THE CONSTRUCTION OF MODERN TIMEKEEPING

THE CONSTRUCTION OF MODERN TIMEKEEPING IN THE ANGLO-AMERICAN WORLD, 1876-1913

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A Thesis Submitted to the School of Graduate Studies in Partial Fulfilment of the Requirements for the Degree Doctor of Philosophy

McMaster University DOCTOR OF PHILOSOPHY (2018) Hamilton, Ontario (History)

TITLE: The Construction of Modern Timekeeping in the Anglo-American World, 1876-1913 AUTHOR: Scott Johnston, B.A. (Hons.) (Brock University), M.A. (University of Waterloo) SUPERVISOR: Professor S. Heathorn NUMBER OF PAGES: x, 351

Lay Abstract

This dissertation asks why the system of time measurement set up towards the end of the nineteenth century took the form that it did. While partially dependent on new technologies such as railways and telegraphs, timekeeping was shaped more directly by the cultural context of the individuals involved. The dissertation uses the 1884 International Meridian Conference as a case study to suggest that time reform was driven by professional norms more than by national interest or changes in technology. Astronomers and engineers came to the conference with very different visions for modern timekeeping. Indeed, questions about the very nature of accurate time was at the heart of the debate: was time a public good, a commodity, or a specialized tool? The answers to these questions depended heavily on one's profession, and as a result the standard time system that emerged was far from inevitable, and in fact remained incomplete.

Abstract

This dissertation asks why the system of time measurement set up towards the end of the nineteenth century took the form that it did. The answer is partially dependant on the advent of new technologies such as railways, steamships, and telegraphs. However, instead of focusing on a teleological story of technological progress, this dissertation derives its answer by examining the social, political, and cultural context of the individuals involved. The dissertation uses the 1884 International Meridian Conference as a case study to suggest that time reform was driven by professional context more than by technological imperatives or national interest. Astronomers and engineers came to the conference with very different visions for modern timekeeping. Using a constructivist lens, this dissertation examines the decision-laden process by which temporal knowledge was constructed. Questions about the very nature of accurate time was at the heart of the debate: was time a public good, a commodity, or a specialized tool? The answers to these questions depended heavily on one’s profession, and as a result the conference, directed by astronomers who preferred time as a specialized tool, rejected standard time as a broad reformation of civil timekeeping for the public. The process of construction continued after the conference as well, as the universality of standard time became wrapped up with the heightened accuracy required by specialized astronomical time. Entrepreneurs latched on to this, selling accurate time as a desirable symbol of modernity, while at the same time large numbers of people continued to use older timekeeping methods that were more convenient. New timekeeping methods did not sweep aside the old, leaving timekeeping a more complex, rather than a simplified, process. The standard time system which

emerged from this complexity was far from inevitable, and in fact remained largely incomplete.

Acknowledgements

This project could not have been completed without the support and assistance of several people. I owe a debt of gratitude first and foremost to my supervisor, Dr. Stephen Heathorn, who helped shape this project from the very beginning, both allowing me space to write on my own, and also offering guidance and support when necessary. I found his insight to be invaluable, and I could not have asked for a better supervisor. I also owe a great deal of thanks to my committee members, Dr. John Weaver and Dr. Michael Egan, who brought their own unique perspectives and expertise to the project. I would also like to thank my external examiner, Dr. David Leeson, for his contributions to the final draft, Wendy Benedetti and Debbie Lobban for their friendly support and administrative genius, my Masters supervisor, Dr. Dan Gorman, for encouraging me in my studies, and Dr. H.V. Nelles for serving on my committee in my first year and for teaching me the value of narrative as an analytical tool.

I was fortunate to have the financial support of several institutions and funding bodies, including Ontario Graduate Scholarships (OGS), McMaster University, and the Wilson Institute for Canadian History, without which I would not have been able to carry out the research necessary for this project. I visited or contacted several archives to whose staff I am indebted, including Mark Hurn at the Cambridge Astronomy Library, Karen Moran at the Royal Observatory of Edinburgh, Kathryn McKee at the St. John's College Library (Cambridge), Sian Prosser at the Royal Astronomical Society Archives, John Cable at the Institute of Engineering and Technology Archives, Julie Carrington at the Royal Geographical Society Archives, Chris Atkins at the Maidenhead Library, and

Krista McCracken at the Shingwauk Residential Schools Centre. I am likewise thankful to the staff at the National Archives of the United Kingdom, the British Library, the Bibliotheque de l'Institute de France, the National Archives of the United States of America, the Archivo General de la Nacion (Dominican Republic), the Archives of Ontario, Library and Archives Canada, the Library of Congress, the BT Archives, the Archives of the Royal Society, Cambridge University Library, and the London Metropolitan Archives.

Several of my colleagues also contributed to this project. First and foremost, thank you to my editing buddy Mica Jorgenson, with whom I traded dissertation chapters for editing over the last three years – she read early drafts of every chapter I wrote. I would also like to thank Chelsea Barranger, who edited dozens of bits and pieces of this project over the years, but more importantly, has been my closest friend and partner-in-crime in the History Department since we both arrived at McMaster. My PhD experience was similarly blessed by the kind support and dear friendship of my peers, including Andrew Kloiber, Jacqueline Kirkham, Kelsey Hine, Oleksa Drachewyich, Curran Egan, Samantha Clarke, Shay Sweeney, and Alex Zavarise, all of whom to which I turned for advice on this project at some time or another.

Lastly, I would like to thank my family. Thank you to my partner, Megan Johnston, whose love and support kept me sane through the entire project – with chocolate, diversions, and countless impromptu pep talks (not to mention her patient help translating documents from French). Thank you to my sister, Melissa Sillett, whom I followed into graduate school, and to my brother, Steven Johnston, who followed me.

And lastly, most of all, thank you to my parents, Gary and Rita Johnston, who encouraged and supported me at every turn. They taught me to be humble and to pursue my dreams. I dedicate this project to them.

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Declaration of Academic Achievement

Scott Johnston is the sole author of this dissertation.

Introduction

In the late nineteenth century, asking someone for the time had the potential to elicit a complicated answer. The problem was not a lack of sources: watches and timepieces were widely available, public clocks adorned city halls and railway stations, and bell signals and calls to prayer of different faiths rang out with religious regularity in many places across the globe. At a pinch, a rough estimate of the time might be determined from the sun or tides. Urban or rural, rich or poor, nation-state or colony, tools for time-telling were ubiquitous.

The problem, then, was not a dearth of methods to measure time, but rather a bewildering multitude of often conflicting and competing times. Clocks were not synchronized, and even the best-made timepieces could not keep ticking out a perfect rhythm for longer than a few weeks. This meant that one clock varied from the next with striking irregularity. To make matters more complicated, the question of whether a clock was considered correct was more often a matter of power, politics, and social dynamics than it was of insufficient technology. Though one clock might differ from another by accident, it was just as common that the difference was deliberate, as different professions, religions, cultures, and nations kept different times. Temporal uncertainty was the norm, and people questioned universal practices that are taken for granted in the twenty-first century. Why should a clock have twelve hours on its face? Why should the day begin at midnight? Why does a clock in Boston have to correlate with a clock in Istanbul or Tokyo? Why should the world’s time be counted from an imaginary line running through Greenwich observatory in Britain? There are no astronomical, or geographical, or indeed any 'natural' imperatives that enforce these things as the only possible way to organize time. These were decisions, originally with uncertain outcomes, made by humans in a particular context. How to measure time was a controversial subject that sparked considerable debate.

This dissertation deals with some of those debates, especially those that surrounded the creation and dissemination of a standardized system of timekeeping in the last decades of the nineteenth century and beginning of the twentieth. The centerpiece of these debates in the international sphere was the International Meridian Conference (IMC), held in Washington in 1884. Here, diplomats, scientists, naval officers, and engineers from nearly thirty countries gathered to discuss the creation of a prime meridian and, by extension, the future of global timekeeping.

To a large extent, historians have downplayed the importance of the IMC. Outside of academic circles, in contrast, the conference has gained mythological status as the origin point of modern standard time. It is the place where the grand schemes of men like Sandford Fleming and William Allen supposedly came to fruition. But this myth, still promoted at museums and institutions like the National Maritime Museum at Greenwich, or in Historica Canada's "Heritage Minutes," is easy to debunk.[1] Standard time as we know it today was not birthed fully formed with pomp and circumstance at Washington in 1884. Most historians of time measurement see the conference as simply one stepping-stone in a long progression of developments, in which the conference plays but a small role. This, for example, is the position of the most recent work to discuss the conference,

[1] *Sir Sandford Fleming (c. 1991-5),* Film, Historica Canada, https://www.historicacanada.ca/content/heritage-minutes/sir-sandford-fleming

Zero Degrees by Charles Withers. Withers rightly emphasizes that the resolutions of the conference were recommendations rather than binding agreements, leading "to particular and geographically uneven consequences in the wake of the meeting."[2] The IMC was a start, not an end, to global changes in time measurement. Other scholars go further than Withers, suggesting that the conference was not just incomplete, but was altogether a failure. Ian Bartky, for example, writes that the idea that the countries represented at the IMC unanimously agreed to recognize Greenwich as the Prime Meridian, and to establish time zones, is nonsense. "Nothing" he writes, "could be further from the truth."[3] Vanessa Ogle agrees. Her masterful book on time reform, *The Global Transformation of Time*, barely mentions the IMC. Ogle makes the case that time reform was an utter failure, and that the IMC in particular was "almost meaningless as the process of time unification dragged on until the 1930s and 1940s."[4] Ogle's most important contribution is the reminder that universal time, as envisioned by western reformers, and all similar projects meant to establish networks and connectivity, are ideological, rather than neutral. They are thoroughly Eurocentric, and in proposing globalizing ideas like universal time, western elites "proposed to create a world in their own image and a world of their own domination."[5] Universal time reinforced imperial and racial hierarchies, and as such these ideas found little acceptance in colonial societies. What happened at Washington, argues Ogle, mattered little to most of the world's population outside North America, Europe,

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[2] Charles Withers, *Zero Degrees: Geographies of the Prime Meridian* (London and Cambridge: Harvard University Press, 2017), 216.
[3] Ian Bartky, *One Time Fits All: The Campaign for Global Uniformity* (Stanford: Stanford University Press, 2007), 99.
[4] Vanessa Ogle, *The Global Transformation of Time, 1870-1950* (London and Cambridge: Harvard University Press, 2015), 14.
[5] Ogle, 204.

and Japan. In a similarly revisionist vein, literary scholar Adam Barrows argues that the IMC "did not in fact achieve the goal for which it is credited," suggesting that it instead represented a critique of the modernist capitalism which drove the attempt at unification.[6] The general consensus among historians of time measurement, then, is that the IMC was a failure.

Likewise, historians of diplomacy and empire have downplayed this international gathering. It is overshadowed by the other famous conference of 1884, the Berlin Conference.[7] At Berlin, the major European Powers carved up the African continent, formalizing the 'Scramble for Africa.' In a way, Berlin set the stage for the twentieth century, foreshadowing the Great Power rivalries, colonization and decolonization, and the humanitarian crises that have plagued the former colonies since Europe's incursions. Next to Berlin, the IMC seems inconsequential.

Yet the events of the IMC take up a considerable portion of this dissertation. That decision requires some justification, given the conference's reputation among academics as being largely insignificant. This dissertation suggests that overlooking the IMC is a mistake. If Berlin foreshadowed the twentieth century, Washington was more representative of the nineteenth – it was a product of Victorian debates about the nature of expertise, professionalization, and the desire to order, measure, classify and categorize the

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[6] Adam Barrows, *The Cosmic Time of Empire: Modern Britain and World Literature* (Berkeley: University of California Press, 2011), 36. Barrows insightfully claims that "the bedfellows of the standard time movement were…science and commerce," 46.

[7] That is not to say historians of empire have not had anything interesting to say about time in history. On the idea of 'anachronistic space' see Anne McClintock, *Imperial Leather: Race, Gender, and Sexuality in the Colonial Contest* (London: Routledge, 1995), 40. See also Giordano Nanni, *The Colonisation of Time: Ritual, Routine, and Resistance in the British Empire* (Manchester, Manchester University Press, 2012).; Elizabeth Povinelli, "The Governance of the Prior" *Interventions: International Journal of Postcolonial Studies* 13, No. 1 (2012): 13-30.

world. There is much to learn from studying the IMC. The conference is done a disservice by its own myth because it makes it an easy scapegoat for 'debunking.' The IMC is certainly not an origin story and is not about how-we-got-to-now. But it does have a lot to teach the careful observer about the world in which it took place. This is what makes it such a fruitful case study. It is easy to forget that 1884 was its own present. The people involved had no idea what was to come, and made their decisions in an already complex, fully formed world. 1884 was not a beginning or stepping stone to something greater. And for some participants at least, it was not a failure. It was an experiment in Victorian modernity, and an expression of a lived present.

The methodology used in this dissertation, therefore, is thoroughly historicist. It seeks to uncover what the Washington Conference meant to its participants in their own time. When 1884 was the present, how and why did people make decisions? How did they perceive their future? What worried them, excited them, and motivated them? The answer obviously involves political and diplomatic considerations, but there is also the social and cultural world into which the delegates at Washington were immersed. Imperial power relations were involved side by side with the lived experience of the working class. The economics of time decided when pubs closed, what privileges gave access to accurate time, and who cashed-in as the clock was commercialized. Time measurement and access to it was also gendered. Meanwhile, scientists, engineers, diplomats, businessmen, and religious authorities competed with each other for control of the debate over international timekeeping. New nations attempted to make their voices heard, and colonies struggled to gain a seat at the table. It is a story of complexity, which perhaps explains why Victorians, like Enlightenment thinkers before them, were so concerned with ordering, measuring, cataloging, and standardizing. Their attempt to standardize time was an attempt to simplify a complicated world.[8]

This dissertation delves into that process by which standard time emerged. It is concerned with how authoritative knowledge about time was produced, a topic which has its roots in the history of science. Historians and sociologists have been grappling with the nature of scientific ‘fact’ and its construction since the middle of the twentieth century. Before 1960, the history of science was written largely as a story of progress. Its subjects were heroic individual scientists who contributed to the accumulation of objective fact through careful experimentation and observation. This simplistic interpretation would begin to change with Thomas Khun’s 1962 book *The Structure of Scientific Revolutions.* Kuhn’s work was a repudiation of the genre of history in which science was understood as pure, logical pursuit conducted by scientists in isolation from their historical context. Kuhn’s argument was that “science does not develop by the

[8] As F.M. Turner suggests, the Victorian period was characterized by uncertainty, not least of which a crisis of faith (Turner discusses six individuals for whom both natural science and religion failed to provide satisfactory answers to the existential questions they hoped to find answers for). F.M. Turner, *Between Science and Religion: The Reaction to Scientific Naturalism in Late Victorian England* (New Haven: Yale University Press, 1974). Victorians hoped the natural science might provide answers. John Brook and Geoffrey Cantor explore how scientific thought was often rooted in theological concerns, suggesting that science was driven by the social and economic desires of the society in which it was embedded. John Brooke and Geoffrey Cantor, *Reconstructing Nature: The Engagement of Science and Religion* (Edinburgh: T. & T. Clark, 1998). Joseph Ben-David similarly claimed that the role of the scientist was determined by two factors: one, the organization of scientific work, and two, by the social values of the population in which it was embedded. Joseph Ben-David, *The Scientist’s Role in Society* (Eaglewood Cliffs, Prentice-Hall, 1984). Donald Mackenzie’s work on the history of statistics suggests that Victorian science was goal-oriented – again, that it was not a purely objective process, but rather that it sought to provide a sense of order to complex systems. Donald Mackenzie, *Statistics in Britain, 1865-1930: The Social Construction of Scientific Knowledge* (Edinburgh: Edinburgh University Press, 1981).

accumulation of individual discoveries and inventions."[9] Instead, the culture of science was often dogmatic, following the norms and expectations of the field. Such a practice "often suppresses fundamental novelties because they are necessarily subversive of its basic commitments."[10] It is only when, by chance, an anomaly is discovered which cannot be explained away, that "the profession can no longer evade anomalies that subvert the existing tradition of scientific practice – then begin the extraordinary investigations that lead the profession at last to a new set of commitments, a new basis for the practice of science."[11] In other word, scientific progress, or scientific revolutions, only occur when current dogma fails to explain an observation, leading to rapid change. But after the revolution, a new norm and new expectations quickly form, and scientists again fall into an inflexible rhythm of habit.

Kuhn did not go so far as to descend into relativism, maintaining that some scientific knowledge, regardless of the context of its creation, was absolute. But other scholars began taking that route. In the decades after the publication of Kuhn's book, new constructivist studies of the history of science argued that all scientific knowledge was the manufactured result of decisions made by scientists under the influence of their social and cultural context, rather than objective truth obtained through careful observation. In *The Manufacture of Knowledge*, for example, Karin Knorr-Cetina argued that while science is done through observation, the results of those observations are not descriptive, but constructive. She regards "scientific enquiry as a process of production," and suggests

[9] Thomas Kuhn, *The Structure of Scientific Revolutions* (Chicago: University of Chicago Press, 1962), 2.
[10] Kuhn, 5.
[11] Kuhn, 6.

that the fact-fabrication in which scientist engage is decision laden.[12] In a similar vein, Harry Collins and Trevor Pinch present "a view of science as fallible and untidy, a matter of craft rather than logic."[13] They suggest in somewhat belittling terms that "science is not an evil creature but it is a little daft."[14]

This dissertation borrows from the constructivist school in that decisions made by scientists concerning the proper method of timekeeping in the late 19th century were not infallible principles logically and objectively deduced from natural laws. Their decisions about timekeeping were made in a rich context, guided by political, national, and especially professional interests. Greenwich time, universal time, standard time and the clock time upon which they were based were all constructed forms of knowledge. That process of construction, combined with its dissemination, underlies all the chapters of this dissertation. Scientific ideas about time were undeniably products of their context. As

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[12] Karin Knorr-Cetina, *The Manufacture of Knowledge: An essay on the Constructivist and Contextual Nature of Science* (Oxford: Pergamon Press, 1981), 3,5.
[13] Harry Collins and Trevor Pinch, *The Golem: What Everyone Should Know about Science* (Cambridge: Cambridge University Press, 1993), abstract.
[14] Collins and Pinch, 2. For another example of constructivism, see Bruno Latour and Steve Woolgar, *Laboratory Life: The Construction of Scientific Facts* (Princeton: Princeton University Press, 1979). Jack Morrell agrees that science was a socially organized effort, though he points out that that does not necessarily mean that its end products – its findings – must be disparaged. Jack Morrell, Science, *Culture and Politics in Britain, 1750-1870* (Aldershot: Ashgate, 1997). F.M. Turner points out that scientist do not work in isolation, but rather must justify their actions to government and the public. They must persuade their audience that the work is worth doing. Successful promotion of science aided the rise in status of elite professional societies and individuals. F.M. Turner, "Public Science in Britain, 1880-1919," *Isis*, 71, No. 1 (1980): 589-608. Jan Golinski similarly looks at how scientific knowledge, which beings as local knowledge within a particular laboratory, for example, becomes public knowledge. Jan Golinski, *Science as Public Culture* (Cambridge: Cambridge University Press, 1992). For an overview of constructivism in the history of science, see Jan Golinski, *Making Natural Knowledge: Constructivism and the History of Science* (Cambridge: Cambridge University Press, 1998). Similar arguments about the construction of knowledge have been made by postcolonial scholars. See Timothy Mitchell, *Rule of Experts: Egypt, Techno-Politics, Modernity* (Berkeley: University of California Press, 2002), 92. Mitchell argues that land surveys and maps of Egypt by Europeans did not produce a more accurate view of the world, but rather simply redistributed forms of knowledge.

such, this dissertation is as much a social and cultural history as it is a history of science or an intellectual history. It is concerned not about the history of science, per se, but rather about the contested authority between experts in science and other professions (engineers, clockmakers, diplomats, etc.) and the population over standardized time keeping.

For late Victorians, the close relationship between science and cultural context would not seem that strange. As Bernard Lightman suggests, "Victorian science and culture were inextricably linked in the eyes of the Victorians themselves, scientists and non-scientists alike."[15] Lightman continues that "in defining knowledge, human cultures often define themselves; by ordering nature to conform to a particular pattern, scientists and intellectuals frequently reveal the social order for which they yearn."[16] The way Victorians ordered the natural world reflected their desires for their own society.

The same can be said of their timekeeping practices. Victorians were eager to manage and control what they could about the changing world around them. The period was one of constant flux. Europe had entered a period of relatively unstable great power politics, with a newly unified Germany, a turbulent Ottoman empire, and a zero-sum competitiveness motivating all the great powers. Meanwhile, the global economy was in recession. Mass urban poverty, along with accelerating industrialization, led to mass social movements, including demonstrations for fair work hours and wages, and early activism for the enfranchisement of women. The beginnings of the American economic powerhouse threatened imperial powers already fraught with rivalries, and, as John Tosh

[15] Bernard Lightman, Ed., *Victorian Science in Context* (Chicago: University of Chicago Press, 1997), 3.
[16] Lightman, 11.

argues, the new imperialism of the late 19th century was not an assertion of strength but a symptom of weakness and masculine insecurity about the future.[17] Victorians turned to religion and science alike in a search for answers. Scientists categorized and measured the world, human societies included, in fields from botany to metrology to phrenology.[18] Accurate and standardized timekeeping was among the goals of these new sciences, and it was perceived to be an attainable and attractive prospect. If the world was in flux, time, at least, could be controlled.

Victorian science inherited its tendency to catalogue, measure, and take inventory of the natural world from the Enlightenment, which "was concerned with subjecting every aspect of human life to reason."[19] But Victorian science differed from that of the eighteenth century in several ways. As Jim Endersby suggests, these changes were the result of three central influences, "the reception of Darwinism, the consequences of

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[17] John Tosh, *Manliness and Masculinities in Nineteenth-Century Britain* (Harlow: Pearson Education, 2005), 194-5, 208.

[18] For a look at the way science and religion interacted, see Jonathan Topham, "Science, Natural Theology, and Evangelicalism in Early Nineteenth-Century Scotland: Thomas Chalmers and the Evidence Controversy," in Livingstone, Hart, and Noll, eds., *Evangelicals and Science in Historical Perspective.* (Oxford: Oxford University Press, 1999), 142-174. Topham suggest that evangelicalism was not inherently opposed to scientific study. For Metrology and Victorian science, see Simon Schaffer, "Metrology, Metrification, and Victorian Values" in *Victorian Science in Context*, Bernard Lightman, Ed. (Chicago: University of Chicago Press, 1997), 438-474.; Malcolm Cooper and Jim Grozier*, Precise Dimensions: A History of Units from 1791-2018* (Bristol: IOP Publishing, 2017).; John Perry, *The Story of Standards* (New York: Funk and Wagnalls, 1955). On Phrenology, see David De Giustino, *Conquest of Mind: Phrenology and Victorian Social Thought* (London: Croom Helm, 1975).; Roger Cooter, *The Cultural Meaning of Popular Science: Phrenology and the Organization of Consent in Nineteenth-Century Britain* (Cambridge: Cambridge University Press, 1984). On botany and imperialism, see Richard Drayton, *Nature's Government: Science, Imperial Britain, and the 'Improvement' of the World* (New Haven: Yale University Press, 2000). On nineteenth century women and botany, see Judith Page and Elise Smith, *Women, Literature, and the Domesticated Landscape, 1780-1870* (Cambridge: Cambridge University Press, 2011). For a literary analysis of Victorian anxiety, including concerns about Darwin and botany, see U.C. Knoepflmacher and Logan Browning, Eds., *Victorian Hybridities: Cultural Anxiety and Formal Innovation* (Baltimore: John Hopkins University Press, 2010), especially the chapter by Johnathan Smith, "Domestic Hybrids: Ruskin, Victorian Fiction, and Darwin's Botany," 117-126.

[19] Anthony Pagden, *The Enlightenment and Why it Still Matters* (New York: Random House, 2013), 20.

empire, and the emergence of a scientific profession."[20] Of these three, Darwinism was perhaps the most revolutionary. It presented a fundamental challenge to the natural theology of Christian Europe. As Barbara Gates writes, "changes in perceptions of the natural order shook Victorian culture to its core."[21] Darwinism was the most influential of these changes. It was not so simple as a two-sided conflict between Darwinian atheists and devout Christians. Quite the opposite. Darwinists were trying to reconcile nature, God, and humankind. As Marxist historian Robert Young shows, most Darwinists were not anti-religious, rather they saw in evolutionary theory a grander view of God's plan.[22] Young suggests that "controversies between nineteenth century biologists were part of a broader debate concerning humanity's place in nature, and that discussions on scientific, economic, philosophical, political, social, and religious issues took place within a common context, no part of which was isolated from others."[23] This context of finding man's place in nature, and by extension, in God's plan, was the same context into which the time debates entered in. Finding and following the 'true' time had a religious imperative for many Victorians, including the controversial astronomer Charles Piazzi Smyth.

[20] Jim Endersby, *Imperial Nature: Joseph Hooker and the Practices of Victorian Science* (Chicago: University of Chicago Press, 2008), 3.
[21] Barbara Gates, "Ordering Nature: Revisioning Victorian Science Culture," in Lightman, 179. James Moore has also argued against the simple Christian vs. science narrative, suggesting that Christian theology was congenial to modern science. James Moore, *The Post-Darwinian Controversies: A Study of the Protestant Struggle to Come to Terms with Darwin in Great Britain and America, 1870-1900* (Cambridge: Cambridge University Press, 1979). For an overview of the debates surrounding Darwinism, see Peter Bowler, *Evolution: The History of an Idea* (Berkeley: University of California Press, 1984).
[22] Robert Young, *Darwin's Metaphor: Nature's Place in Victorian Culture* (Cambridge: Cambridge University Press, 1985), 10-14.
[23] Lightman, 6.

The second theme embedded in the history of Victorian science, the consequences of empire, has been well explored. Richard Drayton, author of *Nature's Government: Science, Imperial Britain, and the 'Improvement' of the World* argues that "science and technology were implicated in many aspects of late nineteenth century imperialism. The knowledge of nature, applied to navigation and war, enabled conquest."[24] Meanwhile, as scholars like Suzanne Zeller and Tamson Pietsch have suggested, imperial networks of scientists and academics facilitated the transfer of knowledge that enabled colonialism.[25] As noted above, much of the substance of Victorian science was what Zeller calls the science of inventory – it involved taxonomy, land surveys, standardized measurements (of time included), categorization, and organization of the natural world, all so that the natural world could be put to use.[26] This emphasis on the science of inventory was born out of the Enlightenment in the eighteenth century, but was carried out well into the Victorian period, especially by amateur natural scientists in Europe. This sort of knowledge was particularly useful to colonial administrators in exploiting the natural resources of their colonies.[27] The argument that imperialism was born out of weakness and anxiety, not strength, was true of scientific institutions as well, as Drayton demonstrated was the case with Kew Gardens in the mid-nineteenth century.[28]

The third unique characteristic of Victorians science, professionalization, is perhaps the most important factor in differentiating Victorian science from that of the

[24] Drayton, *Nature's Government,* 229. See also Suzanne Zeller, *Inventing Canada: Early Victorian Science and the Idea of a Transcontinental Nation* (Toronto: University of Toronto Press, 1987), 6.
[25] See Zeller; Tamson Pietch, *Empire of Scholars* (Manchester: Manchester University Press, 2013).
[26] Zeller, 269. See also Nanni.
[27] See Mitchell, 84-93.
[28] Drayton, 172.

previous century. As Endersby writes, at the beginning of Queen Victoria's reign, there were practically no professional scientists. By the end, however, "they were "a highly visible, influential, and respectable group…scientific expertise had helped to restructure their country."[29] The story of professionalization was not, however, "a drive towards the dignity of professional status."[30] For a long time "British men of science still saw themselves as disinterested gentlemen, not as scientific tradesmen," and relied on gentlemanly codes of courtesy, not professional status to define themselves.[31] As Drayton points out, committing to becoming a professional scientist might mean a life of poverty, as science was previously the purview of the wealthy (or of those with wealthy patrons).[32] But whether by gentlemanly codes or by professional membership, the question at the heart of scientific participation was "who could participate and on what terms."[33] Middle class fears about working class radicalism caused them to delegitimize working class forays into science, as Anne Secord has shown in her article "Science in the Pub."[34] Women were similarly excluded, though they found ways to participate, especially as promoters and publicizers of popular science, acting as disseminators, rather than as producers, of legitimate scientific knowledge.[35] Agnes Clerk, for example, was one such

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[29] Endersby, 1.
[30] Endersby, 2. Amateurs continued to operate alongside professionals. See Philippa Levine, *The Amateur and the Professional: Antiquarians, Historians and Archaeologists in Victorian England, 1838–1886* (Cambridge: Cambridge University Press, 1986).
[31] Endersby, 2, 30.
[32] Drayton, 178.
[33] Anne Secord, "Science in a Pub: Artisan Botanists in Early Nineteenth-Century Lancashire," *History of Science* xxxii (1994): 299.
[34] Secord.
[35] Secord, 297.; Lightman.; Iwan Rhys Morus, "Manufacturing Nature: Science, Technology and Victorian Consumer Culture" *The British Journal for the History of Science* 29 No. 4 (1996): 403-434. See also Marilyn Ogilvie, "Obligatory Amateurs: Annie Maunder (1868- 1947) and British Women Astronomers at the Dawn

popular science author who had considerable success, but when she began writing works that were less accessible and more technical, she was attacked by professional astronomers for overstepping her bounds.[36] As Bernard Lightman writes, "the question of who should participate in the making of science was still unresolved during the Victorian period."[37]

Professionalization could only work if it claimed the same type of legitimacy that gentlemanly science had previously enjoyed. To do so, professional societies engaged in the invention of tradition, establishing symbolism and rituals that invoked authority. In doing so, they reduced the ability of outsiders to engage in the construction of scientific knowledge.[38] In the case of timekeeping, professional difference gave some voices more weight than others. Railway engineers like Sandford Fleming found it hard to convince

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of Professional Astronomy" *British Journal for the History of Science* 33 (2007): 67-84. For more on the study of popular science, see Roger Cooter and Stephen Pumfrey, "Separate Spheres and Public Places: Reflections on the History of Science Popularisation and Science in Popular Culture," *History of Science* 32, No. 3. (1994): 237-267.

[36] Lightman, 204.

[37] Lightman, 204. For more on the relationship between professionals and amateurs, see Levine, *The Amateur and the Professional,* which focuses on the relationship between antiquarians, archeologists, and historians; Roy Porter, who discusses geology as a case study of how gentlemanly amateurism persisted as an ideal throughout the nineteenth century despite professionalization. Roy Porter, "Gentlemen and Geology: The Emergence of a Scientific Career, 1660-1920," *Historical Journal* 21, No. 4 (1978): 809-36.; Roy Porter, *The Rise of Statistical Thinking 1820-1900* (Princeton: Princeton University Press, 1988). T.W. Heyck shows how early Victorians did not conceptualize any group of people known as intellectuals, but by the end of Victorian period they had adopted this idea. Intellectuals almost became a 'class' as a result of the rise of natural science, the reform of universities, and the tradition of culturally oriented criticism of society – intellectual became aloof, self-isolationist, and specialized. T.W. Heyck, *The Transformation of Intellectual Life in Victorian England* (London: Croom Helm, 1982). D.S.L. Caldwell and David Knight both demonstrate the process by which science became specialized, abandoning open and fluid boundaries across various fields of study. David Knight, *The Age of Science: The Scientific World-view in the Nineteenth Century* (Oxford: Basil Blackwell, 1986).; D.S.L. Cardwell, *The Organisation of Science in England* (London: Heinemann, 1972).

[38] Albert Pionke. *The Ritual Culture of Victorian Professionals: Competing for Ceremonial Status, 1838-1877,* (London: Routledge, 2013). On invented traditions, see Eric Hobsbawm and Terence Ranger, *The Invention of Tradition* (Cambridge: Cambridge University Press, 1992).; Simon Schaffer "Metrology, Metrification, and Victorian Values" in Lightman, 442.

professional astronomers and navigators of the need for a new civic time system to work alongside the exclusive scientific time that astronomers wanted to establish. Profession, not nationality, determined where the battle lines were drawn at the International Meridian Conference in 1884.

In this context, achieving temporal homogeneity was not a simple task, nor was it a quick one. The period under scrutiny, between about 1876 and 1913, lies right in the middle of a transition from one timekeeping system to another. By the late twentieth century, standard time zones had become widely accepted, albeit with significant regional variations and riddled with exceptional cases. At the start of the nineteenth century, in contrast, local time was the dominant timekeeping method. The period in between saw a slow, faltering, and ultimately incomplete process by which the world shifted from the use of local time to a global standard time system, during which there was no such consensus about the proper way to order time among professionals of various types, amateurs, or the public at large.

The primary cause of the change in timekeeping practise, from local time to standard time, is fairly easy to identify. New technologies were largely responsible, particularly the train, steamship, and telegraph. They facilitated the ability to travel and communicate at a pace fast enough that time differences now mattered in a way they never had before. Changing the way time was measured was a necessity in order to make safe and efficient use of the train in particular. But that is not what this dissertation is about. Such technological determinism is, at best, uninteresting, and at worst, overly simplistic and misleading. After all, as Paul Glennie and Nigel Thrift have argued, the scope of human ambition and motivation often outpaces the invention of technologies that support those ambitions.[39] Ideas about ordering time differently are much older than trains. As such, this dissertation poses a more ambitious question than, 'what caused the creation of global standard time?' which almost inevitably leads to a whiggish discussion about railroads, telegraphs, and steamships driving progress towards a utopian modern future. Instead, this dissertation begins with the question, 'why did the global system of standardized timekeeping set up in the decades around the turn of the 20th century take the form that it did?' This question opens up more varied avenues of investigation, taking into account the social, political, cultural, and economic context of the time reform debates.

The answer to this question has dozens of facets, but there are two observations that are core to the argument of this dissertation. First, this dissertation forefronts the importance of individual agency – within professional boundaries – in the story of standard time and, more broadly, in the shaping of normative behaviour, in the construction of knowledge, and in diplomatic relations. This is different from previous histories of time reform, which tend to endow one of two things with the transformative power behind the shift to modern timekeeping. One of those, as discussed above, is technology. There is a body of literature on the history of time measurement which focus on technical advances, such as the invention of new clocks and methods of determining longitude. David Landes' *Revolutions in Time*, for example, describes the way European

[39] Paul Glennie and Nigel Thrift, *Shaping the Day: A History of Timekeeping in England and Wales, 1300-1800* (Oxford: Oxford University Press, 2009), 40.

clockmakers contributed to the modern world through their innovations. Landes' goal was to write "a general history of time measurement and its contribution, for better or worse, to what we call modern civilization."[40] He traces the mechanical evolution of the clock. The implementation of a global standard time at the end of the nineteenth century, along with the amazing accuracy of time measurement in the modern era through the use of quartz in timepieces, is Landes' climax. Clock time could at last be relied upon, and thus in the modern world "submission to time is the price of modernization, productivity, potential affluence."[41] Landes' work, although extensively researched and a valuable contribution, is limited by its adherence to the history of progress through technological advancement, for which Ogle has recently criticized it, calling it overly triumphalist.[42] In particular, Ogle chastises Landes' uncritical celebration of European innovation in contrast to Chinese shortcomings. Derek Howse's *Greenwich Time* also tells the story as a triumphant tale of ingenuity, driven not by ordinary people, but by specialists, in particular astronomers and navigators.[43] More recently, scholars have begun to critique such triumphalism. Peter Galison's 2003 book *Einstein's Clock's, Poincaré's Maps,* like Howse's work, traces the creation of standard time and the global coordination of time measurement, but is something of an improvement in that Galison emphasizes that time standardization was closely related, in France at least, with the country's colonial

[40] David Landes, *Revolutions in Time: Clocks and the Making of the Modern World* (London: Harvard University Press, 1983), xv.
[41] Landes, 360.
[42] Ogle, 11.
[43] Derek Howse, *Greenwich Time and the Discovery of the Longitude* (Oxford: Oxford University Press, 1980), 81.

ambitions.[44] Indeed, what Galison's book does best is to point out how much the standardization of time was not a standalone technological achievement. Politics, economics, science, diplomacy, and philosophy all played their role. The story of time coordination was not just one of "ever more precise clocks," but of "physics, engineering, philosophy, colonialism, and commerce."[45] Stephen Kern, meanwhile, tries to show that cultural perceptions of time changed just as much as technological ones, making the claim that the period actually saw a backlash against modern and public timekeeping, and instead represented a reassertion of private time and resistance to collectivizing forces.[46] A similarly revisionist effort to move away from technological determinism is found in Glennie and Thrift's book *Shaping the Day.* This book represents a forceful rejection of the idea of a technological march of progress, as if every stage of history was leading towards the eventual "triumph of time" in the modern world (either that or the opposite, pessimistic equivalent, in which clock time was the cause of all the ills of the modern world). Glennie and Thrift again accuse Landes of this sort of technological triumphalism.[47] In order to escape that trap, Glennie and Thrift redefine clock time, calling it "a number of *concepts*, *devices*, and *practices* which have meant different things at different times and places."[48] Taking this definition as a starting point, they argue that the most preeminent aspect of time measurement is not that it forms a straight line of progress, but that the sheer variety of time measurement practices which exist and have

[44] Peter Galison, *Einstein's Clocks, Poincaré's Maps: Empires of Time* (New York: W.W. Norton, 2003).
[45] Galison, 40-41.
[46] Stephen Kern, *The Culture of Time and Space, 1880-1918* (London: Harvard University Press, 1983), 6, 8, 16-17, 34, 64.
[47] Glennie and Thrift, 8-9, 50-51.
[48] Glennie and Thrift, 9.

existed is enormous. By arguing this, Glennie and Thrift do not mean to suggest an outright cultural relativism, of which they are somewhat skeptical, but rather that time is a "historically variable process."[49] Timekeeping practices change, certainly, but they do not necessarily progress towards a single point (or even evolve *from* a single point, for that matter). Though Glennie and Thrift keenly oppose the technological determinism found in Landes' *Revolution in Time*, they are not opposed altogether to exploring the evolution of timekeeping devices themselves. But they emphasize that ideas drove technological developments, not the other way around.[50]

Works like Landes and Howse, despite their problems, are essential background for understanding what was at work in the 1880s. Technology expands the parameters within which humans can act. But it does not entirely explain why people act as they do within those parameters. In other words, understanding technological advances is necessary, but not sufficient, to explain the shape of the global system of time measurement that was established.

The second thing historians point to as the driving force behind time reform is the concept of national interest. Considerable attention, for example, has been given to the rivalry between Britain and France at the IMC. Peter Galison, for example, writes the history of the IMC from the perspective of France.[51] Withers, too, spends much of his discussion about the conference on the conflict between Britain and France.[52] More

[49] Glennie and Thrift, 13.
[50] Glennie and Thrift, 24.
[51] Galison, 144-155.
[52] Withers, 185-216. Withers' scope is ambitious and has good analysis about continuity and change of an idea over a century, but he also makes several misquotes or attributes a speech to the wrong person: on

broadly, Vanessa Ogle has made a convincing case for the primacy of the nation state in spite of internationalist rhetoric in the diplomacy of the nineteenth and twentieth century.[53] Yet this dissertation argues that individual personalities and professional memberships mattered much more in shaping time reform than Ogle and others allow. It was not some disembodied entity called 'Britain' sitting in the swelteringly hot room at the State Department in Washington in late 1884, but individuals of various skillsets who happened to be from that country. Deep fault lines existed between representatives from the same country, which have been papered over unintentionally by most histories of the IMC.[54] Indeed, this dissertation makes the case that the real conflict at the IMC was not between nations, but between professions – as astronomers and engineers, regardless of nationality, engaged in a heated debate about the very purpose of the gathering.

This leads us to the second broad argument of the dissertation. Standard time took the form that it did in large part because of a disagreement about the very nature of temporal knowledge – was it a public good to be shared freely? A commodity to be sold? Or a scientific tool to be entrusted only to those with the professional expertise to put it to good use? Although this debate is rarely acknowledged directly by the historical figures involved, their opinion on the various positions of the debate underlies nearly all of their actions. And this debate was not confined to the halls of diplomatic courts. The nature of temporal knowledge was discussed everywhere from the poor quarters of British cities to Indigenous communities in Ontario to astronomical observatories across the globe.

page 196, "additional meridian for longitude" should be "standard meridian for longitude." On page 209, Withers attributes to Cleveland Abbe a speech which was actually spoken by William Allen.

[53] Ogle.

[54] Barrows is the exception here.

The consequence of these debates over the nature of temporal knowledge was the creation of a paradoxical situation in which some experts prescribed restricting and controlling who had access to accurate time, even as others attempted to universalize and globalized it. In some ways, this meant that international efforts in the 1880s to standardize time across the globe through a system of time zones actually ended up making access to 'true' time inequitable. Scientists and diplomats at the IMC envisioned universal time as a specialized tool for astronomical, nautical, and other scientific endeavours. To them, universal time was universal only in the sense that it could be used to determine the time anywhere on the globe – if you had the correct tools and education. It was not universal in the sense that it was to be used by everyone. To them, accurate time was an exclusive resource. To reformers like Sandford Fleming, on the other hand, this exclusionary attitude was a travesty. Fleming believed that authoritative, standardized time ought to be accessible to everyone.

Under Fleming's plan, local time would be being replaced with a universal system usable all the world over. But the realities of limited technology, combined with the desire of astronomers for professionally limited access to legitimate temporal knowledge, meant that while the new universal time gained legitimacy, its reach remained limited, allowing older, more accessible forms of time to continue to exist alongside it. This situation made timekeeping complicated. By establishing a universal standard time, scientists forced local timekeepers to refer and compare their old temporal authority to a higher power (Greenwich) – or at least find ways to legitimize the source of their own time. The local church bell may have maintained its independent legitimacy, but its operators now had to compete with other sources of time, or connect themselves to Greenwich time, to stay relevant.

The dissertation is organized into five chapters. Using Canadian engineer Sandford Fleming as our guide into the subject, chapter one follows the idea of standard time from its inception, though various stages of advocacy and lobbying, to the planning and organization of the IMC. It argues that Fleming, as a railwayman and engineer, was an outsider to the scientific community whose proposals prevailed at the IMC. Fleming's notion of universal time for widespread public use was rejected by astronomers and navy personnel, who instead resolved to create an accurate, standardized time system as a tool for specialized tasks, such as navigation and astronomical observation. It was an exclusive, professional project which they went to the 1884 conference to establish. As such, (and also because of Canada's dominion status within the British empire) Fleming found it incredibly difficult to earn himself a seat at the very conference which he initiated.

Chapter two shifts the focus from Fleming to the scientific community. It uses case studies of three individuals, Annie Russell, William Parker Snow, and Charles Piazzi Smyth, to explore the professional boundaries of Victorian science, and place the time debates in the context of the intellectual mood of the period. It argues that the results of the IMC cannot be understood without this context, as participants could not remove themselves from the cultural baggage which they carried, such as the tension between the amateur and the professional. There were rules of etiquette which defined and regulated the class of peoples who were allowed to weigh in on the subject of standardized time.

Modern science was becoming an exclusive and insular pursuit, and this shaped the way scientifically inclined delegates at the IMC understood universal time.

Chapter three picks up the narrative of the IMC, describing day by day the debates that took place in Washington itself. It confirms what the previous chapters set up: that professional difference, rather than national difference, was at the heart of the debate, and is the key to understanding the results of the IMC. Historians that call the IMC a failure have not recognized that the scientific community got exactly what it wanted at the IMC – a universal time that was limited to use by professionals.

Chapter four again broadens the scope of the dissertation, moving away from politics and diplomacy to explore how these time reform debates were understood by the general public in Britain. It asks who had access to accurate time, and, more importantly, who did not. Of course, this is not intended to be a comprehensive discussion of all the ways timekeeping manifested itself in British culture. Instead, it is a collection of a few particularly illustrative examples of the conflicting ways in which the decisions of the IMC percolated into the British public sphere. The evolution of a time-selling industry, including the careers of Maria and Ruth Belville, who sold Greenwich time door-to-door, form a central part of this chapter, which examines the commodification of accurate time in the wake of the IMC. This chapter is all about legitimacy and the construction of authority, as universal time was both mocked as excessive by some of the public and coveted as a symbol of status and modernity by others.

Like the previous chapter, chapter five presents some illustrative examples of how timekeeping in North America changed dramatically in the late 19th century – but it is not intended to be an exhaustive account. It directs much of its attention towards the attempt to reshape public norms of behaviour through education in North America. Reformers failed to enforce standard time in North America by law, so they turned instead to schools as an instrument for shaping public behaviour. Standard time was disseminated through curriculum itself and through the schedule and structure of the day. The results were mixed, leaving a complicated relationship to standard time in place well after its introduction in 1883.

