University Press, 2015).

know it, would have been impossible,"[16] It was only in the seventeenth century that mathematics became sufficiently sophisticated to allow modern science to be born. Thus, from Butterfield's point-of-view science is explicitly European. It arose in Western Europe because it was only there that the social, cultural and intellectual conditions existed such as to allow it.[17] While few historians of science today would engage in so blatant Eurocentrism, elements of his thesis persist as historians continue to frame their subject in ways that favour Euro-America as the scientific center.

At the same time as Butterfield was working on his book, his Cambridge contemporary Joseph Needham was also grappling with the question of the origin of modern science. A chemist by training, Needham came to be interested in Chinese science and technology as a result of being placed in China during the Second World War. While in China he was impressed by what he learned of Chinese history and culture and was persuaded that the absence of Chinese science and technology in the historiography was a gross deficiency and he immediately set about to rectify the situation. His monumental *Science and Civilisation in China* published its first volume in 1954 and remains ongoing to this day. Needham was "convinced of the universality of science as a human enterprise, an expression of an innate curiosity fundamental to human nature, and intrigued by the momentous scientific and technological achievements of China up to the fifteenth century," which led to him asking why modern science originated in Europe and not China. As Needham would put it, "Why, then, did modern science, as opposed to ancient and medieval science (with all that modern science implied in terms of political

[16] Butterfield, *Origins of Modern Science*, 89. For a more nuanced discussion of mathematics and its role in the formation of modern science see Peter Dear, *Disciple and Experience: The Mathematical Way in the Scientific Revolution* (Chicago: University of Chicago Press, 1995).

[17] Notably, Butterfield had nothing to say about the significant mathematical traditions that can be found in the medieval Islamic world. The work of historians of Islamic science has made Butterfield's ignorance especially apparent. For example, see George Saliba, *Islamic Science and the Making of the European Renaissance* (Cambridge, MA: MIT Press, 2007).

dominance), develop only in the Western world?"[18] This question was important for Needham because he wished to view science as culturally universal while acknowledging it as uniquely Western in origin.[19]

The scientific universalism that can be seen in the work of Joseph Needham has a long history. While Isaac Newton was not the origin of the concept, I would argue that he is the most significant figure in the formulation of the Universalist worldview. In the General Scholium of the second edition of the *Principia* Isaac Newton defended his theory of gravitation against criticism that it lacked an explanatory theory by writing: "it is enough that gravity is real." Gravity was demonstrated physically through experiment and, thus, it was not crucial that he did not provide a causal theory. Moreover, gravity was demonstrably true wherever one was in the world—or indeed in the universe. He made this point most succinctly in the explanation of his second rule of reasoning: "Examples are the cause of respiration in man and beast, or of the falling stones in Europe and America, or the light of a kitchen fire and the sun, or the reflection of light on our earth and the planets."[20] He was explicitly making a Universalist claim for natural philosophy. Newton's Universalist position represented a transition from the experimental philosophy practiced by Robert Boyle, which was concerned with particulars and regarded an experiment as a discreet historical event.[21] In making the argument that experimental philosophy

[18] Joseph Needham, *The Grand Titration: Science and Society in East and West* (Toronto: University of Toronto Press, 1969), 11. Cf. Roger Hart, "Beyond Science and Civilization: A Post-Needham Critique," *East Asian Science, Technology, and Medicine* 16 (1999): 88-114.
[19] Kapil Raj, "Beyond Postcolonialism...and Postpositivism: Circulation and the Global History of Science," *Isis* 104 (2013), 338.
[20] Isaac Newton, *The Principia: Mathematical Principles of Natural Philosophy*, translated by I. Bernard Cohen and Anne Whitman, assisted by Julia Budenz (Berkeley: University of California Press, 1999), 795.
[21] Lorraine Daston, "The Cold Light of Facts and the Facts of Cold Light: Luminescence and the Transformation of the Scientific Fact, 1660-1750." *EMF, Studies in Early-Modern France* 3 (1998): 17-44. Michael Bycroft disagrees with Daston's interpretation of Charles Dufay, arguing that she overstated the difference between Dufay and Robert Boyle with regard to their view of strange facts, see Bycroft, "Wonders in the Academy: The Value of Strange Facts in the Experimental Research of Charles Dufay," *Historical Studies in the Natural Sciences* 43 (2013): 334-370.

could be made abstract and universal, Newton represents a crucial transition in the history of science because this claim to universality is at the foundation of the "scientific method."

The presumption that science is universal has significant implications for the deeply embedded Eurocentrism that permeates the history of the modern world and the history of science most especially.[22] Science is a product of nineteenth-century Europe.[23] Much of human history and its "progress" occurred without any of the supposed pillars of modernity. Yet, the history of science has tended to regard such conditions as not only essential for progress, but as the definition of it. To read history as the inexorable march toward modern technoscience is a disservice to the past. As the Bengali historian Benoy Kumar Sarkar recognized in a 1917 lecture delivered at Clark University, New York, while "Western" scholars of the "Orient" "seem to assume these have been the inseparable features of the Western world all through the ages," in reality "the people of Asia from Chandraguptu to Kanghi would not have found any fundamental difference in Europe from Pericles to Frederick the Great."[24] As the rapid rise of Japan from the introduction of the locomotive in 1870 to its defeat of Russia in 1905 demonstrated to Sarkar, "in spite of the epoch-making 'industrial revolution' brought on by steam the West had not gone very far ahead of the East." The East was slightly poorer than the West "only because it had not

[22] "Eurocentrism is therefore anti-universalism, since it is not interested in seeking possible general laws of human evolution. But it does present itself as universalist, for it claims that imitation of the Western model by all peoples is the only solution to the challenge of our time," Samir Amin, *Eurocentrism*, translated by Russell Moore (London: Zed Books, 1989), vii. Though not all cited in the text of this chapter, my thinking has been particularly influenced by Immanuel Wallerstein, *The Modern World-System* (New York: The Academic Press, 1974); Norbert Elias, *The Civilizing Process,* translated by Edmund Jephcott (New York: Urizen Books, 1978); Johannes Fabian, *Time and the Other: How Anthropology Makes its Object* (New York: Columbia University Press, 1983); Andre Gunder Frank, *Reorient: Global Economy in the Asian Age* (Berkeley: University of California Press, 1998); Michel Foucault, *The Order of Things: An Archaeology of the Human Sciences* (New York: Pantheon Books, 1971); *Discipline and Punish: The Birth of the Prison,* translated by Alan Sheridan (Vintage Books, 1995 [1977]); *The History of Sexuality, vol 1: An Introduction,* translated by Robert Hurley (Vintage Books, 1990).

[23] Andre Wakefield, "Butterfield's Nightmare: The History of Science as Disney History," *History and Technology* 30 (2014), 233. See also Sidney Ross, "Scientist: The Story of a Word," *Annals of Science* 18 (1962): 65-85. Cf. Lissa Roberts' argument in "Situating Science in Global History: Local Exchanges and Networks of Circulation," *Itinerario* 33 (2009): 9-30, especially 13-14.

[24] Benoy Kumar Sarkar, "The Futurism of Young Asia," *International Journal of Ethics* 28 (1918): 534. See also, Benjamin Elman, "China and the World History of Science, 1450-1770," *Education About Asia* 12 (2007): 40-44.

independently produced the steam engine."[25] Similarly, Joseph Needham's monumental history of science and technology in China was motivated by a desire to demonstrate that the rise of modern science in Europe was not due to an inherent superiority in European culture, but that many of the necessary conditions for science also existed in China.[26]

Despite Needham's strong support for Chinese intellectual achievements, he was unable to overcome what Andre Gunder Frank has termed Needham's "Eurocentric original sin" because he had framed the entire inquiry on a Eurocentric frame of reference.[27] As Benjamin Elman has observed, "modern portraits of the rise of science" have tended to "represent variations of a story of Western European scientific 'success,' and, by comparison, non-Western 'failure.'"[28] Though Needham wrote against a narrative of European technological supremacy, he did little to counter this basic account. The history of science has increasingly come to recognize the importance of the local and the social. There is not *a* history of science, but histories of science. By recognizing science to be situated, the stories told by historians of science can no longer presume an easy teleology from a primitive, pre-scientific past to a triumphant scientific present. Out of this attention to the local and the social—what Jan Golinski has called the constructivist approach to the history of science—has been the recent "global turn" in the history of science.[29]

Historians of science have developed a number of approaches in order to overcome Eurocentrism and the asymmetrical relationship between the centre and the periphery in order to

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[25] Sarkar, 537.
[26] Joseph Needham, *Science and Civilisation in China, vol. 1: Introductory Orientations* (Cambridge: Cambridge University Press, 1954).
[27] Frank, *Reorient*, 189.
[28] Benjamin Elman, "China and the World History of Science, 1450-1770," *Education About Asia* 12 (2007): 40.
[29] Jan Golinski, *Making Natural Knowledge: Constructivism and the History of Science* , with a New Preface (Chicago: University of Chicago Press, 2005); On the "global turn" in the history of science see Fa-ti Fan, "The Global Turn in the History of Science," *East Asian Science, Technology and Society* 6 (2012): 249-58; Lissa Roberts, "Situating Science in Global History," 9-30; See the contributions to the *Isis* focus section edited by Sujit Sivasundaram, "Global Histories of Science," *Isis* 101 (2010): 95-158; Sarah Hodges, "The Global Menace," *Social History of Medicine* 25 (2011): 719-28. Cf. Sheldon Pollock, *The Language of the Gods in the World of Men: Sanskrit, Culture, and Power in Premodern India* (Berkeley: University of California Press, 2006).

challenge the hegemonic nature of the European intellectual tradition.[30] The most prominent approaches have been the "circulation of knowledge" and Peter Galison's conception of "trading zones."[31] Fa-ti Fan, however, has been unsatisfied with both of these alternatives. Though the circulation of knowledge "shifts attention away from the presumed centers, emphasizes the two-way flow of knowledge, and…takes a broad view of the participants, actions, and sites in the enterprise of science, it asserts an equality that did not necessarily exist.[32] Meanwhile, Galison's trading zones are not universally applicable because not all knowledge production and transfer is analogous to commercial exchange.[33] In all of this, the history of science has begun to fumble along a path previously followed by history of Empire and has only just begun to really confront ideas that historians of late Victorian imperialism first articulated in the 1950s.[34]

The circulation of knowledge does make an admirable attempt at taking seriously the argument by historians of Southeast Asia that "the establishment of empire in India was far from the imposition of despotic rule over an inert people" and that "Imperial purposes appeared to be compatible with the interests of significant Indian elites."[35] As well, such language potentially directs attention to the way in which the colonial enterprise invented not only the Orient, but the Occident as well. However, the historical asymmetry between the hegemonic West and the colonized East should not be unduly obscured. Though Steven Shapin has noted the degree to