Like any dissertation which examines a transnational topic, the argument does have its limitations. Perhaps most apparent is that the dissertation is largely Anglo-centric. It draws primarily from American, British, and Canadian repositories, and therefore does not claim to be all encompassing, though it does try to be cognizant of the selection bias of the archives, and tries to insert non-Anglo voices wherever they crop up. Japanese, Russian, Turkish, Italian, Peruvian, Spanish, French, Caribbean (particularly Dominican), and Indigenous North American voices can all be found within. The motivations, challenges, and contributions of these peoples shaped the conversations at the IMC and beyond just as fundamentally as Anglo ones, and it is the hope of the author that although they are not front and centre in this account, their presence is evident and their influence is felt throughout.

Similarly, the archival record is uneven across subjects and geographies – records are more complete in some places than others, and differ in type and content in different locations. In Canada and America, for example, the records concerning standard time are largely found in private personal papers, whereas in Britain, a large and meticulous imperial bureaucracy ensured that a detailed and comprehensive government record of the period has survived for the historian's perusal (with exceptions, such as the papers of the British Science and Art Department, which have mostly been lost or destroyed). These variations in the archival record inevitably change the way the histories of these areas are written. This dissertation's discussion of educational curriculum in Canada is perfunctory, for example, largely because the author's attention was drawn to the subject of timekeeping in Canadian education not via government documents or official curricula, but via the personal papers of reformer Sandford Fleming. The discussion is therefore written with the assumption that the fact that reformers wanted to use curriculum to reshape public behaviour is in itself important. The extent to which they succeeded – and to which timekeeping entered into official curricula – is harder to gauge, but that does not make the attempt any less significant.

Lastly, this dissertation deals somewhat unorthodoxly with the scale of its analysis. While half the dissertation (chapters one and three) might be considered a narrowly focused microhistory of the International Meridian Conference, the dissertation then zooms out somewhat unceremoniously for chapters two, four, and five, incorporating a much broader scope of peoples and places into the analysis. These chapters explore the ramifications of the Meridian Conference and time reform in general in British, Canadian, and American society and culture at large. This approach has both benefits and challenges. On the one hand, it allows the events of the conference to be set in a broad context, without which the actions of its main actors might easily be misinterpreted. It also allows one to see the broad ramifications of the comparatively tiny gathering. On the other hand, this method can be problematic in that the wide-lensed chapters sacrifice some of the attention to detail, careful chronology, and scrutinization of minutiae that was possible when looking directly at the IMC. This means that those wide-lensed chapters are selective and illustrative, rather than comprehensive in their approach. They should be read with the understanding that the are meant to pick out key examples and highlight transformative moments, rather than to be comprehensive accounts of all timekeeping in all of Britain, America, and Canada across three turbulent decades. Nonetheless, this trade-off allows these chapters to provide vivid case studies which help the modern reader grasp vicariously the experience of those peoples arriving at a radical new way of looking at something fundamental. Late nineteenth-century Victorians were grappling with new and uncertain changes in timekeeping to which we have since become accustomed. Revealing those moments of uncertainty, conflict, and ingenuity is something that this structure excels at.

To summarize, this dissertation argues that universal time was intended by scientists of the late nineteenth century to be a specialized tool for the use of professionals. These professionals – astronomers and navigators for the most part – were part of an international network which had its own malleable but distinct rules of membership and behaviour, shaped by a particular set of ideas about masculinity, class, race, and the nature of expertise. Reformers outside of this professional network but supported by their own circle of influence in commerce and engineering, like Sandford Fleming, offered a competing vision of modern timekeeping which was meant for use by everyone. The uneasy coexistence of these two competing visions, alongside older practises, such as the adherence to local time, led to a perplexing array of apparently authoritative sources of time. Continual changes made it difficult for ordinary people to be sure of the ‘correct’ time. Adherents to one timekeeping system or another claimed legitimacy, emphasizing its desirable ‘modernity’ for various reasons, not least for the commercialization of time. Some enterprising individuals and organizations aimed to control access to the ‘true’ time, but they were never altogether successful. Most people used the time that was convenient and profitable to them, finding alternative forms of access where necessary. The expensive, scientific time established by astronomers would not become accessible to everyone until well into the twentieth century following improvements in wireless technology. The intervening decades, with their comparatively chaotic timekeeping practices, are rich with evidence for the historian to learn about the nature of expertise, authority, and the construction of norms in a complex society.

Chapter 1: "Running full tilt against common sense": Scientific and Bureaucratic Objections to Standard Time, 1876-1884

One summer day in Ireland, Sandford Fleming missed a train. So begins one of the more prevalent myths about the origins of standard time.[1] According to this tale, a misprinted railway schedule caused Fleming, a Canadian railway engineer on holiday, to lose a day of travel, causing him to ponder the problems caused by inconsistent timekeeping. How could the variety of local times be standardized for everyone's convenience? The result of his musings, the story goes, was a system of twenty-four-hour time zones, a system now used almost universally across the globe.

Like many apocryphal tales, this story has a kernel of truth. It comes from a reliable source: Fleming described the event in his earliest pamphlets on time reform.[2] There is no reason to believe it did not happen, though historian Ian Bartky has uncovered discrepancies in the details of Flemings account. There is, for example, some misinformation about the relationship between date of the train event and the publication of Fleming's first paper on time reform.[3] Dating controversies aside, it is more than likely that the event in some form happened. Fleming missed that train.

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[1] See Clark Blaise, *Time Lord: Sir Sandford Fleming and the Creation of Standard Time* (New York: Pantheon Books, 2000), 75-77.; Lawrence Burpee, *Sandford Fleming: Empire Builder* (London: Oxford University Press, 1915), 211-212.; and Lorne Green, *Chief Engineer: Life of a Nation Builder – Sandford Fleming* (Toronto: Dundurn Press, 1993), 56-57. These biographies all make use of the missed train story. Ian Bartky has levelled some criticism at them for this. See Ian Barkty, *One Time Fits All: The Campaign for Global Uniformity* (Stanford: Stanford University Press, 2007), 51.; Bartky, "Sandford Fleming's First Essays on Time," *NAWCC Bulletin* 50, no. 1 (2008): 5.

[2] Sandford Fleming, *Uniform Non-Local Time (Terrestrial Time)*, (Self-Published, 1878), 5. https://archive.org/stream/cihm_03138#page/n11/mode/2up

[3] Bartky, *One Time Fits All*, 51.; Bartky, "First Essays on Time," 6-8. Barkty points out that the first paper was not published until 1878, 2 years, rather than 'a few weeks' after the train incident, as Fleming claimed (Bartky suggests Fleming's use of 'a few weeks' was merely a literary device). I believe it is more likely that Fleming did write the paper shortly after the train incident, and simply did not publish is for several years, when, feeling pressured to publish before someone else did (like Cleveland Abbe), he took

So why call it a myth? It is because, like most origin stories, the missed train story simplifies a much more complicated sequence of events. It does not matter whether Fleming missed a train or not. Standard time as we know it today was not the result of a single ingenious inventor's lightbulb moment. Fleming, and other claimants to the title of inventor of standard time, such as William Allen, Cleveland Abbe, and Charles Dowd, responded to a particular set of circumstances. Modern standard time resulted from a process involving these people, but not as lone 'inventors.' They were more like proponents or activists; champions of a cause which could not be implemented by them alone. This chapter does not deny credit where credit is due, nor diminish the accomplishments of these figures. But the concept of 'invention' misrepresents the nature of their contribution and omits the voices of other interested parties who played just as large a role in setting up standard time. The invention narrative is ahistorical, ignoring the context, the ways in which various factors shaped standard time and its implementation. The personalities mattered, but so did the social, political, cultural, and religious world into which they were embedded.

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steps to circulate his ideas. It is clear at least that he did try to present a paper about time reform with the British Association in 1876, and Fleming's own personal bibliography states that a "Memoir on Uniform, Non-Local Time" was published in 1876 (an inaccurate claim, but perhaps this is merely describing the paper he tried to present at the British Association. The 1876 date is the date it was written, then, not a publication date). See Lawrence Burpee, Bibliography of Sir Sandford Fleming, March 27, 1907, Vol 7, Fleming Papers, MG29 B1, Library and Archive Canada (LAC). Fleming also told Charles Dowd in 1883 that he wrote it after the train incident in 1876, but again he may have been motivated to give the earlier date when the question of credit was in the air. Sandford Fleming to Charles Dowd, December 11, 1883, Vol 65, Fleming Papers MG29 B1, LAC.

Squabbles over credit were well underway in 1904 when William Allen attacked Charles Dowd's claim in favour of his own.[4] Even earlier, Fleming had likely rushed to print in 1878 to avoid being beaten to the punch by Cleveland Abbe and the American Metrological Society.[5] Even if we could pick a 'winner,' the selection tells us nothing useful. Dowd undoubtedly came up with the idea first, but was ignored. Fleming's idea was the one that was adopted - with modifications - after joining forces with Cleveland Abbe. Meanwhile, William Allen played the largest role in getting that idea implemented on North American railroads. We also should not forget the European innovators like George Airy, who helped set up Greenwich time for use by the railroads in Britain in the 1840s and 50s, and the Russian astronomer Otto Struve's work in the early 1870s on the Prime Meridian.

Rather than agonizing over singular moments of invention, this chapter examines more closely the process by which the idea of standard time was brought before the international community. There was nothing inevitable or preordained about the process, and there was considerable opposition to any change. In fact, the adoption of standard time can be reconsidered as a fine example of resistance to innovation. We will use Fleming as our guide into the subject, looking first at his early publications and his (often fruitless) struggle for recognition. We then turn to his widening search for allies on both sides of the Atlantic, where once again he had difficulty obtaining acceptance from the established scientific community, turning instead to fringe organizations and disreputable

[4] William Allen, *Short History of Standard Time* (Philadelphia: Stephen Greene Printing Company, 1904). British Library (BL).
[5] Bartky, "First Essays on Time."

intellectuals. Finally, we demonstrate how Fleming was nearly excluded from the political process of establishing a common Prime Meridian for timekeeping. This exclusion was a result of international norms, imperial realities, and interdepartmental rivalries, each part of a ramshackle system of global governance that shaped the boundaries of what was possible for an independent innovator like Fleming.

Fleming was an outsider. Even if he did have that lightbulb moment while waiting for a train, the challenges he faced while bringing that idea to the world tell a more meaningful story, one far more revealing about how global changes were negotiated and implemented in the late nineteenth century.

Before diving into the morass of ideas that competed for prominence in the time debates of the 1880s, it is important to set the stage. Until the 19th century, residents of most cities and towns used local solar time without much difficulty or complaint. Rural areas too had their own unique and varied methods of time telling. The steam engine, the train, and the telegraph would change all this. Faster communication and travel made these differences in local time much more obvious, and even posed a danger to human life. Trains running on different local times and schedules could, and did, collide with devastating consequences.[6]

It is important to note that technological advances, like the railroads or telegraphs, do not explain everything. While discussions about time standardization did not occur until after the railway's invention, discussions of other types of time reform had been

[6] Most time related collisions were caused by poor signalling, both by human error or technological failure. The complicated railway schedules and conversions necessary to sort out the various local times made such mistakes more likely.

occurring for millennia. Calendar reform, for example, had been attempted and carried out several times over the centuries. Time reforms often had religious impetuses. Islamic scholars and Benedictine monks shaped their days with rhythmic consistency, for example.[7] The seas and tides shaped coastal time, and inspired navigational innovations, making use of the clock and of astronomical bodies to cross empty oceans. But human ambition tends to outpace technology. As Glennie and Thrift point out, ideas about measuring time "are not merely derivative of prevailing technologies. Typically, historical notions of clock time have been considerably more sophisticated than the abilities of clocks at those times to deliver on them."[8]

Nonetheless, we cannot ignore the fact that railways created new challenges for reformers to grapple with which were not present before. This meant that the earliest serious attempts at time standardization took place where railways took hold first: Great Britain. Given Britain's narrow longitudinal width, however, the notion of a single time for the island was sufficient: it did not take the next step to become a complex system with multiple time zones. There was no practical need for it. It is not surprising that it was on the wide North American continent, and to some extent in Russia, that zone time was developed.[9]

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[7] See David Landes, *Revolutions in Time: Clocks and the Making of the Modern World* (London: Harvard University Press, 1983).; Vanessa Ogle, *The Global Transformation of Time, 1870-1950* (London and Cambridge: Harvard University Press, 2015).; Avner Wishnitzer, *Reading Clocks, Alla Turca: Time and Society in the Late Ottoman Empire* (Chicago: University of Chicago Press, 2015).

[8] Paul Glennie and Nigel Thrift *Shaping the Day: A History of Timekeeping in England and Wales, 1300-1800* (Oxford: Oxford University Press, 2009), 40.

[9] Fleming himself says in an early paper that people in Europe cannot understand the problem faced in America or Russia, because of the differences in longitude. Sandford Fleming, *Time Reckoning*, 1879, Canadian and U.S. Papers on Time Reckoning, E.13.1, Cambridge Astronomy Library (CAL).

Advances in technology and the realities of geography can satisfactorily explain why a new system of uniform time was necessary, but it does not explain why it took the form that it did. The zone system is not particularly elegant or intuitive. The hour skips forward or back at arbitrary lines between zones. Many found it disruptive.[10] Indeed, upon implementation, many countries chose to use political boundaries that approximated longitudinal meridians, instead of using exact meridians, to mitigate the worst inconveniences of the zone system. It was, and is, by no means the perfect or natural way of organizing time. So why did the system of time measurement that was implemented take this form? The answer has little to do with technology. Instead, the system that was set up looks the way it does largely because of the particular idiosyncrasies of cultural and political relationships in the 1880s. These relationships include high level diplomatic interactions between states, but also personal and professional relationships. Chapter two will describe the existence of an international professional network of scientists, unofficial but nonetheless influential, who were largely responsible for shaping the discussion on time uniformity. In this chapter, I suggest that the most fervent proponents of standard time, especially Fleming, were not particularly welcomed by this scientific network. Many scientists opposed Fleming's reforms. As an outsider, Fleming's proposals concerning time and time measurement had to be filtered through a harsh process of scrutiny, rejection, and, occasionally, ridicule.

Fleming was an affluent white male, with useful political connections in Canada. From one perspective, however, he was an outsider as a railwayman and engineer, not a

[10] G. Wicksteed to Sandford Fleming, December 13, 1883, Vol 53, Fleming Paper MG29 B1, LAC.; G. Wicksteed to Sandford Fleming, December 22, 1883, Vol 53, Fleming Paper MG29 B1, LAC.

scientist. And railways, by the late 19th century, were about business and politics, not academic inquiry.[11] What is more, during the key period of his advocacy for standard time, Fleming was an unemployed railwayman, having been unceremoniously fired from the Canadian Pacific Railway in 1879. This gave him free time to devote to his cause, but weakened the authoritative capacity of his voice. His campaign was an uphill battle.

Fleming's very first attempt to share his time reform proposal met with rejection. After leaving Ireland for Scotland in 1876 (shortly after the missed train incident), Fleming attended the annual meeting of the British Association for the Advancement of Science (BAAS) in Glasgow, where he planned to give a presentation on uniform time. However, for unclear reasons, he never had the chance to present.[12] He tried again a second time at the BAAS meeting in August 1878, but was once again sidelined. Historian Ian Bartky suggests that given the pre-eminence of the other speakers in the British scientific community, it is unsurprising that Fleming, a relatively obscure

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[11] The railroad as a venue for the politics of nation building is a well-known theme in Canadian historiography, and the Railroad 'Robber Barons' of the United States are a similarly iconic snapshot of the economic and political influence Railways played in the 1880s. See Harold Innis, *A History of the Canadian Pacific Railroad* (Toronto: McClelland and Stewart, 1923). Innis' work on railroads underpins his later staples thesis. Gabriel Kolko, *Railroads and Regulation: 1877-1916* (New York: W.W. Norton & Company Inc., 1970). Kolko discusses the struggle for government regulation of the rail industry in the United States, suggesting that railway leaders themselves pushed for regulation. A.A. den Otter, *The Philosophy of Railways: The Transcontinental Railway Idea in British North America* (Toronto: University of Toronto Press, 1997). Den Otter discusses the railroad in Canada as a physical representation of an idea: of civilization being forged out of the wilderness, of an identity based on trust in progress. Ken Cruikshank, *Close Ties: Railways, Government, and the Board of Railway Commissioners, 1851-1933* (Montreal: McGill-Queen's University Press, 1991). Cruikshank suggests that by the 1880s the 'romance of steam' had evaporated in Canada, replaced with dissatisfaction about the business and regulation of railways. See page 4. Finally, Andrew Smith, *British Businessmen and Canadian Confederation: Constitution Making in an Era of Anglo-Globalization* (Montreal: McGill-Queen's University Press, 2008). Smith claims Canadian confederation owes its success to British investors, including investment in railways.

[12] Bartky, "First Essays on Time," 6-8.

Canadian, was bumped from the list of speakers.[13] It was not a promising start to Fleming's time reform campaign.

Fleming made one more attempt to air his ideas in Europe that year. He printed a version of his paper in French and hoped to have it read at Paris' Exposition Universelle by an American correspondent of his, Frederick Barnard. But Barnard was unable to attend the meeting.[14] Fleming was again out of luck. He returned to Canada in late 1878.

Fleming's earliest pamphlets on time reform were printed privately. They were not published by any scientific society. That important distinction troubled Fleming when Barnard informed him that the American Metrological Society (AMS), of which Barnard was President, was also beginning to discuss time reform. Fleming needed to get his work published by a respectable society immediately, or he would be bypassed by a publication of the AMS. Already, the process of exclusion by the established scientific community had limited Fleming's scope of action and possibility for recognition. Having been rejected by European scientific bodies, Fleming turned to the Canadian Institute, a professional society begun in 1849 as a forum for engineers and surveyors. It later became an advocacy group for the advancement of science in general. The institute was more than willing to publish Fleming's work, to no small degree because he was a founding member. Fleming had helped get the Institute up and running in 1849, however, he had not been involved for at least a decade when he sent his paper in 1878. But his prior connection was enough for Fleming to get a respectable publication with the

[13] Bartky, "First Essays on Time," 8. Speakers included William Thomson (later Lord Kelvin), David Gill, George Darwin, the Hydrographer of the Navy, Robert Ball, and the Earl of Rosse.
[14] Bartky, "First Essays on Time," 8.

backing of a professional society. What is more, he gained, through Barnard and the AMS, an ally who might otherwise have been his competitor: Cleveland Abbe, an American astronomer who had similar plans for unifying time.[15]

Fleming's early papers were full of mistakes and overly complicated methods, and his ideas were modified over time. Boiled down, however, his core arguments were consistent. Fleming advocated for three key changes. First, he wanted to replace the use of individual local times with twenty-four standardized zones around the world, each fifteen degrees wide, representing one temporal hour. Second, he wanted a single Prime Meridian for the world, from which to measure the zones. Meridians were used in navigation, and there were dozens in use in the 1870s, but a single, shared Prime Meridian had never been agreed on. Fleming did not particularly care where this new Prime Meridian was placed, though his favourite suggestion was one hundred and eighty degrees from Greenwich, in the middle of the Bering Strait. Finally, he advocated the use of a twenty-four-hour clock, eliminating AM and PM.

What Fleming lacked in academic standing, he made up for with political clout, at least in Canada. Through the Canadian Institute, he got his paper forwarded to the Governor-General of Canada, the Marquis of Lorne. Lorne forwarded it to the Colonial

[15] Cleveland Abbe to Sandford Fleming, March 10, 1880 (2 letters sent that date, both relevant), Vol 1, Fleming Papers, MG29 B1, LAC.; F.A.P Barnard to Sandford Fleming, March 18, 1880, Vol 3, Fleming Papers, MG29 B1, LAC.; F.A.P Barnard to Sandford Fleming, June 23, 1880, Vol 3, Fleming Papers, MG29 B1, LAC.; F.A.P Barnard to Sandford Fleming, July 6, 1880, Vol 3, Fleming Papers, MG29 B1, LAC.; See also Bartky, "First Essays on Time."

Secretary and asked that it be distributed to the principal scientific societies of Great Britain and other nations for comment.[16]

The response was not particularly encouraging. The Colonial Secretary ruled out any official government action, writing in October 1879:

> It has been the custom of Her Majesty's Government to abstain from interfering with recognized usages in questions of social importance until the spontaneous use of any novel system…has become so extensive as to make it desirable that authoritative regulations should be sanctioned…and it does not appear that such a condition of affairs…has yet arisen.[17]

The British Government opposed forcing any change in time reckoning on the public. It was a question with large implications for political philosophy: should government be able to regulate social norms to such a degree as to rearrange how subjects measure time itself? In 1879, the answer was decidedly no.[18]

The scientific community was skeptical. Members of the Royal Astronomical Society (RAS), for example, read the paper at their council meeting, but declined to offer any feedback.[19] The Royal Geographical Society (RGS) was more amenable, but doubted the feasibility of such a scheme. "There is nothing to be said against the proposal," wrote one member of the society, "except its impractibility, which is such that no scientific body is likely to urge it seriously."[20] It was not exactly a resounding endorsement. The

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[16] Memorial of the Canadian Institute on Time Reckoning and a prime Meridian, 1878-79. In Sandford Fleming, *Universal or Cosmic Time*, YA.2003.A.17994, BL.

[17] M.E. Hicks-Beach to the Marquis of Lorne, October 15, 1879, in Sandford Fleming, *Universal or Cosmic Time*, YA.2003.A.17994, BL. Colonial Secretary Hicks-Beach was likely paraphrasing George Airy.

[18] A few decades later, this would change. The introduction of Daylight Savings Time could be considered an experiment in enforcing changes in social behaviour. See Bartky, One Time Fits All, 161-200.

[19] Council Minutes, November 14, 1879. No 2, Vol 8, Royal Astronomical Society Papers, Part 1, Royal Astronomical Society Archives (RAS).

[20] Sir John Henry Lefroy's Report on Mr. Sandford Fleming's Proposals Respecting a Prime Meridian and Time Reckoning, November 19, 1879, RGS/CB6/1377, Royal Geographical Society Archives (RGS).

Royal Society (RS) took a similar position, stating that although they were disposed to support the idea, "no scheme of the kind would have much chance of success unless there were a general readiness on the part of civilized nations to seriously entertain the question."[21] In other words, there was a near-consensus in 1879 that Fleming's plan for a universal standard time was a pipe dream; laudable, but unachievable.[22]

The Astronomer Royal, George Airy, and the Astronomer Royal for Scotland, Charles Piazzi Smyth, were also asked for their opinions. As the highest astronomical authorities in Britain, their opinions carried great weight (Airy's more so than Smyth's, as we will see). Unfortunately for Fleming, neither was particularly impressed by his plan. Smyth predicted that local time would never be replaced, "no matter what beautifully-written schemes any few very learned men may propose in their closets."[23] Smyth's dismissal was harsh. His lengthy diatribe went on to condemn Fleming's choice of the Bering Strait as a possible Prime Meridian. Smyth was a fervent nationalist, and he was offended by the thought of placing a Prime Meridian so far from British civilization. Fleming's choice was therefore obscene to Smyth, who wrote that "it is in a part of the world where there are either no inhabitants at all, or, if a few do reside near one end of the line, they are a miserable driblet of wretched Kamschatkan savages, prowling with

[21] The Secretary of the Royal Society to the Colonial Office, November 6th, 1879, in Sandford Fleming, *Universal or Cosmic Time*, YA.2003.A.17994, BL.
[22] The admiralty also rejected the proposal on the basis that the public was not yet ready for such a change. The Lords Commissioners of the Admiralty Board to the Secretary of State for the Colonies, October 4, 1879, in Sandford Fleming, *Universal or Cosmic Time*, YA.2003.A.17994, BL.
[23] Charles Piazzi Smyth to Colonial Office, September 5, 1879, in Sandford Fleming, *Universal or Cosmic Time*, YA.2003.A.17994, BL.

difficulty for food over snowy wildernesses under the doubtful rule of Russia!"[24] Smyth's racially charged rhetoric was accompanied by political accusations. He called Fleming's global scheme, and internationalism in all its forms, communist (which he meant as a derogatory accusation). Fleming was, according to Smyth, "running full tilt against common sense."[25]

Rejecting the Bering Strait, Smyth proposed an alternative Prime Meridian. Although Greenwich, Britain's most prestigious observatory, seemed the obvious choice for a British nationalist, Smyth suggested instead that the centre of civilization ought to be shifted eastwards, since Britain now ruled over India. His choice for a Prime Meridian lay in between Britain and India: in Egypt, at the Great Pyramid of Giza.[26] Smyth's choice was also a product of his unorthodox belief that the pyramid held prophetic secrets foretelling the future of the British nation under God. His pseudo-scientific beliefs will be explored in more detail in Chapter two, but for now suffice to say that Fleming's standard time contradicted Smyth's own understanding of the world.

Airy wrote a similarly scathing, though more level-headed, dismissal of Fleming's ideas. "I set not the slightest value on the remarks extending through the early parts of Mr. Fleming's paper [referring to the elimination of local time, and replacing it with zone time, using a complicated system of notation that replaced the numbers 1-24 with letters]. Secondly, as to the need of a Prime Meridian, no practical man ever wants such a

[24] Charles Piazzi Smyth to Colonial Office, September 5, 1879, in Sandford Fleming, *Universal or Cosmic Time*, YA.2003.A.17994, BL.
[25] Charles Piazzi Smyth to Colonial Office, September 5, 1879, in Sandford Fleming, *Universal or Cosmic Time*, YA.2003.A.17994, BL.
[26] Charles Piazzi Smyth to Colonial Office, September 5, 1879, in Sandford Fleming, *Universal or Cosmic Time*, YA.2003.A.17994, BL.

thing."[27] Airy was not wrong about the lack of desire for a Prime Meridian. It had never been necessary.

A meridian is simply any line of longitude that runs from the north pole to the south pole. For navigation at sea, sailors could pick any meridian to be their baseline. Navigators would set a clock to match the time at their chosen meridian. Then, on their journey, by comparing the time at that meridian to their local time wherever they were, navigators could calculate their longitude, and therefore determine their position at sea. It did not matter where on earth their chosen meridian was located. Various charts and almanacs picked specific meridians for convenience, but there was absolutely no scientific or astronomical reason why it must be in one place and not another. Although observatories made the best meridians, because they had the best equipment to accurately confirm the local time, navigators could simply use the last point of land they saw, or their last port of departure.[28] But no one had ever seriously considered a worldwide timekeeping system before. For such a system, a Prime Meridian was a necessity, otherwise there would be multiple competing standard times, one for each meridian in use.

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[27] George Airy to the Secretary of State for the Colonies, June 18, 1879, Charles Piazzi Smyth to Colonial Office, September 5, 1879, in Sandford Fleming, *Universal or Cosmic Time*, YA.2003.A.17994, BL. Fleming failed to realize that the Latin Alphabet used by the English language itself is not universal, other alphabets and writing systems were not represented in his proposal. Cleveland Abbe pointed this out to him in 1880. F.A.P. Barnard to Sandford Fleming, July 16, 1880, Vol 2, Fleming Papers MG29 B1, LAC.

[28] Charles Withers, *Zero Degrees: Geographies of the Prime Meridian* (London and Cambridge: Harvard University Press, 2017), 3.

Airy had previously seen one of Fleming's early unpublished papers on time reform, in February of 1878.[29] He had been less than enthused in that instance, writing privately that the habits of the public must affect this change, not government.[30] He pointed out that this was already happening in Britain, where the railroads had all adopted Greenwich time in the 1840s and 1850s, not by law, but out of convenience (Greenwich time was not made legal time in Britain until thirty years later, in 1880).[31] It is odd that Fleming did not find an ally in Airy, since Airy had been instrumental in setting up the time signals that had made it possible for British railways and telegraphs to replace local time with Greenwich time in the first place.[32] But Airy was not interested in extending Greenwich time's pre-eminence internationally, and certainly not by government coercion.

Having been rebuffed again by the scientific societies of Europe, Fleming changed tactics. In one way, he took Airy's advice, and looked to the railroads. It was in business and the trades, not in government and science, that his time reform ideas would find a home.

The story of standard time in North America has been told before, perhaps most skillfully by Ian Bartky and Mario Creet.[33] The period of time between 1880 and 1883 saw Fleming involved in an incredible flurry of activity: letter writing, networking,

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[29] Smyth had seen it too. Charles Piazzi Smyth to Sandford Fleming, November 12, 1878, Vol 2, Fleming Papers MG29 B1, LAC.
[30] George Airy to Sandford Fleming, February 11, 1878, Vol 1, Fleming Papers MG29 B1, LAC.
[31] Derek Howse, *Greenwich Time and the Discovery of the Longitude* (Oxford: Oxford University Press, 1980), 114.
[32] Allan Chapman, "Sir George Airy (1801-1892) and the Concept of International Standards in Science, Timekeeping, and Navigation," *Vistas in Astronomy* 28, (1985): 325.
[33] Bartky, One Time Fits All.; Mario Creet, "Sandford Fleming and Universal Time." *Scientia Canadensis* 14, No. 1-2 (1990): 66-89.

petitioning, preparing and administering surveys, and attending conferences. In this barrage, Fleming was one voice among many. Abbe, Barnard, Thomas Egleston (an engineer), and William Allen all played major roles. This campaign reveals that standard time was not a product of invention, but of promotion. Advocacy and activism pushed the topic from the obscurity of utopian scheming into the realm of possibility.

The forum for these campaigns and discussions were professional societies. Fleming's Canadian Institute was involved jointly with Abbe and Barnard's American Metrological Society. Fleming joined several other groups as well, presenting his ideas to the American Association for the Advancement of Science (AAAS), and the American Society of Civil Engineers (ASCE).[34] Of course, as Ian Bartky points out, only a handful of members in any of these societies ever paid the issue of time reform much attention.[35] But these individuals' voices had much more authority in the public realm with the tacit support of a professional society behind them.

Fleming managed to convince the ASCE to establish a standard time committee, with Fleming as its chair. He immediately set to work, using the societies' distribution network to circulate a questionnaire to engineers and railway managers in Mexico, Canada, and the USA, as well as other interested academics.[36] The replies were overwhelmingly positive about the benefits of some sort of reform for railroad time, but many respondents were unconvinced that local time ought to change with it. Respondents also debated what shape railway time reform might take. Despite the divisions, the survey

[34] Bartky, One Time Fits All, 70.
[35] Bartky, One Time Fits All, 59.
[36] About 90% of the questionnaires went to "practical railroad men" and the other 10% to "men of a theoretical turn of mind," in other words, astronomers and academics. John Bogart to Sandford Fleming, March 13, 1882, Vol 2, Fleming Papers MG29 B1, LAC.

made it clear that the railroad system in North America was in dire need of a more manageable time system.[37] Armed with these results, the ASCE went on to petition the US Congress to call an international conference to establish a global time system. Meanwhile, the AMS was also lobbying Congress. At first, Abbe felt it was unlikely that the US government would call such a meeting and hoped that the Canadian Government might do it instead.[38] However, after the Governor General of Canada's failure to entice any action on the part of the British, the AMS looked inward.

The AMS was undoubtedly the most respectable and politically influential of the societies pushing for time reform in the United States. As Egleston explained to Fleming in early 1883, the ASCE alone could not achieve much, as engineers had little clout. By joining with the AMS, however, they could "secure the interest and cooperation of the most powerful men in the country, which might not be so certain if we worked with the civil engineers alone."[39] The alliance paid off, and Congress did call for an international conference. But it was not a straightforward process.

Bartky demonstrates the complexities of the lobbying process, showing how internal conflicts between the US Signal Service and the Naval Observatory affected the outcome.[40] But by tracing the progress of the time reform movement's most successful

[37] Vol 2, Fleming Papers MG29 B1, is full of survey responses calling for some kind of reform.
[38] Cleveland Abbe to Sandford Fleming, March 10, 1880, Vol 1, Fleming Papers MG29 B1, LAC.
[39] Thomas Egleston to Sandford Fleming, February 20th, 1883, Vol 14, Fleming Papers MG29 B1, LAC.
[40] Bartky, *One Time Fits All*, 59-85.

players, Bartky omits some of the breadth of the movement, and its fractures.[41] The false starts can be as telling as the achievements.

Sandford Fleming was something of an outsider. This claim seems suspect when you consider that, through the AMS, he was able to reach "the most powerful men in the country." Bartky's narrative makes it seem like his connections in all the right places paved the way for global time reform. There is truth in this, but in seeking allies, Fleming had simply cast his net wide following his failures in Europe, and he clasped eagerly to any society or organization that showed an interest. The AMS was his luckiest catch, but he also became entangled with less reputable organizations.

The best example of this is the International Institute for Preserving and Perfecting the Anglo-Saxon Weights and Measures (IPAWM).[42] Neither Bartky nor Creet (whose 1990 article on standard time is otherwise very thorough in its description of Fleming's relationship with North America's professional societies) mention the IPAWM, yet Fleming's connection with the institute was far from negligible. Formed in 1879 by a railway engineer named Charles Latimer, the IPAWM, based in Cleveland, Ohio, was a small organization ostensibly concerned with advocating for the use of British weights and measures. Such societies were not uncommon. The nineteenth century was the age of quantification, categorization, and measurement. There was a global effort to count, measure, and weigh the physical world.[43] The measurement of time itself could be

[41] Mario Creet, author of one of the more succinct yet comprehensive articles on the topic, makes the same omission. Fleming's relationship with the IPAWM seems to have been universally overlooked by historians until now. Creet, "Sandford Fleming," 66-89.
[42] Acronym has been shortened for brevity.
[43] See for example John Perry, *The Story of Standards* (New York: Funk and Wagnalls, 1955).; Theodore Porter, *Trust in Numbers: The Pursuit of Objectivity in Science and Public Life* (Princeton: Princeton

considered a part of this trend. Whether it was the botanical classification of species, or the calculation of the of rotation of astronomical bodies around the sun, or the surveying of land claims and longitudes, to measure something was to know it: scientists were creating 'knowledge' of a particular kind, which, as post-colonial scholars have pointed out, often aided the processes of European colonialism.[44] The IPAWM was an outspoken, though marginal, part of this movement of quantification.

Calling it a 'movement' should not imply cohesion: divisions and debates about how best to measure the physical world were the norm. The IPAWM was particularly antagonistic towards the French Metric System, which was rapidly gaining global acceptance as a 'perfect,' and impartial system. To the IPAWM, the Metric System was anathema to the perfection of measurement. They believed the Metric System was based on poorly calculated standards, while the British system of weights and measures, on the other hand, was perfect, and ordained by God.

The IPAWM's support for the British system was not unusual, but its line of reasoning was unorthodox. The IPAWM's president, Charles Latimer, was a fervent disciple of Piazzi Smyth's Pyramidology. According to these theories, Israelite slaves had built the Great Pyramid of Giza with divine inspiration from God. Smyth, and other

University Press, 1995).; Norton Wise, ed., *The Values of Precision* (Princeton: Princeton University Press, 1997).; Ian Hacking, *The Taming of Chance* (Cambridge: Cambridge University Press, 1990).; Daniel Headrick*, When Information Came of Age: Technologies of Knowledge in the Age of Reason and Revolution, 1700-1850* (Oxford: Oxford University Press, 2002).

[44] The idea that scientific advancement facilitated colonialism is well represented in the literature. See Michael Adas, *Machines as the Measure of Men: Science, Technology, and Ideologies of Western Dominance* (Ithaca: Cornell university Press, 2015).; Richard Drayton, *Nature's Government: Science, Imperial Britain, and the 'Improvement' of the World* (New Haven: Yale University Press, 2000).; An examination of land surveying in John Weaver, *The Great Land Rush and the Making of the Modern World, 1650-1900* (Montreal: McGill-Queen's University Press, 2006).; Timothy Mitchell, *Rule of Experts: Egypt, Techno-Politics, Modernity* (Berkeley: University of California Press, 2002).

adherents, claimed to have found evidence in the measurement of the Pyramid that the British inch was used in its construction, and therefore British measures must be divinely inspired.

Smyth's membership in the organization justifies the use of 'international' in the IPAWM's name, but the word implies a grandeur that is largely an illusion. Most of the organization's members were Americans, and its activities centered around Charles Latimer in the city of Cleveland.[45] Nonetheless, the IPAWM managed to catch the attention of Fleming in 1881 when Latimer, who was also a member of the ASCE, presented a paper on the pyramid and weights and measures. Both Egleston and Barnard asked Fleming to respond critically to the paper, and shut down its absurd arguments.[46] Barnard called the IPAWM a "reactionary society," and shared with Fleming his own papers which refuted Smyth's and Latimer's claims concerning the Great Pyramid.[47] Egleston explained his hostility towards Latimer, writing to Fleming that the IPAWM was "an organization without standing whose action has been particularly discreditable, and who have mentioned Dr. Barnard in communications to the United States government most disrespectfully by name. I happen personally to know the moving spirits of this society and they are men with whom affiliation is almost impossible."[48] In fact, Barnard and Abbe disliked the IPAWM so much that when Fleming's suggested including the

[45] In 1884 it had around six hundred members. Eric Reisenauer, "The Battle of the Standards": Great Pyramid Metrology and British Identity, 1859-1890," *The Historian* 65, No. 4 (2003): 969.
[46] Thomas Egleston to Sandford Fleming, June 9, 1881, Vol 14, Fleming Papers MG29 B1, LAC.; Thomas Egleston to Sandford Fleming, June 19, 1881, Vol 14, Fleming Papers MG29 B1, LAC.; Thomas Egleston to Sandford Fleming, June 24, 1881, Vol 14, Fleming Papers MG29 B1, LAC.; F.A.P. Barnard to Sandford Fleming, June 11, 1881, Vol 3, Fleming Papers MG29 B1, LAC.
[47] F.A.P. Barnard to Sandford Fleming, June 11, 1881, Vol 3, Fleming Papers MG29 B1, LAC.
[48] Thomas Egleston to Sandford Fleming, June 1, 1883, Vol 14, Fleming Papers MG29 B1, LAC.

IPAWM in joint actions with the AMS and the ASCE, these societies' plans to lobby for an international conference on time reform actually had to be delayed, while their respective committees tried to find a way out of such cooperation.[49] Barnard, Egleston, and Latimer may have agreed on many aspects of time reform, but the hostilities among them ran too deep for cooperation. Barnard in particular was a fervent supporter of the Metric System.

Nonetheless, Fleming kept in contact with the IPAWM, likely because Latimer showed an interest in the standard time question, and Fleming needed allies. In late 1881, Latimer invited Fleming to join the IPAWM's new standard time committee. Latimer wrote to Smyth about him, saying that although Fleming worked with Barnard, there was no indication that he agreed with him on the Metric System. Latimer also told Smyth (correctly) that Fleming was not necessarily attached to the Bering Strait as the Prime Meridian, a position which Smyth had denounced a few years earlier.[50] Then, in December 1882, Latimer took it upon himself to officially enrol Fleming as an IPAWM member. In the same breath, he expressed his hope that Fleming might oppose the Metric System.[51]

Latimer's interest in the time question was partly born of his position as a railway engineer, but it also stemmed from his desire to see the Great Pyramid chosen as the

[49] Thomas Egleston to Sandford Fleming, June 1, 1883, Vol 14, Fleming Papers MG29 B1, LAC.
[50] Charles Latimer to Charles Piazzi Smyth, Jan 1, 1882, A14/66 Charles Piazzi Smyth Papers, Edinburgh Observatory (EO).
[51] Charles Latimer to Sandford Fleming, December 22, 1882, Vol 27, Fleming papers MG29 B1, LAC.

Prime Meridian, cementing its place as a foundation for measurement of all kinds.[52] Fleming, although never committing to Latimer's more fanciful ideals, continued to be involved in the IPAWM's affairs, serving on the standard time committee, answering a questionnaire on time reform, and contributing articles to the IPAWM's publications.[53] When in late 1883 the railroads in the United States agreed to begin using the zone system, Latimer congratulated Fleming, petting his ego by complaining that Dowd and Allen were receiving all the credit, when really it belonged to Fleming.[54]

Fleming's involvement with the IPAWM was ultimately fruitless. In fact, it slowed the progress he had been making with the ASCE and the AMS. After so many scientific societies had rejected his ideas early on, it is not surprising that he joined any organization that would support him, even a disreputable one, especially one so willing to sing his praises as the IPAWM. Elsewhere, however, time reform continued to meet with dismissal.

After his initial failures in Europe, Fleming had focused on North America. But Barnard had contacts overseas. Together they turned their attention back to Europe. Again, they failed. Barnard tried to "secure some declaration in favor of our scheme from the International Association for the Reform and Codification of the Laws of Nations" in

[52] He told Fleming that although he thought the pyramid would make a good choice, Greenwich might be acceptable. Charles Latimer to Sandford Fleming, February 27, 1882, Vol 27 Fleming Papers, MG29 B1, LAC.

[53] Sandford Fleming to A.G. Wood, Feb 14th 1883, Vol 54, Fleming Papers MG29 B1, LAC.; Sandford Fleming, "Standard Time" *International Standard* 1, undated, Vol 65, Fleming Papers MG29 B1, LAC.; *International Standard*, March 1883, Vol 105, Fleming Papers MG29 B1, LAC.

[54] Charles Latimer to Sandford Fleming, October 30, 1883, Vol 27, Fleming Papers MG29 B1, LAC.; Charles Latimer to Sandford Fleming, November 22, 1883, Vol 27, Fleming Papers MG29 B1, LAC.; Charles Latimer to Sandford Fleming, December 5, 1883, Vol 27, Fleming Papers MG29 B1, LAC.

August of 1881.[55] The response was lukewarm. The real opportunity in 1881 came the next month, however, at the International Geographical Congress (IGC) in Venice. The IGC was a professional gathering of geographers, which had met twice before in the 1870s. Both times, the idea of a Prime Meridian for navigational purposes had been discussed, but ultimately shelved for future study.[56] Time reform was not part of these discussions. Barnard and Fleming hoped to change that.

In preparation for Venice, Barnard attempted one last time to convince Smyth and Airy to see reason. He was not successful. Smyth told Barnard that his opinion of the scheme had not changed since he heard of it two years before.[57] Airy was just as stubborn, writing "What does a man living in Ireland or Turkey care about Cosmopolitan Time: it is wanted by sailors, whose profession carries them through great ranges of longitude…and there its utility ends."[58] Barnard was insulted. He felt that Airy had not properly understood Fleming's paper (Airy had said as much in his letter), and Barnard believed he had "little hope of bringing such a man around by talk after he had well committed himself. He is no doubt a great man, but he is excessively opinionated, and he is sometimes mistaken, as he was most lamentably in the case of Adams and the planet Neptune."[59] The Neptune case alluded to a scandal from the 1840s. Airy believed that that a British Astronomer, J.C. Adams (who would later take part in the Prime Meridian

[55] F.A.P Barnard to Sandford Fleming, June 4, 1881, Vol 3 Fleming Papers MG29 B1, LAC. See also Ian Bartky, *Selling the True Time: Nineteenth Century Timekeeping in America* (Stanford: Stanford University Press, 2000), 149.
[56] Bartky, *One Time Fits All*, 35-47.
[57] Charles Piazzi Smyth to F.A.P. Barnard, August 24, 1881, Vol 3, Fleming Papers MG29 B1, LAC.
[58] George Airy to F.A.P Barnard, July 12, 1881, Vol 3, Fleming Papers MG29 B1, LAC.
[59] F.A.P. Barnard to Sandford Fleming, July 30, 1881, Vol 3, Fleming Papers MG29 B1, LAC. See also F.A.P. Barnard to Sandford Fleming, September 3, 1881 Vol 3, Fleming Papers MG29 B1, LAC.

Conference) had discovered the planet Neptune first, when in fact a French mathematician, Urbain le Verrier, had done so. Barnard, upset by the obstinacy of what he saw as a deeply flawed man, told Fleming that "both of them [Smyth and Airy] were disappointing to me."[60]

Unable to sway Britain's principle astronomers, Fleming went to Venice. Abbe and Barnard did not attend, but both sent letters to be read by their representatives. At the IGC, Fleming's proposals were received with mild interest, but not enough to make much impact. They did manage to convince Italian geographers to lobby their government to hold another international congress, but the resolution that was adopted was far weaker than they had hoped, and no vote was taken by the whole conference. Both indifference and outright hostility derailed the reformers' efforts.[61] The Italian government was slow to do as requested, and by March of 1882 nothing had been done.[62] Fleming at this point turned his attention away from Italy, hoping for support from the planned Washington Conference on an International Prime Meridian, which the AMS had successfully lobbied to set up.[63]

In late 1883, a second European scientific conference took place in Italy. This was the International Geodetic Association's (IGA) General Meeting in Rome. The Prime Meridian was once again on the table for discussion. Fleming was not optimistic, given his past failures overseas. As he wrote to his close acquaintance Charles Tupper, then Canada's Minister of Railways and Canals, "from what I know of similar meetings which

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[60] F.A.P. Barnard to Sandford Fleming, Dec 19, 1881, Vol 3, Fleming Papers MG29 B1, LAC.
[61] George Wheeler to Sandford Fleming, March 2, 1882, Vol 53 Fleming Papers MG29 B1, LAC.
[62] George Wheeler to Sandford Fleming, March 2, 1882, Vol 53 Fleming Papers MG29 B1, LAC.
[63] Sandford Fleming to John Bogart, October 26, 1881, Vol 63, Fleming Papers MG29 B1, LAC. See also Bartky, One Time Fits All, 66-67.

have over and over been held in the cities of Europe I do not anticipate any satisfactory results or any results at all beyond postponing a settlement of the question indefinitely. The people of this country [Canada] are more practical."[64] But Rome performed better than Fleming expected. For one thing, he had a new ally. The British delegation included William Christie, who had just recently replaced George Airy as Astronomer Royal. Christie, for his own reasons, was far more amenable to the idea of a Prime Meridian than Airy had been and would campaign behind the scenes over the next two years.[65]

The Rome Conference passed several promising recommendations, including the selection of an international Prime Meridian at Greenwich, and a formal approval of the United States' proposal to hold a diplomatic conference in Washington in 1884, to ratify the new common meridian.[66] But nothing recommended at this conference was binding: it was a gathering of scientists, not diplomatic representatives. Moreover, it had been a complicated road to that agreement. The Rome Conference had suggested a controversial trade-off: if other countries abandoned their own meridians in favour of Greenwich, Britain in return ought to abandon its weights and measures in favour of the Metric System, or at least pay its share of the costs to the Metre Convention of 1875, which had set up a bureau to standardize and verify comparisons between different systems of measure. In this case, fortune favoured Fleming for once, because the British delegation,

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[64] Sandford Fleming to Charles Tupper, October 20 1883, Vol 65, Fleming Papers MG29 B1, LAC.
[65] Christie's actions and motivations are discussed later in this chapter.
[66] "The Geodetic Conference at Rome," *Journal of the Society of Arts* XXXII, No. 1625 (Friday January 11, 1884): 132-33. BL.

led by Christie, did not reject the proposal outright, and was even open to Britain paying its fair share to the Metre Convention.[67]

Regrettably for Fleming, Christie did not have the support of his government, and there was political backlash over the suggestion that Britain pay anything to support the Metre Convention.[68] Moreover, Rome's proposals had one significant difference from Fleming's. While Fleming's introduced time zones universally, eliminating local time's role in everyday life for all people, Rome's proposal was for a specialized time system, to be used by railways, ships, telegraphs, and observatories. The Rome Conference's recommendations meant that ordinary people would still use local time and would have to convert to Greenwich time or its derivative whenever they wanted to travel by rail or sea.[69] For the scientific community, universal time was to be a specialized tool, not a new public norm.

Back in North America, time reformers had greater success. An aggrieved Fleming had suggested somewhat unfairly that North Americans were more "practical" than Europeans. But the notion that there was an Atlantic divide, with forward thinking North Americans being held back by Old World conservatism, is nonsense. There were Americans who opposed time reform, just as there were Europeans who supported it. The Russian Astronomer, Otto Struve, for example, championed the idea of a Prime Meridian long before Fleming had (though not necessarily for timekeeping, but for navigation), and one of Fleming's staunchest supporters was the Spanish Naval Officer, Juan Pastorin. It is

[67] Report by the Committee, Undated, Vol 188, Strachey Papers MSS EUR F127, BL.
[68] The Treasury and the Warden of the Standards, H.J. Chaney, were particularly opposed.
[69] Ian Bartky, "Inventing, Introducing, and Objecting to Standard Time," *Vistas in Astronomy* 28 (1985): 111.

very possible that there was some imperial arrogance on the part of European academics, and British academics in particular, which meant they lent less weight to the ideas of a colonial like Fleming. But scholars from the colonial world did exist, and sometimes were able to rise to prominence in their fields, so long as they conformed to European concepts of scholarship.[70] Imperial prejudice alone does not explain Fleming's failures in Europe. These failures were also the result of professional exclusion. Fleming was an engineer, not a scientist; even in North America his reach was greatest with engineers and railroad officials, not academics.

Enter William Allen. A latecomer to the time reform efforts, Allen was an American railroad worker who learned about the AMS and its joint efforts with the Canadian Institute and the ASCE in late 1881. Allen jumped on board. While the AMS continued to petition the government for an international conference on time reform, Allen looked to the railroads to make more immediate changes. It was Allen who, through several meetings known as General Time Conventions, brought about zone time on all North American railroads. The General Time Conventions were originally designed to coordinate schedules between the various railway companies, but Allen directed their attention towards zone time instead. On November 18th, 1883, only weeks after the Rome Conference had ended, North American railways adopted standard time, using Greenwich as a Prime Meridian.

[70] See Tamson Pietsch, *Empire of Scholars* (Manchester: Manchester University Press, 2013).; Matthew Edney, *Mapping an Empire: The Geographical Construction of British India, 1765-1843* (Chicago: University of Chicago Press, 1997).

This event has been the subject of mythmaking as well. The Association of American Railroads grandly publicized it in the 1940s and 50s as the "day of two noons," the date when clocks across the continent were reset and standard time was born.[71] But the change on November 18th 1883 was not so momentous. It was not truly the birth of universal standard time, as it did not apply to the whole globe, nor did it even apply to all aspects of North American life. It affected only railway time, not local time. In many places, the local clocks were not changed, and travellers now had to set their watches upon arrival at the railway station. It is true that many major cities did change their local time to match railway time on November 18th. Thus that date marked a large step in a piecemeal process.

It is also worth noting that there were quite a few outspoken critics to the change.[72] Entire cities declined to follow the new standard. Counterproposals and alterations were bountiful. The public took an interest. An anonymous Toronto woman, for example, wrote to Fleming on the next day, the 19th, with her own proposal on how best to eliminate AM and PM. Fleming had always hoped to replace AM and PM with a twenty-four-hour system, and the newspapers had picked up on this. In Canada, the news about the railways adopting zone time was nearly everywhere tied to the twenty-four-hour clock. The Toronto woman proposed instead a twelve-hour day, with each hour doubled in length to 120 minutes. In this way, as she put it "then midday would be the sixth hour as in the olden times, among the Jews; and the story of the most momentous event which

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[71] See Time Service, Vol 14523, RG30, LAC. The whole file is all about the "day of two noons."

[72] See Michael O'Malley, *Keeping Watch: A History of American Time* (Washington: Smithsonian Institute Press, 1990), 118-119, 126, 130-144.; Howse, 126.; Fleming vol 53 20651

has ever transpired in all time would read truly again."[73] Referring to biblical methods of time-telling, this women's faith-driven proposal demonstrates that for some members of the public, the change was a deeply personal one. Deliberating the nature of time was an existential question for some; it was far more than just an inconvenient watch adjustment.

Fleming did not even note the change in his diary. For him, the work was far from over. He had two larger goals. The first was to make the new railway zone time into legal time in the United States and Canada. The second goal was to extend zone time worldwide.

The first goal was not easy to achieve. Fleming made only faltering progress. He proposed legislative action immediately, but found himself blocked. His most useful precedent was the act passed in 1880 in Great Britain, making Greenwich legal time in England, Scotland and Wales, and Dublin time legal time throughout Ireland.[74] But Greenwich time was not zone time, as Fleming's critics pointed out. The inconvenience of an abrupt time change at the edge of each zone was avoided in the United Kingdom, because the Irish Sea provided a natural barrier between the two time standards. In North America, such natural divisions were rare. In the United States, the question also became entangled with the issue of state rights and residual powers: should the federal government declare legal time, or the states? The State of Connecticut took it upon itself to declare that railroad time was legal time in 1882. Fleming was both pleased and concerned, as he felt the only way his system would become universal was if the federal

[73] A Toronto Woman to Sandford Fleming, Nov 19, 1883, Vol 54, Fleming Papers MG29 B1, LAC.
[74] Howse, 114.

government acted. But as late as 1892 the federal government had only established standard time as legal time in the ten square miles of the District of Columbia.[75]

In Canada, Fleming met opposition from the Law Clerk of the House of Commons, G.W. Wicksteed. A few weeks after the railway change, Wicksteed wrote a series of letters to Fleming expressing confusion about how intrusive the new time system was meant to be:

> "I do not think you intended that that time [railway time] should be legal time for regulating all the business of life, to which I do not think it can be made applicable…. [but] the people of Quebec, or a great many of them, believed that the Railway standard applies to all the affairs of life civil and criminal, and as I find that the Citadel Gun has been fired, and church services commenced by that Standard Time…and that our parliament clock had been altered to it, I cannot but think that this impression is very extensively entertained and may lead to many very undesirable consequences, which you never intended."[76]

Wicksteed suggested that Fleming correct the public on this 'misinterpretation' of the use of standard time. But Fleming was pleased that railway time was being widely used, and would do no such thing. Wicksteed continued to try and convince Fleming that there was a better way. The time 'jumps', as Wicksteed called them, where each time zone met, were highly problematic, as this happened five times across the continent.[77] Wicksteed suggested that standard time be adopted for travelling and scientific purposes, but that it would be better to leave local time alone, as had been proposed at Rome. Or, better yet,

[75] See G.W. Wicksteed to Sandford Fleming, July 9, 1891, Vol 53, Fleming Papers MG29 B1, LAC.; G.W. Wicksteed to Sandford Fleming, January 12, 1892, Vol 53, Fleming Papers MG29 B1, LAC. The US Government didn't standardize time all over until 1918. See Howse, 126. In Canada, it remained up to the provinces. See Malcolm Thompson, *The Beginning of the Long Dash: A History of Timekeeping in Canada* (Toronto: University of Toronto Press, 1978), 34.
[76] G.W. Wicksteed to Sandford Fleming, December 7, 1883, Vol 53, Fleming Papers MG29 B1, LAC.
[77] G.W. Wicksteed to Sandford Fleming, December 13, 1883, Vol 53, Fleming Papers MG29 B1, LAC.

use a single, universal, time for scientific and railway purposes worldwide, and local time for everything else.[78] Anything, he said, would be better than the time jumps.

Wicksteed was fighting a losing battle. Zone time was here to stay, and Fleming's goal to extend it overseas was well under way. In August 1882, the AMS had finally convinced the US government to convene a conference on the subject. A circular was forwarded to various countries with diplomatic relations with the United States, asking whether such a conference would be met with approval. When positive answers were received (it took some time; the British government was particularly slow in responding), invitations were sent out by the Secretary of State in December of 1883. The conference was to meet at Washington the following autumn, in October of 1884.

As one of the chief activists in the time reform movement, Fleming seemed an obvious choice to represent Canada at the conference. But just as he had been rejected by the scientific community of Europe, he was nearly excluded from the political sphere. The vagaries of international politics, Canada's colonial status, interdepartmental rivalries, and sheer incompetence almost cost him his seat at the table. Despite Fleming's reputation as the father of standard time, he was, at the time, disposable. Seen from Europe, he was simply a wealthy railwayman from the colonies who harbored utopian ideas. His application to join the international conference was an uphill battle.

Fleming began lobbying for his nomination as a delegate early, actually before the conference had been called. At the end of 1882, the U.S. Secretary of State had asked all the countries with which the U.S.A. had diplomatic relations whether they would be

[78] G.W. Wicksteed to Sandford Fleming, December 22, 1883, Vol 53, Fleming Papers MG29 B1, LAC.

interested in such a conference but he did not issue actual invitations until December 1883. Fleming jumped the gun by almost a year, asking the Canadian Institute and the Royal Society of Canada in early 1883 to send memorials to the Governor General, requesting that Canada be represented. The Governor General's reply was guarded. Canada, being a Dominion under the Crown, did not have direct diplomatic relations with the United States. Canada's participation depended on the goodwill of the Foreign Office. But the Governor General did promise that if Canada managed to secure an invitation, either directly, or via the United Kingdom, a representative would be sent.[79]

Not content with that answer, Fleming wrote to Charles Tupper the day after he received the Governor General's reply. Tupper was serving in London as the Canadian High Commissioner to the United Kingdom. "It does not appear," Fleming wrote, "that Canada has been invited to take part in the international conference proposed to be held at Washington, but no country in the world is more interested in a satisfactory solution to the problem than Canada and as a matter of fact the movement for the solution originated in Canada."[80] Fleming was of course referring to his own early publications with the Canadian Institute. He asked Tupper to try and secure Canada's representation at the conference.

Fleming's problem was one of imperial hierarchies and international norms. As a Dominion, Canada could not be invited unless by a specific act of the US Congress, and also by the agreement of Her Majesty's Government. A more likely solution was to have Canada represented as a part of the British delegation. On June 9th 1883, after a campaign

[79] G. Powell to Sandford Fleming, May 8, 1883, File 4-0-2, F1052, Archives of Ontario (AO).
[80] Sandford Fleming to Charles Tupper, May 9, 1883, Vol 65, Fleming Papers MG29 B1, LAC.

of letter writing, Fleming was told that in the event of Canada being invited to the Washington Conference, he would be appointed as the Canadian delegate.[81] Fleming was assured his place, but only if Canada itself had a seat at the table.

In London, Tupper set to work on Fleming's behalf. The process was messy, in large part because it was unclear which government department had jurisdiction. The Colonial Office (CO) was involved, as it was in all of Canada's relations with Britain, but a diplomatic conference was also a matter of foreign policy, which meant the Foreign Office (FO) had a hand in the choice of delegates. But there was a third office: The Science and Art Department (SAD), a branch of the Board of Trade. The SAD was involved in all things to do with science and technology. When British scientists were sent as delegates to the Rome Conference in the fall of 1883, the SAD had selected them. As the Washington Conference was to cover similar ground, it made sense that the SAD would take part in the decision-making process once again. These three departments, each with their own agendas, existed in parallel, without a clear hierarchy. There was a final layer of complexity. None of these departments could act without the oversight of the Treasury, which had to approve funding for the delegates' travel costs.

When the Colonial Office received word, via the Governor General and Tupper, that Canada wished to be represented, it forwarded the request on to the Foreign Office. But the Foreign Office hesitated. There were two problems. First, the USA had not yet sent official invitations; only a request as to whether the UK might be interested in attending if such a conference were to be held. The request, which had been received in

[81] Sandford Fleming to G. Powell, June 23, 1884, Vol 65, Fleming Papers MG29 B1, LAC.

November of 1882, did not include a date for the proposed Conference. Second, the Treasury had already decided internally not to fund delegates for such a conference.[82] As a result, the FO offered an alternative. Its officials had heard that the SAD was involved with organizing the Rome Conference, and asked whether Fleming might like to attend Rome instead.[83] On June 6th, the Colonial Office replied in the negative, stating that Fleming wished to attend Washington, not Rome, and requested that the FO ask the UK's Ambassador in the USA, Lionel Sackville West, to take steps to ensure Fleming's recognition as a delegate. West told the US Secretary of State, Frederick Frelinghuysen, about Fleming's request for representation. Frelinghuysen replied that he would be pleased to recognize Fleming, but only after Great Britain confirmed its intent to participate.[84] In other words, Canada would not be recognized individually; Fleming was to be a British delegate, or nothing. Given the Treasury's decision the previous November, it seemed likely that no representative of the British Empire would attend at all.[85]

In early July, having heard that the UK might not attend Washington, Fleming forwarded via Tupper a letter urging the UK to participate. He stressed that Canada and the United States were willing to accept Greenwich as a Prime Meridian, an outcome which just might be inevitable if only the UK would attend. Fleming suggested that only

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[82] Foreign Office Letterbooks, Entry for November 28, 1882, F0566.19, National Archives of the United Kingdom (NAUK)
[83] Foreign Office to Colonial Office, June 5, 1883, CO42.776, NAUK.
[84] Lionel West To Frederick Frelinghuysen, June 14, 1883, Vol 27, Fleming Papers MG29 B1, LAC.; Lionel West To Frederick Frelinghuysen, June 8, 1883, Vol 27, Fleming Papers MG29 B1, LAC.; Frederick Frelinghuysen to Lionel West, June 13, 1883, Vol 27, Fleming Papers MG29 B1, LAC.
[85] Adoption of a Common Prime Meridian, June 6, 1883, CO42.776, NAUK.; Colonial Office to Foreign Office Draft, June 7, 1883, CO42.776, NAUK.

with Great Britain's participation could this "problem which has long embarrassed geographers, astronomers and navigators" be settled.[86]

Fleming's pleas were greeted with indifference over the summer months. Without further details from the United States, Lord Granville at the Foreign Office was content to leave the matter to rest, awaiting the results of Rome before considering Washington any further.[87] Fleming did not waste the chance to bring up the subject again once Rome was over. He hoped that the outcome of the Rome Conference, as well the adoption of railroad standard time in North America, might entice more interest. He wrote to Tupper in late October and early November, and Tupper forwarded the letters on to the Colonial Office. Tupper was on Fleming's side. The two shared both a friendship and a working relationship. Tupper had been Minister of Railways and Canals in Canada, while Fleming had had a long career with Canadian Railways. The extent of Tupper's admiration for Fleming can be seen in the minutes accompanying Fleming's letters, where Tupper scribbled a note suggested Fleming deserved a full knighthood, an honour which he received in 1897.[88]

Tupper and Fleming emphasized the possibility that Greenwich might become the world's Prime Meridian. They pointed out that recent events on North American railways made the USA an ally in the fight for Greenwich, and that Russia was on board as well. "I anticipate but one result at Washington," said Fleming, "if Her Majesty's Government

[86] Sandford Fleming to Charles Tupper, July 14, 1883, CO42.775, NAUK.
[87] The Earl Granville to Mr. Lowell, July 21, 1183, Vol 11, Fleming Papers MG29 B1, LAC.
[88] Adoption of the Multiple of Greenwich Time in Canada and the United States, November 15, 1883, CO42.775, NAUK.

will only accept the invitation to participate."[89] Despite Fleming's best efforts, however, the matter was not taken up until the New Year.

By then, the United States had finally sent out the invitations, with the date set for October 1st, 1884. In January 1884, the Science and Art Department sent off its report on the Rome Conference, and was waiting on responses before forming a committee to discuss the possibility of a Washington delegation.[90] The FO, with the SAD's report on Rome and the USA's official invitation in hand, had to make a final decision on whether or not to attend. It consulted the Treasury for an opinion. The Treasury, having already rejected the Washington Conference once, was not particularly willing. They asked Granville whether there were any "political grounds" on which the invitation ought to be accepted.[91] The FO admitted that the political ramifications of Washington were not particularly significant, but that the Treasury ought to ask the CO and the SAD. Both attached importance to the subject.[92] The CO, on behalf of Fleming, replied that yes indeed, delegates ought to be sent.[93] Then the Treasury, for an unknown reason, asked the Royal Society for its opinion instead of the SAD. This confused and annoyed the SAD. "What a way of doing business. They never told us – I shall see if my lads won't rub their noses in it," wrote John Donnelly, the secretary of the SAD.[94] But Donnelly was at least

[89] Sandford Fleming to Charles Tupper, October 20, 1883, CO42.775, NAUK.
[90] Science and Art Department to Colonial Office, January 16, 1884, Vol 11, Fleming Papers MG29 B1, LAC.
[91] Treasury to Foreign Office, January 14, 1884, FO5.1886, NAUK
[92] Foreign Office to Treasury, January 21, 1884, FO5.1886, NAUK.
[93] Colonial Office to Treasury, February 7, 1884, FO5.1886, NAUK.
[94] John Donnelly to William Christie, February 16, 1884, RGO7.142, Royal Greenwich Observatory Archives, Cambridge University Library (CUL). Donnelly was a military officer, but spent most of his later career reforming the SAD, and was personally involved in creating scientific education programs in Britain. See R.H. Vetch, "Donnelly, Sir John Fretcheville Dykes," *Oxford Dictionary of National Biography* (2004),

pleased that the Royal Society had not sunk their chances. Royal Society members, having changed their minds since rejecting Fleming in 1879, now wrote to the Treasury that the matter was worth pursuing. After Rome, they said:

> There appears a very good prospect that the meridian of Greenwich will be adopted by the civilized world if our government be duly represented at the Washington Conference. But if the nation which far more than any other is interested in the selection of a prime meridian should not think it worth while to take any steps in the matter, there is no saying how the decision may go; and it is needless to observe how inconvenient it would be to our country if the meridian to which our large mercantile marine have been so long used were changed. Nor would the inconvenience be confined to our country, for many foreign nations as well as our own have adopted the meridian of Greenwich.[95]

It is strange how far opinions at the Royal Society had changed. Now, members considered Britain to be more interested than any other nation in a Prime Meridian, something that only five years before they had dismissed as impractical. This change can be explained in two ways. The first is a change in personnel. William Christie, the new Astronomer Royal at Greenwich, was very keen on having his observatory chosen as the world's Prime Meridian. He had attended Rome on behalf of the SAD and was at the Royal Society Council meeting where the response to the Treasury was drafted.[96] More importantly, however, the Royal Society made it explicit that it was backing a proposal to choose a Prime Meridian for navigation at sea, not necessarily for civil timekeeping. Free from the baggage of Fleming's twenty-four-hour clock system and zone time, a Prime Meridian on British soil was an attractive prospect. The sort of conference the Royal

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http://www.oxforddnb.com/view/10.1093/ref:odnb/9780198614128.001.0001/odnb-9780198614128-e-32861?rskey=byAQ5q&result=1

[95] Royal Society to Foreign Office, February 7, 1884, FO5.1886, NAUK.

[96] Council Minutes, February 7, 1884, CMO17, Archives of the Royal Society (RS).

Society wanted the Treasury to agree to was very different from the one Fleming wanted. If Fleming was to be a delegate, would he fall in line with the other British delegates?

In February 1884, no one asked that question. The Treasury at last agreed on February 13th to provide the funds to pay for two delegates to attend the Washington Conference, but the selection of delegates was left open for future discussion.[97] It is here that cracks between departments widened. The SAD, having organized the Rome Conference, felt that it ought to also be in charge of Washington. However, the Foreign Office was involved because Washington, unlike Rome, was a diplomatic meeting, not just a gathering of scientists. The SAD asked the Foreign Office for clarification as to who was in charge.[98] The FO was somewhat relieved to let go of responsibility and avoid covering expenses. The only role the FO would need to play was to provide the delegates with letters of introduction from Lord Granville, to make their diplomatic status official.[99] But as much as the FO did not want to take on the responsibility, it remained wary of the SAD encroaching on diplomatic affairs. In a private note between FO civil servants, one official wrote that the decision about who ought to be nominated should be left to the Greenwich Observatory, the Hydrographic Department of the Navy, or the Royal Society. A regular diplomat, he said, would not be much help considering the subject. But above all, he wrote, "South Kensington [the SAD] should be shunned (it is no business of theirs, tho' they are trying to push themselves into it)."[100] Unfortunately for the FO officials,

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[97] Treasure to Foreign Office, February 13, 1884, FO5.1886, NAUK.
[98] Science and Art Department to Foreign Office, February 26, 1884, FO5.1886, NAUK.
[99] Memo S+A Dept. February 26, 1884, FO5.1886, NAUK.; Cecil Spring-Rice to Sanderson, March 4, 1884, FO5.1886, NAUK.
[100] Cecil Spring-Rice to Sanderson, February 13, 1884, FO5.1886, NAUK. The SAD's offices were located in South Kensington.

they could not beat precedent, and the SAD had the strongest case, having chosen the Rome delegates.[101] The Treasury made the final decision in March. Following the practice of the Rome Conference, the SAD was put in charge. The FO would have to furnish the delegates with credentials, and pay their expenses, with funds provided by the Treasury.[102]

In April and May, after the question of expenses were worked out, the SAD got to work selecting delegates. They settled on Captain Frederick Evans, the Hydrographer of the Royal Navy, and Cambridge astronomer John Couch Adams.[103] Alongside these two, the SAD suggested to the Colonial Office that perhaps the Canadian and Australasian colonies might like to send delegates as well (paid for by the colonial governments). The CO ran the idea by the Foreign Office, but also raised some concerns about the proposal. Until now, no one had considered a delegate from Australasia. Canada was only being considered because of Fleming's activism. In the practise of fairness, inviting the Australasian colonies was a good idea. But it meant complications for the diplomatic process. The invitation from the United States was for three British delegates, maximum. With Fleming, Evans, and Adams already chosen, there was no room for a fourth from Australasia. There was also a question of whether the Australasians were interested in coming in the first place. While the CO deliberated, they sent a request to the Foreign Office to check if the US might allow a fourth British delegate for Australasia.[104]

[101] Initialled Memo, February 28, 1884, FO5.1886, NAUK.
[102] Treasury to Foreign Office, Mach 7, 1884, FO5.1886, NAUK. The amount decided on was £100 per delegate.
[103] Science and Art Department to Foreign Office, May 3, 1884, FO5.1886, NAUK.
[104] Colonial Office to Foreign Office, May 2, 1884, FO5.1886, NAUK.

The waters were muddied further when the SAD announced a week later that the Indian Council had nominated a delegate as well, General Richard Strachey.[105] The SAD was either unaware of the three delegate limit, or they assumed that colonial delegates did not count as British delegates. From their perspective, Strachey's nomination was not out of the blue, though it may have seemed so to the CO and FO. But Strachey had been involved with the Rome Conference, and the SAD was simply following the Rome Conference precedent. Now, however, there were five prospective delegates, with only room for three.

The Foreign Office dutifully sent a message to the United States, asking if India, Canada, and the Australasian colonies could be represented. Secretary of State Frelinghuysen wrote back with a reasonable compromise. It would be unfair, he said, if Britain and its possessions had five votes, while each other nation had three. On the other hand, involving as many of the world's geographies as possible in the conference would "add to the interest and value of its deliberations and to the weight of its conclusions."[106] Therefore, the United States would allow five delegates from Britain and its possessions, but only three of them would be allowed to vote.

From the United States' perspective, the offer was a fair one. But the British had caught themselves in a trap, which only the Colonial Office seemed to recognize at first. Fleming would expect a vote, having been involved in the process since the very beginning. But the Australasian colonies would resent their delegates have an inferior position to that of Canada. Seemingly unaware of the nomination of an India delegate, the

[105] Science and Art Department to Foreign Office, May 10, 1184, FO5.1886, NAUK.
[106] Lowell to Earl Granville, May 21, 1884, FO5.1884, NAUK.

CO brainstormed two courses of action: replace one of the British delegates with an Australasian one, or, simply do not tell the Australasians about the conference at all. As of yet, no one had actually asked them if they were interested in going; their involvement was simply an idea proposed by the SAD. Besides, said one civil servant, Australia did not even have a single railway running east to west yet: would the Australians care about the subject matter of the conference?[107] They had not attended the Rome Conference, and the first instinct of the head of the CO, the Earl of Derby, was to simply not mention it at all to the Australasian colonies.[108] However, some of his staff disagreed, saying that "this office has been more and more in the bad books of the Australian Colonies since the New Guinea question came to the fore, and they might think it a new slight proceeding from Downing Street if they were not consulted."[109] In the end, thinking it unwise to leave Australasia unasked, the CO asked South Australia to communicate with its neighbouring colonies as to whether they would like to send a shared delegate.

The SAD, meanwhile, unmindful of any possible colonial jealousies, decided on their own that the three delegates who should be able to vote would be Adams, Evans, and the delegate for India, Strachey.[110] The reason they gave for choosing these three over Fleming and the Australasian was that Evans, Adams, and Strachey would receive their

[107] Prime Meridian Conference, Foreign Office Minutes, May 26, 1884, CO42.779, NAUK.
[108] Prime Meridian Conference at Washington, Foreign Office Minutes, April 18, 1884, CO42.779, NAUK.
[109] Prime Meridian Conference at Washington, Foreign Office Minutes, April 18, 1884, CO42.779, NAUK. In 1883, Australian newspapers caught wind of German ambitions towards the annexation of New Guinea. In Queensland, there was a public outcry for Britain to annex it instead. Lord Derby of the Colonial Office shot down the idea, to the Australians' displeasure.
[110] Science and Art Department to Foreign Office, May 30, 1884, FO5.1886, NAUK.

instructions directly from the Home Government, whereas Fleming's instructions might differ, coming from the colonial government in Canada.[111]

CO officials were not pleased. They complained to the FO that the SAD's plan was unfair to Fleming, who had been involved since the beginning, and his exclusion might arouse some anger on the part of Canada.[112] In reply, the Foreign Office washed their hands of the problem, telling the CO that the decision rested entirely with the SAD.[113]

CO officials were livid. In flurry of memos, civil servants critiqued the SAD's decisions. The SAD "had no right to appropriate the votes without previous consultation with us, and I think they ought to be remonstrated with, for there is sure to be unpleasantness if Mr. S. Fleming does not get a vote. Could not private pressure be brought to bear on them?"[114] Another official went further, suggesting that "They ought to treat Canada as a Dominion, as she is, and I cannot help thinking that a little pressure brought to bear upon the U.S. Government would make then rescind the decision [to limit the number of votes to three]…and give one more vote."[115] One suggested writing to the SAD in order to "point out that the unfortunate result of their acting without referring to this Dept. will be to exclude Sandford Fleming who is the originator of the whole Conference, and ask that he may be allowed to have one of the votes."[116]

[111] Science and Art Department to Foreign Office, June 21, 1884, FO5.1887, NAUK.
[112] Colonial Office to Foreign Office, June 24, 1884, FO5.1887, NAUK.
[113] Foreign Office to Colonial Office Draft, June 28, 1884, FO5.1887, NAUK.
[114] Prime Meridian Conference, Colonial Office Minutes, June 28, 1884, CO42.779, NAUK.
[115] Prime Meridian Conference, Colonial Office Minutes, June 28, 1884, CO42.779, NAUK.
[116] Prime Meridian Conference, Colonial Office Minutes, June 28, 1884, CO42.779, NAUK.

Before deciding on any course of action, the department attempted to verify the claim that Fleming was indeed the instigator of the conference, as they would need firm evidence to justify their complaint about his exclusion. Donnelly (the SAD Secretary), seemed to think that the idea had actually originated in America. "It is not certain," one official wrote, "that India would give way to Canada so we must be quite sure of our ground."[117] In response, a full list of Fleming's actions was compiled. Fleming was the first to bring the topic to the attention of the British Government back in 1879, although back then the replies from the "English learned bodies were almost entirely unfavourable to the scheme proposed – which shows that the idea had not then commended itself to our scientific men.... The first intimation we had of the Washington Conference was the request from Canada that Mr. Fleming should represent the Dominion there."[118] The note concluded, "But for Mr. S. Fleming the question (as far as I can judge) might never yet have attained official prominence – there might have been no Washington Conference – we might not have been sending any representatives of this country at all."[119]

In Canada, Fleming was unaware that his role as delegate for Canada was in peril. In June, not having heard anything on the subject officially since he accepted the provisional nomination from the Governor General twelve months earlier, he wrote to Tupper and the Undersecretary of State, G. Powell, asking for an update. He wanted to

[117] Prime Meridian Conference, Colonial Office Minutes, June 28, 1884, CO42.779, NAUK.
[118] Prime Meridian Conference, Colonial Office Minutes, June 28, 1884, CO42.779, NAUK. The Treasury of course knew about the proposed conference before this, directly from the US Government, but the Treasury had decided at that point not to send delegates. Fleming's request may have been the first time the CO had heard of it.
[119] Prime Meridian Conference, Colonial Office Minutes, June 28, 1884, CO42.779, NAUK.

make sure that he would be properly accredited.[120] Powell replied a few weeks later, telling Fleming that they would pass his name on to Her Majesty's Government as having been accredited as the Representative of Canada.[121] Powell did not tell the whole story. Tupper had more to say, telling Fleming that although it was pretty much decided that Fleming would represent Canada, it was still up in the air as to whether he would be allowed to vote. "The Colonial Office is making a hard fight for you not only on the right of Canada but on your own as the projector of the whole thing."[122]

In the meantime, the Colonial Office had heard back from the Australasian Colonies. As their delegate would not be able to vote, all of the Australasian Colonies except Western Australia declined to send a delegate, suggesting that their stance on a Prime Meridian would be better communicated via letters from the government of each colony, rather than via a shared representative with no voting powers.[123] The Colonial Office was relieved, as it let them off the hook for part of the problem (they were already concerned about causing further insult, calling the Australasian Governments "thin

[120] Sandford Fleming to G. Powell, June 23, 1884, Vol 65, Fleming Papers MG29 B1, LAC.; Sandford Fleming to Charles Tupper, June 23, 1884, Vol 65, Fleming Papers MG29 B1, Lac.
[121] G. Powell to Sandford Fleming, July 18, 1884, Vol 39, Fleming Papers MG29 B1, LAC.
[122] Charles Tupper to Sandford Fleming, July 17, 1884, Vol 50, Fleming Papers MG29 B1, LAC. The word projector is nearly illegible, it may also be proprietor, progenitor, etc. The word is 'originator' in Colonial Office Letterbooks, Miscellaneous Correspondence, July 15, 1884, Prime Meridian Conference, CO340.2, NAUK.
[123] Governor of South Australia to Colonial Office, July 9, 1884, CO201.601, NAUK.; Colonial Office Letterbooks, Miscellaneous Correspondence, September 28, 1884, Prime Meridian Conference, CO340.2, NAUK.

skinned" or "skinless" administrators who detected "slights" where none was intended).[124] Only the issue of Canada's vote remained.

Finally responding to the CO's complaints, the SAD claimed ignorance of any desire on the part of Canada to take part.[125] The SAD justified excluding Canada from voting by saying that "the interests of Canada are not necessarily identical with those of this country on the question."[126] As a result, they suggested that the best option might be to plead once more with the United States to agree to recognize a Canadian delegation in its own right, entirely separate from the British delegation.[127] The CO supported the idea as a last resort, and requested the FO make the request to the United States.

It was a long shot. It would mean recognizing a Dominion as an equal at a table of nations. This was problematic because most countries would consider the idea to be a ploy to get the British an extra vote, assuming Canada would inevitably vote in tandem with its colonizing power. It would set a 'dangerous' diplomatic precedent.

Once again, the United States proposed a compromise. The notion of a colony representing itself was rejected outright. "No colony will be separately recognized," the reply stated bluntly.[128] However, the US was willing to make a different sort of concession. The number of voting delegates each nation could send was raised from three

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[124] Prime Meridian Conference, Colonial Office Minutes, October 6, 1884, CO201.601, NAUK. In this case the perceived slight was that the CO had asked about the conference through South Australia's government, instead of directly asking each colony independently.
[125] Science and Art Department to Colonial Office, July 22, 1884, FO5.1887, NAUK.
[126] Science and Art Department to Colonial Office, July 22, 1884, FO5.1887, NAUK.
[127] Science and Art Department to Colonial Office, July 22, 1884, FO5.1887, NAUK.
[128] Lowell to Frederick Frelinghuysen, August 29, 1884, Despatches from U.S. Ministers to Great Britain 1791-1906 Microfilm M30 146, National Archives of the United States (NAUSA).

to five.[129] The compromise was a satisfying one. As Mr. Lowell, a member of Britain's diplomatic mission to the USA, wrote, the new limit allowed "for the representation of the diverse local interests, which might exist within the dominions of any of the powers….H.M.G. can secure representation for all the diversified interests of the British Empire without violating the principle of giving all the powers an equal voice."[130] Britain could now send Fleming, Strachey, and an Australasian as British delegates with full voting powers, alongside Adams and Evans from Britain itself.

Relieved, the Colonial Office made quick work of ensuring Fleming's place. Officials remained fearful that they might fail to "get the Science and Art Dept. not to pounce upon the additional two votes without consulting this office."[131] A CO official wrote to the SAD immediately to prevent this.[132] Frustrations ran high. Upon receiving a redundant note about Canada's voting rights from the SAD, one CO clerk scribbled "More stupidity!" across it.[133] Another wrote that it would be "difficult to jumble up more mistakes in so short a correspondence."[134] They had cause to regard the SAD with disdain for incompetence, but that is not the entire story. The SAD was populated by men involved with the scientific community which had been ignoring and rejecting Fleming's global time reform proposals for years. From the perspective of the CO, the SAD's lack

[129] Lowell to Frederick Frelinghuysen, August 29, 1884, Despatches from U.S. Ministers to Great Britain 1791-1906 Microfilm M30 146, NAUSA.; US Department of State to F.A.P. Barnard, September 18, 1884, Domestic Letters of the Department of State 1784-1906, Microfilm M40 101, NAUSA.

[130] Lowell to Colonial Office, September 5, 1884, CO42.779, NAUK.

[131] Prime Meridian Conference, Colonial Office Minutes, September 16, 1884, CO42.779, NAUK.

[132] Colonial Office to Science and Art Department Draft, September 16, 1884, CO42.779, NAUK.

[133] Prime Meridian Conference, Colonial Office Minutes, August 29, 1884, CO42.779, NAUK.

[134] Prime Meridian Conference, Colonial office Minutes, August 20, 1884, Co42.779, NAUK. In this case the SAD had thought that the CO was asking them to take away the vote from either Strachey, Adams, or Evans, and give it to Fleming. The CO was simply trying to make sure that one of the two new delegate positions now allowed would be saved for Fleming.

of concern for Fleming's nomination was incompetent. However, the SAD's actions were nothing if not consistent. Fleming's ideas had been found wanting, and therefore it made sense to the SAD to have Britain represented by British professional scientists, rather than by this colonial engineer.

The SAD's perspective has been largely missing from this narrative, and the allegations of ineptitude come mainly from other departments. The SAD's positions remain imperfectly understood because many of its papers have been lost or destroyed. However, it is possible to piece together from private papers some of what was going on at the SAD in 1884, enough to partially rehabilitate the department's image. The SAD was attempting to prevent an international incident over the Metric System. It began when the US sent out the invitations to Washington. The invitation had given the Secretary of the Metric Bureau, Dr. Hirsch of Switzerland, an idea. He wrote to several prominent British scientists, suggesting that without Britain's participation, it would be unlikely that a common Prime Meridian would ever be agreed upon. On the other hand, if Britain participated, and made some concessions, it would be almost certain that Greenwich would win out. Given this, he asked, could Britain's scientists suggest to their government that Britain might make a barter, and accept the Metric System in return for France's adherence to a Greenwich Meridian. Hirsch laid out a plan to bring this about:

> The experience gained when reforming the weights and measures teaches us unmistakably that a diplomatic conference, as contemplated in Washington, can only succeed provided a basis has been prepared for it by discussion in some scientific assembly, having an official character, so as to settle the scientific questions involved in the matter. In this way the Conference Diplomatique of

> 1875 was based upon the results arrived at by the Commission International du Metre of 1872.[135]

Hirsch believed the Rome Conference could be a testing ground for Washington, using Rome to set out the scientific basis for the agreements at Washington. Such a predetermined agreement was necessary, Hirsch thought, because Europe must come to Washington united, otherwise the Americans might force the meridian of Washington on the world instead (this was months before the American railroads, led by Allen, based their standard time system on Greenwich). With its own major observatory, Washington had a claim on the Prime Meridian, just as Greenwich or Paris did.

Hirsch's plan started out quite successfully. The Rome Conference did suggest some sort of barter between France and Britain over the Metric System and the Greenwich Meridian. But it had been watered down significantly by British participants. Christie, Strachey and the Rome Delegates appointed by the SAD wanted Britain to join the Metre Convention and pay dues to it, but not necessarily begin using the Metre. The Metre Convention was a useful tool for ensuring accurate conversions between the Imperial and Metric units. For that service, Britain ought to pay its share.

Even this lesser bargain, however, was fraught with tension. Staunch supporters of the Imperial system like Piazzi Smyth regarded such a concession as a slippery slope and tried to undermine any such agreement. H.J. Chaney, the British Warden of the Standards, was firmly opposed to the idea, and discouraged the Treasury from offering any such payment. But the pressure from the international community was rising. Britain was not

[135] Ad. Hirsch to C.W. Siemens, January 13, 1884, Vol 188, Strachey Papers MSS EUR F127, BL.

pulling its weight. It benefitted from the Convention's conversion tools but did not pay dues.

The SAD was caught in the middle of this crisis when the issue of nominating delegates for Washington came up in early 1884. The SAD had to ensure that any delegates chosen would have moderate views in reference to the Metric Convention. Fleming was a wild card where they were concerned. They wanted their own people in the delegation.

This was no trifling disagreement. The Treasury, backed by the indignant Chaney, was resisting payment to the Convention, and only offered a token amount. Wilhelm Foerster, a German member of the Metric Convention, explained to Christie that a token payment was an insult: "You regard such payments as 'a step gained' and I have no doubt that you are right, and that this offer will be only a transition to a full adhesion of your government to the Metric convention. But this transitory step…was necessarily in our eyes of a nearly offensive character."[136] As David Gill, the Chief Astronomer of British South Africa, put it, "the proposed terms have been received with a very strong feeling of indignation."[137] Other countries paid far more for the same benefits, and some were already inclined to dislike Britain. The amount being asked of Britain was the same as that of Turkey, and far less than that of the United States. Neither of those countries used the Metric System, yet they paid their share. Britain's refusal to pay, wrote Christie,

[136] Wilhelm Foerster to William Christie, May 4, 1884, RGO7.147, CUL.
[137] David Gill to William Christie, April 25, 1884, RGO7.148, CUL.

"seems likely to raise a storm of indignation which will put us in a position of complete scientific isolation."[138]

Christie set about lobbying the Treasury to make the payments. He began by asking a Liberal politician, Peter MacLiver, to raise the matter in Parliament, hoping it might "quicken the movement of the Treasury."[139] With MacLiver's help, a deputation was arranged to visit the Chancellor of the Exchequer. The meeting went badly. Chaney spoke against the idea, and Christie feared that they had failed to make themselves "intelligible."[140] But the response was actually somewhat positive. The Treasury explained that before the deputation, they were unwilling to pay the costs of anything that moved Britain towards the use of the Metric System, as it was "repugnant to public feeling."[141] They did, however, consider the subject with due diligence, since they had been given to understand that the decision of the upcoming Washington Conference respecting Greenwich might "be influenced by the action which may be taken by the United Kingdom" on the Metric question.[142] But the two subjects had seemed so unrelated to the Treasury that the cost was not deemed worth a possible gain. When the deputation pointed out that joining the Metric Convention did not actually involve using the Metric System, and that the costs were lower than the Treasury had believed, the Treasury was more willing to consider the request.

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138 William Christie to Peter MacLiver, May 1, 1884, RGO7.148, CUL.

139 William Christie to John Donnelly, February 19, 1884, RGO7.142, CUL.; See also William Christie to Peter MacLiver, May 1, 1884, RGO7.148, CUL.

140 William Christie to Peter MacLiver, May 10, 1884, RGO7.148, CUL.; William Christie to William Foerster, May 20, 1884, RGO7.148, CUL.

141 Treasury to the President of the Royal Society, May 23, 1884, RGO7.148, CUL.

142 Treasury to the President of the Royal Society, May 23, 1884, RGO7.148, CUL.

In the meantime (the spring of 1884), the SAD was in the midst of the messy negotiations described above between themselves, the CO, and the FO over the Washington delegates. Donnelly managed to secure assurance that the SAD would be in charge of picking delegates, and they chose people whom they could be sure would support the Metric Convention in return for the Greenwich. As Strachey was their ally, Christie suggested that Donnelly ask the Indian Office to get him appointed as an Indian delegate.[143] Adams and Evans were also Christie's idea.[144]

The SAD's outlook on the Prime Meridian Conference was based on solving an entirely separate scientific controversy, namely adherence to the Metric System. Fleming's timekeeping schemes were immaterial, so he was ignored. Even had they known about Fleming's desire to attend Washington, his true allegiance concerning the Metric System was unknown (having ties with both sides, via Barnard on one hand and the IPAWM on the other). He was therefore nearly passed over, and would have been if not for the intervention of the CO. The result of this controversy was that most British delegates attending Washington were picked for their position on the Metric System, not on the meridian question. Ironically, the tenuous link between the two concepts was deteriorating rapidly and would evaporate entirely by the time the conference began. The Metric System would only be discussed perfunctorily at Washington. On both sides of the English Channel, the idea of a *quid pro quo*, Greenwich for the Metric System, had lost favour.

[143] William Christie to John Donnelly, February 22, 1884, RGO7.142, CUL.
[144] William Christie to John Donnelly, March 28, 1884, RGO7.142, CUL.

On the French side, politicians had decided that they would not support a Greenwich Meridian no matter what concessions Britain made. As Hirsch put it, even politicians who privately supported the idea of a common Prime Meridian would not dare be seen accepting Greenwich over Paris. Their hand was forced by the weight of public opinion, which was fervently anti-British in 1884, due to Britain's recent interventions in Egypt.[145] On the British side, the trade was never going to work either. Although the Treasury was now considering paying its share to the Metric Convention, it had taken too long, and it was clear that the matter was to be considered entirely separately from the Meridian question. David Gill told Christie to keep the two matters separate. Even if France did not accept Greenwich now, Gill said, they would be probably compelled to do so eventually by international pressure.[146] Christie wrote apologetically to Hirsch:

> Official matters take a long time in this country when several departments of the government are concerned and the question has to be argued out between them by correspondence… I think that this question of adhesion to the Metric Convention will be considered entirely on its own merits quite apart from the adoption of a prime meridian. The feeling, as far as I can judge, is decidedly against making any

[145] Association Geodesique Internationale to William Christie, April 1, 1884, RGO7.148, CUL. In the late 1870s, British and French relations concerning Egypt had been reasonably amicable. It lay between their imperial interests (France in Northern Africa, and Britain via the Suez in India), and a neutral Egypt kept the peace between the two powers, maintaining a 'balance of power.' Unrest in Egypt in 1881-2 persuaded French and British officials to send in warships in an attempt to deter the uprising. When that failed, the British sent in troops, which was a step beyond what France was willing to do. France's fervently imperialist President, Jules Ferry, had just been ousted, and French politics were incredibly turbulent in 1882-3. Ferry was re-elected in early 1883, too late to involve France in the Egyptian conflict, but his expansionist stance fostered resentment towards Britain's unilateralism in Egypt. The result was an Egypt effectively annexed by Britain, and a France disillusioned with British friendship. Britain struggled to maintain order in Egypt over the next several years. The crisis in Sudan in 1883-4 made British rule in Egypt seem particularly incompetent, fueling international criticism of Britain's intervention. All of this, in the larger context of the renewed Scramble for Africa, made French-English relations highly volatile by 1884. See G. Stone and T.G. Otte, *Anglo-French Relations Since the Late Eighteenth Century* (London: Routledge Taylor & Francis Group, 2009).; Peter Mansfield, *The British in Egypt* (New York: Holt, Rinehart and Winston, 1972).