[30] In this chapter I use the word "hegemony" to refer to the discursive dominance of Euro-American academia, rather than hegemony in the more narrow, political sense described recently in Perry Anderson, *The H-Word: The Peripeteia of Hegemony* (London: Verso, 2017). Anderson quotes John Mearsheimer's definition of a hegemon as "a state 'so powerful it dominates all other states in the system,'" which can be easily transcribed to my use of the word here to describe science as hegemonic, see Anderson, *The H-Word*, 177.
[31] James Secord, "Knowledge in Transit," *Isis* 95 (2004): 654-72; Roberts, "Situating Science in Global History"; Bernard Lightman, Gordon McOuat and Larry Stewart, eds. *The Circulation of Knowledge Between Britain, India and China*; Peter Galison, "Trading Zone: Coordinating Action and Belief," in *Science Studies Reader*, edited by Mario Biagioli (New York: Routledge, 1999).
[32] Fa-ti Fan, "The Global Turn in the History of Science," 252.
[33] Fan, "The Global Turn in the History of Science," 253-5.
[34] E.g. Ronald Robinson and John Gallgaher with Alice Denny, *Africa and the Victorians: The Official Mind of Imperialism* (London: I.B. Tauris, 2015 [1961]).
[35] P.J. Marshall, *The Making and Unmaking of Empires: Britain, India, and America c. 1750-1783 (Oxford: Oxford University Press, 2005)*, 271, 378.

which Latour depends on militaristic and imperialistic language and Warwick Anderson how he has omitted local agents and context, his model is more flexible than often described.[36] The Eurocentrism often seen in Latour's work does not have to persist in the application of his vocabulary. The metropole does not have to be in Europe nor the periphery outside of it. Indeed, a given site might be regarded as a centre in one context and a periphery in another.

Communication and Empire

In a series of lectures delivered in 1949, the Canadian economist Harold Innis outlined "the competing tendencies of lightweight portable media such as papyrus and paper to effect the control of space, and of more durable, heavy, materials such as stone, clay, and parchment to permit the control of time."[37] As Innis argued, communication "occupies a crucial position in the organization and administration of government and in turn of empires and of Western civilization."[38] That communication is of central importance to empire is perhaps unsurprising because without a well-developed means of communication how is the imperial will to be imposed? Yet, the example of the English East India Company suggests that the role played by communication cannot be easily established. As Thomas Richards has argued, it might seem obvious that power cannot exist "without its underlay of documents, memoranda, licenses, and files…this assumption was new in the nineteenth century."[39] Indeed, even at the height of the British Raj, the disorder and chaos of communication makes it astounding that the British

[36] Steven Shapin, "Placing the View from Nowhere," 7; Warwick Anderson, "From Subjugated Knowledge to Conjugated Subjects: Science and Globalisation, or Postcolonial Studies of Science?" *Postcolonial Studies* 12 (2009), 392.
[37] Miles Ogborn, *Indian Ink*, 12.
[38] Harold Innis, *Empire and Communications* (Lanham: Rowman & Littlefield, 2007 [1950]), 23. See also Ian Steele, *The English Atlantic, 1675-1740: An Exploration of Communication and Community* (New York: Oxford University Press, 1986).
[39] Thomas Richards, *The Imperial Archive: Knowledge and the Fantasy of Empire* (London: Verso, 1993), 8. Cf. the strong connection between the control of slaves and the control of information that Kenneth Banks has observed, see Kenneth Banks, *Chasing Empire Across the Sea: Communications and the State in the French Atlantic, 1713-1763* (Montreal: McGill-Queen's University Press, 2002), 150-52.

imperial agents were able to get anything done.[40] The limitations of communication were even more acute a century-and-a-half earlier.

Despite the massive flow of communication, the English East India Company was constantly desperately short of information. Indeed, since it took at least six months for a letter to make the voyage, it was not really possible for someone in London to be current on the news in India or China. One possible reading of the history of the English East India Company is the process by which it established systems of bureaucratic forms of long-distance control by which it was able successfully to conquer not only trade, but much of South Asia itself. In 1700, however, the position of the Company was much more tenuous. Indeed, it was not even *the* Company at the time as it had recently split apart and was operating as the Old and New Companies. Yet, trade continued and profits were made by the Company and its stockholders. Despite its weaknesses, the East India Company served its purpose.

While effective systems of communication and long-distance control might appear retrospectively as crucial to the English East India Company's success, the reality was more complicated. I do not deny Miles Ogborn's thesis that writing served as a tool of power for the East India Company or that "these letters and the writings that traveled alongside them were a vital part of making the relationships necessary to establish a global network."[41] Ogborn, however, might go too far in assigning to what Christopher Bayly called the "information order" of the East India Company causation in the development of British hegemony in Southeast Asia.[42] Writing was certainly a central feature of the Company and it was no accident that its foreign employees were called "writers," but it was only enforced in a consistent and coherent

[40] Ferdinand Mount, "Umbrageousness," *London Review of Books* 39 (7 September 2017), 3-8.
[41] Miles Ogborn, *Indian Ink*, 39.
[42] C.A. Bayly, *Empire and Information: Intelligence Gathering and Social Communication in India, 1780-1870* (Cambridge: Cambridge University Press, 1996).

way after the Seven Years' War—after the Company began the transition from commercial enterprise to imperial power.[43] For Bayly, the way that the Company set about collecting and systematizing material it drew from Indian sources demonstrates that its intelligence gathering was crucial to the Company's success.[44] That may have been true in the period after 1780 discussed by Bayly, but at the beginning of the eighteenth century the Company did not even systematically arrange its own correspondence let alone information obtained from Indian sources. The East India Company only began to take a sustained interest in its historical records from the latter part of the eighteenth century. Before then "it appears that the records were largely left to accumulate with fairly minimal attention in the offices of the Secretary and other officials at East India House."[45]

In 1700 England was not yet the global power it would eventually become. While it had begun to establish itself as a naval power, competition for sea trade to the Indies was fierce and the Dutch were still at the forefront even if they had begun their economic decline. Meanwhile Britain's colonies in the Caribbean and North America were yet to generate significant profit. Historians who have studied the economic history of Southeast Asia during the eighteenth century have demonstrated that the European influence on the Asian economy was limited at best.[46] Despite a concerted effort by the English East India Company to promote English trade goods, there was little interest in the products of English manufacturing. As a result the Europeans were forced to trade primarily in South American bullion, which meant there was a massive trade deficit in favour of the East up until at least 1780 when the increasingly

[43] G.J. Bryant, *The Emergence of British Power in India 1600-1784: A Grand Strategic Interpretation* (Woodbridge, UK: The Boydell Press, 2013).
[44] Bayly, *Empire and Information*, 54.
[45] Martin Moir, *A General Guide to the India Office Records* (London: The British Library, 1988), xi-xii.
[46] K. N. Chaudhuri, *The Trading World of Asia and the English East India Company, 1660-1760* (Cambridge: Cambridge University Press, 1978); Kenneth Pomeranz, *The Great Divergence: China, Europe, and the Making of the Modern World Economy* (Princeton: Princeton University Press, 2000).

imperialistic English East India Company began to change the balance of power. While it is easy to view the history Southeast Asia with the benefit of hindsight, as Jack Goody has noted, while:

> The arrival of the Europeans led to the decline of Indian sea-power. But it also meant an increased demand for exports which could not be sent to the West more cheaply and in greater volume to satisfy the rising middle-class demands. And contact through trade and conquest led in turn to a growth in Indian business.[47]

Southeast Asia was ultimately colonised by European powers, but colonisation was neither inevitable nor negative to all non-Europeans. As such, the remainder of this chapter will be devoted to Robert Douglas's expedition to China at the turn of the eighteenth century.

Robert Douglas in China, 1699-1700

Robert Douglas arrived at Macau at the end of August, 1699. While English ships had visited the area previously, the Company had not yet established regular trade in Macau and Canton.[48] Indeed, Douglas noted that the "Portigueese have y^{e} name of y^{e} Government" though "y^{e} Chinese have y^{e} Cheife power and all y^{e} Customes of y^{e} port excepting some small privileges y^{t} y^{e} Portigueese ships injoy," demonstrating the Portuguese established presence and the late arrival of the English as well as the dynamics in the Chinese/European relationship.[49] Though China had long had contact with Europe and was involved in extensive trade throughout Asia and the Pacific, the political situation was very different from that of India. In India the English East India Company had been able to establish permanent factories and settlements from which to operate with agents who lived there for many years at a time. As such, they were able to develop relationships with local merchants and rulers that allowed the Company to entrench its position in the local economic and political spheres. Importantly, the Company was able to play

[47] Jack Goody, *The East in the West* (Cambridge: Cambridge University Press, 1996), 111-2.
[48] Their arrival described in Douglas's journal, IOR/L/MAR/A/CXXIII, pp. 10-1.
[49] IOR/L/MAR/A/CXXIII, p. 22. I have maintained Douglas's spellings in my transcriptions and do not follow modern conventions for Chinese transliteration. For place names I have maintained his spelling when quoting his words, however, I have otherwise used standardized spellings.

Figure 4.1: Location of Macau and Canton (Guangzhou)
(Uwe Dedering CC BY-SA 3.0. Annotated by Author)

Figures 4.2: Google Map of Pearl River Estuary

different factions and rulers against each other in order to ensure that the Company's interests were not undermined by the local governing forces despite the Company's relatively weak position in India at the time.

In China such permanent inhabitation was resisted strongly by the ruling members of the Qing dynasty. In contrast to India, the Qing Dynasty was able to maintain the "Canton sytem" of trade until 1842. The Canton system required Europeans to trade through the "Co-hong," which was a group of firms that had been given monopoly rights by the Chinese state to trade in tea and silk, while in return were responsible for collecting duties, leasing factory space, and controlling foreigners.[50] Controlling foreigners was a constant concern for the Chinese. According to a petition circulated while Douglas was in Canton, the Chinese wished foreigners to leave because they were "whoremongers and quarrelsome people." Douglas was told by the *Hoppo*—the local administrator for the ruling Mandarins—that "Great Mandarines were offended at [their] stay" and the Chinese admiral had "sent him an order to Command us out of the River of Canton."[51] This tension points to conflicting sets of interests within China and how the benefit of trade with European nations was not universal. Similar tensions were at play in England. For instance, at the same time as many Parliamentarians invested in the East India Company the House of Commons also passed an Act at the behest of the English woolens industry that sought to prohibit "the wearing of all wrought silks from India & China."[52]

Though Company ships had visited previously, the tenuous relationship between European merchants and the Chinese administration meant that Douglas was largely forced to

[50] Susan Naquine and Evelyn Rawski, *Chinese Society in the Eighteenth Century* (New Haven: Yale University Press, 1987), 102.
[51] IOR/L/MAR/A/CXXIII, pp. 158-9. The Chinese were not the only ones suspicious of the trading companies as Douglas described how the Portuguese who were established in Macau when the *Macclesfield* arrived interrogated the ship's crew as they suspected the English to be pirates rather than the honest merchants they claimed to be, pp. 12-3.
[52] IOR/E/3/94, f. 84r.

develop his own contacts and local network upon his arrival rather than being able to rely on an already established structure. By preventing European trading companies from permanent occupation of Chinese cities, the Chinese retained the dominant position. It was only much later and after the political and military situation had changed dramatically that the English were able to wrest power away from the Chinese.[53] According to Susan Naquine and Evelyn Rawski, "Chinese officialdom was probably the most highly bureaucratized in the world."[54] This claim is demonstrated by the fact that civil servants continue to be referred to in Europe as mandarins to this day. The imperial administrative position of the *Hoppo* is both central to the story of Douglas's efforts in Canton and instructive regarding how the Qing Emperors sought to define their relationship with the Europeans.

Superintendents of foreign trade had long existed for the purpose of regulating foreign trade, customs collection and to receive and send off tribute missions coming by sea. The precise form, number and location of these superintendents varied depending on the dynasty in power and the post of the *Hoppo* had only been established in 1684 as a direct successor to the *haitao*, which was a civil servant answerable to the Governor and had filled the functions that were taken on by the *Hoppo.* The Governor had held the lucrative supervisory function over maritime trade since 1522; however, the *Hoppo* took over this function, which resulted in a revival of the traditional rivalry between the bureaucrats and inner court favorites. This rivalry had further tension because most bureaucrats were Chinese while the *Hoppos* were Manchus.[55] According to

[53] James Polachek, *The Inner Opium War* (Cambridge, MA: Council on East Asian Studies, Harvard University, 1992); Manhong Lin. *China Upside Down: Currency, Society, and Ideologies, 1808–1856* (Cambridge, MA: Harvard University Asia Center, Harvard East Asian Monographs, 2006).
[54] Naquine and Rawski, *Chinese Society in the Eighteenth Century*, 8-9. For an account of the Qing bureaucracy in practice, see Philip Kuhn, *Soul-Stealers: The Chinese Sorcery Scare of 1768* (Cambridge, MA: Harvard University Press, 1990).
[55] Weng Eang Cheong, *The Hong Merchants of Canton: Chinese Merchants in Sino-Western Trade* (Richmond, Surrey: The Curzon Press, 1997), 193. On the political dimensions see Paul van Dyke, *Merchants of Canton and*

Weng Eang Cheong, the *Hoppo* filled both administrative and ceremonial functions and was "unencumbered by rival sources of authority over his competence."[56] Each *Hoppo* served for a term of one or two years, which caused additional difficulties for Douglas as his stay in Canton overlapped between two terms. While according to Cheong there was only one *Hoppo* at a time, Douglas's diary gives the impression of him dealing with two different *Hoppos* at the same time and attempting to play them off of each other.[57] As will be seen, Douglas clearly expected the *Hoppo* to be favourable to him and to provide protection against deceit or malpractices attempted by Chinese merchants. In practice the *Hoppo's* favour toward Douglas appears to have been quite limited. Though the *Hoppo* was not necessarily inclined to support the Chinese merchants due to existing tensions, this did not mean that he preferred foreign traders such as Douglas. Furthermore, Douglas was severely constrained in his ability to navigate the administrative apparatus as access to the *Hoppo* was guarded by his secretaries, who had ties to Chinese merchants and political concerns of their own. Douglas, on the other hand, was a foreigner who lacked political connections or the ability to speak the language.

The terms of the relationship between foreign traders such as Douglas and the Chinese was established right from the *Macclesfield*'s arrival. Before he could begin trade, or even leave the ship, the *Macclesfield* was inspected by the Chinese and Douglas was required to establish the price of the English goods on board. Until that was done to the *Hoppo*'s satisfaction, he was essentially stuck on board the ship waiting for permission to begin trade. The Chinese merchants in Macau, meanwhile, looked to turn Douglas's presence to their advantage and Douglas was concerned not to enter into any obligations until he better understood the situation:

Macao: Politics and Strategies in Eighteenth-century Chinese Trade (Hong Kong: Hong Kong University Press, 2011).

[56] Cheong, *Hong Merchants*, 194.

[57] Cheong lists the *Hoppo* for 1699 as being named Hei-shen and in 1700 as So-erh-pi while the governor between 1696-1700 was Hsiao-Ch'eng-tsao, Cheong, *Hong Merchants*, 195.

> The Hoppos Secretary sent a present to me & the Cap^{t}: of provisions and fruit, w^{ch} I was very unwilling to accept, but was strongly advised by noe meanes to refuse it lest it should be taken as an affront, but I examined ye messenger strictly to know if it did not come from any of ye Merch^{t}: for if so resolved not to accept of it on aney termes, because I was resolved to be under no lye nor obligation to any of them, till I knew who I was to deal wth.[58]

As has often been recognized, gifts and obligations played an important role in the operation of trade and both the Chinese merchants and Douglas were clearly cognizant of this fact. Indeed, European travelers had a clear view of how such exchanges were to be conducted and took great offense when they considered the established norms to be violated.[59]

The Chinese seem to have dealt with each arriving ship individually and Douglas was treated essentially as an independent merchant rather than as a representative of a large trading company. Though he wrote repeatedly about putting the interests of the Company first, Douglas's status with regards to the Company while in China appears to have been a bit ambiguous. For example, when the Portuguese accused the *Macclesfield* of being pirates and compelled the crew to endure interrogation about whether they had come directly from England and what their intentions were, Douglas and the captain of the ship did not produce their documentation and instructions from the Company as a means of establishing the *Macclesfield* as an India Company ship. The members of the *Macclesfield* were repeatedly reminded of the

[58] IOR/L/MAR/A/CXXIII, pp. 13-4.

[59] Bravo, "Ethnographic Navigation and the Geographic Gift"; In his study of the history of sharing among Stó:lō First Nations in British Columbia and Métis in Northwest Saskatchewan, Liam Haggarty has demonstrated the complex cultural rationales of sharing for indigenous cultures. Importantly, traditions of sharing and exchange were in place before European arrival and served purposes that are not easily assimilated to a Eurocentric perspective. As well, sharing has to be considered historically—with consideration of change over time—because with the arrival of Europeans and the resulting colonialism, the practice of sharing has changed, though often not in the ways that Europeans expected, Haggarty, "Negotiated Identities: A History of Sharing and Indigenous-Settler Relations in Western Canada, 1800-1970," (PhD diss., University of Saskatchewan, 2015). An example of how such norms were embedded in the worldviews of would-be global travelers can be seen in William Gooch, Letter Diary, CUL MSS Add Mm.6.48, f. 32v. On Gooch see Schaffer, "'On Seeing Me Write.'" Schaffer addresses tensions between European and non-European notions of property and hospitality, 113-6. Haggarty discusses a comparable example from the journals of Simon Fraser, in which Fraser's men were subjected to "thieving" (from Fraser's perspective) or "raiding" (from the Natives perspective). In these instances, as Haggarty explains, Fraser was seen as a stranger; thus, such raiding (or "thieving") "was deemed the appropriate form of socio-economic conduct," Haggarty, "Negotiated Identities," 65-6. Haggarty discusses the sociology of raiding in more detail on pp. 68-70.

weakness of their position as the only English ship in a city thousands of miles from home. Both the Portuguese and French were more strongly established in Canton due to a longer trading history and, in the case of the French, the presence of a number of Jesuit missionaries.

While the concept of the go-between has been invaluable for understanding native-newcomer interactions in the history of science, such go-betweens depended upon established relationships, which did not yet exist for English East India Company traders. Indeed, the formation of such relationships was part of Douglas's job as supercargo. Even when his identity was not questioned, cooperation was not assured as the Chinese merchants and bureaucrats had their own interests to protect. In Rudyard Kipling's classic novel *Kim*, the protagonist Kim is the orphaned son of an Irish soldier in the British army in India. Kim spends his early years on the streets of Lahore, easily assimilating into his Indian surroundings; however, he possesses his father's masonic certificate which proves his status as British and he understands something of the implications of this. When he eventually demonstrates his potential worth to the imperial regime, he is provided with an English education and used as a member of the extensive British intelligence network in late-nineteenth-century India. Kim's significance is that of a "go-between**,"** as he easily moves between the worlds of the colonizer and the colonized and is able to use both to his benefit. Kim, thus, is an ideal exemplar of the structure of British colonial rule described by Christopher Bayly.[60] For Bayly, what made the British Empire possible in India was the way in which it was able to co-opt the existing local intelligence networks for the purposes of imperial rule. Bayly's thesis contributed to the development of recent work

[60] Bayly, *Empire and Information*; Simon Schaffer, Lissa Roberts, Kapil Raj, James Delbourgo, eds., *The Brokered World: Go-Betweens and Global Intelligence, 1770-1820* (Sagamore Beach, MA: Science History Publishing, 2009).

regarding brokers or go-betweens.[61] Rather than a hard dichotomy between the colonizer and the colonized, the concept of brokers recognizes individuals such as Kim for whom the boundaries were more fluid and were, therefore, able to exist in both worlds. Moreover, the European imperial project deeply depended on such brokers in order to function.