[146] David Gill to William Christie, April 25, 1884, RGO7.148, CUL.

> bargain with the French or anybody else to adopt the metrical system if they will adopt the meridian of Greenwich.[147]

It was July before the Treasury made a decision. In the end it agreed to join the Metric Convention, as long as it did not have to pay arrears.[148] Christie lamented the long, messy process, saying "It is unfortunate that our government was so slow to be convinced of the desirability of this step, and that thus the good effect which it might have had on the settlement of the Prime Meridian question has been lost."[149] By the beginning of the Washington Conference in October, the two questions could not be further apart. The SAD, which had tried so hard to appoint delegates who would support the Metric Convention, had to tell those delegates not to raise the topic at Washington. Their official letters of instruction to the delegates reiterated the point.[150]

SAD officials were extraordinarily distracted by the Metric controversy, and their inattentiveness to other departments was a real barrier to Fleming. Ultimately, however, the CO's campaign to secure a spot for Fleming paid off. Fleming got his seat alongside Strachey, Adams and Evans. But the gulf between the SAD and the CO highlights the insular nature of the scientific community and its government representatives in Britain. Their understanding of the meridian question as a bargaining chip in a debate over systems of measurement hardly acknowledged the notion of universal, collective timekeeping proposed by Fleming. They may have been sitting at the same table in

[147] William Christie to Ad. Hirsch, April 12, 1884, RGO7.148, CUL.
[148] William Christie to Richard Strachey, July 18, 1884, Vol 187, Strachey Papers MSS EUR F127, BL.
[149] William Christie to Ad. Hirsch, September 16, 1884, RGO7.148, CUL.
[150] John Donnelly to Richard Strachey, June 24, 1884, Vol 188, Strachey Papers MSS EUR F127, BL.

Washington, under the same flag, but had very different ideas about what was to be accomplished.

Fleming received his official appointment on September 25th, 1884, just six days before the conference was to begin.[151] As for Australasia, the question of attendance was reopened in September. Although these colonies had already declined to send delegates, and had offered to send letters instead, the situation had changed. Previously, they believed they would have no vote. Now, they could have one. Given the change in circumstance, a delegate seemed a much more palatable idea. With the conference less than a month away, could a delegate arrive in Washington in time from the South Pacific? Or were there any Australians or New Zealanders in the country with the necessary knowledge to represent them? James Cockle, a mathematician and the former Chief Justice of Queensland, was chosen; he was in Britain, and therefore had a more manageable journey to Washington.[152] All the Australasian Colonies except for Western Australia agreed to pay their portion of Cockle's expenses.[153] However, by the time Cockle was informed, it was too late. He would not be able to arrive until October 13th at the earliest, well after the Conference had begun. Cockle declined the nomination.[154] The decision came very late. The United States did not find out there would be no

[151] H.F. Anson to Sandford Fleming, September 25, 1884, Vol 27, Fleming Papers MG29 B1, LAC. Fleming was concerned about his appointment as delegate arriving so late. A friend wrote to him on the 26th saying "I hope therefore that your papers will be in time." A. McLellan to Sandford Fleming, September 26, 1884, Vol 33, Fleming Papers MG29 B1, LAC.
[152] Prime Meridian Conference, Colonial Office Minutes, September 1, 1884. CO42.779, CUL.
[153] Prime Meridian Conference, Colonial Office minutes, October 3, 1884, CO201.601, CUL.
[154] Prime Meridian Conference, Colonial Office minutes, September 28, 1884, CO309.127, CUL.

Australasian delegate until October 2nd, by which time the conference had already begun.[155]

After all the deliberations, Fleming was at last a full delegate to the Washington Prime Meridian Conference, alongside Strachey, Adams, and Evans. His official title was "British Delegate for Canada." But he was to be dealt one final slight. Despite the months of incessant correspondence and quibbles about how voting was to be carried out, the Conference itself decided on the spot in October that voting would not occur by individual delegate after all. Votes would be cast by nation. And since Fleming was representing Britain, not Canada independently, his voice was significantly diluted.

His American friends fared almost as poorly. At first, all seemed well. Fleming's ally Barnard, who was President of the AMS, was chosen to lead the American delegation. Commander William Sampson, a staff member at the US Naval Observatory, was second. But as Bartky points out, these choices were lambasted by various American scientific periodicals, Barnard for being too old and deaf; Sampson for lack of scientific credentials.[156] Like Fleming, these two faced exclusion. While Fleming was nearly excluded for his colonial status and his engineering profession, Sampson lacked prestige. Barnard, meanwhile, was well known and respected, but in old age he faced significant discrimination. Disability, particularly one which inhibited communication, had no place in the argumentative, masculine worlds of science or diplomacy. Barnard had other enemies too, though less reputable ones. Fleming's unfortunate anti-metric acquaintance,

[155] Earl Granville to J.R. Lowell, October 2, 1884, Despatches from U.S. Ministers to Great Britain 1791-1906 Microfilm M30 146, NAUSA.
[156] Bartky, *One Time Fits All*, 83.

Charles Latimer, was particularly incensed at Barnard's selection. The IPAWM wrote a lengthy diatribe to the President of the United States, exposing the supposed pro-Metric conspiracy hidden beneath the cover of the Prime Meridian Conference. It claimed that twenty of the thirty nations attending were Metric supporters, and pointed out that even the lead American delegate, Dr. Barnard, was favourable to it. The letter went on to suggest a member of the IPAWM be allowed to attend, to counterbalance the misguided Metric reformers.[157]

The IPAWM's efforts were to no avail. Having failed to secure a seat for an IPAWM member in the USA, Latimer wrote to Fleming in August, saying "I hope the Canadian Government will appoint you and I beg that when you get to Washington that you will guard the question of weights and measures and let it not come up at all. Mr. Barnard's whole object is to bring up that subject as you will find when you come to the convention."[158] Despite Latimer's fears, Barnard was interested in the time reform question quite independently of his approval for the Metric System. In late September Latimer wrote to Fleming again, suggesting that the conference "is all worked up for the Metric System by Dr. Barnard… I think it is for the purpose of inveighling [sic] the United States and Great Britain to adopt the French Metric System and you will find that everything they do and say will tend in that direction. Watch it carefully I beg of you."[159] Latimer's fears had some grounds, as we have seen. The idea of trading Greenwich for acceptance of the Metre Convention had indeed been discussed at the Rome Conference,

[157] An Open letter to the President of the United States from the IPAWM, July 30, 1884, Box 1, Records of International Conferences, Commissions, and Expositions RG43, NAUSA.
[158] Charles Latimer to Sandford Fleming, August 21, 1884, Vol 27, Fleming Papers MG29 B1, LAC.
[159] Charles Latimer to Sandford Fleming, September 29, 1884, Vol 27, Fleming Papers MG29 B1, LAC.

but Latimer overestimated the danger. By the time of the Washington Conference, the idea of a trade had been soundly rejected.

The engineers of the ASCE wanted to be represented too. John Bogart, who had worked with Fleming in the ASCE, was upset that no one had been selected to represent the "engineering and transportation interests" of the United States.[160] His preferred candidate, a railway engineer named Mr. Whittemore, was not picked, to Bogart's disappointment.[161] So he was relieved when Fleming had secured his place, even though Fleming was not American. He was even more pleased when William Allen, the architect of standard railway time in North America, was picked as a third US delegate.

The final two American delegates were Cleveland Abbe, (another victory for Fleming), and an amateur astronomer, Lewis Rutherford. Going into the conference, it seemed a strong position for the time reformers, with Fleming, Abbe, and Barnard all attending. But just days before the Conference began, Barnard, who was supposed to be in charge of the entire US delegation, dropped out under pressure over his disability. He wrote to Fleming that on account of poor hearing he decided to give up his seat to Simon Newcomb or Eugene Hilgard, both eminent scientists."[162] Although he gave up his seat by his own choice, it is likely that his decision to step down was informed by the outcry raised in scientific journals about his hearing impairment. What might have been a capstone to a long career instead became a minor scandal.

[160] John Bogart to Sandford Fleming, August 27, 1884, Vol 2, Fleming Papers MG29 B1, LAC.
[161] John Bogart to Sandford Fleming, September 20, 1884, Vol 2, Fleming Papers MG29 B1, LAC.
[162] F.A.P. Barnard to Sandford Fleming, September 21, 1884, Vol 3, Fleming Papers MG29 B1, LAC.

One of the French delegates, Jules Janssen, visited him in September just before the conference. Janssen wrote with regret that Barnard would not attend, calling him "a very deaf, wise old man (we could not talk with him without an ear trumpet), but full of the serenity that a long, interesting career gives."[163] The Frenchman regretted that Barnard had stepped down in favour of "an ordinary naval officer," and seemed to imply that Barnard would have been more willing to listen to the arguments of the French scientists at the Washington (a fair assumption, given Barnard's support for the Metric System).[164] The replacement, a retired Naval officer named C.R.P. Rodgers, was an unknown. Hilgard and Newcomb, Barnard's suggested replacements, were not invited. When Rutherford had been appointed, he wrote to Newcomb, saying "I do not know why I was named… [and am at a loss] to find a good reason why he [the President] has not appointed yourself and Hilgard both of which nominations would have been most manifestly proper."[165] Nonetheless, the final spot was given to Rodgers. At Washington, Rodgers, who had previously been ambivalent to the time reform movement, acted as a somewhat neutral party, whose role at the conference was mainly administrative. Rodgers took up Barnard's role as head of the American Delegation and was elected the President of the Conference.

With the pieces finally in place, the Washington Conference could begin. But as we have seen, a lot can be gleaned about the process of scientific decision making from the months and years *prior* to the conference. Competing interests, sometimes only

[163] Jules Janssen to Henriette Janssen September 27, 1884, Janssen Correspondence MS4133, Bibliotheque de l'Institute de France (BIF). My own translation.
[164] Jules Janssen to Henriette Janssen September 27, 1884, Janssen Correspondence MS4133, BIF.
[165] Lewis Rutherford to Simon Newcomb, July 24, 1884, Box 38, Newcomb Papers, Library of Congress (LOC).

tangentially associated with timekeeping, shaped the discussion. Sandford Fleming's attempts to bring the idea of a universal system of public timekeeping to the attention of the world's scientific community met with opposition and progressed by means of Fleming's relentless lobbying and by some chance developments. Fleming was an outsider. His position as a professional engineer (at times an unemployed engineer), alongside his colonial citizenship, severely limited his scope of action in the scientific community. His early papers and presentations were ignored and derided, and he struggled to find legitimate allies, thus seeking friends who were similarly on the disrespectable fringes of the scientific community, like the IPAWM. Fleming was nearly excluded politically because of rivalries among governmental departments, and by international convention. Through his incessant, tireless efforts, he ensured that his ideas were made known, but they were rarely listened to, except by his peers in the railway profession, like William Allen. In the world of science, he was a Nobody.

This conclusion requires some caveats. It would be incorrect, for example, to regard the scientific establishment as a nasty hegemon, a foil to Fleming's underdog heroism. The notion that European scientists were a conservative elite, holding back the tide of progress, with Fleming as an embattled, enlightened hero, is a false one. Such value judgements are irrelevant, and in fact the narrative of progress itself is altogether unhelpful in explaining how decisions were made. Similarly, one should be careful about drawing too sharp a line between continents. Some geographical determinism might explain why North American railroads felt the need for ordered timekeeping more urgently, but there were competing opinions on both sides of the Atlantic.

A more accurate picture, avoiding false dichotomies, is one that accepts the existence of multiple, variable, and competitive opinions. Nothing about Fleming's plan was inevitable or natural. The eventual adoption of Fleming's time zone idea could have been forestalled by the implementation of a very different system, and in fact for years Fleming's position was the minority one. The establishment position held by men like Christie and Airy was that universal time was a tool for scientific research, not a public good. Most of the men who would come to the Prime Meridian Conference at Washington came not to discuss public timekeeping, but rather to establish a Meridian for navigation and astronomy: in other words, universal time was to be a specialized tool for specific professions, not, as Fleming wished, as a revolution in civil time use and norms of public behavior. Opinions on the subject of time reform were deeply held, even existential for some. These differences in opinion, and the similarly differing goals that motivated some of the key players, shaped the debate. Even before the Prime Meridian Conference, these motivations simmered beneath the surface, moulding perspectives and deciding, ultimately, which ideas, and which people, had a legitimate seat at the table, both literally and figuratively. Debate and discussion shaped what was possible. Time reform was a matter of negotiation, not of invention.

Chapter 2: Amateurs, Professionals, and Eccentrics?: Scientific Timekeeping in Context

> Our Astronomers must wake up! They must take a hint from our Civil Engineers. Look at the steam locomotive. See what a perfect thing it is…our Civil Engineers do hunger and thirst after righteousness in such matters. They watch every new effort for imperfections and hunt them down and search them out until they correct them…Our Astronomers must proceed in like fashion.[1]

So wrote Ralph Sadler, a civil engineer, to the Astronomer Royal in 1915. Sadler had been badgering the staff at Greenwich Observatory with similar letters for more than a decade, in an attempt to correct what he saw as an error in the calculation of the calendar at the turn of the century. He believed that modern timekeeping was out of sync with the natural order of things, and only the Astronomer Royal had the authority to correct it.[2] But although Sadler framed his argument around his profession as an engineer, his motivation came from his theology. Sadler was a fanatic, a believer in Pyramidology and other forms of mysticism. Over the years, his letters to Greenwich became increasingly bilious and insulting, featuring mad ravings about the end of the British nation.[3] And yet his call to reform the measurement of time, and his subsequent rejection by the astronomical authorities, is fittingly symbolic of the nature of time reform in the late Victorian era. Participants in the time debate approached the subject from a multitude of backgrounds, beliefs, and skillsets. Sadler and the astronomers at Greenwich had very little in common. Yet they were all concerned with time and its measurement. These distinct perspectives lent wide-ranging breadth and depth to the time reform debates.

[1] Ralph Sadler to the Astronomer Royal, Greenwich, April 14, 1915 RGO7.182, Royal Greenwich Observatory Archives, Cambridge University Library (CUL).
[2] Sadler believed that the date used to mark the turn of the century was incorrect. Ralph Sadler to the Astronomer Royal, Greenwich, April 14, 1915, RGO7.182, Royal Greenwich Observatory Archives, CUL.
[3] Letters from Ralph Sadler, 1900-1915, RGO7.182, Royal Greenwich Observatory Archives, CUL.

Time reform intersected with, and was shaped by, dozens of other movements, discoveries, and controversies under scrutiny during the period. Time reform did not occur in a vacuum.

This chapter asks how these diverse approaches to time reform filtered through to the professional astronomers and naval officials who made the decisions at the International Meridian Conference (IMC) at Washington in 1884, if they did at all. It suggests that some ideas were more influential than others. We have already seen how the metric debate shaped the Science and Art Department's (SAD) approach to the IMC, though ultimately it did not play as large a role as expected. But the metric debate was not the only question that influenced time reform. Navigational and astronomical questions played the largest roles, but contemporary debates about religion, international politics, and archeology also filtered in, demonstrating the wide-ranging reach of the Victorian time standardization debate.

A subsidiary argument of this chapter reflects on the nature of the relationship between the amateur and the professional. These relationships determined whose voices were heard and whose were not, and thus which of the various intersecting contemporary debates had the most influence on time reform. Professionals with the weight of academic authority behind them commanded more sway than outsiders like Sadler, who's inflamed proposals fell on deaf ears. Sadler's irate mannerisms might explain his rejection, but so might the divide between amateur and professional. In the same vein, the previous chapter argued that Sandford Fleming was an outsider to the scientific community whose voices dominated the discussion on time reform at the IMC in 1884. Late Victorian professional science, especially in the field of astronomy, was insular, with only a limited space for dialogue with non-specialists and amateurs. This led to a particularly narrow understanding of the uses of time standardization, which proved incompatible with the sweeping civic time keeping proposals touted by Fleming. This chapter reasserts, but also complicates and problematizes that statement: the notion of insiders and outsiders is overly simplistic. In reality, the boundaries of that scientific network were shifting and flexible. People moved in and out of the community, and circumstance and personal relationships radically altered people's status within it. Permeability was the primary trait of this community's boundaries. Nonetheless, those boundaries did exist and were very real, no matter how permeable, and the battle lines over time reform were drawn along professional boundaries more than along national ones.

This chapter is broken into roughly three parts, each tracing the role of an individual who represents a set of beliefs or debates which intersected with time reform. These individuals each had to navigate the boundaries of professional science in their own way. Their careers ranged from respectable scholars, to victims of professional discrimination, to purveyors of intellectual snake-oil. Each case directly reflects the cultural and intellectual milieu of professional Victorian science, into which the time reform debates were embedded. Without understanding this cultural climate, the proposals and decisions made about time, at the IMC and beyond, are far more opaque. The first part of this chapter discusses Victorian faith and astronomy as informants of the time debate, as seen through the works of astronomer Annie Russell (and her husband, with whom she collaborated). The second part follows navigator William Parker Snow's hapless attempt to inject the language of nautical safety into the time reform debate. The final part uses the life of Astronomer Royal for Scotland, Charles Piazzi Smyth, to examine the intersection of time reform with atypical religious belief, archeology, nationalism, and the Victorian fascination with Egypt. Built into all these parts is a constant underlying tension between professional and amateur.

To begin, it is worth taking a moment to reflect on scientific disciplines and their relationship to time reform. In large part, how important someone considered time reform depended on their discipline. Astronomers had the most obvious connection to the question because their observations both depended on accurate timekeeping, and, conversely, they were the ones who provided accurate time to others who might make use of it. Geographers were similarly interested, as time measurement was an invaluable tool for determining longitude and facilitating land surveys. Both mapping and navigation relied on it. In effect, disciplines which involved observing the natural world on a grand scale required some consideration of time standardization. On the other hand, disciplines which examined the microscopic, such as chemistry or botany, although they might require accurate time keeping, were less concerned with ensuring that clocks were standardized worldwide. Astronomers and geographers (and their nautical counterparts) were therefore the main players in the time reform debate.

In the 1870s and 1880s, one rare phenomenon dominated the attention of the astronomical world; one which would come to shape the way they understood time and its measurement. This phenomenon was the transit of Venus across the Sun, which occurred twice in the nineteenth century: first in 1874, and again 1882. These events spurred some of the largest astronomical undertakings of the nineteenth century: a global effort to observe the transits, and from the data gathered, determine the size of the solar system. By observing the transit, astronomers hoped to be able to calculate the Astronomical Unit (AU), or the distance between the Sun and the Earth. Observation points were set up in dozens of locations, with experts travelling across the globe to witness the event. To determine the AU, observations needed to be made at different points around the world for comparison by triangulation. Accurate, standardized timekeeping was a necessity in order to properly compare the observations at each location. More than this, the exact longitude of each observation point relative to Greenwich (or another national observatory) had to be determined, a delicate and arduous task to perfect, requiring the use of expensive, accurate chronometers.[4] These expeditions are an excellent example of the role of timekeeping in astronomy, and also of the global scale of the network. So intrinsic was time standardization to the transit of Venus observations that it was these expeditions that most astronomers worldwide had in mind when they considered the usefulness of time reform in the 1880s. In their minds, standardization was tied inextricably to the precision and accuracy of transit calculations, and such perfect standardization was a much more challenging task than standardizing the less accurate clock time required for civilian use. It is for this reason Fleming's time reform for use by the general public seemed so far-fetched to astronomers. Standardized time, for them, was a task suited to scientific endeavours, a specialized tool irrelevant to the average woman or man.

[4] George Forbes, *The Transit of Venus* (London and New York: MacMillan: 1874), 63-67.

The transit of Venus was a globally observed event. While Europeans led most of these expeditions, it would be incorrect to call this a European community only. The transit of Venus was observed by astronomers from every continent. Latin American astronomers, like Luis Cruls in Brazil and Angel Anguiano in Mexico, shared their observations with European and Japanese astronomers, and vice versa. Unfortunately, in both 1874 and 1882, inclement weather ruined the Venus transit observations at several of the stations worldwide, making the results less than spectacular. But the effort and coordination required reveals the broad geographical scope of participants in this network.

The relationships between astronomers of different nationalities reveals that the transit of Venus was both a cooperative international effort, and a competitive one. Nationality divided the community of astronomers, but this divide was one of rivalry more than of actual seclusion.[5] By necessity these events required cooperation, and techniques were shared and improved upon across national borders.[6] Language, though a barrier, did not tend to divide astronomers into silos of English, French, German etc. Rather, language limited those who could participate in the international dialogue, as only those with enough education to learn a second or third language (usually French) could belong. In Britain, most children were not taught French in the Victorian period. The 1870 Elementary Education Act made provisions for elementary schools in Britain which required the teaching of reading, writing, and arithmetic (and needlework for girls), but

[5] The IGC and the IGA meetings at Rome and Venice, discussed in chapter one, are excellent examples of the international nature of astronomy and geography in the late 19th century.

[6] See Forbes, *The Transit of Venus*, 1874.

not foreign languages.[7] Only middle and upper-class children were likely to attend school beyond the elementary level. The 1868 Taunton Report on secondary education in Britain suggested separating these secondary schools into three tiers: a first-grade liberal education for those going on to university; a second-grade education teaching two modern languages and Latin, for those going into the civil service and army; and third-grade schools that taught some basic French and Latin for those likely to become tradesmen.[8] Curriculum was thus divided by class, and by gender, limiting the opportunities available to working class men and women.[9] In this way, language was not so much a barrier between nations and cultures as it was a barrier between classes. Scientists tended to be drawn from the middle and upper classes, creating a transnational network of privileged intellectuals.

I have been using the word 'network' freely, but it needs some explanation. The nature of large communities has been a subject of detailed study and theory. From Benedict Anderson's *Imagined Communities,* which attempts to explain the spread of nationalism, to scholarship on imperial networks and the 'British world', there are varying and competing understandings of the mechanics of widespread communities.[10] One of the most fruitful places to look, given that most of the individuals discussed in this

[7] Stephen Heathorn, *For Home, Country, and Race: Constructing Gender, Class, and Englishness in the Elementary School, 1880-1914* (Toronto: University of Toronto Press, 2000), 166.
[8] Derek Gillard, "Education in England: A Brief History" http://www.educationengland.org.uk/history/chapter03.html
[9] Earlier in the 19th century, girls were actually more likely to be taught French than boys, because the language was considered effeminate. See Marcus Tomalin, *The French Language and British Literature, 1756-1830* (New York: Routledge, 2016), 79.
[10] Benedict Anderson, *Imagined Communities: Reflections on the Origin and Spread of Nationalism* (London: Verso, 1991).; Phillip Buckner, Ed., *Canada and the British Empire* (Oxford: Oxford University Press, 2008).

and the previous chapter are from Britain, Canada, and America, is the literature on the British Empire and the British world. Imperial networks were not merely political institutions: indeed, some of the most lasting connections in the empire stemmed from the movement of people and ideas, not political ties. Furthermore, these connections were not simply one-way paths from metropole to periphery. A better conceptual tool is that of a web, with multiple nodes and smaller pathways interlocking with each other.[11] Scientific networks are a good example of one of these strands that linked different parts of the British world, in tandem with other interests, notably commercial ones, as recently explored by Ted Binnema concerning the Hudson Bay Company's patronage of the sciences.[12] Societies like the British Association for the Advancement of Science (BAAS) and Royal Society, with local chapters and large international gatherings, were the lifeblood of these networks. Mobility, and the ability to afford travel to attend these gatherings was almost a necessity for active membership in these societies.[13]

Perhaps the most useful conceptual tool for this chapter is the understanding that some institutions, societies and individuals were more influential than others. Networks, as Frederick Cooper so vividly describes, are "filled with lumps, places where power coalesces surrounded by those where it does not, places where social relations become

[11] See Thomas Metcalf, *Imperial Connections: India in the Indian Ocean Arena, 1860-1920* (Berkeley: University of California Press 2008), 7-8. Metcalf describes how a web makes more sense than a wheel with spokes to describe the British Empire.
[12] Ted Binnema, *"Enlightened Zeal": The Hudson's Bay Company and Scientific Networks, 1670-1870* (Toronto: University of Toronto Press, 2014).; See also Bernard Lightman, ed., *Victorian Science in Context* (Chicago: University of Chicago Press, 1997).; Richard Drayton, *Nature's Government: Science, Imperial Britain, and the 'Improvement' of the World* (New Haven: Yale University Press, 2000).
[13] Charles Withers, "Scale and the Geographies of Civic Science: Practice and Experience in the Meetings of the British Association for the Advancement of Science in Britain and in Ireland, c. 1845-1900," in *Geographies of Nineteenth-Century Science*, eds. David Livingstone and Charles Withers (Chicago: University of Chicago Press, 2011), 99.

dense amid others that are diffuse."[14] Tamson Pietsch's examination of the British academic world bears this out, demonstrating the importance of personal connections, and the existence of systematic forms of marginalization from the academic world by race, class, and gender.[15] Much of Pietsch's argument applies to scientific networks beyond the university, as well as beyond the empire. The world of astronomy was an international network, not just an imperial one.

If this global network consisted of unevenly distributed nodes, connected by a dialogue of ideas, discoveries, and challenges, and channeled through institutions, what determined which ideas and which people would succeed in gaining acceptance? The answer is intersectional. Some methods of exclusion seem obvious. We have already seen that education and multilingualism, and therefore class, limited the opportunities of many. Similarly, race was a significant barrier to a career in astronomy. Late 19th century conceptions of race in Britain were hierarchical and exclusionary, based in theories of Social Darwinism which leant them legitimacy. Phrenology and similar anthropological studies shaped public understandings of the colonial 'other' in Britain. As Laura Tabili suggests, racial difference changed with context: race was a construct, a "relationship and not a thing."[16] In practice, this means that "the same struggles over wealth and power that shaped other aspects of…politics and society also constructed racial difference."[17] The experience of colonial citizens visiting Britain were thus varied, shaped by their own

[14] Frederick Cooper, *Colonialism in Question: Theory, Knowledge, History* (Berkeley: University of California Press, 2005), 91. See also Simon Potter, "Webs, Networks, and Systems: Globalization and the Mass Media in the Nineteenth- and Twentieth-Century British Empire," *Journal of British Studies* 46, No. 1 (2007).
[15] Tamson Pietsch, *Empire of Scholars* (Manchester: Manchester University Press, 2013).
[16] Laura Tabili, *We Ask for British Justice: Workers and Racial Difference in Late Imperial Britain* (Ithaca: Cornell University Press, 1994), 3-4.
[17] Tabili, *We Ask for British Justice,* 4.

circumstances, class, and gender. In the 1880s, Indian visitors to Britain, for example, ranged from destitute workers to honoured guests of royalty.[18] Some made careers in medicine, law, and science, either educated in Britain or at home. As Michael Fisher argues, Britain in the early 19th century could even be a "site of pleasure and advancement" for Indian aristocrats.[19] But these were the minority. Most colonial visitors to the imperial center found themselves outcasts.

Racial difference was similarly divisive beyond the empire. Britons saw themselves in competition with other races, fueling Anglo-German, Anglo-Russian, and Anglo-French antagonism, and heightening tensions with 'internal others,' such as Irish nationalists.[20] But competition did not always mean conflict. The Japanese delegate at the Washington Conference in 1884, Kikuchi Dairoku, though neither British nor a colonial subject, was educated in Britain. He was the first Japanese graduate of Cambridge University, and attended lectures with renowned physicist Lord Kelvin in America. He later became president of Tokyo Imperial University. Very clearly a part of the international scientific community, Kikuchi's experience demonstrates that racial bias could be overcome in the right circumstances. Just as "the gendered body is performative," as Judith Butler argues, so is the racialized body.[21] Non-European

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[18] See Rozina Visram, *Asians in Britain: 400 Years of History* (London: Pluto, 2002).; Antoinette Burton, At the Heart of the Empire: Indians and the Colonial Encounter in Late-Victorian Britain (Berkeley: University of California Press, 1998).

[19] Michael Fisher, Counterflows to Colonialism: Indian Travellers and Settlers in Britain, 1600-1857 (Delhi: Permanent Black, 2004), 299.

[20] See Tabili, *We Ask for British Justice.;* Tabili, "A Homogenous Society? Britain's Internal 'others,' 1800-present," in *At Home with the Empire: Metropolitan Culture and the Imperial World,* eds. Catherine Hall and Sonya Rose (Cambridge: Cambridge University Press, 2006.

[21] Judith Butler, *Gender Trouble: Feminism and the Subversion of Identity* (New York: Routledge, 1990), 173.

scientists like Kikuchi adopted western modes of dress, for example, in order to more easily find acceptance. Many Japanese elites like Kikuchi donned western dress *en masse* as part of policy of 'modernization' adopted by Japan after the Meiji restoration in the mid nineteenth-century.[22]

Gender was another barrier to participation. Given the nineteenth-century European middle class' disposition towards separating gender by public and private sphere, women had difficulty finding any prominent position in this network.[23] But even this is overly simplistic. To begin with, the notion of separate public and private spheres was an ideal, rather than a reality.[24] Women did participate in the public sphere and found roles in the sciences as well. Women who expressed their scientific interests in terms of "natural theology and thereby moral education were acceptable in scientific narrative."[25] Female botanists exploited gender norms, 'performing' their expected roles as moral wellsprings, in order to gain acceptance as practitioners of science.[26] Botany and similar fields thus became the most accessible to women, but these was not their only options. Throughout the second half of the 19th century, higher education for upper and middle-

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22 Donald Shively, *Tradition and Modernization in Japanese Culture* (Princeton: Princeton University Press, 1971).; Daikichi Irokawa, *The Culture of the Meiji Period* (Princeton: Princeton University Press, 1985).

23 See Leonore Davidoff and Catherine Hall, *Family Fortunes: Men and Women of the English Middle Class 1780-1850* (Chicago: University of Chicago Press, 1991). Some fields were more open to female scientists. Botany, for example, was seen as appropriate for women because studying plants and the natural world had religious connotations as God's creation, a study which was well within the purview of the respectable woman's sphere.

24 See Davidoff and Hall, *Family Fortunes.*; Amanda Vickery, "Golden Age to Separate Spheres? A Review of the Categories and Chronology of English Women's History," *The Historical Journal* 36, No. 2, (1993).; Anna Clark, *The Struggle for the Breeches: Gender and the Making of the British Working Class* (Berkeley: University of California Press, 1997).; Marjorie Levine-Clark, *Beyond the Reproductive Body: The Politics of Women's Health and Work in Early Victorian England* (Columbus: Ohio State University Press, 2004). Levine-Clark suggests that working class women did not share this ideal.

25 Ruth Watts, *Women in Science: A Social and Cultural History* (London: Routledge, 2007), 103.

26 See Butler, 173. "The gendered body is performative"

class women was slowly becoming more accessible, though it was, as Ruth Watts points out, "heavily contested."[27]

It is here that we come to our first case study of the intersection between timekeeping and other aspects of Victorian culture, religion in this instance. Astronomer Annie Russell had studied at Girton College in Cambridge, one of the earliest colleges open to women in Britain. Girton was founded in 1869, offering courses in mathematics, science, and classics, although not degrees. After completing her education, Russell found work at Greenwich Observatory, where she was involved with observing, calculating, and distributing Greenwich time to all of Britain. Just as Kikuchi Dairoku overcame racial bias, Annie Russell subverted gender norms to work in the field of astronomy. Her experiences at the Greenwich Observatory, and her later publications concerning historical astronomy and the scientific interpretation of the bible, reflect a practical and grounded approach to timekeeping. Although most of her work was written after the 1884 conference, Russell's perspective is nonetheless representative of the interactions between astronomy, time reform, and Christianity in late nineteenth-century Britain. At the IMC, proposals for Rome or Jerusalem to house the Prime Meridian were voiced with as much rigour as Greenwich, based on religious grounds and yet still reflecting scientific principles. Russell's career demonstrates this interaction between science and religion. Russell's expertise in astronomy and in the study of religious texts led her to consider all of humankind's timekeeping methods to be arbitrary, noting dozens of variations in practise from biblical times to the present. The exception to this rule was when

[27] Watts, 124.

timekeeping methods were founded on natural astronomical rhythms. The smallest possible division of time that could be ascertained, without mechanical timepieces, was the day, determined by the turn of the earth.[28] Smaller divisions like hours and minutes, according to Russell, were superficial additions to the natural truth of God's heavenly creations.

Russell, more so than time reform activists like Fleming, was able to view the reform movement of the late Victorian era in the perspective of the *Longue Durée,* as an inconsequential blip in the pattern. Timekeeping methods were ultimately predetermined by the stars (the work of God), and were unchangeable at their core, whatever cosmetic finishes reformers might want to put on them. Russell viewed the heavens through the dual lenses of both her telescope and her bible, a mix of science and religion that was not uncommon in Victorian Britain. This fusion of religion and science was present in the time reform debates at the IMC and beyond.

The relationship between religion and science was contested in Victorian Britain. For many people, they were compatible. Science, the successor to the Natural Philosophy of the 18th century and earlier, was undertaken to better understand Creation, and could therefore be understood as an act of devotion in itself. But there were those who came to see religious teaching as antithetical to science, such as John William Draper, whose 1874 book *History of the Conflict Between Religion and Science* popularised that conflict.[29]

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[28] Walter Maunder [and Annie Maunder, Uncredited], *The Astronomy of the Bible: An Elementary Commentary on the Astronomical References of Holy Scripture* (Bungay: Richard Clay and Sons, 1908), 271-272.
[29] John Draper, *History of the Conflict Between Religion and Science* (New York: D. Appleton, 1874).

Most scientists fell between the two extremes, suggesting that religious belief was compatible with science, but the worst forms of dogmatic sectarianism were not.[30]

A subsidiary debate, intrinsically related to the science versus religion framework, was the debate over whether biblical texts were literal or metaphorical. If an astronomical observation or scientific discovery contradicted a passage from the Bible, which took precedence? The most famous debates about biblical literalism and scientific theory revolved around Darwin's *On the Origin of Species*, but it was representative of a broader debate, some of which went to extreme lengths. Literal interpretations of biblical texts led one lecturer named Samuel Rowbotham to conclude that the earth was stationary, flat, and only a few thousand years old. Writing under the pseudonym 'Parallax,' he published *Zetetic Astronomy: The Earth Not a Globe* in 1881, which argued for biblical literalism, challenging modern astronomy for misreading the nature of the heavens. Rowbotham and his followers engaged in several high profile public experiments in an attempt to prove their theories. When these experiments did not go their way, they were able to spin them in such a way as to discredit the legitimacy of the experiments, and in this way kept a significant number of devotees.[31] In one particularly extravagant incident in 1870, a Zetetic follower named John Hampden bet £500 to anyone who could prove the globe was round. Alfred Wallace, a naturalist who had independently conceived of the theory of natural selection alongside Darwin, took Hampden's bet, and Wallace won it, though not without controversy. These debates over biblical literalism and scientific observation had

[30] Christine Garwood, *Flat Earth: The History of an Infamous Idea* (New York: St. Martin's Press, 2007), 11-12.
[31] Garwood, *Flat Earth*, 60-61.

ramifications for the time reform debates. The calendar was determined by the movement of heavenly bodies, and so the nature of that movement was of real concern to time reformers. A spherical earth was the underlying assumption of Fleming's time zone proposal. He did not even acknowledge the possibility of a flat Earth.

Annie Russell's career was deeply entangled in these questions concerning both scientific and religious timekeeping. She worked at the literal and symbolic centre of global timekeeping, and, and at the same time she was fascinated by the relationship between biblical text and modern astronomical observations. The daughter of an Irish Presbyterian Minister, she had won a three-year scholarship to Girton in 1886. Upon completion of her coursework, Russell found a position at the Greenwich observatory in 1891. Her time there was not glamorous. She was one of several women were employed at the observatory as computers, the others being Alice Everett, a fellow Girton graduate who went on to be a physicist and engineer, and two graduates of Newnham College, Edith Rix and Harriet Furniss.[32] Women were similarly employed at the Harvard Observatory in America around the same time, so their appointments at Greenwich were not without precedent in the astronomical community, but it was still a rarity.[33] The positions held by Everett, Furniss, Rix, and Russell, though highly technical, were not particularly prestigious. As computers, they were doing the grunt work of astronomy, mostly mathematical calculations and some limited observations with the observatory's

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[32] See Mary Bruck, "Lady Computers at Greenwich in the Early 1890s," *Quarterly Journal of the Royal Astronomical Society* 36 (1995): 86-87. Russell was hired to replace Furniss, who left after a year. Rix left soon after for health reasons.

[33] These women were crassly known as 'Pickering's Harem' (Pickering was the observatory director). Over 80 women had worked with Pickering by 1918. As they were paid less than men, Pickering could hire more of them.

instruments.[34] At Greenwich this kind of work was normally carried out by teenaged boys in temporary positions, who used it as a stepping stone to get into the Civil Service.[35] While boys only had to sit an entrance examination to earn a position, women's applications were denied unless they had studied at a "University Ladies College."[36] Nonetheless, these women proved more capable than most of the boy computers, and were trusted with more complicated tasks and responsibilities.[37] For example, and most pertinent for our purposes, Rix, Russell and Everett were all tasked with taking observations with the transit instrument. The transit instrument was used to establish Greenwich time for all of Britain. The time was distributed from the observatory twice daily, after they had taken their observations. It was sent by wire to the post office, where it was disseminated to the rest of the country. These women were the instrument of standardized time for naval, astronomical, and civil purposes. While working the transit instrument, they were quite literally the producers of accurate scientific time for Britain and the world.

But Russell's role as timekeeper for the world lasted only four years. There were restrictions in place to keep women out of the observatory in the long run. To begin with, the salary was far from appealing.[38] At just four pounds a month, Russell took the job knowing that her salary would be almost half what she had been earning as a

[34] Lady Computers, RGO7.140, Royal Greenwich Observatory Archives, CUL.
[35] Lady Computers, RGO7.140, Royal Greenwich Observatory Archives, CUL.
[36] H.H. Turner to Fanny Allen, February 18, 1892, RGO7.140, Royal Greenwich Observatory Archives, CUL.
[37] Russell's letter of recommendation upon leaving listed more than just computing. William Christie re. Annie Russell c. 1897, RGO7.138, Royal Greenwich Observatory Archives, CUL.
[38] One woman who applied turned down the job because of its low salary, L.S. Walter to H.H. Turner, December 22, 1891, RGO7.140, Royal Greenwich Observatory Archives, CUL.

schoolmistress.[39] For Russell, the experience and unique opportunity of the position outweighed the low salary. But for other women with less means to support themselves, the low pay was an impossible barrier. Several women, including astronomer Agnes Clerk, turned down the job because of the low salary.[40]

Even during her tenure at the observatory, Russell was not entirely welcomed by the scientific profession. Although nominated to become a fellow of the Royal Society in the early 1890s, she was barred from joining because she was a woman. Two decades later, at the start of the First World War, she was nominated again, but this time she herself declined in protest. She wrote that the Royal Society had blackballed her "solely because I was a woman. But – I remain a woman still; a fact I never regretted until the call came for *men* to join Kitchener's Army."[41] Russell, once rejected by the Royal Society, this time rejected it herself. Her career is an excellent example of the alternative channels of scientific pursuit which were possible in late Victorian Britain. Faced with exclusion, she created her own space for astronomical endeavours.

Nonetheless, Russell faced challenges her male counterparts did not. Only single woman could be employed at Greenwich, and upon marriage a woman had to leave.[42] Russell was forced to retire from her post at the observatory upon marrying another

[39] Annie Russell to H.H. Turner, c. 1891, RGO7.140, Royal Greenwich Observatory Archives, CUL. She was offered 48 pounds a year, while the school had paid 80 a year with residence. Her salary eventually increased.
[40] Lady Computers, RGO7.140, Royal Greenwich Observatory Archives, CUL.
[41] Annie (Russell) Maunder to Dr. Dyson, December 4, 1914, RGO8.150, Royal Greenwich Observatory Archives, CUL.
[42] Mary Bruck, "Lady Computers," note 42. "Women in the public service were required to resign upon marriage."

Greenwich employee, Walter Maunder, in 1895.[43] But even that was not the end of her career. Despite her official exclusion from both the Royal Society and from Greenwich, Russell carried on as a partner in her husband's observations, collaborating with him on several books. She was not alone. Women were often silent partner's in their husband's scholarly work, acting as editors or even authors, though sometimes published under their partner's names. Others acted as confidants.[44] Henriette Janssen, for example, the wife of French Astronomer Jules Janssen, was in constant communication with her husband during his astronomical voyages and at the Washington Conference in 1884.[45] The exclusion of women from science, therefore, was incomplete, and often circumvented by the initiative of upper and middle-class women who were keen to participate.

The intersection of religion, astronomy, and timekeeping is clearest is Russell's publications following her stint as a Greenwich Computer. As discussed above, women were more accepted in scientific profession when their work was tied to morality and religion. They were also more likely to be relegated to amateur status, kept out of official institutions and denied professional membership. Russell embraced both amateurism and religious study. As Marilyn Ogilvie suggests, "Forbidden professionalism by her gender, Annie Maunder was compelled to be an obligatory amateur. But rather than resenting this niche, she took advantage of the situation to become an advocate of the amateur."[46]

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[43] Annie Russell to William Christie, September 1895, RGO7.138, Royal Greenwich Observatory Archives, CUL.

[44] See Pat Jalland, *Women, Marriage, and Politics, 1860-1914* (Oxford: Oxford University Press, 1987), 189, 195-204. Jalland discusses women as political confidants.

[45] Lettres écrites, au cours de ses nombreux voyages, par Jules Janssen à sa femme Henriette, MS 4133, 273-280, Correspondence de Jules Janssen, Bibliotheque de l'Institute de France (BIF).

[46] Marilyn Ogilvie, "Obligatory Amateurs: Annie Maunder (1868- 1947) and British Women Astronomers at the Dawn of Professional Astronomy," *British journal for the History of Science* 33 (2007): 83.

If amateurs and the public were Russell's audience, her passion was biblical astronomy. Much of her and her husband's work (often published under his name, but their work was shared) in the ensuing decades concerned either public astronomy, such as her 1908 *The Heavens and their Story*, or the study of ancient texts with reference to modern understandings of the night sky, such as in the cowritten book *The Astronomy of the Bible.*[47]

In both these books, the nature of human timekeeping is central. Interestingly, what is left unsaid speaks volumes. There is little discussion of the Prime Meridian or standard time or time zones, no analysis of IMC resolutions or the Universal Day. All of that, for Russell, was cosmetic, the mere trappings of modern timekeeping. For the two angles of her work (amateurism and religion), they were irrelevant. Timekeeping in the Bible was derived from astronomical bodies, not clocks and watches, and the amateur astronomer need use of a clock only to better understand how to measure the degrees of a circle (Russell illustrates 47 degrees as equal to the space a clock hand moves in 8 minutes on a round clock face, for example).[48]

The first of these books, *The Heavens and their Story*, was written as a handy guide to new astronomers. Russell took pains to point out that astronomy could be done without a telescope, describing how Hilly Fields Park in London could be used as an open-air observatory, using nearby church spires as meridians and points of reference.[49]

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[47] Russell was the lead author of *The Heavens and their Story*, and a significant contributor to *The Astronomy of the Bible.* Maunder wrote in the dedication, "To my wife, my helper in this book and in all things."

[48] Annie Maunder and Walter Maunder, *The Heavens and their Story* (London: Robert Culley, 1908), 26, 35.

[49] Maunder and Maunder, *The Heavens and their Story*, 8, 26.