The example of Robert Douglas shows the challenges the English East India Company faced when operating in a location where it did not have an established network or reliable brokers. Kipling and Bayly, however, both were writing about the nineteenth century when power was in favour of the British. The emphasis, thus, is on how those individuals outside of the colonial regime were able to take advantage of the system and use it to improve their situation.[62] My concern is that such an emphasis promotes an undue sense of inevitability about nineteenth-century imperialism and results in a teleological narrative in which the British Empire in India is the ultimate result. By the end of the eighteenth-century intermediaries "not only plied their trade as go-betweens, but actively and intelligently theorised the role of the go-between;" however, the China being discussed in this chapter was not yet colonised and the balance of power between European and Chinese commercial interests greatly favoured the latter.[63]

The *Macclesfield* attracted the interest of a number of Chinese merchants, but Douglas had difficulty finding a merchant with whom he could enter into an equitable contract. After being disappointed by the merchants in Macau, Douglas and his assistant John Biggs decided to

[61] According to Alida Metcalf, go-betweens can be understand as serving as either "mediators" or "arbitrators" depending on whether the two parties determine the outcome of their conflict on their own or only with the judgment of the go-between. As Metcalf observes, go-betweens are rarely neutral in practice and, therefore, tend to become arbitrators. See Alida Metcalf, *Go-Betweens and the Colonization of Brazil: 1500-1600* (Austin: University of Texas Press, 2005), 2-3. What Metcalf's depiction of go-betweens emphasizes, then, is that they must be recognized for the significant power they were able to exercise.
[62] See David Arnold, *Colonizing the Body: State Medicine and Epidemic Disease in Nineteenth-Century India* (Berkeley: University of California Press, 1993).
[63] Schaffer, "The Asiatic Enlightenments of British Astronomy," in *The Brokered World*, 51.

go directly to Canton themselves in hopes of obtaining more advantageous trade closer to the source. Suspecting that the prices he had been offered thus far were inflated:

> This morning Mr Biggs and I went very early into y^{e} City to try y^{e} pryces of Several Goods wthout letting y^{e} Merch^{t} know nor our Linguist Rosario (Mr Biggs understanding y^{e} way of tradeing by y^{e} Dutchen) y^{t} we might know whither y^{e}Merch^{ts} came near y^{e} marke wth y^{r} pryces and we found we could by Chepper in y^{e} Shops then we had bene yet offered, we returned againe by 9 aclock to meet some merch^{ts}.[64]

Without an established presence or regular merchants it was difficult for the Company's representatives to obtain fair prices and quality products. It is, however, important to remember that just because the Company's directors regarded a certain price to be fair does not mean that the price they wished to pay was actually market value and European merchants had little ability to affect prices.[65] Though Douglas might technically have been able to buy goods at a lower price directly from the shops, he still needed an approved merchant from whom he would be able to purchase in bulk and who would also find markets for the English goods on board the *Macclesfield*.

Due to his tendentious status, Douglas was forced to negotiate himself with the *Hoppo* and was at a distinct disadvantage. He was not entirely without knowledge of how trade was organized by the Chinese administration as the Company collected as much information as it could from published works and previous expeditions and sought to disseminate this information to its agents.[66] As well, his assistant, John Biggs, had some experience in the region and was able to offer advice.[67] In practice, however, this primarily meant that Douglas was moderately informed as to the procedures and customs, but had limited ability to impose himself on the

[64] IOR/L/MAR/A/CXXIII, p. 36-7.
[65] Chaudhuri, *The Trading World of Asia and the English East India Company*, 54-5.
[66] Anna Winterbottom, "Producing and Using the *Historical Relation of Ceylon*: Robert Knox, the East India Company and the Royal Society," *British Journal for the History of Science* 42 (2009): 515-38.
[67] Biggs was described by the Directors of the Company as "a Person who has been at China and is (as we are informed) well skill'd in all sorts of Trade in those parts," IOR/E/3/94, f. 44r.

Chinese bureaucracy. For instance, it was required that the goods carried on board foreign ships be measured and recorded when a ship arrived in port; however, Douglas had difficulty getting this procedure carried out to his satisfaction. Much of this was because Douglas expected the *Hoppo* to carry out his duties personally and to meet with Douglas himself. When the *Hoppo* neglected to do this, hoping that Douglas could be satisfied with an assistant, Douglas was incensed and told the assistant to inform the Hoppo that he "would doe nothing as to any Contract…till I had finished wth him about our measurage." At which point the *Hoppo*'s secretary "intreat[ed] me to stay 7: dayes longer else he was undone for y^{t} y^{e} Hoppo could not possibly arrive sooner," though Douglas noted that the *Hoppo* was already in town. [68] The *Hoppo* would continue to try to deal with Douglas through surrogates and Douglas's path to the *Hoppo* was consistently blocked by the lower level administrators in a way that is undoubtedly familiar to anyone who has attempted to negotiate a bureaucracy. As well, in this early incident Douglas demonstrated his prevailing concern with the signing and execution of written contracts that would continue throughout his time in China. For Douglas, such written contracts were assurances of good faith and tools that would allow him recourse should they not be fulfilled and thus he was determined that he have them in every instance. His ability to ensure that the contracts be made in good faith and executed to his satisfaction was highly limited, however, due to the weakness of his position.

[68] IOR/L/MAR/A/CXXIII, pp. 15-6. Douglas's perception of the Chinese as duplicitous and untrustworthy was consistent with the views of other Europeans in the regions. Shortly after arriving at Macau, Douglas received three letters from French men who were in Canton, including the agent for the French Company, all of which advised Douglas not to dispose of any goods until he had come to an agreement with the *Hoppo* over measurage so as to be sure not to be cheated. Douglas was hardly more trusting of the French, however. When a Chinese man came to him looking for employment as a translator, Douglas rejected him despite a positive account from his assistant John Biggs who knew him from when he had previously served as translator for the English. Douglas was prejudiced against him because he had also translated for the French and had been the one to deliver the letters. Douglas, thus, suspected him as being an agent for the French who would allow the French to "defeat us in any thing y^{t} interfeared with theire intrest," IOR/L/A/CXXIII, p. 17.

Macau was not a particularly beneficial as a base of Douglas's operation as it was not the main centre of trade and at the time he arrived there were no merchants of note in town. When a group of "Great Merchants" came to Macau, Douglas "received them very Courteously" and they "seemed verey well pleased by their eating and drinking freely;" however, they told Douglas "y^{t} they came not now about business but only for a visit but y^{t} in 2: or 3: dayes they would provide musters of all Goods and likeways give me their pryces."[69] When a "Chinese Citizen" offered his services as translator, Douglas rejected him even though he had previously translated for the English and knew Mr. Biggs because the man had served the French and Douglas had "often found verey great deceit in y^{e} World" and he "was resolved to be upon his guard and to suspect every one I did not thorrowly know." This mistrust was also a factor with his difficulty finding a merchant as he was not impressed by his impression of the group of merchants from Canton who had visited him on board the ship. He had a rather better impression of a merchant—whose name Douglas gives as Hun Shun Quin—who came after the first group of merchants had left and whom Biggs knew because he had done business with Biggs's ship in a previous voyage. While the first merchants had arrived with great pomp and with an introduction from the *Hoppo*'s secretary, the later merchant came directly by boat from Canton without calling at Macau. Unlike the other merchants who had eaten and drunk the *Macclesfield's* provisions, but did not make any promises, this merchant offered to handle the whole of their cargo and to purchase Chinese goods for them as he would be able to secure them more cheaply. Perhaps because this was the offer that he had been hoping for, Douglas was more inclined to accept Biggs's positive character reference than he had been with the translator whom he had refused to hire.[70]

[69] IOR/L/MAR/A/CXXIII, p. 16.
[70] IOR/L/MAR/A/CXXIII, pp. 17-9.

Douglas had been careful to ensure that he be allowed to choose his own merchants, but he came up against collusion that impeded his plans. While the two "Great Merchants" "bid us try other Merch^{ts} and see w^{t} they would bid us & they would doe better by us then any of them," Douglas found the smaller merchants "durst not sett any incurageing pryce nor…a Contract wth us" out of fear of the Great Merchants. In Macau Douglas found the merchants who had come down from Canton were "were combineing together to make a prey of us and to procure y^{t} no others should be permitted to deale wth us." When they seemed to fall out and split into three or four competing groups of merchants, Douglas was informed that in fact the different factions were intentionally seeking to play him by colluding on their prices so as to drive down Douglas's and ensure the chosen merchant would receive an advantageous contract.[71] Such an incident fit well with Douglas's existing prejudices that caused him generally to judge the Chinese as devious and untrustworthy. It is in the context of his perceived mistreatment by the favoured merchants that informed his positive initial impression of Hun Shun Quin.

Hun Shun Quin was able to take advantage of Douglas's mistrust of the other merchants in order to provide Douglas with a number of favours. It was aboard Hun Shun Quin's vessel that Douglas went to Canton and they stayed at his house while there because of Douglas's antagonism toward the French and mistrust of the other merchants. Hun Shun Quin had obvious motivations for his actions beyond hoping to make a financial profit. Taking on the responsibility of Douglas's contract was a significant risk, especially at the prices expected by the Company. Hun Shun Quin was willing to take on this risk for reasons of self-interest. Douglas quickly found that Hun Shun Quin's relationship with the other merchants in Canton was not good, describing them as "prejudiced to him wth whom we lodged" and observing that none of the merchants would treat them at Hun Shun Quin's house. Unlike the lesser merchants, Hun Shun

[71] IOR/L/MAR/A/CXXIII, pp. 39; 29-30.

Quin "seemed to stand in fear of non of them, nor their Masters nether and valued him selfe upon y^{e} frendship he pretended to have at y^{e} Court of Pekine" where "he had formerly bene y^{e} King of Cantons Merch^{t} before it was reduced to y^{e} Vice=Royship and likewayes had bene y^{e} Dutch Mercht for Many years since y^{t} time."[72] Hun Shun Quin saw Douglas as an opportunity he might be able to exploit to improve his own situation. The self-interest of go-betweens in their interactions with Europeans has been important to the way in which they have been portrayed by historians; however, the situation being discussed in this chapter is different because the power dynamics are not nearly so tilted in favour of European hegemony as has been the case in many such studies.[73]

While in general terms Douglas and Hun Shun Quin's interests were the same—to conduct business with each other—the reality was more complicated. European activity around the world relied on reliable go-betweens and native collaborators, but non-Europeans collaborated with Europeans for a reason and Europeans were hardly reliable in their interactions. Certainly, Douglas did not have the best interests of Hun Shin Quin in mind and was quick to undermine him if he thought it would benefit the Company. Everyone involved in European-Asian trade hoped to advantage themselves personally. Even the *Hoppos* saw opportunities to exploit. The *Hoppo* Douglas dealt with first in Macau was one of two who held the position in Canton. When Douglas and Biggs sent word to the *Hoppo* in Macau that they were preparing to go to Canton, the *Hoppo* "seemed much concerned at our goeing fearing he might loose y^{t} advantage he hoped to gett by us"[74] As long as Douglas stayed in Macau, the *Hoppo* had an advantage over his rival as he had direct access to both Douglas and the merchants whom he favoured to receive the English trade.

[72] IOR/L/MAR/A/CXXIII, p. 40.
[73] E.g. Raj, *Relocating Modern Science*.
[74] IOR/L/MAR/A/CXXIII, p. 35.

Thus, Douglas found himself to be caught between the Great Merchants on the one side and Hun Shun Quin on the other. Due to Hun Shun Quin's pre-existing relationship with Douglas's assistant Biggs and the unfavourable impression the Great Merchants had made on him when he first arrived in Macau, Douglas was predisposed toward Hun Shun Quin. As well, Hun Shun Quin's experience as a merchant for the Dutch might have helped him to present himself to Douglas in a favourable manner and to make the right promises to obtain the contract over his more powerful rivals. Unfortunately for Douglas, once he had settled upon Hun Shun Quin to handle his affairs, things did not go smoothly. Hun Shun Quin was not able to deliver on the promises he had made and his rivalry with the other merchants turned out to be problematic in ways that Douglas had not anticipated.

Though he styled himself as a great merchant and claimed friends in high places, Hun Shun Quin's position was rather more tenuous. While this may have encouraged him to take a greater risk in seeking Douglas's contract, it also left him open to attack from his enemies if things did not work out as desired. The terms of Hun Shun Quin's contract was questioned by other merchants and they responded by putting him under house arrest. These merchants tried to get Douglas to break his contract with Hun Shun Quin:

> He likewayes owned y^t y^e Cause of his Present trouble was from some Mandarines Marchts who did believe y^t he would reap great advantage by our Contract and were inraged y^t he had not Concerned y^m in it, who had promised y^e En=Sha=Lee Money to detaine him a Month under Examination of such things as should be brought against him and by y^t time they questioned not but to dissolve our Contract and force us to Court them or loose our Monsoon.[75]

Hun Shun Quin's rivals claimed his contract with Douglas had not been done legally and that he had violated the monopoly laws. He assured Douglas that the dispute would ultimately settle in his favour as "he had such freinds as would stand by him and help him out of y^s trouble and y^t he

[75] IOR/L/MAR/A/CXXIII, p. 82.

feared neither y^{e} power nor malice of all his Enimies, so much as our Displeasure."[76] His statement did not exactly deny the accusations against him; rather he claimed his political connections would ultimately protect him. Douglas was thus left in a difficult position. He could continue to deal with Hun Shun Quin and try to enforce the terms of the contract they had signed and run the risk of their stay in Canton dragging out so long that they would not be able to return to England as scheduled and even then there was no guarantee the trade would work in his favour. Meanwhile, abandoning Hun Shun Quin for the other merchants would all but assure a poor outcome.

Meanwhile, the merchants with whom Douglas had contracts began to chafe against the terms. When Douglas visited his merchant to learn what the delay was, he told Douglas that he was having difficulty procuring so much money "to these Merch^{ts} to help him" and, while acknowledging the honesty of the English, "he was so unfortunate in our service as to loose by every thing he did and also how he had sould a great deale of our Cloath for less y^{n} he bought itt, and had paid y^{e} Custome likewayes."[77] The principal asymmetry between England and China in this period is reflected in the response that Douglas recorded with regard to the English cloth: its quality was substandard compared to Chinese products and there was little market for it. The merchant "complained how unjust it was to putt upon him for fine cloath w^{ch} was so course y^{t} they had never seen such before for y^{t} in y^{e} Riseing Eagle had non such & it was because he presumed y^{t} our Cloath was like his y^{t} he did so willingly buy it from y^{e} masters wth out seeing of it." To the merchant's complaints and attempts to get out of the contract, Douglas responded that it had been his "own choyce" to enter into the agreement and that "he could not expect any

[76] IOR/L/MAR/A/CXXIII, p. 82.
[77] IOR/L/MAR/A/CXXIII, p. 124.

alteration now & y^{t} he did ill not to declare his mind more positively before I sent my last letters by y^{e} French ship."[78]

In order to ensure the contracts he had signed would be carried out as agreed, Douglas felt compelled to take the issue to the *Hoppo* in hopes that he would rule in his favour. Doing so was less than straight-forward as the *Hoppos* were protected by a layer of bureaucracy below them in the form of their secretaries. The secretaries had their own interests to protect and much of their power was derived from their ability to control access to the *Hoppo*. When Douglas learned the eight merchants who had taken the English goods to sell intended to return them in order to get an "abaitment." In response, he went the warehouse where the goods were being stored in order to see them and speak to the merchants. The merchants "seemed very much concerned y^{t} I should distrust y^{r} word and refused to give any writing, upon w^{ch} I left y^{m} and went imediatly to y^{e} Hoppo." The *Hoppos'* assistants, however, "told us we could not be admitted at y^{s} time, I told him my business was urgent and therefore entreated him to send in to tell his master, but when I could not prevail wth him because he said y^{s} time was not convenient." By this point Douglas was concerned about statements made in favour of the eight merchants with whom he was experiencing difficulties "by w^{ch} I found they had gained him over to y^{r} intrest." In an effort to resolve the issue and force the *Hoppo* to treat with him, Douglas threatened to take the matter to further up the bureaucratic chain: "After w^{ch} threatening w^{ch} I did seeme to doe wth great passion & concernedness stamping and tearing like a Mad Man, he went in to acquaint y^{e} Hoppo, who imediatly came out to y^{e} Place of Justice and called us in."[79]

At this point Hun Shun Quin arrived having just spoken to the eight merchants and told them that "they had againe changed y^{r} minds and insisted upon y^{e} delivering of our Goods."

[78] IOR/L/MAR/A/CXXIII, p. 124-5.
[79] IOR/L/MAR/A/CXXIII, p. 153-4.

Unfortunately for Douglas, gaining access to the *Hoppo* did little to resolve the situation. Though he assured Douglas that he would not force him to do so, he advised "as a friend" that Douglas take the goods back from the eight merchants without receiving any money, which Douglas stated was not in the interest of his King or Company. Instead of siding with Douglas and demanding the merchants carry out the contract as agreed, the *Hoppo* decided that Douglas was to take back 1000 bales of his own goods from the merchants with Douglas requesting an equal quantity of Chinese goods in compensation. In response to the failed negotiation, Douglas concluded the *Hoppo* had gone over to the side of the eight merchants and sent his translator Quiqua to learn if the *Hoppo*'s "dispenser" could be brought over to their side and to assure him that he would be very well rewarded if he would help them in their cause and give them access to the *Hoppo*. When the assistant was amenable to bribery, Douglas told him he "was very sorry his Master had refused to doe us Justice In our affaires and y^{t} he knew it was not in our power to bring our Merch^{ts} to any reasonable termes wthout his assistance."[80] While Douglas presented the merchants as being against him, their position that the English "goods were sould very Dear and y^{t} the merch^{ts} assured him they should loose by them" was not unreasonable, despite Douglas's argument that they could not blame him "for y^{t} since they were not compelled to buy y^{m} it was their owne free voluntary Choice."[81]

As the layers of bureaucracy that Douglas was required to negotiate demonstrates the complicated situation that he was in with regard to go-betweens. It was not a matter of a single go-between. Moreover, the situation was constantly fluid. The example of the dispenser makes this particularly clear, as he started out acting against Douglas's interests, but was amenable to coming over to Douglas's side for the right price. To a certain extent, the merchants could also

[80] IOR/L/MAR/A/CXXIII, p. 156-7.
[81] IOR/L/MAR/A/CXXIII, p. 140.

be regarded as go-betweens. For example, one of the qualities that Hun Shun Quin promoted about himself to Douglas was that his connections would aid the sale of Douglas's goods.[82] As Douglas himself argued, he could not do business in Canton without the support of the *Hoppo*. In order to have such support, he needed access to the *Hoppo* when required. More importantly perhaps, though, was that he needed an advocate on his behalf whose position in the community was less compromised than Hun Shun Quin's turned out to be. In this regard, Douglas was in a difficult situation because the more secure merchants were in a position to negotiate from strength and, therefore, were not inclined to accept Douglas's rather difficult terms. As well, as they had the backing of the *Hoppo*, they were not forced to abide by the terms they had originally negotiated when the situation turned out to be disadvantageous to them. This undoubtedly contributed to the perception of the Chinese merchants as untrustworthy; however, Douglas's dogged insistence that the terms of the deal be adhered to even when it was clearly not working out for any of the parties involved and his constant demands to have all agreements set down in writing likely did little to endear him to the local merchants.

An equally important example of go-betweens without whom Douglas was completely unable to operate was that of his translators. During his time in Macau and Canton, Douglas primarily employed two translators: Rosario and Quiqua with whom he often had a rocky relationship as he did not particularly trust their motives. For example, when Douglas wanted to leave Macau for Canton, he was afraid to leave "lest they might find some means to prevent our Chop." In order to avoid this possibility, Douglas had "a Chinese Citizan privately to draw us up a petition to be presented to ye Hoppo" to remind him of his promise "and to signifie ye advantages and even almost nessicity of it in order to incurage trade." Douglas presented this as the best approach because they did not dare "to trust our Linguists whom we found to favour

[82] IOR/L/MAR/A/CXXIII, p. 40.

these merch^{ts} intrest and therefore would not be foreward to procure any thing to there disadvantage."[83] While the translators nominally operated as go-betweens between Douglas, the merchants and the *Hoppo*, in practice Douglas lacked the close relationship with them that was necessary for a go-between to be effective.

Despite not trusting the translators whom he had hired, Douglas had limited options. When Douglas first chose his translators, his two candidates were Rosario—whom he judged as lacking the courage to speak to the *Hoppo* and the great Mandarines and Quiqua—whom he judged to be "very sharp" with "boldness and confidence enough and could express himself very well;" however, he "was also reputed by some to be a Rogue."[84] Faced with these two choices, Douglas judged Quiqua to be the better option, though he made use of both of them during his time in Macau and Canton. Upon his first return from Canton to Macau, Douglas noted that "Before I went off I accounted wth our Linguist Rosario who had bene at Canton wth me of whom I had received a bad Character and had heard severall ill reports as to his dealing wth Mr Willmott therefore I resolved to discharge him hear y^{s} being y^{e} place of his residence."[85] Similarly, on a few occasions Douglas chose to visit markets without the benefit of a translator, which he did in part because he believed the translators would transmit information to the merchants that might have been used against him.

By employing two translators and keeping information from them, Douglas sought to limit their ability to act against what he regarded to be his best interests. Be that as it may, however, he still required their assistance in most of his daily interactions. As much as he did not trust the translators to have his interests in mind, when he sought to replace his linguist with another, he quickly found how limited he was in this regard in finding a new translator knew the

[83] IOR/L/MAR/A/CXXIII, p. 30-1.
[84] IOR/L/MAR/A/CXXIII, p. 23.
[85] IOR/L/MAR/A/CXXIII, pp. 52-3.

Chinese or European languages necessary to carry out the job. A rather amusing example of this that I came across in the East India Company archives took place in Persia when a translator by the name of Auga Doud was fired due to alleged improprieties. He was replaced by a new translator who had been recommended by the Armenian merchants with whom the English merchants were trying to trade. The replacement translator, however, turned out not to speak "English nor any European language neither is he acquainted w^{t} one word of our business y^{t} hath past in Persia or wth anything belonging to y^{e} Court so y^{t} we have no benifitt by him neither can we venture upon renewing Phirmaunds or getting others when we cannot understand w^{t} may be granted us."[86] Though Auga Doud might have been "a great Rogue," they were "of opinion a Rogue may be made use off especial w^{n} no other is to be got y^{t} can doe y^{t} business."