But Russell directed her readers' attention to the heavens in an attempt to teach about creation beyond Earth. She spent very little time on practical astronomy, i.e. taking transit measurements to determine longitude or time. Russell was more interested in teaching her readers about how to determine the length of a Martian day than how to determine the divisions of a day on Earth.[50] Her goal was to impress on the reader "the vastness and mystery of that great starry system of which our sun and his family occupy a small and insignificant corner."[51]

In *The Astronomy of the Bible*, cowritten by Russell and her husband, the pair took a similar approach, beginning the chapter on timekeeping with a discussion about the length of the day on Venus, rather than Earth.[52] But they quickly turned their attention homeward to discuss ancient timekeeping systems on Earth, comparing biblical passages to modern observations of the stars. They wrote, "The making of the calendar is in all nations an astronomical problem: it is the movements of the various heavenly bodies that give to us our most natural divisions of time…but as there are many heavenly bodies and several natural divisions of time, the calendars in use by different peoples differ considerably."[53]

Though they were discussing ancient history and myth, it was also a commentary on current timekeeping. Russell and Maunder were of the opinion that the squabbling over whose time was right was immaterial. Divisions of the day were arbitrary beyond what could be ascertained by the stars. In describing how ancient Judea had an

[50] Maunder and Maunder, *The Heavens and their Story*, 228-9.
[51] Maunder and Maunder, *The Heavens and their Story*, 9.
[52] Maunder, *Astronomy of the Bible*, 269.
[53] Maunder, *Astronomy of the Bible*, 271.

ecclesiastical day beginning at sunset separate from the civil day which began at dawn, the Maunders pointed out that in modern times, “We have a similar divergence of usage in the case of our civil and astronomical days; the first beginning at midnight, and the second at the following noon, since the daylight is the time for work in ordinary business life, but the night for the astronomers.”[54] The difference was merely one of convenience, not worth fighting about. Of course, as we will see in chapter three, the astronomical day was fought over, by Fleming and other reformers who wished to see the complete unification of time measurement and wanted astronomers to take the lead by abandoning their astronomical day and adopting the civil day. But to Russell and Maunder, such conflict was unnecessary, and even short-sighted.

Religious justifications for methods of temporal measurement were common in the timekeeping debates. It led some commentators to condemn certain methods of timekeeping by associating them with rival denominations or sinful practices.[55] But religion led Russell to a far more flexible approach to timekeeping. After years of studying both scripture and the stars, she came to believe that there were only a few natural or God-given measures (the solar day, the lunar month, and the year), anything else was either superficial adornment or constructed convenience. As such, there was little point in arguing about timekeeping beyond finding what was most convenient. This perspective was radically tolerant, and made vitriolic timekeeping debates seem somewhat petty. Russell was not a biblical literalist: she would have abhorred the opinions of Rowbotham and Hampden. The last line of *The Astronomy of the Bible* makes

[54] Maunder, *Astronomy of the Bible*, 273-4.
[55] See chapter 4 for some examples.

that clear. The final chapter of the book had attempted to explain the nature of the star of Bethlehem, but Russell and Maunder found they did not contain enough evidence to decide definitively what the star might be:

> The narrative [in the gospels] appears to me astronomically too incomplete for any astronomical conclusions to be drawn from it. The reticence of the narrative on all points, except those directly relating to our Lord Himself, is an illustration of the truth that the Scriptures were not written to instruct us in astronomy, or in any of the physical sciences, but that we might have eternal life.[56]

It was a direct attack on literalists like Rowbotham and Hampden. As we have seen, Russell was open to any convenient form of timekeeping, since God had left no natural clues for its measure beyond the solar day, lunar month, and Earth's orbital year, and Scripture could not be trusted for its astronomical accuracy.

But religious belief was not always so tolerant as in the case of Annie Russell. It could also be used to make an argument for a much narrower attitude toward timekeeping. Denominational rivals had their own preferred time systems, accusing others of corrupting God's true time. While Russell's study of heaven, both scriptural and astronomical, bent her towards flexibility, others used religious arguments to back more rigid beliefs about the proper way to keep time. Charles Piazzi Smyth, discussed later in this chapter, is one of these.

While some people's approach to time reform was shaped by religious belief, others came to the subject from a more material practical background. This was truest amongst seagoing professions. Navigation and timekeeping had long been linked, as the best method to determine longitude at sea was to compare the local time with the time at a

[56] Maunder, *Astronomy of the Bible*, 400.

known longitude on land. In 1714, the British government had passed the Longitude Act, which offered prize money to whomever could come up with a method of establishing longitude at sea. One of the best competing methods involved measuring the movements of the moon in comparison to an almanac designed for the purpose, but this was clumsy and ultimately too finicky to be done on a ship in constant motion. Famously, the winner of the prize was clockmaker John Harrison, whose clocks were built well enough to be accurate on long voyages overseas, allowing for the determination of longitude at sea without the need for complex lunar observations. By the 1880s, Harrison's clocks had been improved on many times over, and his method was used worldwide. But that did not mean that sailors had no further interest in standardizing timekeeping. The work of William Parker Snow, a lifelong sailor who took an interest in time reform in the 1880s, is a good example. Snow believed that standardizing timekeeping with a single Prime Meridian could be used to improve safety at sea and prevent loss of life.

As required by his profession, Snow had a working knowledge of navigation and practical astronomy. He led a troubled life, leading one scholar to conclude he may have suffered some sort of mental disability.[57] Nonetheless, he was an intelligent author and experienced seaman. Recruited by Lady Jane Franklin in the early 1850s, he participated in several expeditions searching for the missing ships of Franklin's husband, John Franklin, who had been lost in the Northwest Passage in 1845. The widely publicised search for Franklin was a windfall for Snow, but it did not last. By the 1880s Snow had

[57] See J.K. Laughton, "Snow, William Parker," *Oxford Dictionary of National Biography* (2004) http://www.oxforddnb.com/view/10.1093/ref:odnb/9780198614128.001.0001/odnb-9780198614128-e-25980?rskey=C0SUzT&result=1

fallen on hard times, and was living a life of genteel poverty, supported by his publications and, in part, by relatives.

Snow had long been interested in finding new ways to reduce the number of lives lost at sea. In November, 1880, he published an article in *Chambers's Journal of Popular Literature, Science, and Art*, proposing several possible lifesaving techniques.[58] He wanted to establish floating telegraph lines into the Atlantic, for example, to serve as an emergency communication system. He also wanted unused naval ships to act as floating lighthouses, guiding ships into dangerous ports. Perhaps Snow's most ambitious plan was to establish a series of 'ocean relief depots.' These depots were essentially small settlements or stores of food, water, and supplies placed in remote areas, where stranded or lost crewmen could find refuge and survive until rescue arrived. He proposed placing these relief depots in the most desolate of places, like the St. Paul's Rocks, a lonely landmark in the middle of the Atlantic, or in particularly dangerous places like the Cape of Good Hope, where a high number of vessels continued to be lost every year. Snow believed that the relief depots could save countless lives, but critics argued that they would be too expensive, and difficult to maintain. The editors of *Chambers's Journal* found Snow's proposals to be "ingenious, but we fear not very practicable."[59] Of course, that response is very similar to what the Royal Society said about Fleming's time reform proposals: clever, but utopian. Like Fleming's ideas, Snow's proposals were not really so far-fetched, if only the political will had existed to carry them out.

[58] William Parker Snow, "Ocean Relief Depots" *Chambers's Journal of Popular Literature, Science, and Art* No. 833 (November 27, 1880): 753-55.
[59] Snow, "Ocean Relief Depots," 753-55.

When the subject of a common Prime Meridian for navigation and timekeeping rose to prominence in the early 1880s, Snow wanted to be involved. He immediately saw it as a possible lifesaving tool. The meridian question intrigued Snow because he himself had had a personal experience with the confusion caused by the lack of a common Prime Meridian. It had occurred during a storm at sea, when the ship he was sailing came across a second vessel fighting its way through the gale.[60] The two ships traded their longitude with each other (a common practice, as it helped each ship confirm that its own calculations were correct) and found that each ship's longitude was "wildly different" from the other.[61] Getting the longitude wrong in a storm with poor visibility was an often deadly mistake. Indeed, the 1714 Longitude Act itself had in part been a response to a naval disaster near the Scilly Islands, in which four ships had sunk in a storm because they could not calculate their longitude. Snow implies that the ship he was on in 1832 may have done their calculations correctly, and so might the other, but the two ships were each using a different Prime Meridian. This was a cause for unnecessary and possibly life-threatening confusion. Snow was convinced that a shared international Prime Meridian would prevent such mistakes in the future.

To this end, Snow published a circular letter in 1883, addressed to the Royal Geographical Society and other interested parties. In the circular, Snow extolled the life-saving benefits of a common Prime Meridian. By contrast, he accused Lloyds, and other insurance companies, of opposing a common Prime Meridian and the establishment of

[60] The storm described took place in 1832

[61] William Parker Snow, "An International Prime Meridian: Greater Safety at Sea by Uniform Routes" Circular Letter, Mic.A.19863, British Library (BL).

relief depots, because such life-saving efforts would minimize the insurance companies' financial gains. If sea travel was safe, Snow insinuated, the insurance companies would make no money, and so they lobbied against his plans.[62] Snow implored scientists to ignore these immoral corporations and support his ideas which, if they were only accepted, might save countless lives.

Snow's choice for the Prime Meridian was the St. Paul's Rocks in the middle of the Atlantic.[63] He felt that the spot was ideal because it was neutral, avoiding any national jealousy. Furthermore, he wanted to turn these rocks into more than just an abstract line marked on maps and charts: The Prime Meridian could house one of his long-proposed relief depots. Responding to his critics at the *Chambers's Journal* who had called his ideas impracticable, he wrote: "As to its *practicability*, I argue nothing now. Man is the mighty spirit to surmount all difficulties; therefore I say, like Archimedes of Old – 'Give me a lever strong enough,' (money in this case,) 'and I could lift the whole world.'"[64] Here, Snow revealed his true purpose. He was looking for a patron to finance his writing, perhaps the nineteenth century equivalent of a modern academic grant proposal. Snow concluded the circular: "How to *utilise* these Rocks, and form a PRIMARY *Station* there, as, also, one at the *Magnetic Poles* - North and South, - and other places, - I should be happy to explain, if means be afforded me, as I am too impoverished now to do it at my own expense."[65]

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[62] Snow, "An International Prime Meridian," Circular Letter, Mic.A.19863, BL.
[63] The Saint Peter and Saint Paul Archipelago.
[64] Snow, "An International Prime Meridian," Circular Letter, Mic.A.19863, BL. Italics are Snow's.
[65] Snow, "An International Prime Meridian," Circular Letter, Mic.A.19863, BL. Emphasis and italics are Snow's.

Snow's plans fell on deaf ears. While men had fewer barriers to participation in the sciences than women, there were limits to their ability to engage with professionals. Professional masculinity had its own performative rituals and behaviours to regulate membership. As John Tosh suggests, elite masculinity often marginalized other masculine traits.[66] Professional societies were rife with ritual and symbolism, in an effort to legitimize their elitism, separating them from other men.[67] Expertise itself was not enough to guarantee acceptance. Without money or position, even a highly experienced person could be ignored.

Given these circumstances, Snow was unsuccessful. Despite his experience with navigation, and his firsthand understanding of the need for a common Prime Meridian, he was largely ignored. He brought the language of nautical safety to the time reform debate, a laudable cause, but nowhere at the Washington Conference would the notion of lifesaving be mentioned. Snow's exclusion was not due to a lack of expertise, nor due to class, race, or gender. It was a lack of position, and of funds. Just as Fleming's early papers were not legitimized until published by a professional society, Snow was an outsider looking in because he lacked official standing. He was an amateur.

Amateurism in Victorian science deserves some further examination. The gap between paid professionals and unpaid amateurs was growing wider by the end of the nineteenth century, and the two sides had a conflicted relationship. The process of professionalization was underway in many fields, from the Civil Service to historians and

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[66] John Tosh, *Manliness and Masculinities in Nineteenth-Century Britain* (Harlow: Pearson Education, 2005), 42.
[67] Albert Pionke, *The Ritual Culture of Victorian Professionals: Competing for Ceremonial Status, 1838-1877* (London: Routledge, 2013).

lawyers.[68] In Britain, amateurs actually made up the bulk of all astronomers. As historian John Lankford points out, very few people actually earned a salary doing astronomy, the exceptions being the staff of university and government observatories like Greenwich or Cambridge, the staff of the Nautical Almanac, and a research group led by Norman Lockyer in South Kensington, supported by the Science and Art Department (SAD).[69] For decades prior to the 1880s, amateurs had been the guiding lights of astronomy, and worked closely with professionals. But by the late 19th century, the two sides were drifting apart. In fields like natural history, amateurs continued to find acceptance.[70] But in other fields, the gap widened. As Lankford explains, "professionals demanded specialization, technical knowledge gained only through advanced education, and access to large-scale research facilities. Further, they sought government support for their research, an action to which many amateurs strenuously objected."[71] Lankford goes on to show how amateur astronomers argued that small, personal telescopes were more useful than the large, expensive variety used by their professional peers. There was a significant market for such cheap, portable instruments. In the 1880s, Josiah Latimer Clark, an electrical engineer and amateur astronomer, produced and sold relatively cheap (though not cheap enough for most working-class families to afford) transit telescopes to the

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[68] Philippa Levine, *The Amateur and the Professional: Antiquarians, Historians and Archaeologists in Victorian England, 1838–1886* (Cambridge: Cambridge University Press, 1986), 124.
[69] John Lankford, "Amateurs versus Professionals: The Controversy over Telescopes Size in Late Victorian Science," *Isis* 72, No. 1 (March 1981): 12.; See also A.J. Meadows, "Lockyer, Sir Joseph Norman, 1836-1920," *Oxford Dictionary of National Biography* (2006). http://www.oxforddnb.com.libaccess.lib.mcmaster.ca/view/10.1093/ref:odnb/9780198614128.001.0001/odnb-9780198614128-e-34581
[70] Douglas Lorimer, *Science, Race Relations and Resistance: Britain, 1870-1914* (Manchester: Manchester University Press, 2013), 114.
[71] Lankford, "Amateur versus Professional," 12.

public.[72] Testimonials show a keen interest in both astronomical study and timekeeping. One customer from Pallasgrean, Ireland, wrote that operating it "would be quite a simple matter, and in this out-of-the-way part of the country will be most useful in regulating our time."[73] Accompanying the instrument was a yearly publication of transit tables, a simplified version of the official *Nautical Almanac*. The tables included instructions on the use of the transit instrument, and on how to determine accurate time, and to find Greenwich time, in any part of the world, and any day of the year.[74] With instruments like these available to the public, Greenwich did not have a monopoly on timekeeping, nor on astronomy in general.

Nonetheless, the divide between amateurs and professionals was significant. Amateurs performed regular, steady observations, collecting data which made up the primary sources upon which professionals relied for their more advanced studies.[75] But at the same time, professionals were seeking greater accuracy and technical skill, as well as recognition for the work they were doing above and beyond basic observation. As Albert Pionke points out, they invented new ways to separate themselves from amateurs, legitimizing their expertise with rituals, ceremonies, oaths, and organizations.[76] The end of the nineteenth century was not the end of the amateur, but merely the separation of amateurs from professionals. Relationships between them could be friendly, but not

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[72] They cost 7 pounds, 10 shillings: Almost two month's wages for Annie Russell's Greenwich computer job. 7.5 pounds was about the monthly wages of a highly skilled working man in the 1880s; most skilled workers earned between 6 and 8 pounds a month; unskilled workers between 3 and 5 pounds a month.
[73] Josiah Latimer Clark, *Transit Tables for 1884: Giving the Greenwich Mean Time of the Transit of the Sun, and of Certain Stars, for Every Day in the Year, etc.* (London: E & F.N. Spon, 1884), BL.
[74] Clark, *Transit Tables*, BL.
[75] Lankford, "Amateurs versus Professionals," 28.
[76] Pionke, *The Ritual Culture of Victorian Professionals*.

always. Charles Piazzi Smyth, Scotland's Astronomer Royal, looked upon one visitor to his Edinburgh Observatory on Calton Hill with disdain. In his diary in November 1884, he wrote:

> At dusk, an unknown gentleman [a medical professor at the university] with a little boy 6 or 7 years old accosted me… 'When could I show my little boy your observatory, Calton Hill?' This is a good illustration of the extraordinary contempt and ignorance college people have of the nature of a Royal Observatory. I told him visitors were forbidden, that we were required to attend to our work; - and that he must get a telescope for himself... But just as with… Lord McLaren, wanting to make use of the Observatory through the winter, to save himself the expense of putting up a telescope in Edinburgh - so the wealthy medical professors at the college have no notion of spending their own money in getting themselves telescopes, even for their children.[77]

Smyth believed the professional's work was above public engagement and education. Though not all professionals agreed with Smyth (Norman Lockyer regularly held public lectures, even for children), there was nonetheless a clearly widening gap that cordoned off both the public and the skilled amateur from the professional expert.

Smyth's particular antagonism to outsiders might stem in part from his own precarious position within the world of professional astronomy. He himself was in danger of being sidelined. This needs some explanation. Smyth met all the criteria needed to be included in the professional scientific community. He was white, affluent, and male, with both position and expertise. There is no denying he was a competent astronomer, and even a leading innovator in matters of public timekeeping. His time signal system in Edinburgh was one of the most advanced in the world, and experts from other countries

[77] Charles Piazzi Smyth, Journal, November 24, 1884, Journal 36, Charles Piazzi Smyth Archives, on loan from the Royal Society of Edinburgh, Royal Observatory of Edinburgh (ROE).

regularly went to him for advice.[78] It was his unorthodox opinions, not his talent, which made him a target for exclusion.

Smyth's role in the time reform debate highlights several intersecting conflicts and cultural phenomena from the Victorian period. We have seen how time reform was caught up in the debates over the relationship between science and religion through the works of Annie Russell, and how timekeeping was integral to navigation though William Parker Snow's campaign for nautical safety. An examination of Smyth's career adds not one but several new contemporary issues to the milieu in which the time debate was conducted. Religion is again one of these, though in a different way than Annie Russell. If Russell represented a tolerant, respectable blend of science and religion, Smyth represented its fractious counterpart. Smyth's involvement also demonstrates how scientific debates over the Metric System, archeology, Egyptology, and international politics all intersected with time reform. Underlying all of this is the story of professionalization and exclusion in the sciences.

As was noted in the first chapter, Smyth believed that the Prime Meridian ought to be placed at the Great pyramid of Giza. The way he arrived at this conclusion informs much of the following section, as it reveals multiple layers of the popular and professional attitude towards science and the production of knowledge in the Victorian era. Smyth was a biblical literalist like Rowbotham, at least to the extent that he believed that the account of the Hebrews in ancient Egypt were accurate enough to compare them

[78] There are plenty of requests for advice in Correspondence A12/52, A12/54, A13/58, Charles Piazzi Smyth Papers, Royal Observatory of Edinburgh, (ROE); George Airy forwarded questions about timekeeping from the German Ambassador to Smyth for answers in 1878, RGO6.13, Royal Greenwich Observatory Archives, CUL. See also Hermann Bruck and Mary Bruck, *The Peripatetic Astronomer: The Life of Charles Piazzi Smyth* (Bristol: A Hilger, 1988), 256-7.

to the physical remains of the ancient past, such as the pyramids. Smyth was one of the foremost proponents of Pyramidology; the belief that the Great Pyramid of Giza held instructions from God for the Anglo-Saxon race, and, in particular, proved that the British system of measurement was divinely inspired. Smyth was not the first to promote this theory. Its originator was John Taylor, a publisher whose 1859 book *The Great Pyramid; Why was it Built: and Who Built it?* was motivated by a nationalist desire to preserve Britain's national system of measurement in the face of the increasing popularity of the French Metric System. On first reading, Smyth was actually unimpressed with Taylor's theories. It was not until Smyth read Taylor's second book, *The Battle of the Standards*, in 1864, that Smyth became a convert.[79] He rapidly took up the cause, publishing his own book late in 1864, titled *Our Inheritance in the Great Pyramid.* Unlike Taylor's book, Smyth's was far more carefully constructed as a scientific argument, filled with diagrams, measurements, and citations. But Smyth himself was unsatisfied with his own work. He was inspired to put his and Taylor's theories to the test, and actually travelled to Egypt to measure the pyramid for himself (something that Taylor had never done). Smyth and his wife, Jessica Duncan Piazzi Smyth, spent the early part of 1865 in Egypt, on a mostly self-funded expedition to the pyramid. Whether by coincidence or by way of self-fulfilling prophecy, Smyth's measurements affirmed for him that his theories were accurate.

According to Smyth's argument, the ancient Egyptian cubit, which one would expect the architect of the pyramid to have used, when "applied either to the Great

[79] See Eric Reisenauer, "The Battle of the Standards: Great Pyramid Metrology and British Identity, 1859-1890," *The Historian* 65, No. 4 (2003): 943-44.

Pyramid's base-side, or base diagonals, or vertical height, or axis-lines, or any other known radical length of the building," does not come out to any round number.[80] On the other hand, if one uses a base of twenty-five British inches to measure the pyramid's dimension, it brings out "so many of the most important coincidences."[81] Given this striking discovery, Smyth concluded that the ancient architect must have used British inches; that somehow there was "intercommunication in idea and knowledge between the architect of the Great Pyramid, and the *origines* of the Anglo-Saxon race."[82] That architect was supposedly of Hebrew descent, and had inherited the 'sacred cubit' of twenty-five inches from Noah's son Shem. This argument drew a direct connection between the Hebrew people of biblical times to modern Britons, thus imbuing modern Imperial measures with both divine favour and ancient gravitas. The pyramid's purpose, according to Smyth, was to be a message to future generations, a time capsule showing the proper system of measure intended for man, as ordained by God.

Smyth's book went on to show how the Pyramid's measurements match not just British length measures, but also measures of capacity, weight, temperature, and even time. Smyth, for example, wrote that "When the British farmer measures his wheat which the bounty of Providence has afforded him as the increase of his land, in what terms does he measure it? In *quarters.* Quarters! Quarters of what? The existing British farmer does not know…but from old custom, he calls his largest corn measure a quarter."[83] Smyth discovered that the modern British measure of capacity seemed to be exactly one quarter

80 Charles Piazzi Smyth, *Our Inheritance in the Great Pyramid* (London: Isbister & Co., 1874), 39.
81 Smyth, *Our Inheritance*, 39.
82 Smyth, *Our Inheritance*, 339.
83 Smyth, *Our Inheritance,* 115.

of the contents of the coffer in the King's Chamber of the Great Pyramid. That unit of measure had somehow survived down 4000 years of history, and Smyth had now rediscovered its heavenly origin.

Similarly, Smyth believed that the pyramid taught the correct use of the stars to tell time. He wrote that "to astronomy therefore only, of the modern sciences, can we reasonably look for some safe guidance in the practical measuring of time. In the broadest sense, time is said to be measured by the amount of movement of some body moving at an equable rate."[84] These movements in modern times were measured with a transit instrument, and Smyth claimed the pyramid contained its own ancient transit instrument. "To myself, who have been an astronomical transit observer for a great part of my life, it immediately occurred, that the narrow entrance-passage of the Great Pyramid directed up Northward, looked very much like a meridian *Polar* pointer."[85] Thus the inspired ancient architect had known astronomical methods "unknown elsewhere, and only recently begun to be appreciated in the best *European astronomy*."[86] Smyth's argument in this section then becomes somewhat convoluted, going on to suggest that the astronomical alignment of the pyramid may even be predictive, prophesizing about events to come in the modern age. Modern Britons were to learn from and be guided by these discoveries, rejecting the Metric System in favour of the Imperial System, and granting the Great Pyramid its rightful place as Prime Meridian for global timekeeping.

[84] Smyth, *Our Inheritance*, 291.
[85] Smyth, *Our Inheritance*, 338.
[86] Smyth, *Our Inheritance*, 351.

The pyramid, in other words, was a form of religious scripture. “In an age when writing was a rarity indeed,” the pyramid was an alternative way to record sacred measures for posterity.[87] The Hebrew architect, inspired by God, foresaw that the scientific age would come one day, at which time its secrets could be unlocked though careful study. Smyth himself spent 1865 conducting that study. Findings in hand, he returned to Scotland a true believer. It was his work, not Taylor’s, that would come to popularize Pyramidology. When the time reform movement gained momentum in the early 1880s in preparation for the IMC, Smyth unsurprisingly put forward the great pyramid as the most logical site for the Prime Meridian.

Later historians and observers would scoff at Smyth’s fantastical beliefs, labelling him with the dismissive moniker ‘the Pyramidiot.’ But their dismissal of Smyth’s scientific investigation of the Great Pyramid is ahistorical. In the 1860s and early 1870s, Smyth’s study of the pyramid was considered to be the most thorough ever undertaken and was praised by both professionals and by the public.[88] Pyramidology, for a time, gained widespread acceptance, and it offers insight into the way that various aspects of Victorian culture were interrelated. Time reform, astronomy, archeology, professional networks, religious belief, a cultural fascination with Egypt, international politics, imperialism, and race relations all fed into one another in unexpected ways. The following section explores these connections through Pyramidology and Smyth’s extraordinary career.

[87] Smyth, *Our Inheritance*, 552.
[88] Reisenauer, “The Battle of the Standards,” 950.

Before Smyth publicized his findings, Egypt and its monuments already held a prominent position in the public mind of Britain. If time reform was on the lips of many in the 1880s, popular Egyptology eclipsed it. The phenomenon known as 'Egyptomania,' a cultural fascination with ancient Egyptian civilization, spread from France to Britain and America after the Napoleonic Wars. Egyptomania is commonly associated with three events: Napoleon's campaigns in Egypt in the 1790s, the translation of the Rosetta Stone in the 1820s, and the discovery of the tomb of Tutankhamun in 1922. While these dates may have been the peak moments of the phenomenon, Egypt continued to capture the imaginations of the British between these major discoveries too, as historian David Gange masterfully demonstrates. The fascination was alive and well throughout the Victorian period, especially in the 1870s and 1880s.[89] Though the export of Egyptian antiquities was illegal in the 1880s, the British Museum and various private collectors managed to amass large collections. Wallis Budge, for example, an agent for the British Museum, found ways to undercut the legal barriers, and carried off several valuable sets of items for the Museum in 1887 and 1888.[90] He was not alone, and with the steady flow of artifacts arriving in Britain, "Londoners of all classes…could spend the afternoon gazing at curious foreign objects in public pavilions and exhibition venues."[91] Egypt peaked the curiosities of many.

[89] David Gange, *Dialogues with the Dead: Egyptology in British Culture and Religion, 1822-1922* (Oxford: Oxford University Press, 2013), 1-2.
[90] Peter France, *The Rape of Egypt: How the Europeans Stripped Egypt of its Heritage* (London: Barrie & Jenkins, 1991), 174.
[91] Lynn Parramore, *Reading the Sphinx: Ancient Egypt in Nineteenth Century Literary Culture* (New York: Palgrave MacMillan, 2008), 27.

Perhaps the most sought-after prizes were mummies. The voyeuristic spectacle of mummy ‘unwrappings’ became a popular and exotic form of entertainment. Public shows, sometimes accompanied by music from a brass band, drew audiences from the working classes, while private parties with professional surgeons and dissectors entranced the wealthy. *The Times* claimed these surgical demonstrations were in no way indelicate, and the audiences included “highly respectable spectators, a great part of whom were ladies.”[92] Victorian Britons had a deep fascination with the ancient Egyptian ‘other.’ Through these unwrappings, the Egyptian body became an object to be explored, a vessel that carried hidden secrets from the past.

Throughout the 19th century, Ancient Egyptian architectural styles found purchase in Britain as well. Stylized Egyptian motifs began to appear on religious and commercial buildings, as well as in the monuments and architecture of cemeteries.[93] In large part this cultural fascination and imitation was driven by a seemingly endless stream of new discoveries. Archeological finds brought media attention, and artifacts which seemed to confirm biblical events, such as the Pithom Stele, drew especially high levels of public interest.[94] Just as Annie Russell looked to astronomy to explain biblical passages, other looked to archeology to do the same. As David Gange points out, “in the 1880s a biblically inspired constituency provided the bulk of Egyptology’s readership: they revelled in the proofs and illustrations of the bible that archaeologists, year on year,

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[92] See Parramore, *Reading the Sphinx*, 30-31.
[93] Parramore, *Reading the Sphinx*, 34-5.
[94] Gange, *Dialogues with the Dead*, 2. The Pithom stele was believed to relate to the exodus.

appeared to unearth."[95] Smyth's pyramid measurements carried a similarly religious appeal: they seemed to confirm or supplement interpretations of the Old Testament. To get some sense of the popularity of such writings, take one remarkable statistic uncovered by historian Eric Reisenauer. In the three-year period prior to 1886, 147 people checked out Smyth's book, *Our Inheritance in the Great Pyramid*, from the Free Public Library in Barrow-in-Furness, which averages out to about once a week. The majority of the readers, apparently, were from the working class.[96] Britons, rich and poor, wanted to read about Egypt, and to see and touch its mementos.

Larger artifacts that were transported to Britain sometimes became public monuments. The inaccurately named 'Cleopatra's Needle,' gifted to Britain by Khedive Muhammad Ali Pasha, was erected on the bank of the Thames in 1878, after an expensive and arduous trip from Alexandria, in which several sailors lost their lives. The Needle, in spite of its own ancient inscriptions, was dedicated instead to the memory of British 18th century military victories in Egypt. The monument's erection in London, like Smyth's Pyramidology, tied ancient Egyptian prowess to modern British nationalism.

British orientalist imaginings of Egypt were many and varied: there was not one single vision of the ancient Egyptians.[97] Some mid 19th century Christians reviled them and their monuments. As one Egyptologist put it, the later Egyptian monuments were built by an "idolatrous monarchy."[98] Smyth himself held this view. He carefully distinguished the Great Pyramid, supposedly a sacred structure built by God's chosen

[95] Gange, *Dialogues with the Dead,* 154.
[96] Reisenauer, "The Battle of the Standards," 955.
[97] See Edward Said, *Orientalism* (London: Routledge, 1978).
[98] Waynman Dixon to Charles Piazzi Smyth, January 7, 1877, A13/58, Charles Piazzi Smyth Papers, ROE.

people, from other Egyptian monuments. Smyth remarked that those people fascinated by the profane relics of Egyptians were angered to learn that "the Great Pyramid, though *in* Egypt, is not, and never was, *of* Egypt - that is, of their favourite idolatrous Egypt."[99] Other monuments left behind in Egypt were not worthy of the same reverence. The Old Testament's portrayal of Egyptians as the nemesis of God's chosen people, and their worship of an enigmatic pantheon of unfamiliar gods, did little to endear ancient Egyptian civilization to British Christian sensibilities. At the same time, that exotic 'Otherness' attached to the ancient Egyptians created as much fascination as it did disdain. The imagined Egypt of idolatrous tyrants captivated some members of the public. Smyth's vision of a sanctified and holy pyramid was doubly attractive, because while it too exploited this fascination with the 'Other,' it also removed the negative connotations of idolatry. It was an enchanting combination, and in the decades that followed Smyth's work, Egyptian civilization would be seen in a new light. By the 1880s, as Gange explains, "the wanton Egypt of Ezekiel and Pusey slid into the void; in its place there flourished a different imagined society celebrated for creativity and vigour"[100] Here was an Egypt worth preserving and protecting.

This shift towards a belief that the ancient Egyptians were enlightened and modern had not only cultural, but political ramifications. Promoting Egyptian history, archeology, and the preservation of its monuments suddenly became politically expedient in 1882, when Britain needed to justify its occupation of Egyptian territory. It would be difficult to overstate the significance of Egypt to British foreign policy in the 1880s. Even

[99] Smyth, *Our Inheritance,* ix.
[100] Gange, *Dialogues with the Dead*, 152-3.

before the occupation, Egypt was expected to play a role in resolving the so called 'Eastern Question;' the perceived problem of a weakening Ottoman Empire. Egypt was independently ruled, but under the nominal control of the Ottomans. A stable Egypt was considered an invaluable counterbalance to the ongoing uprisings and conflicts in the Balkans. The opening of the Suez Canal in 1869 gave the British another reason to be interested in Egypt, as the canal provided the shortest route to India. Even before the canal, the land route through Egypt to India had been well travelled by Britons, but now it was by far the most efficient path of travel.[101]

When Egypt came under British rule, Egyptologists and Pyramidologists alike were overjoyed. Smyth himself unambiguously wrote that the opportunity to study the pyramid alone justified the British occupation of Egypt, and others shared his enthusiasm.[102] One admirer wrote to Smyth: "Is this not wonderful news about our purchasing Egypt? – Fancy the Pyramid ours!! – I should like to go there if this is to be."[103] Another wanted to examine it more carefully. "If our intervention in Egypt succeeds and we reach Cairo as conquerors, the scientific members of the force would have an opportunity of remeasuring the four sides and setting the question at rest once and for all."[104] One women told Smyth's wife, Jessica Duncan, that the pyramid study was as important as the "great Eastern Question" itself.[105] There was a great deal of excitement about the idea of a British Egypt. The general public was entranced by the

[101] Martin Anderson, "The Development of British Tourism in Egypt, 1815 to 1850," *Journal of Tourism History* 4, No. 3 (2012).
[102] Charles Piazzi Smyth, Report of the Royal Observatory of Edinburgh, June 30, 1888, A17/95, Charles Piazzi Smyth Papers, ROE.
[103] Jon Smythe to Charles Piazzi Smyth, May 24, [1877?], A13/59, Charles Piazzi Smyth Papers, ROE.
[104] A. Bedford to Charles Piazzi Smyth, August 12, 1882, A14/66, Charles Piazzi Smyth Papers, ROE.
[105] Nicola Mary Belham to Jessica Smyth, May 1, 1877, A13/59, Charles Piazzi Smyth Papers, ROE.

Egyptian intervention and the subsequent Sudan crisis. The exploits of General Charles Gordon and his doomed last stand inspired poetry and art, and visceral fascination.[106] Others simply got angry. Astronomer J.C. Adams, a stanch conservative who represented Britain at the IMC, was particularly incensed at Gladstone's government failing to follow up early successes.[107] Either way, Egypt was at the heart of British foreign policy in the early 1880s, and everyone knew it.

Besides the cultural and political centrality of Egypt to Victorian Britain generally, there were two specific movements that championed Pyramidology itself, taking Smyth's findings as gospel. The first was the anti-metric movement, made up of men like Charles Latimer, who joyfully accepted Smyth's work as a new justification for their cause. What greater argument was there for continuing to use Imperial units of measure than the fact that they were ordained by God? As Latimer put it in a letter to Smyth, "you have given us the weapon to utterly overthrow the French metric people…We will work until we overthrow the French meter in its own house."[108] The British parliamentary debates on measure reform in 1864 and 1878, and the subsequent bills which legalized the use of the Metric System in Britain, gave the anti-metric movement a sense of urgency, and Smyth's theories were a ready-made counter-argument.[109] Latimer suggested that while many people believed the question of weights

[106] Charles Piazzi Smyth copied a poem by John Stuart Blackie about Gordon from *The Leisure Hour* into his journal, July 1885, Journal 37, Charles Piazzi Smyth Archives, on loan from the Royal Society of Edinburgh, ROE.
[107] J.C. Adams to Rev. Bashforth, November 21, 1884, 4/26/3-4, John Couch Adams Papers, St. John's College Library, Cambridge (SJCL). In the same breath Adams criticizes the proposed lowering of the franchise in Ireland.
[108] Charles Latimer to Charles Piazzi Smyth, February 20, 1880, A14/65, Charles Piazzi Smyth Papers, ROE.
[109] Reisenauer, "The Battle of the Standards," 37.

and measures was a practical one and not in any way religious, he argued instead that "the only weapon that can ever prevail over the French meter is the scriptures and the Great Pyramid."[110] He wished to appeal to the Anglo-Saxon people's faith and their sense of nationalism to secure the future of Britain's weights and measures.

Meanwhile, a second movement, equally nationalist in tone, but more religiously motivated, took up Pyramidology with equal vigour: the British Israelites.[111] Adherents believed that the Anglo-Saxon peoples were the direct descendants of the tribes of Israel, and therefore God's chosen people on Earth. This belief contained circular reasoning which both justified British imperial expansion as God's will, and at the same time, made the extent of Britain's imperial expansion seem to be a validation of the belief in British superiority over other peoples.[112] The rise in popularity of the British Israelites coincided, not surprisingly, with a renewed imperial identity in Britain.[113] Smyth's theory that the British had inherited divinely inspired measurements directly from Israel, as demonstrated by the appearance of those measurements in the ancient Pyramid, was all to easily adopted into the teachings of the British Israelites.

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[110] Charles Latimer to Charles Piazzi Smyth, March 8, 1880, A14/65, Charles Piazzi Smyth Papers, ROE.
[111] See Bruck and Bruck, *The Peripatetic Astronomer*, 133.; Reisenauer, "The Battle of the Standards," 28-33.
[112] Reisenauer, "The Battle of the Standards," 962.
[113] The notion that imperial sentiment reached new heights in Britain from the 1880s is widely accepted, though the exact nature of that sense of imperialism is hotly debated. See John Mackenzie, *Propaganda and Empire: The Manipulation of British Public Opinion, 1880–1960* (Manchester: Manchester University Press, 1986).; Bernard Porter, *The Absent-Minded Imperialists: Empire, Society, and Culture in Britain* (Oxford: Oxford University Press, 2006).; Andrew Thompson, *The Empire Strikes Back? The Impact of Imperialism on Britain from the Mid-Nineteenth Century* (Harlow: Pearson Education Limited, 2005).

Although Smyth eventually fell out of favour with the intellectual community, his work found more and more purchase with these nationalist and religious sub-cultures.[114] His followers regularly wrote to him, asking for permission to give public lectures, or to convert his book into Sunday school lessons, or print cheap pamphlets that would summarize his book for the masses.[115] While Smyth's professional acceptance diminished in the mid 1870s and early 1880s as he turned a blind eye to the arguments of critical peers, and repudiated new evidence against his ideas, his theories continued find following with these less mainstream communities well into the 20th century.

As we have seen, a combination of cultural fascination, political expediency, and imperial nationalism contributed to the widespread public obsession with Egypt past and present, which in turn facilitated the acceptance of Smyth's pyramid theories by professionals and amateurs alike in the 1860s and 1870s. His ideas continued to find a more niche following into the 1880s and beyond with groups like the IPAWM and the British Israelites. Time reform was not immune from its influence. Letters from believers flooded into the IMC organizers in 1884, lobbying for the Prime Meridian to be placed at Giza. To provide one snapshot from the 1870s of how all of these factors intertwined, let us look at a letter written to Smyth by one of his more upstanding devotees, Waynman Dixon. The letter is an excellent first-hand account of how Pyramidology fit into the cultural, political, and scientific, and religious context of late Victorian Britain. Dixon was an engineer and amateur Egyptologist, who was responsible for designing the vessel

[114] Reisenauer, "The Battle of the Standards," 956.
[115] See Correspondence, A12/52, A13/59, Charles Piazzi Smyth Papers, ROE.

which carried Cleopatra's Needle from Alexandria to its perch on the bank of the Thames in London. In early 1877, Dixon wrote to Smyth:

> It is so long since I last wrote to you that I fear you must have almost forgotten me, or at any rate think that I have abandoned my first love in the Gt. Pyd. when I took up with a monument of Egypt's later an idolatrous monarchy! Such however is not the case, and I can assure you that altho I have gone enthusiastically into the removal of Cleopatra's Needle, it has been principally from the intense pleasure in carrying out this unique piece of engineering on what I claim as my own original design. Tho I admit that I consider the monument one of great historic interest, and think a good thing was done in removing it to preserve it from destruction and loss, I candidly confess that £10,000 might have been very much better spent, especially on the further investigation and opening up of the Gt. Pyd. – Will no one come forward with a like sum for this purpose?"[116]

Dixon's letter goes on to describe his stay in Egypt and Somalia, commenting on their 'uncivilized' customs. He then states, with remarkable foresight, that:

> I cannot help believing we are on the eve of some great political crisis arising out of the Eastern Question, in which Egypt will play a prominent part, and I should not be surprised if what I have long foreseen – namely an English occupation or protectorate of that country should be one of the first events to be noted. It would be a glorious deliverance from bondage, to the Egyptians and a commencement of the blessings foretold for that oppressed country. And if such be the case will there not be a great work before the Gov't to perform in the clearing up of the doubts – to my mind – still hanging over the Great Pyramids origin and meaning?[117]

Dixon concluded his letter by asking for any new updates on pyramid research, inquiring "How does the transit of Venus accord with Pyramid measures?"[118] The imperial nationalism inherent in Pyramidology is visible in the way Dixon speaks dismissively about the Somali people, and in the ways he describes the annexation of Egypt as an act of liberation. The letter also makes clear the centrality of Egypt to both British foreign

[116] Waynman Dixon to Charles Piazzi Smyth, January 7, 1877, A13/58, Charles Piazzi Smyth Papers, ROE.
[117] Waynman Dixon to Charles Piazzi Smyth, January 7, 1877, A13/58, Charles Piazzi Smyth Papers, ROE.
[118] Waynman Dixon to Charles Piazzi Smyth, January 7, 1877, A13/58, Charles Piazzi Smyth Papers, ROE.

politics and culture, predicting the coming crisis and the opportunities it might provide for further archeological exploitation. Finally, and perhaps most significantly, it emphasizes the nature of pyramid study as a scientific endeavour, as Dixon wonders if the pyramid could in any way assist in the largest international collaboration project in astronomy during that period, the transit of Venus. Seen in this light, Smyth's Pyramidology is not the far-fetched aberration it first appears to be. It was a tested scientific hypothesis, which tapped into both public cultural fascinations and political machinations, as well as religious and nationalist sentiment, thus garnering widespread acceptance.

Among the scientific community, a similar willingness to accept Pyramidology existed, at least for a time. The *London Quarterly Review*, for example, showed a healthy agnosticism towards Smyth's first publication on the subject, deciding to withhold judgement until after Smyth had finished his measurements in Egypt.[119] Only a very few persons rejected it outright from the very beginning. In Victorian science, religious or divine phenomenon were tested by the scientific method just as any other natural phenomenon would be. With his careful measurements in hand, Smyth seemed to have a compelling case for his theory, and, for a decade or so, convinced quite a few scientists of the possibility that he was correct. Upon his return from his 1865 trip to Egypt, Smyth's findings were presented to the Royal Society of Edinburgh, and they caused enough of a stir that he was awarded the Keith Medal, a biannual prize given to the most significant paper published in the Royal Society of Edinburgh's journals for those years.[120] Of course not all Egyptologists accepted his conclusions, but nonetheless he received generally

[119] Reisenauer, "The Battle of the Standards," 948.
[120] See Bruck and Bruck, *The Peripatetic Astronomer*, 119.; Reisenauer, "The Battle of the Standards," 953.

positive feedback for his contributions, particularly about the meticulousness of his measurements.[121] It was not until a second survey of the pyramid's geometrical dimensions in 1880 contradicted Smyth's findings that he fell entirely out of favour. Oddly enough, Flinders Petrie, who carried out the 1880 expedition to remeasure the pyramids, went there hoping to confirm Smyth's findings. Flinders Petrie's father had been Smyth's friend, and both Petries believed Smyth to be correct. It was only upon taking his own measurements, which called Smyth's in to question, that Flinders Petrie became an opponent of Pyramidology.[122] Petrie discovered that the pyramid's dimensions could be explained with the regular Egyptian cubit, pointing out several mistakes Smyth had made in his first expedition that undermined the existence of a sacred cubit of twenty-five inches.[123]

Petrie's measurements, combined with the pro-metric lobbying of F.A.P. Barnard in America, and the criticism of another prominent astronomer, Richard Proctor, ruined Smyth's reputation. Like any other scientist whose theory has been proved wrong, Smyth would not have been sidelined forever if he accepted his mistake and changed his hypothesis to fit the new evidence. But Smyth did not back down. Instead, he further entrenched himself in Pyramidology, losing the respect of mainstream science and embedding himself instead into the hyper-nationalist theological discourse of British

[121] Reisenauer, "The Battle of the Standards," 951-956.; For one example of someone who disliked his theories from the beginning, see Bruck and Bruck, *The Peripatetic Astronomer*, 119-23.
[122] Reisenauer, "The Battle of the Standards," 972-973.
[123] Bruck and Bruck, *The Peripatetic Astronomer*, 229.; W.M. Flinders Petrie, *The Pyramids and Temples of Gizeh* (London: Field and Tuer, 1883), 189.

Israelism and anti-metric fanaticism.[124] It was his abandonment of scientific principals for unfettered mysticism which alienated him from the astronomical community, not the theory of Pyramidology itself. Had the IMC taken place twenty years earlier, Smyth's case for the pyramids as Prime Meridian might have been taken more seriously.