As was emphasized in this example, the translator needed to have a strong understanding of business operations as well as the ability to speak the required languages. Moreover, the linguists were expected to act as go-betweens and Doud's value came not only from his knowledge of languages and business, but that he "hath more influence on y^{e} Officers at Court then any Christian in all Persia."[87] While to a certain extent this points to the weakness of the English presence; however, the English had made a number of recent voyages. Rosario, at least, had previously served in the same capacity for other English merchants despite his supposed ill character. Undoubtedly if the Company had a more established presence in Canton it would have been able to cultivate stronger relationships with locals and English nationals would be able to learn the languages necessary to do business with less reliance on translators. The mistrust of locals, however, continued through the whole period and can been seen reflected in the work of

[86] The Phirmaund was "a Right to 'a free Navigation of the Ganges,'" John Dunning, *A Defence of the United Company of Merchants of England Trading to the East-Indies* (London: Printed for J. Brotherton, in Cornhill, and Sold by R. and J. Dodsley, in Pall-Mall, and T. Walker, in Fleet-Street, 1762), 19.
[87] IOR/E/3/51, f. 138r.

Rudyard Kipling as a crucial aspect of what made Kim reliable was his British parentage and the British education that he received.

The journal that Robert Douglas kept during his time in Canton and Macau is a valuable resource because it is representative of much of the problems and concerns that employees of the English East India Company had to deal with on such voyages in the late seventeenth and early eighteenth centuries. In particular, it reflects the weakness of the European position when it came to the China trade. This is important to keep in mind because it is easy to forget that European hegemony was not a given and Imperial Britain and the East India Company as a colonial power should not be taken as a given. Indeed, the Company at this time had little interest in exercising colonial power as such activities were extremely expensive and it lacked the military personnel to impose itself in any significant way. Establishing an operational military in Southeast Asia would have required greater British naval support than it currently had and the expense would have undermined what profitability the Company had. As Douglas's inability to sell the English wares demonstrates, the English needed the China trade far more than the Chinese did. Trade between Europe and China and India was financed almost entirely by European access to South American bullion.[88] The English East India Company doggedly attempted to create a market for English goods, but did not have significant success until the nineteenth century. While modernity and industrialization is typically regarded as a European phenomenon and placed alongside the Enlightenment, China and India both had well-developed manufacturing systems and trade networks. Moreover, the reliance on transferring gold and silver from the Americas to Asia in

[88] Frank, *Reorient*, 74-5, 111. Timothy Brook, *Vermeer's Hat: The Seventeenth Century and the Dawn of the Global World* (New York: Bloomsbury, 2008), Ch. 6.

return for commodities desired in Europe such as silk, spices and tea emphasizes that the modern world and its history is inherently global, a point that is at the core of the world systems theory.[89]

As useful as Douglas's journal is, however, it is important to keep in mind that he too was motivated by self-interest. Douglas's journal was not a private record. The Company required its employees to maintain accounts of their activities as part of its efforts of maintaining control over its representatives despite the vast distances separating London from Canton. This can be seen most clearly in the frequency and detail of the correspondence between the various factories and the Court of Directors. Like the correspondence, the log books and the accounts that were sent back to London, Douglas's journal was meant to be read by others and to serve as something of an archive of his activities for the future benefit of the Company, which was concerned with building up a library of knowledge about those with whom it wished to trade. As such, Douglas framed his narrative with this in mind. In particular, he was careful to emphasize how much he had sought to protect the Company's interests. In Douglas's version of the story, it was always the obstruction of others, especially the cabal of Mandarin merchants, who thwarted his efforts to execute efficiently his orders from the Company. There does not seem to be other similar journals kept by Company supercargoes from this time period in the East India Company archives. Thus, it is possible that supercargoes did not typically keep such accounts or that Douglas's survived due to its length and detail. It is somewhat difficult, therefore, to judge the success of Douglas's voyage without similarly detailed day-to-day accounts from other voyages. There is little evidence to suggest, however, that his experience was unusual.[90] The detail provided in his journal, therefore, provides us with a rare opportunity. Douglas's journal is an

[89] Frank, *Reorient*, xxii-xxiii.
[90] See, for one example, Michael Wintroub's recent account of the 1527 encounter between the French ship *La Pensée*, captained by Jean Parmentier, and the Malagasy, Michael Wintroub, *The Voyage of Thought: Navigating Knowledge across the Sixtheenth-Century World* (Cambridge: Cambridge University Press, 2017), 171-99.

extremely valuable account of commercial trade on-the-ground and has not previously been subjected to historical analysis.

Conclusion

What does Robert Douglas's trade expedition have to do with the history of science? At first blush, the answer might appear to be very little. Yet, the case is illustrative in important ways that do relate to the history of science. As I discussed in the opening section, a basic assumption that has underlined the scientific view of the world over the past three hundred years is that science is universal. The universal nature of science, moreover, has had significant implications to the Euro-American worldview. One of these implications has been that of the metropole. Drawn directly from a model of the British Empire developed in the nineteenth century, the idea of the metropole has been one that has imperial connotations that must be addressed. I have sought to do so by historicizing the metropole with the example of Robert Douglas. What Douglas tells us about European-Chinese relations is that European hegemony was not yet remotely established or even really in consideration at the turn of the eighteenth century. Power—who defines and controls knowledge and how do knowledge practices get put to work—has been an underlying theme of this dissertation. The metropole and periphery has comes with the presumption of an asymmetrical power dynamic in which the metropole holds the greater strength. If, as has been the case, we take it as read that the metropole means Western Europe, we are stuck with the unavoidable problem that Asia and not Europe was to a significant degree the dominant economic and political power until well into the eighteenth century. The struggles experienced by Robert Douglas while in China illustrate the weakness of the European position.

The example of Douglas, then, has everything to do with the history of science because if we are to comprehend the global development of science it is necessary to understand the historical context. As global commerce and imperialism have been recognized as having been of critical importance, it behooves us to understand the European experience of trade in the non-European world. Historians of science have acknowledged the major role played by travel in the construction of the European view of the world. Travelers kept diaries, wrote letters and published books that sought to describe and explain distant parts of the globe to European readers.[91] During the course of the seventeenth and eighteenth centuries, such travel literature both exotified and normalized the non-European world.[92] The cultures and peoples were exotified and contrasted to the "superiority" of Europe, but, at the same time, it has been argued that global travel and exchange served to render the world regular.[93] This supposed normalization of the planet was of fundamental importance to the project of Isaac Newton's experimental science and his contemporaries. Newton's natural philosophy was based on the argument that the laws of nature are universal, which had obvious implications for global travelers. As discussed in Part One of this dissertation, such Universalism underlies the claim that navigation was transformed from a practice to a science in the eighteenth century. Rather than depending on local knowledge, recasting navigation as a science based on universal principles meant that navigators could operate according to a set of universal laws that could be applied regardless of the setting. Scientific Universalism combined with Eurocentrism to form scholarly assumptions that continue to inform the world today.

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[91] Mary Louise Pratt, *Imperial Eyes: Travel Writing and Transculturation* (London: Routledge, 1992); Daniel Carey, "Compiling Nature's History: Travellers and Travel Narratives in the Early Royal Society," *Annals of Science* 54 (1997): 269-92; Jaś Elsner and Joan Paul Rubiés, eds. *Voyages and Visions: Towards a Cultural History of Travel* (London: Reaktion Books, 1999); Margaret Topping, ed. *Eastern Voyages, Western Visions: French Writing and Painting of the Orient* (Berlin: Peter Lang, 2004).
[92] Elias, *The Civilizing Process*; Fabian, *Time and the Other*.
[93] Cook, *Matters of Exchange.*

In this chapter, I have sought to begin to unpack how the Universalist ideology underpins the historiography, especially as it relates to the history of science. While Bruno Latour's notion of centres of calculation has been criticized on the grounds of being Eurocentric, I have tried to demonstrate that his vocabulary can be subverted for the purposes of critique. The study of the English East India Company at the turn of the eighteenth century demonstrates the dissonance between the presumption that Europe is *ipso facto* the centre and Asia the periphery. My intention is not to reject the accomplishments of science; however, it is imperative that we, not only as historians but as citizens, become more cognizant of the deeply embedded and pervasive connection between science and Western, imperialist hegemony. The historical record has made it clear that science can flourish outside of the European context and, *contra* Herbert Butterfield, there is little to suggest Western hegemony is due to some kind of European exceptionalism.

Martin Bernal controversially argued that the contemporary understanding of the classical world emerged out of the development of the academic discipline of history at the beginning of the nineteenth century. Developing as it did in parallel with nineteenth century European imperialism, Bernal contended that the imperial worldview has deeply embedded Classics.[94] Such concerns are perhaps even more evident in the history of science because, as Lissa Roberts has put it, "no matter how local the origins of scientific knowledge, modern science seems to possess and validity that extends far beyond that point."[95] Yet, evidence needs to be interpreted. Centres and peripheries are historically constructed and are contingent on the political and social context in which they are placed. London is not the centre and Canton the periphery in all

[94] Martin Bernal, *Black Athena: The Afro-Asiatic Roots of Classical Civilization* (London: Free Association Books, 1987). For the controversies generated by Bernal's thesis, see Mary Lefkowitz and Guy MacLean Rogers, eds., *Black Athena Revisited* (Chapel Hill: University of North Carolina Press, 1996); Jacques Berlinerblau, *Heresy in the University: The Black Athena Controversy and the Responsibilities of American Intellectuals* (New Brunswick: Rutgers University Press, 1999). For Bernal's response to his critics, Bernal, *Black Athena Writes Back: Martin Bernal Responds to His Critics*, edited by David Chioni Moore (Durham: Duke University Press, 2001).
[95] Lissa Roberts, "Situating Science in Global History," 14.

circumstances regardless of the situation. By recognizing this we can more successfully harness the history of science as a critique of oppression rather than as an extension of it. To quote the geographer Derek Gregory in lieu of a conclusion: "In order to conduct ourselves properly, decently, we need to set ourselves against the unbridled arrogance that assumes that 'We' have the monopoly of Truth and that the world is necessarily ordered by—and around—Us."[96]

[96] Derek Gregory, *The Colonial Present: Afghanistan, Palestine, Iraq* (Oxford: Blackwell Publishing, 2004), 262.

Conclusion

This dissertation has a politics. Stated most broadly, it is concerned with the presumed progression toward what have come to be recognized as the institutions that comprise the modern state. In the second edition of his classic work on the formation of nationalism, Benedict Anderson wrote that his previous assumption that "official nationalism in the colonized worlds of Asia and Africa was modelled directly on that of the dynastic states of nineteenth-century Europe" was incorrect. He had since come to believe "that the immediate genealogy should be traced to the imaginings of the colonial state. Thus, "beneath the colonial ideologies and policies," Anderson found there to be a grammar in which the lineage became much clearer. In particular, he pointed to three key institutions of power that made this grammar visible: the census, the map, and the museum.[1] Anderson's grammar, however, anticipated nineteenth-century colonialism and did not interrogate the history of the institutions to which he pointed. The guiding agenda of this dissertation has been not to read history backwards from a position that presumes later developments like the English East India Company to be inevitable. Instead, I have sought to put concepts such as expertise into context in order to recognize specific sites of contest and to avoid writing history as a progression toward an inevitable end.

The argument that historians need to be careful not to write the present back onto the past is a standard refrain. Yet, for both the history of science and postcolonial histories the present reality has been allowed to define the problems of the past.[2] Such an emphasis on history as a progression toward the present runs the risk of erasing from history the actions and concerns of the vast majority of people who did not explicitly contribute to such forward momentum.

[1] Benedict Anderson, *Imagined Communities: Reflections on the Origin and Spread of Nationalism, Revised Edition* (London: Verso, 1991), 163-4.
[2] Cf. Noami Oreskes' case for "motivational presentism" in which she argues that historians should be guided by present concerns, see Naomi Oreskes, "Why I am a Presentist," *Science in Context* 26 (2013): 595-609.

However, I have not been concerned with simply rescuing my historical actors "from the enormous condescension of posterity," to quote E.P. Thompson's memorable line.[3] Resuscitating otherwise forgotten individuals is important inasmuch as it enables us to detach history from established narratives and see a particular question or problem anew. The debates over navigation that I described in the first part of the dissertation are significant to our broader understanding of science because expertise was heterogeneous and contested. In other words, there were alternatives. Not only were there alternatives, moreover, the contests over authority that I described in this thesis continued through the eighteenth century. While many in science and technology studies have become increasingly concerned with an erosion of expertise and the authority of science, expertise has never been a closed subject.[4]

Similarly, postcolonial scholarship originated in the context of anti-imperialism and, therefore, has tended to emphasize the ways in which European hegemony was constituted and how that hegemony reshaped the peoples who were colonized. As Robert Young has defined it, postcolonialism "marks the broad historical facts of decolonization and the determined achievement of sovereignty – but also the realities of nations and peoples emerging into a new imperialistic context of economic and sometimes political domination."[5] Crucially, postcolonialism is an active intervention within the oppressive circumstances of imperialism. Thus, the postcolonial approach explicitly draws its analytical strength from the emergence of European hegemony and cannot exist separately from it. Though postcolonial theory has aimed to foreground the agency of colonized peoples, in practice it has struggled with its deterministic account of history. For example, Edward Said's concept of orientalism has emphasized the way

[3] E.P. Thompson, *The Making of the English Working Class* (New York: Vintage Books, 1963), 12.
[4] E.g. Philip Kitcher, *Science in a Democratic Society* (Amherst, NY: Prometheus Books, 2011); Harry Collins, *Are We All Scientific Expertise Now?* (Cambridge, UK: Polity, 2014).
[5] Robert Young, *Postcolonialism: An Historical Introduction* (Oxford: Blackwell, 2001), 57.

in which "the Orient" was invented by eighteenth-century European scholars and then imposed during nineteenth-century imperialism as the colonial administrators sought to reshape colonial states to look more like Europe's imagined version of the Orient.[6] Said's argument, then, gave little room for colonial agency and resulted in a rather top-down view of history. As Ernest Gellner noted (albeit in a review largely in defence of colonialism), Said at times appeared rather uncomfortably Orientalist in his approach.[7] Ultimately, this was because Said's primary commitment was to advance a political argument regarding Middle Eastern politics in the present rather than making a rigorous a historical argument.

The risk of focusing too much on nineteenth and twentieth-century colonialism is that it has the result of reinforcing the European hegemony that is meant to be challenged. For example, the imperial map has been held up by historians of cartography such as J.B. Harley and Matthew Edney for the way in which the map was used to constitute European power by asserting the European geography.[8] In the nineteenth century, Europeans actively took their detailed earlier maps of Africa and remade them into Joseph Conrad's Dark Continent and, therefore, into a "primordial point of space" in which colonialism was justified. Yet, it is crucial that we do not continue to perpetuate that colonial act by also disregarding this earlier knowledge or ignoring experiences within the colonial states.[9] Furthermore, the projection of imperial power that we see in the imperial map was also in many regards an illusion. The assertion of power is not the

[6] Edward Said, *Orientalism* (New York: Pantheon Books, 1978). Cf. Timothy Mitchell, *Colonising Egypt* (Berkeley: University of California Press, 1991), Ch. 1.
[7] Ernest Gellner, "The Mightier Pen? Edward Said and the Double Standards of Inside-Out Colonialism," *Times Literary Supplement* (February 19, 1993): 3-4.
[8] J.B. Harley, "Maps, Knowledge, and Power," in *The Iconography of Landscape: Essays on the Symbolic Representation, Design and Use of Past Environments*, edited by Denis Cosgrove and Stephen Daniels (Cambridge: Cambridge University Press, 1988); Matthew Edney, *Mapping an Empire: The Geographic Construction of British India, 1765-1843* (Chicago: University of Chicago Press, 1997).
[9] Nicholas Mirzoeff, *An Introduction to Visual Culture* (London: Routledge, 1999), 130.

totality of the situation and in practice colonial administrations relied heavily on locals and sought to structure their institutions around previously established structures of power.[10]

This dissertation represents a first step toward a larger attempt at putting the vocabulary on which imperialism relied into a longer historical context. In particular, Benedict Anderson's assertion of the map as crucial imperial grammar is in need of continued historization. It was in eighteenth-century India that the British began the project of the creating the imperial map and, therefore, continuing the investigation of India from a close perspective that emphasizes the experience on-the-ground is a logical starting point from which to historicize imperialism. At the heart of my historiographical concerns, then, has been the idea of the metropole and its relationship to expertise. An example of this can be seen with the Asiatick Society, which was established in Calcutta in 1784 for the purpose of advancing Orientalist knowledge. It did so from a notably European gloss, however, as it did not elect a single non-European member for nearly fifty years.[11] Instead, the Asiatick Society appears as a relatively straightforward example of metropolitan science. Data (in this case ancient Indian texts) were collected at the periphery and transformed by the metropolitan scholars into part of a coherent system of knowledge. It was only then that this knowledge could be returned to the periphery where it was imposed on the native population. Orientalism was infused with European assumptions that privileged Western intellectual traditions and approaches and this Orientalism formed one of the bases by which nineteenth-century imperialism was justified. Moreover, the structure of the colonial administration was deeply informed by Orientalist assumptions about the peoples they were

[10] David Arnold, *Colonizing the Body: State Medicine and Epidemic Disease in Nineteenth-Century India* (Berkeley: University of California Press, 1993); Alice Conklin, *A Mission to Civilize: The Republican Idea of Empire in France and West Africa, 1895-1930* (Stanford: Stanford University Press, 1997); Kapil Raj, *Relocating Modern Science: Circulation and the Construction of Knowledge in South Asia and Europe, 1650-1900* (Houndsmills, Basingstoke: Palgrave Macmillan, 2007).
[11] "Proceedings of the Special Centenary Meeting of the Society," in *Centenary Review of the Asiatic Society of Bengal: From 1784-1883* (Calcutta: Asiatic Society of Bengal, 1885), 12-13.

governing. Thus, Eighteenth-century expertise is a subject that is deeply intertwined with colonial concerns.

The Asiatick Society is an example of one kind of expertise. Its membership included numerous representatives of the elite European intellectual world. Yet, we must be careful not to credit the Orientalists too much or regard them as the only form of expertise at play in eighteenth and nineteenth century colonial Asia. The Orientalists did not represent the only approach to knowledge production about Asia at this time. An example that complicates the Orientalist narrative is that of Scottish astronomer and experimental lecturer James Dinwiddie (1746-1815). Dinwiddie lived in India from 1795-1806 and was professor of natural philosophy at Fort William College from 1801. At first he would appear to be another example of metropolitan science. He was skilled in the experimental philosophy of his day and had originally traveled to China in order to demonstrate instruments for the Chinese emperor as part of Lord Macartney's 1792 Embassy to China, though the British instruments famously failed to impress the Chinese.[12] Instead of returning to England, Dinwiddie went on to Calcutta where he sought to make a living as a lecturer of natural philosophy and he became a member of the Asiatick Society. Thus, in principle he was occupied with disseminating Western natural and experimental philosophy. Yet, he does not comfortably fit the metropolitan model because he also was deeply engaged in intellectual, cultural and commercial exchange with the inhabitants of India.[13]

Dinwiddie is significant because he points to an alternative approach to understanding the production and circulation of knowledge. Instead of privileging elite European accounts, we can

[12] Simon Schaffer, "Instruments as Cargo in the China Trade," *History of Science* 44 (2006), 219; Larry Stewart, "The Spectacle of Experiment: Instruments of Circulation, From Dumfries to Calcutta and Back," in *The Circulation of Knowledge Between Britain, India and China: The Early-Modern World to the Twentieth Century*, edited by Bernard Lightman, Gordon McOuat, and Larry Stewart (Leiden: Brill, 2013), 30-1.
[13] Savithri Preetha Nair, "'Bungallee House set on fire by Galvanism': Natural and Experimental Philosophy as Public Science in a Colonial Metropolis (1794-1806)," in *Circulation of Knowedge*, 68; Jan Golinski, "From Calcutta to London: James Dinwiddie's Galvanic Circuits," in *Circulation of Knowledge*, 86-87.

look at the experiences of those who were there and engaged in knowledge production at the time. Thus, while I discussed the concept of the imperial map earlier, the view that the map was produced by the "West" and imposed on the "East" is not as simple as that might suggest. If we turn our attention away from the map as a finished product and toward sites of production we end up with a rather different story. Though the imperial map might have imposed European geography on the colonized, these maps could not have been produced without the active support and participation of non-Europeans. Hydrography and surveying, for example, were crucial sites of exchange rather than an example of metropolitan science at work.