The rejection of pyramidology by the astronomical community was a turning point for Smyth and speaks to the question of amateurism and professional networks that were also dealt with by Russell and Snow. Class, gender, nationality and position formed limiting barriers to relatively homogenized professional networks. But in this case in particular, a different problem emerges. Smyth met all the criteria normally required for inclusion. But he harboured an eccentricity which could delegitimize the entire community of professional experts, and so he needed to be ejected. What tools were at the disposal of the scientific community to silence or sideline outliers like Smyth? After all, Smyth fit the description of someone who ought to be included. He had no small position of authority as the Astronomer Royal for Scotland. It was it was only his unwillingness to accept Petrie's updated evidence that made him 'unfit' in the eyes of other astronomers. The first and simplest method was to critique his findings in print. Publishing counter-arguments in journals and books offered the first line of defense. Almost immediately after his return from Egypt in 1866, Smyth was attacked in both the *Proceedings* of the Royal Society of Edinburgh, by medical doctor James Simpson, and in *The Athenaeum*, by Sir Henry James, director of the Ordinance Survey. Both were critical of his

[124] Smyth himself never espoused British Israelism itself, but he engaged with that community because they supported his theories. See Reisenauer, "The Battle of the Standards," 956. Smyth attempted to convince the war office to remeasure the pyramid after Egypt was invaded in 1882, to no avail. See Charles Piazzi Smyth Journal, February 24-27, 1882, Journal 34, Charles Piazzi Smyth Archives, on loan from the Royal Society of Edinburgh, ROE.

conclusions, though they both recognized the quality of Smyth's careful measurements. Similar criticisms came later, as we have seen, from Barnard and Proctor.[125] Of course, publishing counterarguments against someone's theory is not the same as excluding them from the scientific network. In fact, it should be considered quite the opposite, engaging with their work in scholarly debate, and therefore actually legitimizing their place in that environment. These early attacks on Smyth's work were merely debates among equals. To actually exclude someone like Smyth would require more extreme measures.

One such measure would be to prevent them from sharing their work altogether. Professional societies could decline publications or speaking engagements from unwanted authors, and/or make them otherwise unwelcome. Twice in his career, Smyth felt sufficiently mistreated by such societies that he threatened to resign from them. The first time was with the Royal Society of Edinburgh (RSE) in the mid 1860s at the height of his scientific acceptance, and the second was with the Royal Society of London (RSL) in 1874, when his theory had begun to lose favour after a decade of scrutiny by critics. Although Petrie's damning findings did not come until 1880, work had been done by Astronomer David Gill in 1874 that began to supersede Smyth's. Gill was in Egypt for the transit of Venus, and he measured parts of the pyramid on his spare time, but could not complete the work before he had to leave, sparking Petrie's expedition. Academic opinion was thus turning against Smyth well before Petrie delivered the final blow.

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[125] See for example *Proceedings of the American Metrological Society*, Vol 4 (May-December 1883): 116, Vol 188, Strachey Papers, MSS EUR F127, BL.

The two contrasting resolutions of these controversies show quite plainly how Smyth standing had changed in the intervening decade. The first occurred when the RSE allowed one of Smyth's early critics, James Simpson, to publish disparaging remarks about Smyth's pyramid theories in their *Proceedings*.[126] Smyth threatened to return the Keith Prize and resign altogether from the RSE. The President of the RSE personally visited Smyth and talked him out of it. The Council further defended him against exclusion, declaring that they would not act as censors, and that "anyone acquainted with Professor Piazzi Smyth as they were themselves could not fail, whether they agreed with him or not, to treat him with respect and do justice to his conscientious diligence, his perfect integrity as a scientific enquirer and his desire to conduct controversy with the courtesy of a gentleman."[127] Such a glowing endorsement of his character, if not his work, reinforced Smyth's welcome place within the RSE.

The same was not true a decade later at the RSL when Sir Henry James attacked his work in the RSL's *Proceedings.* James had never liked Smyth's conclusions, and had once called his theory "sheer nonsense in a comically solemn dress."[128] James' RSL article was similarly scathing, and Smyth desired an opportunity to respond, but he was denied by the secretary of the RSL, who wrote that Smyth's work was "not of a nature suited for a public reading before the society."[129] Smyth, clearly insulted by the snub, wrote an indignant letter of resignation:

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[126] The argument raged in various publications. See "The Great Pyramid," *The Daily Review* (1869), RGO6/365, Royal Greenwich Observatory Archives, CUL.
[127] Quoted in Bruck and Bruck, *The Peripatetic Astronomer*, 123.
[128] "The Great Pyramid," *The Daily Review* (1869), RGO6/365, Royal Greenwich Observatory Archives, CUL.
[129] Quoted in Reisenauer, "The Battle of the Standards," 957. See also Charles Piazzi Smyth's Letter of Resignation, February 7, 1874, A12/55, Charles Piazzi Smyth Papers, ROE.

> I beg to say, that having then failed in all that I can do to open the eyes of the Society as to whether they are seeking 'accurate measuring, truth stating, and justice doing' or the exact opposite thereof, in researches concerning the most ancient and exalted monument of intellectual and religious man on the face of the earth, - there is nothing now left for me, but to come out of the Royal Society, as I do hereby, resigning my Fellowship therein and hoping that you, Sir, at least will not consider my reasons for withdrawing 'not suitable for a public reading before the Society.'[130]

Smyth's resignation may have only been meant as a threat.[131] His experience with the RSE suggested to him that such threats brought about positive results. This time, however, no one came to try and convince Smyth not to resign. His resignation was accepted, and he was forced to leave, now thoroughly convinced that the RSL had mistreated him. It was the first time ever in the Royal Society's history that anyone had resigned their fellowship.[132] As Mary Bruck and H.A. Bruck suggest, it brought him ridicule, and, more importantly, "put a barrier between him and the influential scientists of the 'establishment.'[133] Now unceremoniously removed from the RSL, Smyth retreated to other less reputable, though friendlier, forums, such as Latimer's IPAWM.

Smyth left behind a society, with all its privileges of membership and recognition, but he did not cut off all personal relationships with it members. Networks of science were personal as much as they were professional. Astronomer J.C. Adams, for example, continued to dine with Smyth on occasion, and regretted that Smyth had resigned. James R. Napier, another member of the RSL, wrote to Adams in early 1876. "I have not seen our friend Piazzi Smyth I think since I dined with you and Mrs. Adams at his house. I

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[130] Charles Piazzi Smyth's Letter of Resignation, February 7, 1874, A12/55, Charles Piazzi Smyth Papers, ROE.
[131] Bruck and Bruck, *The Peripatetic Astronomer*, 177-8.
[132] Reisenauer, "The Battle of the Standards," 957.
[133] Bruck and Bruck, *The Peripatetic Astronomer*, 180.

wish he had not left the Royal Society in the way he did – I wish he would let the Pyramids alone – for I dare say you and your telescopes with a little friendly intercourse with Venus can tell us more about the sun's distance than that Egyptian monument he has made so much of."[134] Napier's and Adam's personal relationship with Smyth helped ease the break, but nonetheless Smyth's ideas were quickly left behind in the face of more promising scientific endeavours such as the transit of Venus.

Smyth found himself on the outs again in the spring of 1879. Another society, another controversy. This time, it was a familial crisis, rather than one of Smyth's own making. In fact, this crisis highlights another method of inclusion and exclusion not mentioned yet in this chapter: nepotism. Although by the late nineteenth century professionalization and meritocracy began to push some elements of nepotism out of the sciences, it was far from absent. Smyth's position as Astronomer Royal for Scotland had been granted in large part because of the high standing of his father, William Henry Smyth, who had been an astronomer and hydrographer in his own right (and a critic of Rowbotham's Zetetic Astronomy, alongside George Airy).[135] When the previous Astronomer Royal for Scotland died in 1844, Smyth was working in Cape Town, so his father put an application in for his son in his absence. Backed by John Herschel, another prominent astronomer, Smyth's absentee appointment was approved with ease. Smyth owed his position as Astronomer Royal entirely to familial connections.

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[134] James Napier to John Couch Adams, January 23, 1876, 11/26/1 John Couch Adams Papers, SJCL.
[135] Bruck and Bruck, *The Peripatetic Astronomer*, 7-8.; Garwood, *Flat Earth,* 48-49.; Hermann Bruck, "Piazzi Smyth, Charles, 1819-1900" *Oxford Dictionary of National Biography* (2004). http://www.oxforddnb.com.libaccess.lib.mcmaster.ca/view/10.1093/ref:odnb/9780198614128.001.0001/odnb-9780198614128-e-25948?rskey=dKtQYM&result=1

Piazzi Smyth came from a large family of scientific persuasion. Besides his father, Smyth's brother-in-law Reverend Baden Powell was a famed theologian and Oxford mathematician, who embraced the theory of evolution. Like Russell, Powell was convinced that Christians ought to engage in the natural sciences, as they delineated the laws of creation laid down by God.[136] Indeed, Smyth's own mingling of science and religion in Pyramidology might owe something to his brother-in-law's influence.

In 1879, however, it was Smyth's father's work that came under scrutiny. Herbert Sadler, a member of the Royal Astronomical Society, accused the now deceased William Henry Smyth of fraud, suggesting that his work completed many years before had been inaccurate. The accusations caused an uproar. Several prominent members of the society, including Astronomer Royal George Airy, rose to William Henry's defense, threatening to resign themselves in protest.[137] In the end, Sadler himself was forced to resign. Piazzi Smyth kept a low profile throughout. The end result was far different from Piazzi Smyth's RSL resignation five years earlier: no one had rushed to his defense in the face of Sir Henry James' attack like they did for his father. But William Henry Smyth had been in good standing and friends with Airy before his death, and it seemed cruel and impolitic to poison a dead man's legacy.

In Smyth's last few years as Astronomer Royal for Scotland, he found himself increasingly isolated. At the same time, it took more than a decade before Smyth was

[136] Powell was the father of the eccentric Robert Baden-Powell, founder of the Boy Scout and Girl Guide organizations. See Pietro Corsi, "Powell, Baden, 1796-1860," *Oxford Dictionary of National Biography* (2004). http://www.oxforddnb.com.libaccess.lib.mcmaster.ca/view/10.1093/ref:odnb/9780198614128.001.0001/odnb-9780198614128-e-22642?rskey=ctK0qx&result=2

[137] John Russell Hind to John Couch Adams, April and May 1879, 9/36/1-5, John Couch Adams Papers, SJCL.

finally ousted entirely from his position. Despite his unfortunate obsession with Pyramidology, he was still a competent astronomer, and one of the leading lights on the subject of civic time signals, and he was regularly consulted on questions of time distribution. But in other ways he found himself alone and disenchanted. The rejection of Pyramidology by his fellow astronomers eventually led, in part, to his resignation as Astronomer Royal in 1888. His final notes as Astronomer Royal in his Equatorial Book from 1888 are disenchanted and morose, though also defiant, including stories about being pelted with stones by "mischievous boys" on his way home in the evenings, being taunted by the other professors of Edinburgh University, and advice to his successor to be watchful about anything "unexpected and untoward" that commonly occur.[138]

Let us take a step back now, and consider what the case of Smyth, Snow, and Russell tells us about Victorian science and the way it engaged with time reform. To begin with, Victorian science was interdisciplinary. A medical doctor like James Simpson could engage on an even footing with an astronomer on a subject dealing with archeology, metrology, and theology. In a similar vein, areas of expertise as varied as nautical safety and scriptural interpretation were each legitimate gateways into the time reform debate. Second, Victorian science was transnational. Although this chapter has dealt largely with Britain, it is quite clear that these conversations crossed national borders with relative ease. Of course, this needs to be qualified by recognizing the realities of colonialism and racial prejudice. When British astronomers asked the opinions of the South African astronomical community, for example, they were not really asking

[138] Charles Piazzi Smyth, Equatorial Book Vol 2, 1879-1888, A17/95, Charles Piazzi Smyth Papers, ROE.

the opinions of South Africans, but those of David Gill, a Scottish born scientist serving in Cape Town. Similarly, class was perhaps the most significant barrier to participation in the sciences, even more so than race or gender. Wealthy women and colonial citizens, though they faced various forms of discrimination, could ultimately make a space for themselves in the sciences if they wished. Working class families could not. Even amateur astronomy, for example, was prohibitively expensive. This made the astronomical community quite small and insular.

The margins of the astronomical network were vibrant and stimulating places, populated with both skilled and eccentric personalities, including Russell, Snow, and Smyth. These were capable of producing knowledge in equal capacity with 'insiders.' However, as we have seen, they faced challenges in finding a platform for their work, excluded by social norms and regulations, both formal and informal. The knowledge they produced was often not considered 'authoritative', and therefore carried little weight when it came to policy decisions.

The experience of these outsiders shows that the debate over time reform did not occur in a vacuum. It was taken up by experts and amateurs alike in multiple fields and intersected with a variety of other debates and movements of the period, ranging from navigation and astronomy to religion, the Metric System, Egyptology and archeology, and more. Religious belief could either offer a sense of lighthearted apathy about manmade timekeeping, as in the case of Russell, or drive a person to extreme unyielding opinions, as in the case of Smyth. Occupational expertise, such as Snow's seamanship and concern about safety offered unique perspectives on time reform not seen elsewhere. All of this rested in a cultural climate which searched for meaning from both modern science and ancient texts, looking to understand global crises in Egypt and elsewhere through a variety of means. This swirling sea of beliefs and ideas came to a head at the IMC in 1884, where time reform could not free itself of the baggage that surrounded it. In particular, the IMC results reflected the struggle between amateur and professional (as well as between professions), as insular networks tried to drown out the voices of less influential ones. Time reform was pursued equally by persons who were respected professionals connected to the web of scientists across the globe, as well as by those who were at the fringes of those networks. But the rise of professionalization meant that outsiders ideas about time were often unheeded. Yet they still had some influence, filtering into the discussions at the IMC in small ways. As the next chapter will show, the divisions at Washington in 1884 were built along these professional lines. Professional boundaries mattered more than national ones. The ultimate reflection of this is found in the resolutions of the IMC, which succeeded in creating a Universal Day, accepted by nearly all nations present. Yet it was not universal in that it was limited in use to specific professions, notably astronomy and navigation. Civil timekeeping for the public was exempted from any change.

When it comes to time reform, the implications of the insular nature of this network are significant. As we have seen, most of the astronomers who found themselves involved in the discussions about standard time, such as William Christie and J.C. Adams, saw standardization as a highly specialized task, of little use to the working class.

It was a tool that facilitated complex observations like those used in the transit of Venus, or for navigation at sea, a similarly skilled trade requiring astronomical expertise.

When these astronomers came to the table at Washington in 1884, then, to discuss time reform, they found themselves entirely at odds with reformers outside the realm of science, Fleming included. To their eyes, engineers lacked the expertise needed to fully understand the complexity of the subject (it is significant that Smyth, for example, only began working with fellow Pyramidologist Charles Latimer, an engineer, *after* he had been rejected by his fellow astronomers). Fleming's plan to have the general public adopt new norms of time measurement went well beyond what these astronomers hope to achieve. How those differences in aim and scope played out in the context of international diplomacy at Washington is the subject of the next chapter.

Chapter 3: Two Ideas Collide: Standard Time and Universal Time at The Washington Conference, 1884

In 1884, Washington D.C. was a city in transition. Coming out of the American Civil War with dirt roads and poor infrastructure, and characterized by poverty and crime, Washington was a far cry from the grandiose capital that the city's planner, Pierre Charles L'Enfant, had envisioned.[1] Built on swampy wetland which occasionally flooded, and plagued by periodic political instability, the most complimentary thing one could say about Washington a century after its founding was that it was a work in progress.

However, in the 1870s there were signs of renewed growth, although growth came at the price of deep debt. The governor, Alexander Robey Shepherd, began massive public works projects, including new paved roads, street cars, public buildings, and monuments. The Washington Monument, which had long stood unfinished in the midst of civil war, was finally completed at the end of 1884. As America's most ostentatious appropriation of Egyptian architecture, the obelisk was at the time the world's tallest structure, combining nationalist airs of inherited civilization with modernist messages of progress and power.

Another of the gleaming symbols of the new Washington was the State, War and Navy Building (now known as the Eisenhower Executive Office Building), built between 1871 and 1888 in the French Second Empire Style. In 1884, it too was a work in progress. The south wing, which housed the Department of State, was the first side finished, and had been in use since 1875. More recently, the Navy Department had moved into the east

[1] Constance Green, *Washington: Village and Capital, 1800-1878* (Princeton: Princeton University Press, 1962), 363.

wing. The rest of the building was still a construction site. The south wing housed a great gilded reception hall, which was America's showpiece to foreign diplomats. In this hall, the swampy roads outside could be forgotten, and the business of state could be transacted.

In October of 1884, that business was the establishment of a shared global Prime Meridian. There has been precious little written about the International Meridian Conference (IMC) that took place in Washington that year. The most recent tome on the history of time reform, Vanessa Ogle's *The Global Transformation of Time*, dismisses the conference as an event "largely without impact."[2] She is not entirely wrong to do so. The notion that standard time was established at the IMC is a fanciful myth at worst, and an oversimplification at best. To ignore the conference entirely, however, is a step too far. Ogle's argument is that time was ultimately organized piecemeal by individual nations, regardless of international efforts like the IMC. But why did international efforts fail? Twenty-five nations came to the table in 1884 to discuss a Prime Meridian and its uses, only to leave without a consensus on timekeeping. Ogle's otherwise insightful account offers no explanation.

Most authors who have spent time analysing the IMC attribute its failure to friction between France and Britain.[3] These were certainly the two most vocal opponents at Washington, having come to the conference with incompatible proposals for the

[2] Vanessa Ogle, *The Global Transformation of Time, 1870-1950* (London and Cambridge: Harvard University Press, 2015), 35.
[3] See Derek Howse, *Greenwich Time and the Discovery of the Longitude* (Oxford: Oxford University Press, 1980).; Peter Galison, *Einstein's Clocks, Poincaré's Maps: Empires of Time* (New York: W.W. Norton, 2003).; Ian Bartky, *One Time Fits All: The Campaign for Global Uniformity* (Stanford: Stanford University Press, 2007).

location of the new international Prime Meridian. But a more recent analysis by literary scholar Adam Barrows makes a revisionist case that several peripheral voices at the conference – delegates of Germany, Spain, and the Ottoman Empire, none of whom were astronomers – were the ones who undermined the talks.[4] Barrows' chapter is by far the most insightful analysis of the IMC to date. But Barrows' revisionism could have gone further. He suggests that aside from the astronomers, very few delegates wanted standard time.[5] In fact, as this chapter shows, most of the astronomers were not interested in standard time either. Barrows' had it backwards: 'peripheral voices' at the IMC did not undermine the designs of the European astronomers, instead it was the astronomers themselves who undermined standard time. The true outsider voices at Washington were those who desired standard time, figures such as Sandford Fleming and William Allen. These representatives of the commercial and engineering interests of North America were not able to overcome the misgivings of the astronomers, navigators, and diplomats who were mainly interested in the nautical and astronomical applications of a Prime Meridian, rather than its role in civil timekeeping.

This conflict between engineers and astronomers has been missing from the historical discussion of the IMC mainly because it is not obvious: it is one thread among dozens at play. The IMC was a moment where layers of conflicting interests clashed: timekeeping vs. navigation, astronomer vs. engineer vs. naval officer, French vs. English, Christian vs. Muslim, Metric vs. Imperial, and more. The milieu of debates and ideas

[4] Adam Barrows, *The Cosmic Time of Empire: Modern Britain and World Literature* (Berkeley: University of California Press, 2011), 7.
[5] Barrows, *Cosmic Time of Empire,* 34.

which informed time reform discussions outside the conference, as explored in chapter two, remained relevant inside the conference. These debates all came to a head at Washington, complicating the proceedings.

The task of unravelling these threads is daunting. Most works on the IMC tackle it by summarizing the conference's two-hundred page long proceedings, describing the resolutions it passed, and stating which nations voted for them. This approach tells us what happened, but it fails to explain why. The previous two chapters have provided some insight to help guide us through the mess of threads, allowing us to pick out the ones which are the most significant. We have seen what motivated several of the participants. In some cases, like Fleming's, the IMC was the climax of six years of campaigning for a change to civil timekeeping. Others, like J.C. Adams, arrived at the conference with little knowledge of the timekeeping campaign, having been chosen by the SAD to attend the conference solely because of their anti-metric outlook. Others still were diplomats, non-specialists there to represent their nation's interests, without any knowledge of the particulars of the subject. Lionel Sackville-West, for example, the British Ambassador to the USA, was in charge of greeting and coordinating the British delegation, but knew little about the subject matter. Richard Strachey's brother warned him that "West is a very good fellow, but would hardly understand 'geodetic' without looking it up."[6] The result was a massive imbalance between participants in terms of the level of investment they had in the subject matter. Very few IMC delegates came to talk about timekeeping, and this explains why the historiography underplays Fleming's

[6] E. Strachey to Richard Strachey, September 6, 1884, Vol 114, Strachey Papers, MSS EUR F127, BL.

conflict with the astronomers. The battle between France and Britain, which had its roots in the Metric debate, attracts the attention of most historians, because it seems the ‘biggest’ conflict. But to answer the central question of this dissertation, ‘why did the system of global standard timekeeping take the form that it did,’ we need to shift the focus away from that Anglo-French conflict. Instead, this chapter focuses on the moments where attempts were made to introduce civil timekeeping into a debate which was otherwise centered on navigation. Further, it will examine the more obscure resolutions of the conference, which related to changes in the ‘astronomical day,’ a subject which Barrows omits from his otherwise thorough chapter on the IMC.[7] The debates on the astronomical day, both at the conference and after, highlight once again that accurate, standardized timekeeping was seen by astronomers as a specialized tool, unrelated to civil timekeeping. In order to access these undercurrents, this chapter draws from personal papers in addition to the proceedings of the conference, in order to examine the ‘culture’ of the conference. What was going on during the days between the official meetings? Who talked with who, and where? Drawing from the previous chapter’s notion of an international scientific community, this chapter imagines the IMC as a gathering of that community, albeit complicated by the presence of diplomats and lawmakers in their midst. This unique lens focuses on the personal and relational experiences of the decision makers, which is perhaps more useful for explaining their decisions than are abstract notions of ‘national interest.’ The drawing together of all these different threads makes for a very different picture of the IMC than that drawn by other scholars.

[7] Barrows *Cosmic Time of Empire,* 37. In Barrows’ list of the conference’s resolutions, two of the resolutions are missing.

The IMC by the Numbers

The IMC lasted exactly one month, from October 1st to November 1st, 1884. During that time, eight sessions were held, of which the first and last were mainly ceremonial and organizational. The real work of the conference was done during the middle six sessions. Forty-one delegates from twenty-five countries attended the conference. A twenty-sixth nation, Denmark, was expected to participate, but the Danish Consul-General, Carl Steen Anderson de Bille, never showed up. Of those countries which did participate, eleven were European, ten were South American or island nations, two were North American, one was Asian, one was African, and two colonies (Canada and India) were present under the banner of the British Empire. This make-up has a lot to do with the United States foreign policy: these were governments with which America had diplomatic relations. The United States' long held Monroe Doctrine stated that the American hemisphere ought to be the exclusive sphere of influence of the United States. The Monroe Doctrine partially explains the heavy participation of South American nations. Of course, South American participants came to Washington with their own ambitions and alliances, so not all voted in line with the United States. Some, like Brazil and San Domingo, often voted instead with France.

Some countries were less committed to the process than others. A few even missed parts of the conference: the Turkish delegate did not arrive until the third session; Liberia, Holland, and Chili's delegates arrived in time for session four; and Salvador missed sessions four, six and seven.[8] There were also significant variations in the number of delegates each country decided to send. The cost of travel expenses explains in part why small nations sent fewer delegates, most relying on their permanent ambassadors to Washington. Another important factor at play, however, was the last-minute concession the USA made to Britain, changing the number of delegates allowed from three to five. As we saw in chapter one, this change was made mere months before the beginning of the conference, leaving little time to make plans for new delegates. In the end, of the twenty-five countries that attended, only nine of them sent more than one delegate, most of which were European, and of these only Britain and the USA exceeded three.

Broken down by occupation, the delegates came from five general areas of expertise: twenty were diplomats, eight had naval backgrounds, seven were scientists, four were engineers, and two were land surveyors.[9] Five non-voting experts were invited to speak as well, all but one of whom were scientists.[10]

It was the scientists who spearheaded the discussion. Using the proceedings, it is possible to break down the number of times each delegate spoke (see Appendix). Doing so gives a rough picture of who was most engaged in the discussion. 'Number of times spoken' is not a perfect variable: a lengthy speech is weighted the same as someone suggesting to take a break. The numbers are also skewed by the fact that Rodgers, the

[8] The spelling of Chile as 'Chili' is the spelling used in the conference proceedings from 1884, as is Salvador for El Salvador.

[9] Note: some of the breakdown by occupation is imperfect, as several delegates fit into more than one category: for example, some naval representatives were also astronomers, such as S.R. Franklin.

[10] *International Conference Held at Washington for the Purpose of Fixing a Prime Meridian and a Universal Day, October 1884: Protocols of the Proceedings* (Washington: Gibson Bros, 1884), 15. Simon Newcomb, Julius Hilgard, Asaph Hall, Karl Wilhelm Valentiner, and William Thompson (Lord Kelvin). Hilgard was more of an engineer or surveyor.

American delegate, spoke 107 times as the president of the conference and merely moderated the discussion. Nonetheless, a word count is a useful way to see who was most involved. For example, the only countries with delegates who spoke more than five times were France, Britain, Russia, Spain, Sweden, and the United States, meaning that this was a heavily Eurocentric gathering. Broken down by occupation, diplomats spoke ninety-eight times, scientists (not including the non-voting experts) seventy-nine times, navy representatives thirty-six times (excluding President Rodgers), engineers thirteen times, and surveyors once. Although scientists made up 17 percent of the delegates present, they spoke 35 percent of the time, making theirs the only occupation to punch above its weight at the conference in terms of verbosity.[11] In other words, diplomats spoke more times than scientists, but only because there were more of them present. Statistically speaking, the most vocal delegates by far were the scientists.

Beyond the Numbers

Statistics only take us so far. Historical context provides further insights into the makeup of the gathering. It is noteworthy that there were dozens of nations, kingdoms, and other types of polities in existence in 1884 that were not invited. Many of these were not recognized as sovereign entities in European or American eyes. Indeed, quite the opposite, as evinced by the only other diplomatic conference of significance to take place in the fall of 1884: The Berlin Conference. Beginning in November, just days after the end of the IMC, the Berlin Conference saw the European powers carve out arbitrary

[11] See appendix.

spheres of influence for themselves in Africa. This formalized 'Scramble for Africa' illustrates the lack of recognition given by Europeans to African polities and explains the absence of these African nations from the IMC. Many African polities, such as the Ashanti Empire, would be occupied and colonized in the ensuing decades. The one African nation which did attend the IMC, Liberia, was in a way both an American colony and a colonizing power itself, albeit in a strange way. Liberia's origins lie in the anti-slavery movement, created by Americans in an effort to 'repatriate' freed American slaves to Western Africa in the 1840s. Liberia kept close ties with the United States even after its independence, guaranteeing its place in American foreign policy, and earning it a certain amount of patronage. Indigenous African polities found no such favouritism, let alone recognition of their sovereignty.

Because of their temporal proximity, several scholars have drawn connection between the Berlin Conference and the IMC.[12] Barrows suggests that while Berlin set the terms for Western exploitation, Washington enabled that exploitation.[13] Giordano Nanni and Vanessa Ogle both take pains to point out that implementing standard time amounted to a temporal reinforcement of a core-periphery relationship, with London at the centre of both the temporal and the material world.[14] "The project to incorporate the globe within a matrix of hours, minutes and seconds" writes Nanni, "demands recognition as one of the most significant manifestations of Europe's universalising will…The conquests of space

[12] Barrows, *Cosmic Time of Empire,* 23-29.; Giordano Nanni, *The Colonisation of Time: Ritual, Routine, and Resistance in the British Empire* (Manchester, Manchester University Press, 2012). Ogle, *Global Transformation of Time.*
[13] Barrows, *Cosmic Time of Empire,* 23-29.
[14] Nanni, *The Colonisation of Time,* 54.

and time are intimately connected."[15] Ogle echoes this sentiment, cautioning that globalizing processes, such as time standardization, are not neutral but ideological: "When Europeans and Americans wrote about time-and-space-defying connections and uniform time as a means to bring order to a globalizing world, they proposed to create a world in their own image and a world of their own domination."[16] This world was hierarchical, rather than equitable.

The geographical makeup of the IMC delegates bears out Ogle's, Nanni's, and Barrows' insights. Smaller South American nations, although better represented at the IMC than African polities, were similarly vulnerable to the whims of their more powerful neighbours, particularly the United States. For example, the assertion that Colombia sent a delegate to the IMC is somewhat deceptive. Colombia was represented by an American naval astronomer, S.R. Franklin. In February 1883, the Director of the Astronomical Observatory of Bogota, wrote to the US Naval Observatory, requesting that the American Superintendent choose someone to represent the views of Colombia at the conference. The request was based on the assumption that, "on account of the aproximity[sic] of the two meridians of Bogota and Washington, [the interests of Colombia] must be naturally identical with those of the United States of America."[17] The US Naval Observatory did nothing to disabuse the Colombians of this assumption, despite the fact that since the request from Colombia had been received, the USA had ceased to use the meridian of Washington and begun using Greenwich. Colombia was not notified exactly who was

[15] Nanni, *The Colonisation of Time,* 2.
[16] Ogle, 204.
[17] Director of the Astronomical Observatory of Bogota to the Director of the Navel Observatory of Washington, Febrary 16, 1883, Letters Received, PC42, Entry 7, Box 49A, Records of the United States Naval Observatory, RG78, National Archives of the United States of America (NAUSA).

representing them until October 14th, after the conference had begun.[18] During the conference, Franklin barely spoke, and voted in line with the United States on every major resolution. In his report to the Colombian government, Franklin was matter of fact, stating the results of the IMC without offering any justification for voting the way he did.[19]

Similarly, Guatemala was represented by American-born surveyor Miles Rock. As president of the Boundary Commission that established the position of the Mexico-Guatemala border in 1883, Rock had been instrumental in ensuring that Guatemala retained some of its contested frontier territory, despite Mexican ambitions. His work on the Boundary Commission earned Rock the respect of the Guatemalan government and explains its appointment of the American surveyor as its delegate at the IMC. Another similar case, though not South American, is that of Hawaii. One of its representatives was a Yale graduate, and a member of the American and European elite in Hawaii. Soon after the IMC, a coup instigated by this elite class overthrew the Hawaiian Monarchy, and the islands were annexed by the United States before the century's end. The cases of Colombia, Guatemala, and Hawaii, though not overtly malicious, indicate ways in which the representation of smaller nations at the IMC could be appropriated or undermined by larger nations.

What does this mean for our analysis? It shapes the lens we use to examine the IMC. Scientific endeavours are never politically neutral. The choice of a Prime Meridian

[18] Vice- Admiral, US Navy to Envoy Ex. And Min. Plen. Of Colombia, Draft October 13, 1884, Letters Received, PC42, Entry 7, Box 49A, Records of the United States Naval Observatory, RG78, NAUSA.
[19] S.R. Franklin to Ricardo Becerra, November 4, 1884, Miscellaneous Letters Sent, PC42, Entry 4, Vol. 5, Records of the United States Naval Observatory, NAUSA.

was no exemption. Barrows, Nanni, and Ogle are right to connect the IMC to Berlin, and to the western project of globalization, with its colonialist underpinnings. It is in this context that we must place the actors who arrived at Washington in the fall of 1884.

Arrivals

For many IMC delegates, the expedition to Washington lasted several months, in which the Conference was just one stop of several. Most delegates had professional obligations besides the IMC itself. For example, Kikuchi Dairoku's expedition to America in 1884 was as much an exercise in scientific networking as it was a diplomatic mission. The Japanese delegate to the IMC was a professor of mathematics at Tokyo Imperial University and had received his education at Cambridge University. The IMC was just one of his reasons for being in America. Another was the chance to attend physicist Lord Kelvin's Master Class lectures on molecular dynamics, which Kelvin held at John Hopkins University in Baltimore. Alongside Kikuchi were attendees from several countries, as well as some John Hopkins students, including one women, psychologist and mathematician Christine Ladd-Franklin. The Prime Meridian question only occupied a portion of Kikuchi's time in America.

Kikuchi's experience was not unique. Many other IMC delegates made similar calls on overseas colleagues and participated in other professional gatherings. The annual meeting of the British Association for the Advancement of Science (BAAS) was held in Montreal in August and September of 1884, the first time it had ever been held outside of the British Isles. British delegate J.C. Adams attended the BAAS meeting, as did

Sandford Fleming. Richard Strachey considered going as well.[20] After arriving in North America early for the BAAS meeting, Adams and his wife went on a whirlwind tour, combining both pleasure and academic outings. They visited wilderness destinations in Quebec, and then gazed in awe at Niagara Falls, which Adams recalled was "grand beyond description".[21] They then attended a scientific meeting in Philadelphia, where they stayed at a Ladies college, having been invited by a "lady professor of mathematics," Mrs. Cunningham, whom they had met previously in Cambridge.[22] The pair travelled through the Alleghany Mountains, and took a cruise on Lake Champlain, before heading at last to Washington. Adams took it upon himself to offer some political commentary to his friends, saying that although he enjoyed the trip, he was disgusted by the newspaper coverage of the American presidential campaign, which was full of "the vilest personal attacks."[23]

Sandford Fleming also travelled with his wife, Jeannie. They arrived via New York on September 30th.[24] While her husband was in conference sessions, Jeannie took advantage of the time to take an excursion to Mount Vernon. The home of George Washington, Mount Vernon was a popular tourist destination for high class visitors to Washington. It was a pilgrimage Fleming had already taken. In May 1882, after a meeting

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[20] Sandford Fleming, Diary Entry, August 27, 1884, Vol. 81, Fleming Papers, MG29 B1, Library and Archives Canada (LAC).; J.C. Adams to Francis Bashforth, April 25, 1884, 4/26/3-4, John Couch Adams Papers, St. John's College Library, Cambridge (SJCL).; Ralph Strachey to Richard Strachey, July 20, 1884, Vol 132, Strachey Papers, MSS EUR F127, BL.; Henry Strachey to Richard Strachey, July 29, 1884, Vol 122, Strachey Papers, MSS EUR F127, BL. Though I cannot confirm that Strachey went for sure, it is likely that he did. J.F.O Evans might have attended as well.

[21] J.C. Adams to George -, September 28, 1884, 16/1/1, John Couch Adams Papers, SJCL.

[22] J.C. Adams to George -, September 28, 1884, 16/1/1, John Couch Adams Papers, SJCL.

[23] J.C. Adams to Francis Bashforth, April 25, 1884, 4/26/3-4, John Couch Adams Papers, SJCL.

[24] Sandford Fleming, Diary Entry, September 30, 1884, Vol. 81, Fleming Papers, MG29 B1, LAC.

with members of Congress about organizing the IMC, he had boarded a cruise ship and travelled down the Potomac to Mount Vernon. At that time, he had written that he wished Jeannie was there to go too.[25] Now was her chance.

Tourism and networking went hand in hand. French delegate Jules Janssen made his own networking visits upon arrival in America. He gave interviews with New York reporters (lamenting that he did not have his wife as interpreter, as Janssen only spoke French), and dined with Alexander Graham Bell and his father. He also met with Frederick Barnard, the President of the American Metrological Society, who, as we have seen, would have been an IMC delegate but had resigned due to hearing loss.[26] These visits mixed leisure and professional social calls, and very few of either had anything to do with timekeeping and the Prime Meridian.

The IMC's conference proceedings should not be considered in a vacuum. The conference was embedded in the late nineteenth century's network of scientists, a network that was forming and consolidating professional organizations. The gathering was wrapped up in the trappings of professional science, as much if not more than it was in diplomatic and political procedures. It is significant that the conference lasted thirty-two days, but formal sessions were held on only eight. Much of the time in between the IMC's sessions would have been spent preparing, translating, and reading proposals for discussion, but delegates also spent those days and weeks engaged in socializing and networking.

[25] Sandford Fleming, Diary Entry, May 18, 1882, Vol. 81, Fleming Papers, MG29 B1, LAC.
[26] Jules Janssen to Henrietta Janssen, September 27, 1884, Lettres écrites, au cours de ses nombreux voyages, par Jules Janssen à sa femme Henriette, MS 4133, 273-280, Correspondence de Jules Janssen, Bibliotheque de l'Institute de France (BIF).

A significant portion of the IMC delegates were diplomats who were similarly wrapped up in their own networks and negotiations. Manuel de Jesus Galvan, the envoy from San Domingo, for example, was in the midst of negotiating a trade deal between his country and the United States. On days when the IMC was not in session, Galvan was negotiating with US Secretary of State Frederick Frelinghuysen (Frelinghuysen also attended some of the IMC meetings).[27] In the midst of a divisive presidential election, the United States was a ripe source of fascination for Galvan and other diplomats, including the British envoy Sackville-West. They had much to report back home about the possible ramifications of the election for their own countries' relations with the United States.[28]

Many of the diplomats at the IMC were assigned to Washington long term and had long-established relationships that the new arrivals lacked. They made connections with local elites and were the subject of both admiration and gossip. *Hon. Uncle Sam*, a tongue in cheek exposé of Washington high society, described the social rankings of various diplomats. Sackville-West ranked at the top. "I am inclined to think Uncle Sam dearly loves a lord – when he comes from England,"[29] the book chided. The French minister was less well respected. "Is it because he has no title? Is it because he is a republican?" the author wondered.[30] Meanwhile, "Baron de Struve, the Minister from Russia, is popular in society. The Americans rather like the Russians." The book gave a

[27] Manuel de Jesus Galvan to Senor Ministro de Relaciones Exteriores, September 20, October 13, October 28, October 30, 1884, Vol LIX, Textos Reunidos 4: Cartas, Ministerios y misiones Diplomaticas, Archivo General de la Nacion, Santo Domingo, Dominican Republic (AGN).

[28] Manuel de Jesus Galvan to Senor Ministro de Relaciones Exteriores, October 28 1884, Vol LIX, Textos Reunidos 4: Cartas, Ministerios y misiones Diplomaticas, AGN.; Sackville West Reporting on the US Presidential Election, October - November 1884, FO5.1872, National Archives of the United Kingdom (NAUK).

[29] Viscount Valrose (Pseud.), *Hon, Uncle Sam* (New York: John Delay, 1888), 44.

[30] Valrose, *Hon. Uncle Sam*, 44.

positive appraisal of de Struve, who represented Russia at the IMC. Although de Struve spoke several Asian and Slavic languages, he had not yet mastered English.[31] Nevertheless, he was popular. American astronomer Simon Newcomb, in a letter to Russian astronomer Otto Struve, the minister's brother, wrote: "You would be delighted to know what your brother has done for the Russian legation here. I think he is the most popular of all the foreign ministers in Washington and is sought after on all occasions."[32]

Hon. Uncle Sam also praised the Italian delegate to the IMC, Albert de Foresta. To dance with him, it said, "is an honor that any girl will remember all her life."[33] Clearly, this was a social network as much as it was a professional one. American socialite Marian Hooper Adams made friends with the wife of the Swedish minister and IMC delegate, Count Lewenhaupt.[34] Their activities were followed by newspapers and by more esoteric publications alike. The *Phrenological Journal and Science of Health*, for example, made declarations on the disposition of the various ministers based on their skull shape. Sackville-West was described in the best of terms, with "fine manners" and "a practical mind." The German IMC delegate, Baron H. von Alvensleben, in contrast, was supposedly "a man of quick mental impressions, and rather earnest and intense in feeling."[35]

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[31] Randolph Keim, *Society in Washington: Its Noted Men, Accomplished Women, Established Customs, and Notable Events* (Washington: Harrisburg, 1887), 55.
[32] Simon Newcomb to Otto Struve, Feb? 1885, Box 6, Newcomb Papers, Library of Congress (LOC).
[33] Valrose, *Hon.Uncle Sam,* 45.
[34] Ward Thoron, Ed. *First of Hearts: Selected Letters of Mrs. Henry Adams 1865-1883* (San Francisco: Willowbank Books, 2011), 20.
[35] "Some Foreign Ministers at Washington: Eight Portraits," *Phrenological Journal and Science of Health* Vol. 84, (August 1887): 61-68.

Not everyone was so closely connected to these social networks. Fleming for example, was more interested in his business endeavours than diplomatic or scientific networking. Between IMC sessions, Fleming left Washington several times. In a week-long gap between the third and fourth session. Fleming travelled to New York, where he met with Donald Smith and George Stephen, the leading promoters of the Canadian Pacific Railway, as well as John A. Macdonald, who was on his way to England.[36] The four of them discussed the building of the St. Lawrence Bridge in Montreal. Jeannie, Fleming's wife, went back to Montreal with Donald Smith, riding in his private car named 'Saskatchewan.' Fleming returned to Washington alone.

Fleming left Washington again after the fifth session for another week-long recess, this time to Montreal to deal with some Hudson Bay Company matters (of which Fleming was a Director), as well as engaging in more discussion about the St. Lawrence Bridge.[37] While his business engagements kept him occupied, he missed out on some networking opportunities back in Washington. The rest of the IMC delegates were courted with a presidential reception. On October 16th, the delegates gathered at the White House and met United States President Chester A. Arthur. After a few speeches and a round of hand shaking, the delegates were given a tour of the White House, before being paraded outside for a group photograph.[38] Afterward, British delegates J.C. Adams and Frederick Evans dined at the Cosmopolitan Club with S.R. Franklin, the American naval astronomer who was representing Colombia at the IMC. The next day, the 17th, the

[36] Sandford Fleming, Diary Entry, October 6-8, 1884, Vol. 81, Fleming Papers, MG29 B1, LAC.
[37] Sandfrod Fleming, Diary Entry, October 15, 1884, Vol. 81, Fleming Papers, MG29 B1, LAC.
[38] *New York Times,* October 17, 1884.; J.C. Adams, Diary Entry, October 16, 1884, 39/11/4, John Couch Adams Papers, SJCL.

delegates were again treated, this time with a cruise down the Potomac to Mount Vernon with the Secretary of State, Fredrick Frelinghuysen.[39] Fleming, busy in Montreal, was not there. Of course, he had done the trip to Mount Vernon before, but not with this company.

These receptions, dinners, and outings were specifically designed for IMC delegates to socialize in both formal and informal settings. It created a rather strange intermingling of networks, with Washington high society mixing with international astronomical experts. Members of these three groups, scientists, diplomats, and businessmen, were given the chance to interact beyond the confines of the IMC meeting room. But as much as they were given space to intermingle, each prioritized his own network. Fleming's met with his railway contacts; Adams and Kikuchi attended academic gatherings.

Th significance of this is that the people at the table at the IMC were arriving with very different preconceptions about what was to occur. Diplomats looked at the IMC in terms of national interest; Astronomers and Naval Officers regarded it as a sequel to the Venice and Rome conferences, aimed at determining a Prime Meridian for navigational purposes; while businessmen like Fleming and Allen had civil timekeeping in mind, based on their careers in commerce and railway management. The proceedings at the grand hall of the State, War and Navy Building were in large part a result of what went on outside of it. The fault lines between delegates in session at the IMC closely matched professional differences.

[39] Invitation from Secretary of State to IMC Delegates to Mount Vernon, October 16, 1884, Vol 188, Strachey Papers, MSS EUR F127, BL.

Preconceptions

What expectations did delegates have of the IMC at its start? As we have seen, Fleming came to Washington with the expectation that the IMC was tasked with establishing standard time worldwide, based on a new common Prime Meridian. It is easy to understand why Fleming felt this way: this was *his* conference. As we saw in chapter one, the IMC would never have taken place if not for his lobbying. What is more, a common Prime Meridian was unnecessary for navigation. Any line of longitude would do. (More than a dozen were currently in use. A nuisance, but not necessarily a problem). A shared system of timekeeping, on the other hand, required a Prime Meridian. It made perfect sense that the IMC should therefore focus on timekeeping and not longitude.

Not everyone shared these priorities. The rest of the British delegation arrived with an entirely different understanding of what was to occur. The official letter of instruction received by Strachey, Adams, and Evans had two main points. The first was that Britain was not to be bound to any decision, especially if it should force Britain to use anything other than Greenwich as a Prime Meridian. Second, they were instructed to avoid in every way possible any discussion of the Metric System. The three British delegates were given no instruction, meanwhile, as to what they should support when it came to time reform. The subject, as we saw in chapter one, was simply unimportant to the SAD which had appointed them.[40]

Adams expressed his own personal preconceptions of what the conference was supposed to achieve in July 1884 in a letter to American astronomer Simon Newcomb.

[40] John Donnelly to Richard Strachey, June 24, 1884, Vol. 188, Strachey Papers, MSS EUR F127, BL.

Adams wrote, “I hope that the business will be strictly confined to the question of the Prime Meridian, and the time from which the astronomical day shall be reckoned, and not allowed to be mixed up in any way with other questions.”[41] Although Adams did not specify what the other questions might be, it is fairly clear from context that he meant two things: standard time, and, probably more importantly for him, the adoption of the Metric System. Adams did have an interest in timekeeping, but it concerned only the astronomical day as used by astronomers, not the civil day used by everyone else. He had no wish to alter the way ordinary people measured time. Adams was coming to the IMC with a very narrow view of its aims and scope.

Some of Fleming’s allies recognized this difference in opinion and tried to warn him. Barnard wrote to him in late September. Having just come to the conclusion that he would resign his own seat at the IMC, Barnard wanted to ensure that all would go smoothly in his absence. His primary concern was reigning in Fleming’s ambitions. Barnard asked Fleming to consider carefully the scope of the conference. “I am of the opinion,” he wrote, “that it would be best not to go beyond the single object for which the conference is ostensibly called viz. the agreement upon a common Prime Meridian, and that dependant questions which may naturally grow out of this should be put aside.”[42] The reason for this hesitance, Barnard continued, was because although standard time was a fine goal, a discussion of standard time might not go our way. Any lack of unanimity

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[41] J.C. Adams to Simon Newcomb, July 14, 1884, 37/21/4, John Couch Adams Papers, SJCL.