A longer term project, then, is to continue the work of uncovering less remembered modes of expertise. This dissertation has begun that project in its approach to the issue of expertise. I have sought to demonstrate that expertise in the eighteenth century was a contested subject. Instead of an increasing stabilization of knowledge from diverse, artisanal practices to something more recognizably scientific, when eighteenth-century navigation is studied from the point of practice it points to the continued diversity of expertise. History tends to be normative in that one cannot write the totality of it, but must pick which evidence to use and to present it in a way that renders it coherent.[14] The need for coherence has, to an extent, imposed imperialism on the history of science because it exists within the context of science. Science, in all its many facets, has been crucial to the history of the last few centuries to be sure. It is, therefore, necessary that we continue to study its history. At the same time, however, the more elite practices and theories that have often been regarded as the centrepiece of the history of science were not the only knowledge practices in existence and science did not go uncontested. As Steven Shapin and Simon Schaffer argued in *Leviathan and the Air-Pump*, the alternatives

[14] William Cronon, "A Place for Stories: Nature, History, and Narrative," *The Journal of American History* 78 (1992): 1347-76.

deserve to be taken seriously.[15] They deserve respect not just because they were conceivable alternatives to the path that was ultimately taken, but because they were important in their own right. As David Edgerton has shown, the new does not simply displace the old; instead, old and new technologies and ideas continue to exist alongside each other.[16]

In the first part of this dissertation I emphasized the strength of the old for early-modern navigation. What I wanted to make clear was that there were longstanding navigational practices and the discipline had established methods of recognizing expertise and asserting credibility. Despite what Samuel Pepys thought, European navigation was broadly successful and its practices were the result of centuries of improvement derived from hard experience. While dead-reckoning might seem haphazard and imprecise, it was in fact the most effective means of navigating and continued to be so for most mariners well after the longitude problem was solved. In the first chapter I used the example of the Royal Mathematical School because the school was a space where the tensions between traditional and new approaches to navigation were particularly vividly displayed. A key element that has previously been overlooked in accounts of the school is the way that the attempt to formalize the school as a centre of navigational expertise also sought to relocate the authority to assign credibility from mariners to the state. Thus, the Royal Mathematical School and the series of debates it engendered were fundamentally about power.

The contest of authority and the question of state power continued to animate the dissertation in the second chapter. Again debates over expertise played an important role. As the subject of Chapter Two was the dispute between Edmond Halley and his chief-mate Edward

[15] Steven Shapin and Simon Schaffer, *Leviathan and the Air-Pump: Hobbes, Boyle, and the Experimental Life* (Princeton: Princeton University Press, 1985).
[16] David Edgerton, *The Shock of the Old: Technology and Global History Since 1900* (London: Profile Books, 2006), xi-xii.

Harrison, the tension between "craft" and "elite" conceptions of expertise were in even more sharp relief. In the second chapter I argued that the contests over expertise also undermine attempts to present early-modern European expansion as an example of successful long-distance control. Such long-distance control did not really exist on board English ships because to the degree that there was a unified system of navigation it was one that was largely independent of external control. Marine navigation was a practice that drew its strength from experience and local knowledge rather than from a broad understanding of astronomical theory and universal knowledge. Navigational practices often could not be unproblematically applied to new contexts; however, the depth of local knowledge and experiential skill was also its strength. In particular, the emphasis on experience enabled navigators to define expertise for themselves. Thus, Part One introduces and demonstrates the two central problems of this dissertation: expertise and long-distance control.

In Part Two the concepts developed in Part One are applied to the English East India Company. In particular the issue of long-distance control is pursued further. Chapter Three takes the tensions between institutional authority and local agency and puts it into the context of the East India Company bureaucracy. In this chapter I presented a selection of illustrative examples from the East India Company correspondence that demonstrated the limited ability for the Company in London to assert control over its agents on the other side of the globe. Despite the presumption that a degree of long-distance control was essential for European imperialism, it was at least not necessary for successful commercial enterprise.[17] The Company administrators discussed in Chapter Three were a heterogeneous group who were motivated by advancing their

[17] The evidence of the British Raj suggests that long-distance control was not necessary for the establishment of nineteenth-century colonialism, see Jon Wilson, *India Conquered: Britain's Raj and the Chaos of Empire* (London: Simon and Schuster, 2016).

own personal interests. The Company administration outposts existed within a local context that operated at a remove from the situation in England and must be understood as such.

One of the lessons of the East India Company administration in India is that the British position in Asia was tenuous at the turn of the eighteenth century. The weakness of the Company was particularly central to the fourth and final chapter. I devoted this chapter to a close study of the journal of an East India Company supercargo in China by the name of Robert Douglas. His journal does much to demonstrate the status of the British circa 1700 and the lack of economic power that it possessed at the time. I argue that this story also has something to say for the history of science because it challenges efforts to frame the relationship between the "West" and the "East" as one of the metropole and periphery. To claim London as the metropole and China as the periphery also asserts a power relationship in which London is the dominant partner. From an economic point-of-view this was certainly not the case and from an intellectual perspective the example of Dinwiddie in China at the end of the century suggests that it was not in the stronger position in terms of knowledge practices. In Chapter Four I claim London as the periphery because it was in Asia and not London where the knowledge and trade commodities upon which the East India Company depended were located.

The principal argument of this dissertation is that expertise was contested and local and that this localization is important to science and technology studies. Thus, by focusing largely on figures that have been forgotten by history, my intention was not just to rescue these individuals from obscurity, but to make a broader historiographical point. By subjecting expertise, one of the foundational concepts of science and technology studies, to historical scrutiny I also make an argument about the larger narrative of the eighteenth century. The diversity of local expertise further demonstrates that we cannot view history as a progression

toward “modernity.” In this dissertation I show how concepts like expertise should not be viewed deterministically. In doing so, I make the case for the necessity of a local approach to the history of global science. Instead of being minor figures that made no discernable contribution to science, I contend that the obscure figures such as some of those I have discussed in these chapters were in fact fundamental if we are to understand science in context.

Appendix: Guide to the India Office Records at the British Library

This guide is intended to provide a sense of the scale and scope of the India Office Records and to help the reader to understand references contained within the footnotes of this dissertation. The source for the figures provided here is Martin Moir, *A General Guide to the India Office Records* (London: British Library, 1988), which also provides a more complete catalogue and description of the India Office Records.

A Charters, Deeds, Statutes and Treatises, 1500-1950 (3000 individual documents and 27 volumes)

B Minutes of the East India Company's Directors and Proprietors, 1599-1858 (273 volumes)

C Council of India Minutes and Memoranda, 1858-1947 (144 volumes)

D Minutes and Memoranda of General Committees and Offices of the East India Company, 1700-1858 (262 volumes)

E East India Company General Correspondence, 1602-1859 (1607 volumes)

F Board of Control Records, 1784-1858 (2889 volumes/files)

G Factory Records, 1595-1858 (1555 volumes and 18 boxes)

H Home Miscellaneous Series, 1600-1900 (839 volumes)

I Records relating to other Europeans in India, 1475-1824 (214 volumes)

J Haileybury Records, 1749-1857 (127 volumes)

K Records relating to other Establishments, 1809-1925 (66 volumes)

L Departmental Records

/AG Accountant General's Records, 1601-1974 (Approximately 8200 items, mostly volumes)

/E Economic Department Records, 1786-1950 (4245 volumes/files and 960 boxes)

/F Financial Department Records, 1800-1949 (Approximately 6538 volumes/files plus 225)

/I Information Department Records, 1921-1949 (1712 volumes/files)

/L Legal Adviser's Records, 1550-1950 (1095 boxes and volumes)

/MAR Marine Department Records, 1600-1879 (10571 volumes)

/MED Medical Board Records, 1920-1960 (173 boxes)

/MIL Military Department Records, 1708-1957 (44968 volumes and 1935 boxes)

/PARL Parliamentary Branch Records, 1772-1952 (726 volumes and 4 boxes)

/PO Private Office Papers, 1858-1948 (Approximately 495 files/volumes plus 5 boxes)

/PWD Public Works Department Records, 1838-1931 (4516 volumes/files plus 1 box)

/P&J Public and Judicial Department Records, 1795-1950 (Approximately 21660 volumes/files plus 224 boxes)

/P&S Political and Secret Department Records, 1756-1950 (Approximately 13246 volumes/files plus 318 boxes)

/R Record Department Papers, 1859-1959 (Approximately 848 volumes/files and 117 boxes)

/SUR Surveyor's Records, 1837-1934 (26 volumes and 24 boxes)

/S&G Services and General Department Records, 1920-1970 (1670 volumes/files plus 720 boxes)

/WS War Staff Papers, 1921-1951 (1840 files)

M Burma Office Records, 1932-1948 (Approximately 341 volumes/files and 505 boxes)

N Returns of Baptisms, Marriages, Burials, etc, 1698-1969 (1103 volumes)

O Biographical Series, 1702-1948 (487 volumes and 44 boxes)

P Proceedings and Consultations of the Government of India and of the Presidents and Provinces, 1702-1945 (Approximately 46500 volumes)

Q Commissions, Committee and Conference Records, 1895-1947 (Approximately 193 volumes, 74 boxes/bundles and 285 folders)

[Records transferred later through official channels]

R/1 India: Crown Representative's Political Department records, 1880-1947 (Approximately 7257 files/volumes and 163 boxes)

R/2 India: Crown Representative's Residency Records, 1789-1947 (Approximately 1370 boxes and 271 volumes)

R/3 India: Other Records of the Central and Provincial Governments, 1899-1948 (488 files/volumes)

R/4 India: British High Commission Cementary Records, 1870-1967 (Approximately 864 files/volumes)

R/5 Nepal: Kathmandu Residency Records, 1792-1872 (115 volumes)

R/8 Burma: Records of the Governor's Office, 1942-1947 (50 files/volumes)

R/9 Malaysia: Malacca Orphan Chamber and Court of Justice Records, 1685-1835 (98 boxes)

R/10 China: Canton Factory Records, 1623-1841 (80 volumes)

R/12 Afghanistan: Kabul Legation Records, 1923-1948 (207 files)

R/15 Persian Gulf: Records of the Bushire, Bahrain, Kuwait, Muscat and Trucial Coast Agencies, etc, 1763-1951 (15326 files/volumes)

R/19 Egypt: Records of the Cairo, Alexandria and Suez Agencies, 1832-1870 (27 volumes)

R/20 Aden: Records of the British Administration, 1839-1967 (Approximately 12232 files/volumes and 120 maps)

S Linguistic Survey of India Records, 1900-1930 (74 boxes)

U Documents in Oriental Languages, 1871-1880 (11 items)

V Official Publications, 1760-1957 (Approximately 70000 volumes, including duplicates)

W, X, Y Map Collection, 1700-1960 (Approximately 40000 items)

Z Registers and Indexes, 1700-1950 (Approximately 2500 volumes)

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