[42] F.A.P. Barnard to Sandford Fleming, September 21, 1884. Vol. 3, Fleming Papers MG29 B1, LAC.

about standard time "might endanger a failure in regard to the main object."[43] Barnard also warned Fleming that raising the idea of a twenty-four-hour day, or other calendar reforms, might have similarly disastrous consequences.

Fleming did not take the hint. Barnard had to warn him again on October 2nd. "I am afraid… that you are disposed to occupy the Conference with the uses to which the Prime Meridian may be put, in advance of the determination of the more important, and only really essential question, what shall the Prime Meridian be."[44] If you bring up the uses of the meridian, such as standard time, "differences of opinion are liable to arise which may not easily be adjusted, and which, if brought prematurely into activity, may prejudice the main question."[45] Barnard begged Fleming to leave aside time reform until after a meridian had been chosen. But this advice, as we will see, went unheeded.

While most historians of the IMC have focused on the French-English conflict over the location of the Prime Meridian, the real struggle at the IMC was a clash over the *uses* of that Prime Meridian. Was it meant to be used for determining longitude alone, and perhaps for astronomical timekeeping, as Adams desired, or was its purpose to implement a global reform in civil timekeeping, as Fleming wanted? Lines were drawn not between nations, but between competing professional networks.

The First Days

[43] F.A.P. Barnard to Sandford Fleming, September 21, 1884. Vol. 3, Fleming Papers MG29 B1, LAC.
[44] F.A.P. Barnard to Sandford Fleming, October 2, 1884. Vol. 3, Fleming Papers MG29 B1, LAC.
[45] F.A.P. Barnard to Sandford Fleming, October 2, 1884. Vol. 3, Fleming Papers MG29 B1, LAC.

This state of affairs was not obvious on day one. Indeed, very little happened at all, besides the formalities of introductions, and the election of a president (C.R.P. Rodgers). There was some discussion about the languages to be used in the conference proceedings, and whether or not the public should be allowed to attend, but these questions were put off to the second meeting.

It was in that second meeting that fault lines began to emerge. Career diplomats like French delegate A. Lefaivre, for example, seemed flustered at the naivety of some of the scientists about how diplomatic meetings were run. British and American delegates proposed a motion to invite other scientific experts to participate in the deliberations. But these experts were not authorized to speak on behalf of any government, Lefaivre protested. They had no status as diplomatic representatives. "It was not in accordance with the object of this Conference that private individuals, not authorized by their respective Governments, should be permitted to influence the decision of this body"[46] Ultimately, the experts were invited, but not as full participants. They could speak only when invited to do so. A similar proposal, which would have allowed the public to participate, was also rejected by Lefaivre, and it was decided not to answer any of the correspondence or proposals received from the public by mail. This was to be a closed and guarded process, not an open forum.

The Conference's attitude towards public mail is worth examining. The IMC formed a committee to read and summarize any correspondence received, and to recommend whether any of the letters' propositions were worth pursuing. British delegate

[46] *Protocol of the Proceedings*, 18.

J.C. Adams, the chair of this committee, warned that "the Conference should be very cautious in admitting the devices and schemes of people who have no connection with this body; that there are, no doubt, many inventors and many people who have plans and schemes which they wish to press upon the Conference."[47] Certainly he was right about some of the letters. A few of them consisted of time reform schemes based on new inventions or clock dials, for which the writer had the patent and was hoping to cash in. Other letters, though, offered suggestions to the IMC which were easily as viable as those discussed by the official delegates, and were ignored out of hand. Several suggested Greenwich as Prime Meridian, or 180 degrees from it. Bethlehem and Jerusalem, meanwhile, were both suggested as possible locations for the Prime Meridian on religious grounds, noting that the calendar was based on the birth of Christ. The author of the Bethlehem proposal brought up William Parker Snow's choice of the St. Paul's Rocks as Prime Meridian, praising Snow's effort to pick a neutral meridian which would avoid national jealousy. But ultimately he preferred the sacred symbolism of Bethlehem to the lonely rocks in the Atlantic which Snow had proposed. Other writers also tried to ease the expected French-English tension. A French author submitted a note supporting the notion of a neutral Prime Meridian, while another suggested using Greenwich, but calling it Le Havre (a French town which lies on the same meridian as Greenwich).

The desires of Charles Piazzi Smyth made their way into the correspondence via the IPAWM, whose members sent multiple letters and pamphlets to the conference

[47] *Protocol of the Proceedings*, 21, 74. The rest of the committee included: the Delegate of Germany, Mr. Hinckeldeyn; the Delegate of the United States, Professor Abbe; the Delegate of Japan, Mr. Kikuchi; and the Delegate of Costa Rica, Mr. Echeverria.

recommending the adoption of the Great Pyramid of Giza as Prime Meridian, as well as expressing again their fear that Barnard and the French delegates would force the Metric System on the world. One of the more colourful proposals came from a patriotic American who wrote that the "pristine shaft" of the soon to be completed Washington monument ought to serve as the Prime Meridian, given the symbolism of the obelisk as the highest achievement of humankind.[48]

While some of these proposals were rightly dismissed outright, especially those with patents attached to them, others were reasonable. Unfortunately, the committee did not share their report on the correspondence with the rest of the delegates until the sixth session of the conference, by which time a Prime Meridian had already been chosen, rendering the majority of the letters useless. The insular nature of diplomacy silenced outside opinion in favour of those sitting at the table. As a result, the opinions of Snow and Smyth never made it to the table at Washington.

The second session of the IMC was relatively short. After the decisions about public correspondence was made, the delegates moved on to other matters. The French-English rivalry that some of the letter writers had anticipated and tried to assuage began to rear its head. The French diplomat Lefaivre made it as clear as possible that the IMC was not binding on his country, rather its role was simply to recommend. He also took pains to disavow the resolutions of the Rome conference (which had decided on a

[48] D.J. Byrne to Admiral Rodgers, Undated, Letters to the International Meridian Conference 1884, Box 1, Records of International Conferences, Commissions, and Expositions, RG43, NAUSA.

Greenwich meridian), stating that this conference was different: it looked at political, not just technical, variables.[49] He was setting the stage for a rigid opposition to Greenwich.

It was also during this second session that it was decided to vote by nation, rather than by individual, removing Fleming's ability to cast votes independently of the rest of the British delegation. The conference adjourned for its second day having only agreed on one resolution: that a single Prime Meridian was more desirable than the 'multiplicity' of meridians that currently existed.

Days Three and Four: Drawing Lines in the Sand

There were a few days recess before the conference met for the third time. There was time for the delegates to plan, and to meet with possible allies. On October 3rd, Fleming dined with one of the Spanish delegates, Juan Pastorin.[50] The two had corresponded on time reform in the past, and Pastorin was a supporter of Fleming's civil time reform ideas. Now they were together with the opportunity to implement their schemes. But Fleming and Pastorin both faced a similar challenge in the coming days. Their opinions on time reform differed from the rest of their own delegations. Fleming and his fellow British delegates, especially Adams, agreed on almost no aspect of the IMC, and Pastorin found that the other Spanish delegates were equally disinclined to support the implementation of standard time. Indeed, Fleming, Pastorin, and railwayman William Allen were the only delegates at the conference who showed any interest in standard time (Cleveland Abbe, strangely, said next to nothing about timekeeping,

[49] *Protocols of the Proceedings,* 24.
[50] Sandford Fleming, Diary Entry, October 3, 1884, Vol. 81, Fleming Papers, MG29 B1, LAC.

perhaps taking to heart Barnard's advice about focusing on the main object of choosing a Prime Meridian, which Fleming ignored). The rest of the delegates were concerned with a Prime Meridian for navigation, and perhaps a universal day for astronomical purposes, but little else.

After meeting with Pastorin, Fleming spent the rest of his downtime drafting a notice to his fellow delegates, which he circulated to them on October 4th. The note urged them to consider time reform alongside the longitude problem, rather than separating them. Alongside the note, Fleming also circulated a pamphlet concerning the use of standard time, hoping it would spur some discussion, and at the very least demonstrate to his fellow delegates that the Prime Meridian was as much concerned with timekeeping as with longitude.[51]

As the third session opened on October 6th, it became clear that Fleming's pleas had fallen on deaf ears. Instead, the third session opened the floodgates of the French-English rivalry. Eloquent speeches from both sides argued back and forth about the proper location for the Prime Meridian. On the one hand, France, resting its case on the principal of scientific neutrality, argued that the Prime Meridian should not lie within any national boundary, nor even intersect "any great continent – neither Europe nor America."[52] The Bering Strait or an Atlantic isle seemed the most advantageous to them. Britain and America, meanwhile, based their argument on two points: convenience and scientific precision. Most of the world's shipping already used Greenwich, making it the

[51] Sanford Fleming, *On Uniform Standard Time, For Railways, Telegraphs and Civil Purposes Generally,* Vol. 122, Fleming Papers, MG29 B1, LAC.
[52] *Protocols of the Proceedings,* 36.

most convenient choice for navigators. Furthermore, longitudinal determination required precision which was only possible with a top-notch observatory, such as Paris, Greenwich, Berlin, or Washington. An imaginary neutral line in the middle of an ocean would be useless for precise calculations, they argued.[53] The argument between the two sides was so contentious that no vote was taken that day, and the conference adjourned with unfinished business.

This debate between France and Britain has been thoroughly analysed elsewhere, and I will not repeat it here.[54] But there was one small interjection that was made early on in day three that is easily missed amidst the national rivalries, and it is essential to understanding the place of timekeeping in the debate. Lewis Rutherfurd, an astronomer representing the United States, had previously tabled a proposal to adopt Greenwich as the Prime Meridian, a proposal which began the French-English argument. However, before the motion was discussed on day three, he amended it, so that it now read: "That the Conference proposes to the Governments here represented the adoption of the meridian passing through the centre of the transit instrument at the Observatory of Greenwich as the standard meridian for longitude."[55] The only real change was the addition of the last two words: "for longitude." The initial proposal had included no

[53] *Protocols of the Proceedings,* 36-37.
[54] Galison, 128. Galison describes an "explosive atmosphere surrounding the prime meridians showdown" because of French and British competition to "possess" mapmaking.; Charles Withers, *Zero Degrees: Geographies of the Prime Meridian,* (London and Cambridge: Harvard University Press, 2017), 185-215. Withers describes the IMC as a conflict between British common-sense (and self-interest), and French principles of scientific perfectibility and neutrality. See also Derek Howse, *Greenwich Time,* 138-151. Howse's account is perfunctory. Bartky, *One Time Fits All*, 82-95. Bartky focuses on the American delegation.
[55] *Protocols of the Proceedings,* 36.; Withers misquotes this amendment, using the word 'additional' instead of 'standard'. Withers, *Zero Degrees,* 196.

reference to the uses of the new Prime Meridian. Now, it was made explicit. The Prime Meridian was to be a tool for establishing longitude, whether for navigation, surveying, or map-making. This definition purposefully excludes timekeeping. The conference proceedings suggest that the amendment was passed unanimously, but it is hard to imagine Fleming acquiescing so easily to a motion that threatened his entire purpose in campaigning for the past five years to bring about the IMC, and completely undermined the memo he had just circulated to all the delegates two days earlier. Unfortunately for him, because of the change in voting procedure, his vote was now subject to the whims of the rest of the British delegation, none of whom were interested in time reform. This was the first hint of disaster for Fleming's plan, and it makes no sense if one only considers the rivalries at the conference along national lines. It makes much more sense if we look at the delegates by occupation. The railway engineers and Pastorin were the only ones at the table committed to time reform. The astronomers and naval officers in attendance (Pastorin excepted), no matter their nationality, were only concerned with longitude. This professional divide would only become clearer in the coming weeks.

A week-long recess followed the contentious third session. This week, between October 6th and 13th, was the most heavily reported by the press, which was fascinated by the Anglo-French antagonism. "A Strong Probability That No Agreement Will Be Reached" proclaimed a *New York Times* headline on October 8th.[56] "It is believed that the conference will fail…" the article continued, "The opposition of the French delegates to the adoption of an English meridian is still firm, although that opposition seems to be the

[56] *New York Times*, October 8, 1884

result of patriotic and sentimental rather than partisan considerations."[57] The papers were biased against the French position. "Should the conference fail in the object for which it has met, the responsibility will rest entirely on France," wrote the *Daily News*.[58] Of course, the British delegates were equally stubborn, but English and American papers did not say so.

News of the impasse spread far and wide. One of Richard Strachey's American acquaintances wrote to him on October 11th, asking him if he would like to come stay in New Orleans when the conference was finished. The friend noted that he hoped "our testy French cousins may become more reasonable in their demands, agree upon Greenwich as the only proper common meridian, and thus enable you to see something of our country before you return to England."[59]

Of all the delegates, the French astronomer Jules Janssen faced the most intense scrutiny from the newspapers that week. Their pestering, along with a sweltering heat wave that had washed over Washington, left him in a state of exhaustion. The weather that October was unseasonably hot. During the first several weeks, Fleming recorded in his diary that it was unbearably hot, over 90 degrees, he recorded on October 4th.[60] The gilded diplomatic hall in the Department of State was stuffy and uncomfortable, providing little relief from the temperature outside. The heat wave persisted through the

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[57] *New York Times*, October 8, 1884. The word choice of 'partisan' is a strange one, but from the context of the article the author is accusing the French of being a sentimental rather than practical.
[58] *Daily News*, October 7, 1884.
[59] C.H. Mastin to Richard Strachey, October 11, 1884. Vol. 151, Strachey Papers, MSS EUR F127, BL.
[60] Sandford Fleming, Diary Entry, October 4, 1884, Vol. 81, Fleming Papers, MG29 B1, LAC.

first half of the October, and then swung violently the other way: by the seventh session of the IMC on October 22nd, Fleming recorded, it had now become "very cold."[61]

During that grueling first week, Janssen struggled to stay positive. From his perspective those sessions were an onslaught of verbal abuse, as the English-speaking delegates, one after another, tried to tear down his proposal for a neutral meridian (Janssen, who only spoke French, received notes from Lefaivre explaining their counterarguments). The heat just made it worse, as Janssen explained to his wife: "I fought for four hours tirelessly. When I left this boiler-room, my shirt was wringing wet: it took two days to dry…And because here everything is done with breathtaking rapidity, I had to spend two days without getting undressed…Added to that, the whole of the American press is hot on our heels every day. You can imagine whether it is a bed of roses."[62]

Others were not so hard pressed and found ways to escape the humdrum. Sundays were days of rest but were also opportunities for a form of religious tourism. Fleming noted in his diary on October 5th that he attended a black Presbyterian church, followed by a second service elsewhere in the afternoon.[63] Similarly, on October 12th, he invited Juan Pastorin to join him at a Presbyterian service, noting that it was the first time the Catholic Spaniard had ever been in a protestant church.[64]

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[61] Sandford Fleming, Diary Entry, October 22, 1884, Vol. 81, Fleming Papers, MG29 B1, LAC.
[62] Jules Janssen to Henrietta Janssen, October 13, 1884, Lettres écrites, au cours de ses nombreux voyages, par Jules Janssen à sa femme Henriette, MS 4133, 273-280, Correspondence de Jules Janssen, BIF. Translation by Storm Dunlop in Francoise Launay, *The Astronomer Jules Janssen: A Globetrotter of Celestial Physics* (New York: Springer, 2012), 132-133.
[63] Sandford Fleming, Diary Entry, October 5, 1884, Vol. 81, Fleming Papers, MG29 B1, LAC.
[64] Sandford Fleming, Diary Entry, October 12, 1884, Vol. 81, Fleming Papers, MG29 B1, LAC.

But Fleming did not waste the opportunity to prepare either. He needed to try again to refocus the conference away from squabbles arising from national pride to focus instead on timekeeping. After the week-long recess, the IMC delegates reconvened for the fourth session on October 13th. After some housekeeping, Fleming was the first to speak. In an attempt to rescue what seemed to be a failing cause, he had prepared a lengthy speech. To understand Fleming's speech, let us take a moment to remember his motivations: to establish a system of global civil timekeeping, similar to what he had already introduced to the United States and Canada. This timekeeping system *required* a single Prime Meridian. Navigation did not. All the other IMC delegates could, if they wished, leave the conference and resume using their national meridians for navigation, with little consequence. But for Fleming's timekeeping plan, that would be disaster. So Fleming needed to bridge the gap between the French and British, and ensure that a Prime Meridian was chosen.

He proposed a compromise. The Prime Meridian should be placed in the middle of the Bering Strait, thus making it a neutral meridian as France proposed. But it would also be exactly 180 degrees from Greenwich, allowing the precise calculations which astronomers required to be made at Greenwich observatory, and then translated to the Prime Meridian by a simple calculation. Of course, the association with Greenwich hurt Fleming's case that this was a 'neutral' meridian, but it was nevertheless his intent to reconcile the two opposing sides.

His compromise fell on deaf ears. The Brazilian delegate, Luis Cruls, immediately doubled down on the principal of neutrality proposed by France. Cruls was Belgian; he had moved to Brazil in 1874 to work at the Imperial Observatory.[65] He was trained by a French astronomer, Emmanuel Liais, and their relationship likely explains the Brazilian delegate's support for the French proposals. Vanessa Ogle presents a further reason, hypothesizing that the Brazilian Emperor's ongoing conflict with Britain over slavery may have influenced the decision to vote against Britain.[66] Furthermore, Brazil was not one of the 72 percent of countries which already used Greenwich for navigation, instead using Rio de Janeiro. They had no reason, therefore, to support the British position.[67] Unfortunately for Brazil, they were in the minority. As Jules Janssen later complained, America had invited a horde of smaller countries as allies to overwhelm any opposition.[68]

Fleming's compromise had satisfied no one. Brazil and France continued to press for a neutral meridian, and nearly everyone else advocated for Greenwich. When a vote was taken on the principle of neutrality, it was swiftly defeated. Only France, Brazil, and San Domingo had voted for it. With this barrier out of the way, the American delegate Lewis Rutherfurd immediately reintroduced his proposal to adopt Greenwich as the Prime Meridian for longitude.

Seeing his compromise slipping away, and desperate for a way to reintroduce timekeeping back into the debate, Fleming proposed his own amendment to the resolution:

> That a meridian proper, to be employed as a common zero in the reckoning of longitude *and the regulation of time* throughout the world, should be a great circle

[65] Antonio Videira, "Luiz Cruls e o Premio Valz de Astronomia," *Chronos* 7 No. 1 (2014): 85-104.
[66] Ogle, 86-7.
[67] *Protocols of the Proceedings*, 81.
[68] Galison, 156.

> passing through the poles and the centre of the transit instrument at the Observatory of Greenwich.[69]

The amendment did two things. First, it put timekeeping front and centre as one of the primary purposes of the Prime Meridian, alongside the determination of longitude. This was an attempt to undo the damage caused by Rutherfurd, whose earlier amendment had only mentioned longitude, ignoring timekeeping. Second, Fleming's amendment was carefully phrased to keep his compromise on the table. If the meridian was a great circle, then it could still be interpreted to mean that the neutral Bering Straight, 180 degrees from Greenwich, was the Meridian, not Greenwich itself. Fleming still needed to hold out the olive branch to France if his global timekeeping system was to succeed.

It is this moment where previous historians' focus on national rivalries rather than occupational ones are unhelpful, because Fleming, a representative of the British Empire, was immediately undercut by his fellow representatives of the British Empire. J.C. Adams, the Cambridge astronomer, stood up to quash Fleming's amendment. "I desire merely to state…that the remaining delegates of Great Britain are by no means of the opinion expressed in that amendment, and that it is their intention, if it should come to a vote, to vote against it."[70] The SAD's earlier fears that the opinions of Canada's representative might not align with those of Great Britain proved well founded. Fleming's amendment was rejected by Adams, and further condemnations followed. The German delegation suggested that Fleming's amendment mixed up two separate questions, and

[69] *Protocols of the Proceedings,* 87. Emphasis my own.
[70] *Protocols of the Proceedings,* 87.

that time and longitude should be considered separately.[71] The amendment was put to a vote, and lost. The conference fell back into national camps. Spain revived the compromise proposed at Rome of trading the adoption of a Greenwich meridian by France for the adoption of the Metric System by Britain. This was quickly stymied by both sides. Lefaivre, still clinging to the principle of scientific neutrality, argued (somewhat prophetically) that if Greenwich were chosen out of convenience, because it currently was the most commonly used meridian by commercial shipping, it would soon seem an anachronism: “Nothing is so transitory and fugitive as power and riches. All the great empires of the world, all financial, industrial, and commercial prosperities of the world, have given us a proof of it, each in turn.”[72] Britain’s dominance of the seas, in other words, would not last forever.

Lord Kelvin, one of the non-voting experts invited to attend the conference, was called on to respond. He reiterated, correctly, that no one meridian was more ‘scientific’ than another. Any line of longitude would do. But Greenwich, he argued, ignoring Lefaivre’s warning, was the most convenient.

When the vote on Rutherfurd’s resolution was finally taken, only San Domingo voted against it. One London publication vainly printed the opinion that San Domingo voted against Greenwich because Galvan did not understand the question at hand.[73] Such arrogant claims are unfounded. Galvan voted against it because he, like the French delegates, believed in the notion of a neutral meridian, and because a neutral meridian in

[71] *Protocols of the Proceedings,* 88.
[72] *Protocols of the Proceedings,* 92.
[73] “Greenwich Time all Over the World,” *The Leisure Hour* 34, (1885): 66.

the Atlantic would be closer in accordance with Dominican local time than Greenwich.[74] Besides, his negative vote was not the only sign of disagreement; France and Brazil abstained from voting altogether. But the majority had spoken: Greenwich was now the world's Prime Meridian

Only now, with the question of a Prime Meridian for longitude settled, were other participants willing to discuss the question of time. Fleming found a surprise ally. The Russian delegate, Charles de Struve, happened to be the half-brother of Otto Struve, a Russian astronomer who was in favour of some of Fleming's time reform ideas. In particular, the Russian delegate supported the introduction of a twenty-four-hour clock to replace twelve-hour clocks. He also recommended the introduction of a universal day, based on the Prime meridian. However, this recommendation should not be mistaken for a full endorsement of Fleming's radical civil timekeeping reform. De Struve proposed not to change local time, but simply to introduce a separate universal time "for international telegraphic correspondence, and for through international lines by railroads and steamers."[75] In essence, de Struve was advocating the creation of two tiers of time: a universal time for specialized tasks, and local time for civil and everyday use. This was not what Fleming wanted.

The rest of session four devolved into a discussion of which way longitude should be counted: East and West up to 180 degrees, or in one direction 360 degrees. The conference adjourned without an answer. It had been a day of mixed results for Fleming.

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[74] Manuel de Jesus Galvan to Senor Ministro de Relaciones Exteriores, October 27 1884, Vol LIX, Textos Reunidos 4: Cartas, Ministerios y misiones Diplomaticas, AGN.
[75] *Protocols of the Proceedings,* 101.

He had his Prime Meridian now, but France was still noncommittal, and civil time reform was still not up for discussion.

Day Five: Putting Time Reform on the Table

At the IMC's fifth session, held the next day, Fleming was again the first one to speak, aside from a few formalities. His goal was to turn the IMC's attention away from the relatively minor question of which direction, east or west, to count degrees of longitude, to the larger task of standardizing global timekeeping. "To my mind," he began "longitude and time are so related that they are practically inseparable, and when I consider longitude, my thoughts naturally revert to time, by which it is measured. I trust, therefore, I may be permitted to extend my remarks somewhat beyond the immediate scope of the resolution."[76] In the space of a few generations, Fleming observed, "the application of science to the means of locomotion and to the instantaneous transmission of thought and speech have gradually contracted space and annihilated distance. The whole world is drawn into immediate neighborhood and near relationship."[77] The lack of a common time in this contracting world was bound to become more and more of a nuisance, if not dealt with now. What was needed was a single universal day, based on the time at the Prime Meridian. Fleming appealed to the scientific sensibilities of the room, suggesting that a myriad of local times was "inconsistent with reason." But he also spoke to the general utility of a shared universal time: it would have practical application. Convenience was as important as precision. Ordinary people are used to rising at seven,

[76] *Protocols of the Proceedings,* 116.
[77] *Protocols of the Proceedings,* 117-18.

eating lunch at noon, etc. A single universal day would mean that some people would rise at midnight, have lunch at breakfast, and so on, depending on where they lived around the globe. This change would be something of a shock to many. So a compromise was needed between local and universal time. Standard time, as had been implemented in the United States, was the solution, the tool that linked local time to universal time in a rational way.[78] It created twenty-four local times, all one hour different, and in line with universal time, to replace the thousands of local times currently in use.

To simplify the connection between time and longitude, Fleming suggested that longitude be counted in one direction around the globe. Imagining the turning earth like a clock face with twenty-four hours, longitude and time reckoning would be united in perfect harmony.

Fleming's impassioned speech was immediately undercut, once again, by his fellow delegates from Great Britain. J.C. Adams rose to suggest instead that longitude should be counted in two directions, East and West, in blatant opposition to what Fleming had just proposed. He similarly dismissed the notion of standard time zones, suggesting instead to continue using local time, which could be determined by using a simple formula: "Local time at any place is equal to universal time plus the longitude of the place…Now, I think it is perfectly impossible for Mr. Fleming to make a more simple formula than that."[79] Adams' simple formula, were it put into practice, would entrench local time for civil use, and exclude the use of time zones.

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[78] *Protocols of the Proceedings,* 121.
[79] *Protocols of the Proceedings,* 127.

Frederick Evans, a third British delegate, made a further attempt to dismiss Fleming's folly, and disassociate the time question from that of longitude, this time from the point of view of a navigator. Longitude at sea, he argued, was always counted in two directions, not one. Evans continued:

> My colleague, Mr. Fleming, made the remark that he could not disassociate longitude from time. If he had mixed with seamen, he would have found out that there is very frequently a well-defined difference between the two in their minds. Longitude with seamen means, independently of time, space, distance. It indicates so many miles run in an east or west direction. Consequently, I am not able to look upon longitude and time as being identical.[80]

There was a fundamental disagreement between professions about the very nature of longitude and its relationship to time. As this and previous chapters have argued, engineers like Fleming, and astronomers like Adams came to the IMC with very different goals. Evidently the opinions of naval officers were split. Pastorin sided with Fleming, but all the other navigators in the room, including Evans, opposed him. There is little room for other interpretations when Evans told the IMC that to him, universal time was "a matter of indifference."[81] While for Fleming the whole purpose of the IMC was timekeeping, for astronomers and most navigators, longitude was the only real question up for debate.

The fourth and final British delegate, Richard Strachey, spoke next, and found some common ground between the two warring factions of his own delegation. He agreed with Adams and Evans on the counting of longitude in two directions, but he also did not dismiss Fleming's plea for a discussion of a universal day. Instead, Strachey engaged

[80] *Protocols of the Proceedings,* 128.
[81] *Protocols of the Proceedings,* 129.

with the question, proposing that the location of the Date Line (not yet called the date line) be 180 degrees from Greenwich, so that the date changed at Greenwich midnight, not Greenwich noon.

No one took up Strachey's proposal right away. Instead, the conference proceeded to vote on the direction of counting longitude. Counting both directions from Greenwich, East and West, won out. France, Brazil, and San Domingo, among others, abstained from the vote, still refusing to recognize the authority of a Greenwich meridian in the first place.

After the resolution passed, universal time was at last put on the table for formal discussion. The proposed resolution read:

> Resolved, That the Conference proposes the adoption of a universal day for all purposes for which it may be found convenient, and which shall not interfere with the use of local time where desirable.[82]

One phrase stands out in this resolution which needs highlighting: "Shall not interfere with the use of local time." This phrase earmarks this resolution as one which aligned more with Adams than with Fleming. The universal day as envisioned here was to be a tool for specialized purposes, not for general adoption by the public. Local time would still reign supreme in everyday life.

The resolution was immediately controversial, from both sides. The Italian delegate proposed as an alternative the resolution adopted at Rome:

> The Conference recognizes, for certain scientific needs and for the internal service of great administrations of ways of communications, such as those of railroads, lines of steamships, telegraphic and postal lines, the utility of adopting a universal

[82] *Protocols of the Proceedings,* 134.

> time, in connection with local or national times, which will necessarily continue to be employed in civil life.[83]

This was in its essence the same resolution, except that it even more explicitly separated universal time for "scientific needs," and local time for "civil life." Before either resolution could be discussed, William Allen proposed a third alternative, which swung the emphasis the other way:

> Civil or local time is to be understood as the mean time of the approximately central meridian of a section of the earth's surface, in which a single standard of time may be conveniently used.[84]

Allen's amendment asserted the use of standard time for civil use, such as the system put in place on American railroads the year before. The floodgates were finally open on a discussion of timekeeping, and it was divisive. The center of the controversy was whether or not the universal day should be applied to everyone via standard time, or if the universal day was for scientific purposes only, and local time would continue to inform daily life.

Allen's resolution was an attack against the creation of a hierarchy of time systems. Businessmen, scientists, railways, and common people, he said, must all share the same time system. Standard time zones, he argued, are the best way to satisfy the needs of all. He went on to illustrate the success of standard time in North America, as testament to its utility. Strangely, Allen then withdrew his resolution, possibly due to

[83] *Protocols of the Proceedings,* 135.
[84] *Protocols of the Proceedings,* 136.

Rutherfurd's objection that determining the definition of local time was beyond the competence of the conference.[85]

The Italian resolution was defeated. Delegates felt it was too specific, preferring the vague wording of the original resolution, which left the uses of universal time open to whatever interpretation might be desired. As a compromise, the wording of the original resolution was changed just slightly to read that the universal day "shall not interfere with the use of local *or other standard time* where desirable."[86] The added words allowed a nation to choose their own method of timekeeping, whether national time, or local time, or railway standard time. Instead of establishing standard time across the globe, as Allen's resolution would have done, the IMC adopted a resolution which allowed each country to choose its own method of civil timekeeping. It was adopted unanimously (Germany and San Domingo abstained). The universal day now existed, but was restricted in its use, subordinate to whatever local timekeeping system a nation wished to use. The conference had decided that standard time was an option, not an obligation.

Nonetheless, a universal day had been established. This was no small thing. Remembering Ogle and Nanni's insight that global time reform was a Europeanizing project, which reinforced colonial realities, the unanimous adoption of a 'universal' day should give us pause. While few colonial voices were present to object (Fleming and Strachey alone represented any colony), there were some non-western nations represented. The response of the Ottoman Empire's delegate, Rustem Effendi, offers a glimpse at the shallowness of the 'universality' of the universal day.

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[85] *Protocols of the Proceedings,* 136.

[86] *Protocols of the Proceedings,* 146. Italics show the new words which were added.

Rustem was the son of a polish refugee escaping the failed 1848 revolution, who moved to the Ottoman Empire in 1854. Born on the Ottoman island of Midilli, his name was originally Alfred Bilinski, but he changed it upon conversion to Islam.[87] Rustem joined the Ottoman Empire's diplomatic service, and in 1884 was their envoy in Washington, speaking Turkish, French, English, and Italian fluently.[88]

The Ottoman Empire's relationship with time reform is an interesting one. Ottoman reformers in the 1880s were painfully aware of the threat the West posed to their Empire, particularly after Britain's occupation of Egypt.[89] And, just as at the beginning of the 20th century Britons were concerned about the 'decline' of their race in the face of other great powers, Ottoman reformers in the in 1880s wanted to revitalize their people and stave off external threats by instilling an ethic of self-improvement. This ethic included notions of time-management, and disparaged its opposite, time-wasting.[90] In practical terms, meanwhile, the Ottoman Empire balanced a multiplicity of times, including differing religious and legal forms of timekeeping. Rustem was thus representing a vibrant and complex polity, whose interests were somewhat different from those of his colleagues.[91]

Rustem voted in favour of the resolution to introduce a universal day. However, he had taken pains to make clear that his government was not bound to any decision of

[87] Selim Deringil, *Conversion and Apostasy in the Late Ottoman Empire* (Cambridge: Cambridge University Press, 2012), 175.
[88] George Gawrych, *The Young Atatürk: From Ottoman Soldier to Statesman of Turkey* (London: I.B. Tauris, 2013), 86.
[89] Ogle, 132-33.
[90] Ogle, 121, 129, 135-6.
[91] For more on the Ottoman organization of time, see Avner Wishnitzer, *Reading Clocks, Alla Turca: Time and Society in the Late Ottoman Empire* (Chicago: University of Chicago Press, 2015).

the conference. This was true of all delegates, but Rustem made that point absolutely clear: “My vote does not bind my Government. I am, indeed, obliged to vote against any proposition which would tend to bind it in any way, for I desire to leave it free to act in the matter.”[92] His role was to recommend that his government follow the resolutions of the IMC, but they were not bound to act on them. After the vote on the universal day passed, the conference moved on to determine its details: when would the day begin, for example. But Rustem was not ready to accept the universal day in principle just yet.

Speaking candidly to the conference, Rustem undermined some of the assumptions which underpinned the notion of a universal day. “The question of a universal hour is not of equal interest and importance to all,”[93] he began. Smaller nations, he explained, could make due with a national hour. The complex systems required in the United States, Canada, Russia, or the British Empire were of little use to France or Italy, for example. As for the Ottoman Empire, it too had little need for another method of timekeeping. Indeed, the Ottomans required “more latitude” than other nations with respect to the universal day. Rustem explained:

> In our country we have two modes of reckoning time: one from noon to noon, or from midnight to midnight, as everywhere else, (heure à la franque), the other (heure à la turque) from sundown to sundown. In this latter case the hours count from the moment when the disk of the sun is bisected by the horizon, and we count twice from 0h. to 12h., instead of counting without any interruption from 0h. to 24h. We are well aware of the inconveniences this system of counting produces, because 0h. necessarily varies from day to day, for the interval of time between one sunset and the one following is not exactly 24 hours. According to the season the sun will set earlier or later, and our watches and clocks at Constantinople will be at most about three minutes fast or slow from day to day, according to the season.

[92] *Protocols of the Proceedings,* 114.
[93] *Protocols of the Proceedings,* 178.

> Reasons of a national and religious character prevent us, however, from abandoning this mode of counting our time. The majority of our population is agricultural, working in the fields, and prefer to count to sunset; besides, the hours for the Moslem prayers are counted from sundown to sundown.
>
> Therefore it is impossible for us to abandon our old system of time, although in our navy we generally use the customary reckoning or "heure à la franque."[94]

Rustem wanted to ensure that the universal day would only be used for international affairs and that it would not interfere with the domestic timekeeping practices of his country. His hesitation was religiously motivated, and he apologized that his objections were not scientific in nature, but of "a different and inferior order."[95] Rustem's apology should have been unnecessary. After all, he was far from the only one to make claims about the proper measurement of time based on religion. The Spanish delegates attempted to establish the anti-meridian of Rome as the basis for global timekeeping, based on the Gregorian calendar. As we have already seen, Charles Piazzi Smyth proposal of the great pyramid of Giza as the Prime Meridian was based on religious beliefs, as were the proposals for Jerusalem and Bethlehem. Christian sensibilities were just as prominent in the time reform debate as Muslim ones.

Rustem's objection passed with little discussion. It was pointed out to him that the resolution already conceded that universal time would not in any ways interfere with local time.[96] The universal day passed into existence. Now it was time to define it.

[94] *Protocols of the Proceedings,* 179-180.
[95] *Protocols of the Proceedings,* 179.
[96] When a later resolution decreed that the universal day would be counted from 0 to 24 hours, however, Rustem voted against it (he voted for it at first, but later voted it down.) *Protocols of the Proceedings,* 205.

The first order of business was to determine at what time the universal day should start (essentially, where should the Date Line be?). The Spanish diplomat in the room, Juan Valera, motioned to leave the discussion for the next day. After all, he said, he had already fulfilled his mandate: to select a Prime Meridian. He felt this discussion of timekeeping was beyond what his government had authorized him to do, and so he needed time to deliberate. The session adjourned.

Day Six

The discussion of the location of the date line was complex. Several options were considered. Lewis Rutherfurd proposed 180 degrees from Greenwich. Count Lewenhaupt of Sweden proposed following the resolutions of the Rome conference, using Greenwich itself as the date line (meaning the universal day would begin at noon Greenwich time). The Spanish delegates proposed 180 degrees from Rome, which they claimed was the practice already in use by most of the world by way of the Julian calendar (including the Gregorian correction). The Spanish delegate claimed that a change from this practice would involve a much more complex change in the calendar itself. Let Greenwich be used for navigation, but time has always been measured by Rome.

J.C. Adams immediately countered his Spanish peer. The notion of reckoning time by one meridian and longitude by another seemed unnecessarily complex. Strachey agreed. Besides, the idea that Greenwich would cause confusion in the daily use of the calendar was simply wrong. In his response, Strachey reiterated the notion that the universal day was not intended to affect everyday life:

> The adoption of this so-called universal day will not interfere in the smallest degree with any purpose for which time is employed in civil life. The two objects are entirely distinct. It is obvious that the conception of the necessity of having a universal day has arisen from the more clear conception of the fact that time on the globe is essentially local; that the time upon any given line (supposing it to be a meridian) is not the time at the same moment on either side of that line, however small the departure from it may be; and for scientific accuracy it has, therefore, been thought desirable to have some absolute standard to which days and hours can be referred.[97]

Strachey wanted his peers to understand that the establishment of a universal day was a minor reform, useful mostly to astronomers. It would not have far-reaching ramifications (Fleming, who did want to change civil timekeeping, must have been upset by this).

The Spanish diplomat responded: Who knows "what difficulties we may be driven into? Every country will be obliged to count both ways. They will have to use civil time and universal time."[98] The confusion of having multiple times was more complex than was necessary, he claimed. At this moment, Juan Pastorin broke ranks with his countryman, and offered the obvious solution, namely, some form of standard time, as Fleming had been advocating. Unfortunately, the proposal was once again voted down. The debate shifted back to whether the universal day should begin at noon or midnight, Greenwich time.

To understand why anyone would propose to change the day at noon instead of midnight, it is important to remember that astronomers used their own system of timekeeping. The astronomical day changed dates at noon, so that astronomers taking observations overnight would not have to change the date in the middle of their work (some sailors also used a nautical day which changed the date at noon, as the Spanish

[97] *Protocols of the Proceedings,* 164-5.
[98] *Protocols of the Proceedings,* 165.

delegate pointed out).[99] For those who believed that the new universal day ought to be for scientific purposes only, it made sense to make the universal day align with the astronomical day, not the civil day. This was the conclusion reached at Rome in 1883.

At the IMC, however, a new idea was proposed by J.C. Adams. If railways and telegraph operators were to be using universal time as well, not just astronomers, then perhaps the universal day should be aligned with the civil day. Indeed, the astronomical day could be changed as well, so it too would begin at midnight, despite the inconvenience of a date change in the middle of their overnight work. Adams suggested that it would be easier for astronomers to change than the public, because astronomers were few in number, and were intelligent enough to understand the change and implement it.[100]

A few further objections and questions were made, but ultimately the IMC agreed with Adams: the universal day would change at midnight Greenwich time, not at noon. Even Fleming backed the resolution, as it corresponded with the way standard time worked in the United States and Canada. Similarly, a resolution was passed "that the Conference expresses the hope that as soon as may be practicable the astronomical and nautical days will be arranged everywhere to begin at midnight."[101]

After this discussion, the debate moved away from timekeeping. The French delegate put forward a motion that studies be carried out on the use of the decimal

[99] *Protocols of the Proceedings,* 176.
[100] *Protocols of the Proceedings,* 171.
[101] *Protocols of the Proceedings,* 182.

system. It was a vague proposal that required little real effort on anyone's part and passed without much thought. Things were coming to a close.

Day Seven

The next session was the last at which any major discussion took place. The subject up for discussion was once again the question of standard time. Strachey, the delegate for India, had proposed a motion at the end of the last session suggesting that some form of time zones be implemented, that would be at least 10 minutes, or two and a half longitudinal degrees, wide. The exact width was to be left up to the determination of individual nations. However, Strachey withdrew his proposal, having discussed in the intervening days with his colleagues, and found that there was no consensus on the idea of standard time in any form.

Fleming had spent the entire previous day preparing a speech, but unfortunately, Strachey's withdrawal of the proposal meant that there was no longer the space for the discussion of standard time.[102] Fleming was silenced. The final word, the summation of the IMC's contributions to the world, was given by Lewis Rutherfurd. "We should not seem, in any way, by our action here, to interfere with the convenience of the world in the use of its present civil time…Our universal day is for those purposes only for which it may be found convenient, and that it is not to interfere in any way with the use of civil or

[102] Sandford Fleming, Diary Entry, October 21, 1884, Vol. 81, Fleming Papers, MG29 B1, LAC.

other standard time where that may be found convenient."[103] It was the end of Fleming's ambitions. Standard time was not to be made a global project.

Behind the scenes, the evenings around session six and seven offered several opportunities for informal discussion. Fleming spent the evening of October 21st dining with colleagues. He ate with Evans and Rustem at 'the club' (Rustem in particular, Fleming noted, was his guest).[104] Another dinner was held the next night at the Metropolitan Club, where Rustem returned the favour, inviting Fleming, Evans, and the secretaries of the British legation in Washington to join him.[105] By this time, the real work of the conference was finished, and a more formal dinner was held on the night of the 23rd at the British Embassy. The ambassador and his wife hosted the four British delegates, Adams, Evans, Strachey, and Fleming. The Russian and Swedish ministers were invited, along with their wives.[106] The next day, Fleming left Washington for good. He did not stay for the final ceremonial end to the Conference on November 1st. Many delegates didn't. As Rodgers wrote to Fleming on October 31st, "so many delegates are gone or are impatient to go."[107]

There was a mix of emotions about the end of the conference. Fleming's premature departure suggests some disappointment, but he was ever the optimist, and soon got back to campaigning (Pastorin aptly named him an "indefatigable propagandist").[108] Fleming would go on to claim that the IMC was a great step on the

[103] *Protocols of the Proceedings,* 198.
[104] Sandford Fleming, Diary Entry, October 21, 1884, Vol. 81, Fleming Papers, MG29 B1, LAC.
[105] Sandford Fleming, Diary Entry, October 22, 1884, Vol. 81, Fleming Papers, MG29 B1, LAC.
[106] Sandford Fleming, Diary Entry, October 23, 1884, Vol. 81, Fleming Papers, MG29 B1, LAC.
[107] Admiral Rodgers to Sandford Fleming, October 31, 1884, Vol 41, Fleming Papers MG29 B1, LAC.
[108] *Protocols of the Proceedings,* 167.

road to worldwide standard time. Janssen, meanwhile, had failed to prevent Greenwich becoming the Prime Meridian, but he was nonetheless proud of the fight he had put up, and maintained that France had the moral high ground. Galvan, too, was proud of his efforts to support scientific neutrality in the face of the Anglo-coalition.

Adams, on the other hand, had gotten exactly what he wanted. He wrote, "I am perfectly satisfied with the results of our Congress at Washington in which I took a more prominent role than I expected to do."[109] Adams left Washington on the 25th, not staying for the final formalities.[110] The career diplomats, of course, stayed in Washington, carrying on their business. Galvan, now finished with the IMC work, was once again negotiating with the Secretary of State over trade agreements on the 26th.[111] Of those who were not long-term residents in Washington, Rodgers, Cruls, Strachey, and Janssen were among the last to leave.[112]

Aftermath

So what did the IMC achieve? In principle, it had established Greenwich as the world's Prime Meridian, to be used for determining longitude. It had also established a universal day based on that meridian. However, it had not prescribed any specific uses for the universal day. There was no resolution establishing standard time or time zones in any form. Indeed, the only specific time reform suggested by the IMC resolutions was that

[109] J.C. Adams to Francis Bashforth, April 25, 1884, 4/26/3-4, John Couch Adams Papers, SJCL.
[110] J.C. Adams, Diary Entry, October 25, 1884, 39/11/4, John Couch Adams Papers, SJCL.
[111] Frederick Freylinghuysen to Manuel de Jesus Galvan, October 26 1884, Vol LIX, Textos Reunidos 4: Cartas, Ministerios y misiones Diplomaticas, AGN.
[112] Admiral Rodgers to Sandford Fleming, October 31, 1884, Vol 41, Fleming Papers MG29 B1, LAC.; See also *Protocols of the Proceedings,* 207.

astronomers change their astronomical day to match the civil day. The impact on civil timekeeping, apparently, was nil.

The global response to the IMC resolutions was underwhelming. By the end of the 1880s, the only country to ratify its resolutions was Japan, under the influence of Kikuchi Dairoku.[113] Ian Bartky calls this ratification by Japan “the only tangible result of the International Meridian Conference.”[114] France of course refused to use the Greenwich meridian, and would not switch over until the 1910s. Even the host of the conference, the United States, failed to ratify the IMC resolutions. The presidential election changed the political landscape of the U.S., and the new administration under Grover Cleveland had little desire to implement the plans of the old administration.[115] Rodgers kept pressure on the new Congress, but failed to achieve results, telling Fleming, “When the new administration came in, I found no great interest in what its predecessors had begun.”[116] The IMC resolutions were treated with such dismissiveness that in in 1889, there were calls for a new conference to choose a Prime Meridian, preferably Jerusalem, ignoring the IMC altogether. This new conference was proposed by Italian reformer Tondini de Quarenghi at the Fourth International Geographical Congress (the follow-up to the Venice conference in 1882). Fleming pleaded with de Quarenghi to let Greenwich stand, as reopening the question could do irreparable damage to what had been achieved thus

[113] Bartky, *One Time Fits All*, 96.; William Allen to Sandford Fleming, October 18, 1887, Vol. 1, Fleming Papers MG29 B1, LAC.
[114] Bartky, *One Time Fits All*, 96.
[115] Bartky, *One Time Fits All*, 95.
[116] Admiral Rodgers to Sandford Fleming, December 15, 1887, Vol. 41, Fleming Papers MG29 B1, LAC. See also Message from the President to the House of Representatives Recommending taking action on the Prime Meridian Conference, 1888, Vol 122, Fleming Papers MG29 B1, LAC.

far.[117] The new conference never occurred, but the proposal itself demonstrates that the IMC was by no means considered definitive.[118]

Among the astronomical community, the IMC was just as divisive. Astronomers were a conservative bunch, and the notion that they must change the astronomical day to match the civil day was considered preposterous by many. The idea sparked furious controversy. At first, William Christie, the Astronomer Royal at Greenwich, intended to comply, announcing that on January 1st, 1885, the clocks at Greenwich would be changed to match the civil day, using a twenty-four-hour notation. Some newspapers printed the story of the change with excitement, wondering if the use of the twenty-four-hour clock might leak into civic timekeeping as well. “Perhaps in this scientific age it may gradually creep from scientific men and scientific books into ordinary usage,” wrote one paper.[119] In the United States, Christie’s counterpart, S.R. Franklin, also planned to change on January 1st.[120] But not everyone was so enthusiastic.

Simon Newcomb was the most vocal opponent of the change in astronomical day. It “is not merely a change in habit…” he wrote “but a change in the whole literature and teaching of the subject. The existing system permeates all the volumes of ephemerides and observations which fill the library of the astronomer.”[121] What is more, the Nautical Almanac was prepared several years in advance, so they could not make the change immediately, or there would be a gap of four years where the almanac would read incorrectly.

[117] Sandford Fleming to Tondini de Quarenghi, Various Letters, Vol. 13, Fleming Papers MG29 B1, LAC.
[118] Bartky, *One Time Fits All*, 97.
[119] *Daily News*, December 31, 1884.
[120] S.R. Franklin, General Order, December 4, 1884, Box 46, Newcomb Papers, LOC.
[121] Simon Newcomb to Nautical Almanac Office, December 6, 1884, Box 46, Newcomb papers, LOC.

Franklin did not agree with Newcomb's objections. He wrote "It seems to me eminently proper that the nation which called the Conference should be among the first to adopt its recommendations."[122] Yet the opposition gave him pause, and he quickly wrote letters to other American observatories requesting their opinions, as well as to Christie in Britain.[123] Only two of the eleven responses he received agreed with Newcomb, the rest were open to change.[124] Yet Newcomb's influence was such that Franklin gave in at the last moment, deciding on December 31st to postpone the change in astronomical day in the United States, at least until the Nautical Almanac could be changed alongside it.[125]

Kikuchi Dairoku, hearing of Newcomb's opposition, wrote to Adams on December 12th, asking what the United Kingdom would do, including Adams' observatory at Cambridge. Kikuchi had heard that Newcomb's objection had caused Christie to "defer taking any public action though he will adopt the change in the Observatory itself."[126] Indeed, although Christie fully supported the change, he limited himself to the somewhat symbolic gesture of adopting the change for internal use at Greenwich.[127] The Nautical Almanac, however, would not be altered.

The tendency of astronomers and naval officers towards the status quo was stronger than anyone thought. The astronomical and nautical days would not be changed to match the civil day until 1925. A decade and a half after the IMC, Fleming and the

[122] S.R. Franklin to United States Naval Observatory, December 11, 1884, RGO7.146, Royal Greenwich Observatory Archives, CUL.
[123] S.R. Franklin to William Christie, December 10 and 15, 1884, Letters Received, PC42, Entry 7, Box 49A, Records of the United States Naval Observatory, RG78, NAUSA.
[124] S.R. Franklin to Simon Newcomb, January 2, 1885, Box 46, Newcomb papers, LOC.
[125] S.R. Franklin, December 31, 1884, Letters Received, PC42, Entry 7, Box 49A, Records of the United States Naval Observatory, RG78, NAUSA.
[126] Kikuchi Dairoku to J.C. Adams, December 12, 1884, 24/16/2, John Couch Adams Papers, SJCL.
[127] William Christie to A. Hirsch, February 5, 1885, RGO7.148, Royal Greenwich Observatory Archives, CUL.

Canadian Institute were still campaigning to unify the nautical, astronomical, and civil day. Fleming blamed Newcomb for the inertia, writing savage attacks against him in 1895 claiming that he had long opposed international cooperation concerning time reform of any kind, including time zones. According to Fleming, when asked if standard time zones could be extended beyond the United States, Newcomb had answered, "We don't care for other nations, can't help them and they can't help us." Indeed, Newcomb's opinion of the entire scheme was that it was "a capital plan for the millennium. Too perfect for the present state of humanity. See no more reason for considering Europe in the matter than for considering the inhabitants of the planet Mars."[128] Fleming went on to say that "Newcomb stood alone in his antagonism to this scientific reform in which all nations were concerned….Mr. Newcomb has always been at war with the movement to promote the unification of time-reckoning throughout the world."[129] After more than a decade of unsuccessful lobbying, Fleming's frustrated revisionist history of how Newcomb undermined the IMC is understandable, but should be taken with a grain of salt. He conflates the issue of standard time (which was never agreed upon at the IMC) with the much smaller question of changing the astronomical day to match the civil day, and thus attributes the IMC's failure entirely to one man.

But as we have seen, the failures of the IMC were not of Newcomb's making. Indeed, it was only a 'failure' from certain perspectives. Fleming and Janssen might

[128] Third Report [1st Amendment] of the Joint Committee of the Canadian Institute and the Astronomical and Physical Society of Toronto on the Unification of Astronomical, Nautical, and Civil Time, File 4-0-8, F1052, Archives of Ontario (AO).

[129] Third Report [1st Amendment] of the Joint Committee of the Canadian Institute and the Astronomical and Physical Society of Toronto on the Unification of Astronomical, Nautical, and Civil Time, File 4-0-8, F1052, AO.

consider the IMC a failure, but if you asked Adams, or nearly all of the other astronomers and navigators (and even diplomats) in the room, the IMC achieved exactly what it was supposed to: the establishment of a Prime Meridian for determining longitude.

Conclusions

Many layers of conflicting interests gathered in Washington in October 1884. National rivalries played a role, but on a more fundamental level, conflict at the IMC emerged out of two competing understanding of what the conference was meant to accomplish. On one side were the few, like Fleming, who wished to effect radical change in civil timekeeping worldwide. It was their efforts that brought about the conference in the first place. Ironically, they were outnumbered at the IMC by the other interests at the table: the navigators who desired a standard for longitude, and astronomers whose only interest in timekeeping was the creation of a tool (the universal day) for the use of scientists and specialists.

The latter won out. The majority of the IMC delegates who came to Washington had no intention of ever discussing sweeping civil time reform (recall that the British delegates, for example, were chosen by the SAD for their opinions on the Metric System, a completely unrelated issue to timekeeping). For these astronomers, the discussion of a Prime Meridian and universal day was always about specific astronomical and navigational uses. As Russian Astronomer Otto Struve observed upon reading the conference proceedings in 1885, its decisions would be most valuable to science, navigation, telegraphy, and railway lines; while "ordinary, every-day life, which in its locality is regulated by the sun, would not immediately be effect by it."[130] Struve went on to say that astronomers, of all scientists, required the unification of time least, because they were experts in matters of time. They dealt with time differences daily, and conversion was an easy thing for them. But they had no intention of forcing the general population to regulate their clocks in a new way.

Vanessa Ogle's argument, which reasserts the primacy of the nation in global politics, suggests that international cooperative efforts like the IMC were ineffective. She is correct in the observation that the principle of national sovereignty ensured that civil timekeeping would remain a question to be determined by individual states. France, Brazil, and the Ottoman Empire marched to their own tune. Meanwhile, the process of colonization would transplant European national times to subjugated territories by force. Upon independence, many of these former colonies would remake their own national times. It would take decades of piecemeal legislation to establish standard time worldwide, as each nation made its own decisions about regulating time. And even then, standard time was not perfected: today's standard time conforms more to national boundaries than it does to lines of longitude, and there are plenty of exceptions and temporal oddities to be found on a map of time zones, not to mention Daylight Saving Time or Summer Time, which throws the whole system for a loop twice a year in some countries. Fleming's dream of twenty-four geometrically perfect time zones was never realized.

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[130] Otto Struve, "The Resolutions of the Washington Meridian Conference," in Sandford Fleming, *Universal or Cosmic Time,* 1885, YA.2003.A.17994, BL.

Yet Ogle's generally sound conclusion about the primacy of national interest might benefit from a closer look at how these international agreements were made. Few national delegations were united amongst themselves. William Allen overstepped the ambitions of the rest of the American delegation, Sandford Fleming was undercut by his British peers, and Juan Pastorin did not agree with the opinions of his fellow Spaniards. Which persons were in the room, their occupation, their background, their vision of the modern world, mattered more to the IMC's outcome than which nations were in attendance. The IMC was a failure for the designs of civil engineers and businessmen, but it was a victory for astronomers and navigators. Railwaymen in North America had already demonstrated that international cooperation in civil timekeeping was possible, after all. But at the IMC, astronomers held all the cards, and naval and astronomical interests drove the debate, not those of railway corporations. The network of astronomers who dominated the IMC, as we saw in chapter two, were insular and narrowly focused on scientific pursuits like the transit of Venus, or determining longitude for the surveying of colonized territories. They had little interest in regulating time for the ordinary person, preferring to allow local time where convenient, and create universal time for those few who wanted it. The results of the IMC, when looked at through this frame of reference, are unsurprising.

We come back now to the central question: Why did the system of time standardization set up in the 1880s take the form that it did? In Chapter One, we saw how railway engineers acted on the need to simplify the growing complex network of trains and telegraphs across North America and, to a lesser extent, Europe and India. But the campaign for standard time became entangled in the scientific quest for longitudinal and astronomical accuracy, as well as the politics of systems of weights and measures. These interests, held by the insular astronomical community described in chapter two, dominated the Prime Meridian debates, edging out the interests of railway engineers. This left time reform up to the discretion of national governments, not all of whom were interested in regulating time in the same way as North American railroads had. The IMC was not the definitive moment in standard time's implementation.

If not the IMC, then what else? Given France's initial opposition, we can look to the French for an answer. They finally accepted the Greenwich meridian just before the First World War. However, they managed to concede Greenwich without diminishing the importance of Paris, via the power of a new technology: the radio. From the 1920s, the time was broadcast incredible distances instantaneously from the Eiffel Tower, making Paris the means by which Greenwich time was disseminated. With the advent of the radio, the usefulness of universal time became much more generalized, now that it could be easily shared. Aviation would soon make use of it, as would other industries, making universal time far less esoteric, and more useful to more people. The norms established by North American railroads in 1883, by the IMC in 1884, and by the radio in the 1920's all shaped way time was measured, each in their own way.

But this leaves a gap of some forty years between the IMC and the radio. During these decades there was a disconnect between methods of timekeeping. Accurate, universal time existed for telegraphy, railway travel, and esoteric scientific tasks, but was difficult to disseminate to the public. On the other hand, less precise local time in all its variations was in common usage for everyone else. The multiplicity of times in use was a source of confusion, frustration, and, occasionally, humour. Exploring the way people navigated their way through this tangle of competing timekeeping methods around the turn of the century is the focus of the next chapter.

Chapter 4: "All Over the House that Jack Built": Selling Time, Constructing Modernities

In previous chapters, we have seen how civil time reform was championed primarily by North American railway engineers, such as William Allen and Sandford Fleming. However, the global astronomical community repurposed that reform effort to suit their own specific needs at the International Meridian Conference (IMC) in 1884. The result was that the IMC had practically no effect at all on civil timekeeping. Instead, it established a universal day, based on the Greenwich meridian, which was intended for use primarily by astronomers and navigators, not by the general public.

But what was happening in the world of astronomy and diplomacy was far from secret. Engaged readers around the world read about the IMC results, wondering how the new universal day might affect their own lives. Indeed, the fact that the new universal day was not meant for use by everyone was poorly communicated, and it created quite a bit of confusion. The answer to the question "what time is it?" seemed more complicated now than ever. Ordinary people were aware of the changes in time reckoning, even if it only rarely impacted their own schedules, and from that awareness came debate. Questions were raised about temporal authority, and whose time was the 'true' time. Throughout the three decades after the IMC, there was a simmering contest for supremacy between the supposedly perfectible scientific time, and other, more practical, if less precise, forms of timekeeping.

The fact that the new scientific time was contested, even outside the sphere of professionals and elites, is significant. Norms of public behavior are just as important, if not more important, than academic practices or diplomatic agreements like the IMC.

Based on this assumption, this chapter looks beyond the scientific community to see how official changes in time measurement influenced other persons in Britain, while the next chapter does the same for Canada and the United States.

This chapter makes two central arguments. First, that people continued to use the time that was convenient to them, ignoring scientific time, or treating it as a joke, whenever they wished. Regardless of race, class, or gender, most people were aware of the changes in time measurement going on in scholarly circles, on railways, and at the IMC. But such changes evoked mixed responses: confusion, nostalgia, derision, mirth, even indifference. The influence on most people's lives should not be overstated: the world did not devolve into chaos because there were too many competing times. Indeed, few people actually paid much attention to the new scientific time; they carried on measuring their lives in their own way. Accurate Greenwich time was inaccessible to the majority, being expensive and complicated to disseminate.

Nonetheless, its existence could hardly go unnoticed. Scientific time was a symptom of 19^{th} century visions of modernity, and this leads us to the second central argument of this chapter, that people made use of scientific time as a status symbol, to appear modern, lend credence to their businesses, or establish themselves as 'legitimate' authorities on the future development of communication networks and human society at large. The promise of the universal day was one of progress, and those who wished to be perceived as modern attempted to access scientific time, to claim it as their own. Both the attempt to access universal time, and equally, the business of disseminating it, became battlegrounds for competing visions of the future. Just as at the IMC, where nations debated over who got to own the prime meridian, civic timekeeping was a question of power and authority. There was conflict over whose time was the 'true' time, but just as important was the question of who had access to that time. Those who had access could claim to hold the future in their hands.

To summarize, people both satirized scientific time and coveted it. Both of these impulses: the tendency to mock scientific time, and the desire to be seen using it, or at least to seem knowledgeable about it, stemmed from the extreme difficulty in accessing scientific time. This is the story of the social ramifications of limited distribution – exploring how hard it was to distribute, who did the distributing, who received it, and who could not. Being as restricted as it was, scientific time was not a practical option for everyone. Yet that scarcity, along with the legitimacy lent it by the IMC, made it highly desirable in some circles.

This chapter will begin with a look at public reactions to the IMC: how the new times were accessed, if at all, where time debates entered into popular and material culture, and how the growing multitude of new times were perceived. It will then dive into the story of the distribution of time: who had the right to sell the time, and who could afford to buy it. The story of time distribution here goes beyond technical debates, as it was based in 19th century assumptions about, and re-evaluations of, race, class, and gender. While this is a story about systems of distribution, and new technologies certainly lie at its heart, it is ultimately not so much a story of new technology as it is about people, and the way they used tools like time measurement to constitute and re-constitute their place in the world.

Before the IMC, there was already a confusing number of times used by the public. Local time was still measured by the sun in many places, while railways ran on standard time in North America, or national time in the UK (Ireland excepted, which followed Dublin time). Religious schedules, marked by church bells or muezzins, were often the most prominent markers of time for communities around the world, as were town halls and other public buildings. Competing local, imperial, and religious times battled for prominence in many places.[1] The IMC did not do away with this multiplicity of times, instead it added more. Now there was a universal time, based on Greenwich, which was meant to be authoritative worldwide. All other times were supposedly subservient to it. Yet it was cloistered, inaccessible to most of the population. This meant that in practice, its existence merely added a new layer of complexity to telling the time in the late 19th century. There was nothing universal about it at all.

Victorians responded to the confusion by poking fun at it. In British newspapers and magazines, confusion about the time was regularly the punch line in cartoons and humour columns. As Robert Darnton famously suggested, when a modern reader no longer understands a joke from the past, it is worth studying. There has been a change in *mentalité*.[2] The following wisecracks are not so opaque as Darnton's cat massacre. Frustration over unexpected time changes and incorrect clocks still troubles twenty-first century peoples enough for us to commiserate with these nineteenth century woes. Yet not, perhaps, to the same extent. A lack of temporal accuracy appears to have been

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[1] See Vanessa Ogle, *The Global Transformation of Time, 1870-1950* (London and Cambridge: Harvard University Press, 2015).
[2] Robert Darnton, *The Great Cat Massacre and Other Episodes in French Cultural History* (New York: Basic Books, 1984), 5.

unpleasantly ubiquitous in Victorian Britain. The following jokes and anecdotes illustrate some of this frustration. One humorous story from the *Aberdeen Weekly Journal* in 1887 featured a working-class man questioning the police about the proper time:

> He sort of squeezed himself into police headquarters, hat in hand, and shambled up to the desk, bowed very low, and inquired – "Am da boss officer in?" "Yes, sir." "Wall, boss, I wants to know 'bout dis time bizness." I've bin havin' a heap o' trubble fur a week past." "What time are you running on?" "Dat's what I want to find out. One feller he tells me to go on solar time, an' another tells me standard time, an' my ole woman she's got a third time, an' Ize all mixed up. I told de ole woman dat I was comin' down to get purleece time an' stick to it." "Well. Set your watch at 1:28." "Yes, sah. Dat's de fust satisfacksun I've had in two hull weeks." He pulled out an ancient "turnip," felt around for a key, and had just got ready to set the hands when the crystal fell out and smashed, there was a long continued whirring among the works, and as he held the timepiece to his ear and shook it the internal mechanism fell on the floor, and rolled under a bench. "I speckted sunthin' of the sort," said the man as his chin began to quiver. "Dat comes of tryin' to run on three sorts o' time. No watch kin stand any such foolin' as dat, an' I might a knowed it." "What will you do now?" "Nuffin'. Dat settles time on dis chicken fur de ne' six months, an' Ize gwine to git up in de mawnin' when Ize hungry, an' go home at night after the old woman has got de wood in."[3]

In this story, the reaction of the poor working man to the 'scientification' of time was to shun it altogether, returning to natural rhythms in a knee-jerk rejection of a modernity which promised more complexity than convenience. In a similar vein, the *Hampshire Telegraph and Sussex Chronicle* joked in July of 1885 that "St. Louis has standard time, meridian time, Southern time, Western time, and so many other kinds of time that only a crazy man carries a watch."[4] The United States railway times, with multiple zones across the continent, seemed even more convoluted to British observers than the situation in Britain. These stories of bemusement were common on both sides of the Atlantic. *The*

[3] "A Mixed Timekeeper," *Aberdeen Weekly Journal*, April 2, 1887.
[4] "Johnathan's jokes," *Hampshire Telegraph and Sussex Chronicle*, July 11, 1885.

Manchester Courier and Lancashire General Advertiser in 1895, told another tale of temporal misadventures:

> A Gentleman rode up to a small boy sitting on the fence in front of his home and inquired if he lived there. "I try to," was the response. "Well, my boy, I want to know what time it is; can you tell me?" "Yes, I kin; I wuz in the house just five minutes ago, and the old clock was pintin' at eleven." "What kind of time do you have?" "Oh, us have all kinds." "But I mean do you have solar time or standard time?" "That's what I said. We have all kinds." "I don't understand you." "Don't you? Well, come to our house and live a while, and yer'll learn. My sister Sal she has standard time – that's the clock; I has city time – that's the town clock; the hired girl has sun time – that's watching the shadders; and pap and mam has a deuce of a time – that's what they're doing in there now, and I'm settin' on the fence till they get her reggerlated. By gosh, you hadn't better wait roun' jere if you don't want to hear suthin' strike, an' strike mighty durn hard." The man rode away rapidly, and the boy kicked another plank off the fence.[5]

The punchline of the joke plays off working class stereotypes regarding turbulent marital relationships and errant, unsupervised children, both being part of the received wisdom of the British middle class in the 1880s, but confusion about timekeeping was just as prevalent a trope in late Victorian society as the supposed immorality of the poor. *The Manchester Times* humour column in 1887 squeezed in a similar short segment on time, between a joke about parliamentarians 'whipping' their own party, and a quip suggesting that men would never go to church if British women were not so attractive. The column imagines a brief exchange between a layman and a scientist. In what is becoming a familiar pattern, a bemused inquirer is befuddled by the multiplicity of times available to them: "Stranger: 'what time is it please?' Scientific man (absently): 'What do you want – sun time, mean local time, or standard time?'"[6] There is no further punchline provided by the paper, and none was needed. The ridiculousness of the scientist's overzealous quest

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[5] "What time is it?" *Manchester Courier and Lancashire General Advertiser,* March 14, 1895.

[6] *Manchester Times*, September 28, 1889.

for accuracy, combined with the absolute lack of standardization between the numerous types of time, is enough to make the joke work.

Of course, confusion was not the only reaction to time differences. It was also an opportunity to be taken advantage of. Mischievous schoolboys used and abused time differences, and, equally, were foiled by them. For example, at Oxford, the clock tower of Christ Church College, known as Great Tom, struck local time, which was five minutes slower than all the other clocks in town, which kept Greenwich time. According to a story in *The Observatory* from 1908, one student, arriving a few seconds later than his nine PM curfew, protested that Great Tom had not yet stuck. The porter refused him entry, quipping that the curfew rule had been put in place centuries before Great Tom was built.[7] Other students of Christ Church made use of the five-minute gap to argue that they should be released early. As one former student reminisced, "we earnestly contended and thought that we ought to begin by the later and end by the earlier, thus effecting a saving of ten minutes in the hour."[8]

Cartoons about time changes found their way into *Punch* in 1884, just weeks after the end of the IMC, where it had been decided that universal time would be counted up to twenty-four hours instead of twelve. One cartoon from December 13th shows a baffled Father Time, unable to read a new twenty-four-hour clock at Lincoln's Inn. The artist suggests that a twelve and a twenty-four-hour clock ought to both be put up, side by side,

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[7] *The Observatory*, November, 1908.
[8] *The Observatory*, November, 1908.

allowing passers-by to “choose their own time, rather than having the new, ‘scientific’ 24 hour clock imposed on them without choice.”[9]

In scanning these newspaper columns and cartoons, a careful reader might also pick up on the notion that telling time ‘properly’ was a marker of status. For example, the servant girl in the *Manchester Courier* column only knew how to tell time by the shadows, while the family members she worked for used various forms of clock time. The more mechanical the time telling method, the more modern, the more respectable. On the other hand, scientific time-telling devices which seemed to complicate time-telling, rather than simplify it, alienated the population. Scientists like the absent-minded academic from the *Manchester Times* column are portrayed as overzealous in their search for accuracy, complicating what should be a simple question. As John Rodgers, Superintendent of the US Naval Observatory said in 1881 in opposition to time reform, scientists “sometimes overestimate their functions,” interfering in the simplicity of everyday living.[10] Rodgers concluded, “The people who do not care for scientific time are a thousand for the one of those who do.”[11] This disdain for scientific jargon is captured in another brief story written up in *The Observatory*, in which Astronomer Royal George Airy made a particularly lengthy speech. Afterward, a bored Lord Palmerston was said to have remarked under his breath, “Is there not some confusion between Greenwich Time and eternity?”[12] Astronomers were considered brilliant but impractical, complicating

[9] *Punch*, December 13, 1884.
[10] Quoted in Peter Galison, *Einstein’s Clocks, Poincaré’s Maps: Empires of Time* (New York: W.W. Norton, 2003), 122.
[11] Galison, 122.
[12] *The Observatory*, 1910, 188.

unnecessarily the rhythm of daily life. What Britons of all classes wanted was something in between; accuracy and modernity, yes, but also simplicity.

The social implications of the confusion over the correct time went beyond the newspaper funny pages. Time and its measurement was also connected with political, economic and social movements of the 19th century. In particular, the quest for worker's rights and the end of the exploitation of labour was couched in the language of time. Tom Mann's 1886 pamphlet "What a compulsory 8 hour working day means to the workers" helped sparked the Eight Hour Movement, in which the Fabians, Social Democratic Federation, Trade Unions, and other workers' rights and socialist organizations pushed for legislation to limit the length of the working day.[13] The wellbeing of workers was described not through working conditions or wages, but in the measure and use of workers' time. Though the movement failed to enact legislation enforcing the time limit, it connected time and work in public consciousness in the 1880s, much as the Factory Acts of the 1840s had done when they enacted the ten-hour work day for women and children. Measuring time, then, had wider political and economic implications, particularly in the charged reformist atmosphere of Britain in the 1840s, and again in the 1880s.

Time, its measurement, and its cultural meaning also found its way into the popular literature of the period. Jules Verne's 1873 story *Around the World in 80 Days* is perhaps the most obvious example. The plot relies on a timekeeping error for its climax, in which the hero, who has made a bet to travel around the world in eighty days, believes

[13] A.E.P. Duffy, "The Eight Hours Day Movement in Britain, 1886-1 893" *The Manchester School* 36, No. 3, (2008).

he has failed and lost the bet by a slim margin. However, because he travelled Eastward around the globe, he unknowingly gained a day as he crossed the date line, meaning he won the wager after all. In Verne's capable hands, this temporal oddity made for a dramatic change of fortune.

As Adam Barrows points out, Bram Stoker's classic 1897 gothic horror *Dracula* also employs time and timetables to raise the stakes. The heroes race across Europe, calculating railway timetables and steamship speeds to outwit the undead threat. In addition, as Barrows writes, "*Dracula* narrates the violent struggle of the last vestige of an 'outside' to standard time's grid." Barrows points out that the landscape surrounding Dracula's castle is entirely unmapped, a vestige of an older age. "The ultimate elimination of that vestige, or more accurately, its transformation into a temporally synchronized narrative, provides the fin de siècle foundation myth for an empire of temporal uniformity."[14] Both in literature and in reality, the universal day established by the IMC was symbolic of the imperial drive to modernize the world, to count and measure it, to make it knowable and erase the unexplored edges of the map. In *Dracula*, scientific time was meant to overcome the unmodern, the antiquated, and the immoral. The old method of local solar time was being eradicated.

But that process of eradication was more successful in literature than it was in the real world. Confusion about, and opposition to, scientific time abounded. Perhaps the most explosive example of this opposition came in 1894, when a French anarchist named Martial Bourdin attempted to bomb the Greenwich Observatory. The attempt failed.

[14] Adam Barrows, *The Cosmic Time of Empire: Modern Britain and World Literature* (Berkeley: University of California Press, 2011), 87.

Bourdin's bomb exploded prematurely, and he succeeded only in killing himself.[15] The motivation to attack the observatory came from the symbolic place Greenwich had gained as the physical centre of the temporal world order. The attack on Greenwich was an attack on order and British imperial authority itself. A decade and a half later, there were rumours and speculation that the suffragettes might make a similarly symbolic attack on the observatory, and the Astronomer Royal had to ask for an increased police presence in the area.[16] These attacks and threats captured the imagination of the public. Bourdin's botched bombing was fictionalized by Joseph Conrad in 1907, with the publication of his book *The Secret Agent*. People were interested in reading about the conflict between order and chaos, and about temporal perfection and its unattainability. Victorian and Edwardian authors fulfilled that wish.

Indeed, literature was not just the outcome of changing timekeeping policies, it helped shape those policies. In preparing for the IMC, Frederick Barnard wrote to Sandford Fleming about how best to convince the other delegates of the merits of his proposed reforms. In one of his letters, Barnard ends with a description of a book he had been reading:

> I came across a curious illustration, the other day, of the blunders a man may commit who is ignorant or inattentive to the differences between local times under different meridians. It occurs in a novel of a rather sensational character, but possessing a great deal of literary merit. The devil of the story is a married man who deserts his wife and runs off (from England to the continent) with a charming young woman who supposes him single and whom he promises to marry. But he

[15] These are numerous accounts of the attack in RGO7.58, Royal Greenwich Observatory Archives, Cambridge University Library (CUL).

[16] Astronomer Royal to the Secretary of the Admiralty, February 24, 1913, RGO7.52, Royal Greenwich Observatory Archives, CUL. Police patrols of the observatory were carried out to protect it from the suffragette threat, and continued for more than two years. Frank Dyson to Scott, November 10, 1915, RGO7.52, Royal Greenwich Observatory Archives, CUL.

> puts her off from year to year till he becomes tired of her and jealous. He breaks down in health, and finally conceives a diabolical scheme by which to inflict pain and injury upon her. To her surprise and delight he proposes at last to marry her, and does so, but then makes a will of which he acquaints her with the provisions and in which he leaves all that he has "to his beloved wife." His own death directly follows. On the very day of the marriage (at Naples) the "beloved wife" dies in London, and the poor injured girl finds herself without money and without character, or else the heiress to a handsome fortune. "It depends on the hour" says the lawyer. If the marriage at Naples took place earlier than the death in London, the man is a bigamist and the mistress is ruined. If the death in London occurred before the marriage in Naples, the erring fair one is rehabilitated and wealthy. On careful investigation, it is found that the London wife died just before the public clocks struck the half hour after nine. The novelist seems to think that his point will be effective in proportion to the narrowness of the margin on which he sums. So he causes it to be discerned that the priest in Naples commences the marriage service at a quarter before ten. But as half past nine at London means half past ten in Naples (a fact which the writer forgot or never knew), there was ample time for the completion of the marriage service before the life of the London wife came to an end. So that it was a case of bigamy, in fact, though the writer intended it should not be. It amused me that I should encounter so curious a misconception just as this subject is exacting so lively an interest with us.[17]

Barnard's reading of the story caught a plot hole which other readers less invested in time reform might allow to pass by, but nonetheless the novel raises questions about the correct measure of time internationally, using temporal accuracy as the linchpin of the plot. It was exactly these sorts of mistakes, which Barnard accuses the unknowing author of, that Fleming's system, if it became universal, was meant to fix. But, as we have seen, it did not. The difference between local and standard time continued to cause confusion, compounded by the varying reliability of the clocks on which they were measured.

This phenomenon was not new to the 1880s in Britain. As we saw, for example in the hours of work movements, the debates of the 1880s about time echoed those of the 1840s. Complaints about local and Greenwich time had become commonplace for the

[17] F.A.P. Barnard to Sandford Fleming, October 2, 1884, Vol 3, Fleming Papers, MG29 B1, Library and Archives Canada (LAC).

first time in the 1840s, when British railroads began to run on Greenwich time. The *Glasgow Herald* published a column in 1848 in which the author urged the public to change their own clocks and watches away from local time to match the new railroad time. “All that is needful to ensure the general and cordial adoption of uniform time is to prepare the public mind for the change…Those who are acquainted with the story of the discontented pendulum will recollect that the farmer found his watch wrong a few minutes one fine morning; and this would be the sum total of inconvenience to the public. Having set their watches with the railway clocks, things would be all right again…the change would inconvenience astronomers only, and they are quite able to take care of themselves.”[18] The discontented pendulum, mentioned by the article, is a short story by Jane Taylor, common in schoolbooks, in which an anthropomorphised pendulum, owned by a farmer, refuses to work any longer, overwhelmed by considering the many thousands of swings it would have to make in the coming, weeks, months, and years. After a few minutes, the pendulum is convinced by the rest of the clock’s components to continue its task, teaching it to carry out its monumental workload by taking it one swing at a time. The farmer wakes to find his clock is a few minutes slow. Moral lessons aside, the point the author of the column was making was that after a single, simple time change of a few minutes, no one would notice the difference anymore. This argument, made in 1848, is much the same as those made in the 1880s. It criticized “half-measures” such as keeping both Greenwich and local time, by adding extra hands to a clock dial, for example.[19] The

[18] *Glasgow Herald*, January 28, 1848.
[19] *Glasgow Herald*, January 28, 1848.

author argued that these half measures added to, rather than took away from, the confusion.

But in the 1840s not everyone was ready to accept the change easily. Exeter, apparently, was one of the first communities in the West of England to adopt Greenwich time.[20] But there was opposition. Church officials at Exeter Cathedral, whose clock was the most prominent time signal available, refused to change its time.[21] A similar event took place in Accrington. An anonymous letter to the editor of the *Blackburn Standard* wrote, "The inhabitants of Accrington and its neighbours would, I am sure, feel very grateful if the parties in authority would keep the Church clock, (there being no other public clock in town) by Greenwich time; as its being kept so irregular causes a great deal of disappointment and chagrin to the inhabitants. Strangers in particular are very often left by the Railway trains, no fewer than twelve or fifteen persons being so left on Wednesday morning last."[22] Steeple clocks had long communicated community time in Britain, and timekeeping became a theological debate as much as it was a practical one.

Ecclesiastical opposition to the time change was commonplace in some circles. One column writer derided the staunch opposition to Greenwich time of one Reverend John Cummings, who believed Greenwich time was a papist conspiracy. Cummings preached that "to make Exeter, and Plymouth, and Glasgow all preserve the same time as Greenwich, is just to make them tell lies – unblushing chronological lies – to make the church bells tell lies, ladies' and gentlemen's chronometers to lie – in fact, to enact lying

[20] *Hampshire Telegraph and Sussex Chronicle*, September 25, 1852.
[21] Derek Howse, *Greenwich Time and the Discovery of the Longitude* (Oxford: Oxford University Press, 1980), 109.
[22] *Blackburn Standard*, July 26, 1848.

by the law of the land... It is essential Popish, for it is sacrificing truth to uniformity… I hope you will keep protestant watches."[23] Not everyone took such extreme exception to the change, but there was certainly widespread public debate.[24] A more level-headed objection to Greenwich time came from rural Wales, where one commentator complained that the towns of Carnarvon and Beaumaris were both to switch to Greenwich time, even though neither town was "in the immediate vicinity of a rail-road, and yet the arrangements and convenience of rail-roads are the only pretence that can be assigned for thus disturbing an order of time-keeping which has existed since the computation of time began."[25] This was a reasonable objection for a place with no railway travel.

But the railways were expanding quickly, and the infrastructure for distributing Greenwich time went with them. For example, under the direction of George Airy, telegraph wires for the transmission of time signals began to be installed alongside the rails in the 1840s and 50s. Meanwhile, a clock exhibited at the Great Exhibition in 1851 was purchased by the Great Northern Railway Company, to be placed at King's Cross station, where it would transmit Greenwich time to other stations up the line once the electric telegraph lines had been completed.[26] The Great Exhibition itself helped cement the primacy of the railways, as it drew "the greatest increase of passenger traffic on the railways" ever.[27] The exhibition, according to Derek Howse, "resulted in travel in Britain on an unprecedented scale," requiring new levels of accurate scheduling.[28]

[23] *Liverpool Mercury*, October 17, 1848.
[24] For more examples, see Howse, 105-113.
[25] *North Wales Chronicle*, January 18, 1848.
[26] *Friday London Gazette*, August 16, 1851.
[27] Howse, 105.
[28] Howse, 105.

What this meant was that in Britain, Greenwich time already dominated local time in the 1880s, and had for decades, at least in the major cities. Yet the 1880s saw a revival of these conversations about which time to use. Three events in the 1880s brought the subject of time back into the public eye as it had not been for decades. First, Greenwich time finally became legal time in Britain in 1880 (and Dublin time in Ireland). This change affected the closing and opening times of shops, pubs, and public offices, for example. Second, the North American railways switching to time zones based on Greenwich time in 1883 made waves in Britain, as did the third event: the IMC's 1884 introduction of a universal day for scientific purposes, using a twenty-four-hour clock. While these last two events changed little practically about lay timekeeping in Britain, they pushed timekeeping back into public discourse in a way that it had not been since the 1840s and 50s. Furthermore, the IMC's resolutions leant Greenwich the semblance of authority as the centre of time for the world, in theory if not in practice. The answer to the question of which time was the true time seemed to be Greenwich time, yet reliably accessing it was still a challenge, and other forms of timekeeping refused to disappear altogether. The argument I am making here is that although the IMC could quite reasonably be said to have had no tangible impact on public timekeeping in Britain, it nonetheless helped reopen the conversation about time and authority, about modernity and accuracy, conversations which had been somewhat dormant since the 1840s.

News of the IMC was printed widely in British newspapers. The sensationalist nature of French-English antagonism at the IMC drew the attention of some papers, while others merely reported brief summaries of the resolutions. Only a few went into more detail, some predicting momentous changes to come.[29] "Perhaps in this scientific age [twenty-four-hour time] may gradually creep from scientific men and scientific books into ordinary usage," mused one paper.[30] Besides these summaries, along with the speculative articles pondering when and if scientific time would filter into common use, news about the IMC resolutions was related by clubs and institutions. Scientific bodies like the Balloon Society took it under discussion at some of their meetings in London, for example.[31] But interestingly, one of the first groups to learn about the IMC and its possible ramifications were children. While timekeeping was not taught officially in the curriculum of the British education system, it was taught informally. Picture books from the end of the century taught moral lessons alongside time-telling. But in late 1884 and 1885, in response to the IMC, a series of lectures for "juveniles" were held in London on the subject. This meant that children, not adults, were among the first people to learn about the IMC resolutions in detail, along with some speculation about their possible ramifications. The lectures were put on by the Society of Arts in London, the first on December 31st, 1884, and the second a week later on January 7th, 1885. The speaker, astronomer Norman Lockyer, inspired by the resolutions of the IMC a few months earlier, titled his Lecture series "Universal Time: Our Future Clocks and Watches."[32] Both lectures sold-out.[33]

[29] *Birmingham Daily Post*, December 27, 1884.; *Daily News*, December 18, 1884, December 31, 1884.
[30] *Daily News*, December 31, 1884.
[31] *Daily News*, February 6, 1885.; William Christie to Dr. Schram, April 16, 1891, RGO&.146, Royal Greenwich Observatory Archives, CUL.; W.H. Le Fevre, "A Standard of Time for the World: Address Delivered before the Balloon Society," September 11, 1891, Vol. 123, Fleming Papers, MG29 B1, LAC.
[32] "Juvenile Lectures," *Journal of the Society of Arts* XXXIII, No. 1673 (Friday December 12, 1884): 81.
[33] "Juvenile Lectures," *Journal of the Society of Arts* XXXIII, No. 1674 (Friday December 19, 1884): ?.

Lockyer began his lecture on the first night with a whimsical flourish. "Once upon a time, ages ago, when the world was very much younger than it is now, and there were very many more elves and fairies than there are now, and even long before Santa Claus was born, and was going about as we hope she[sic?] will be going about so merrily tonight [the lecture was given on New Year's eve] – all that while ago I say you can quite understand that people had not any clocks and watches."[34] Having caught the attention of the children with Santa Claus and Elves, Lockyer went on to describe the history of timekeeping, and the internal workings of a modern clock, including how barometer pressure and temperature make clocks run slow or fast. But then Lockyer arrives at the heart of his presentation: the IMC, and the possible changes it might bring to timekeeping. He explained, "Now the reason I suppose that I am talking to you now, on New Year's-eve – when it is too bad of the Society of Arts to have anybody lecturing or being lectured to – is that on this particular New Year's-eve a very wonderful thing is going to happen in connection with time, which will be remembered down the centuries. At midnight to-night, one of the assistants at Greenwich Observatory will go and put back that wonderful clock, which I hope many of you have seen, showing the astronomical time at Greenwich…"[35] Lockyer was of course referring to the IMC resolution which recommended that Astronomical time be changed to match civil time, beginning at midnight instead of noon. This change, as we saw in chapter three, was rejected at the last

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[34] Norman Lockyer, "Universal Time: Our Future Clocks and Watches," *Journal of the Society of Arts* XXXIII, No. 1677 (Friday January 9, 1885): 172. Lockyer may have originally intended this lecture to occur on Christmas Eve. It is also possible that he meant New Years Eve, as in the late 19th century, traditions concerning Santa Claus were not yet exclusively tied to Christmas Eve, appearing variously on the nights of December 5th, 24th, and 31st, hence Lockyer's reference to the gift-toting saint on New Years Eve.

[35] Lockyer, "Universal Time," 174.

minute in the United States, and in Britain the Greenwich Observatory only made the change internally, rather than adopting it officially. It would not be until 1925 that astronomers actually made the shift that Lockyer was describing as an imminent, momentous event. But Lockyer was not aware in late December 1884 that the plans put in motion at the IMC would fall through. So he continued confidently as if the change in astronomical time was going to happen in just a few hours time after the lecture ended.

Time ran out for him however. Lockyer had paused the discussion of time reform to explain the basics of physical geography to his audience, who were, after all, children. He explained that the world was round, and large, and spinning, and why people did not fall off the globe and float out into space. He needed to establish this background if his young audience were to understand the complexities of global timekeeping. So he ran out of time. The conclusion of his lecture had to wait until the 7th of January, 1885.

Lockyer had a lot of ground to cover, and he wasted no time delving into it the next week, with no talk of fairies or elves this time around. He described the way in which astronomers use a transit telescope to measure exactly the length of a day, as a chosen star passes across the instrument. He then pointed out that different countries did the same task in their own observatories, leading to differences in both nautical maps and timekeeping. Lockyer admitted the usefulness of local time, but he argued that "one set of maps ought to do for all the people in the world."[36] Telegraphs too became confusing unless an agreed upon meridian was referenced. In other words, he summed up, "there is use for time beyond the uses of everyday life, and there are uses for longitude besides the

[36] Lockyer, "Universal Time," 186.

absolute necessity of knowing how many miles it is from place to place. These difficulties and others like them have been growing for years, until at length, last year, there was a meeting of wise men at Washington, and I am going to conclude my lectures by referring to the conclusions at which these wise men arrived."[37] Lockyer then lists the major resolutions of the IMC, stating that the new universal day, based on Greenwich, would be counted up to twenty-four hours instead of twelve. "It is that which is going to alter all our clocks and watches," he predicted. "Some people say, 'Oh, this will not come in our time. It is a thing which is all very well for astronomers, people who look at comets and such outlandish things, but we shall not want it.' But I think you will want it, for the reason that it is so very convenient."[38] Telegraph companies, he explained, will want to use it to standardize their practices around the globe, as will the railways with which the telegraphs are "closely associated."[39] Here Lockyer parroted Fleming's refrain that using twenty four hour time would end any confusion between AM and PM. Lockyer then showed his audience various examples and patents of new clock face designs, each of which showed twenty-four hours rather than twelve. He also briefly mentioned that clock bells would continue to strike only twelve, despite the predicted change in clock faces.

In concluding his lecture, Lockyer assured his young listeners that universal time, and its twenty-four-hour notation, will not be meant for astronomers alone, but for everyone. "If the railway companies and the telegraph companies adopt this time, we

[37] Lockyer, "Universal Time," 187.
[38] Lockyer, "Universal Time," 187.
[39] Lockyer, "Universal Time," 188.

shall all of us have to do it."[40] This is the most important part of the lecture: Lockyer, and many like him, assumed that the changes at the IMC would indeed affect civil timekeeping, despite the fact that the IMC specifically indicated that civil time was to be left unchanged by universal time. Like the *Punch* magazine cartoonist, Lockyer was preparing for a revolution in time measurement for all, though Lockyer was optimistic about that change, whereas the newspaper cartoons were hesitant and confused. But in both cases, the IMC had put the notion of changing civil timekeeping back into public discourse.

Not everyone agreed with Lockyer. His opinion, that civil time would have to be adapted to meet universal time, was not the norm among astronomers, as we saw at the IMC. Although his lecture was aimed at children, adult critics took pains to correct him. The *Horological Journal*, a publication circulated among British watch and clock makers, published several critiques of Lockyer's shortcomings. Some were minor. The clockmaking community was quick to make fun of Lockyer's lack of understanding about the intricacies of how a clock works (in particular, Lockyer apparently misguided his young audience as to the sound a watch makes when the balance spring breaks).[41] But one reviewer levelled a more serious complaint against the entire thesis of Lockyer's lecture, that ordinary people would soon have to adopt universal time. The reviewer was Edmund Beckett, a prominent designer who constructed the clock mechanism that controlled 'Big

[40] Lockyer, "Universal Time," 186.
[41] "Jottings," *Horological Journal,* XXVII, No. 318 (February, 1885): 78.; "Twenty-Four O'Clock," *Horological Journal,* XXVII, No. 319 (March, 1885): 90.

Ben' at Westminster.[42] Beckett complained that Lockyer's lecture material was "suitable enough" for juveniles, "but when he got beyond the appropriate elementary information into schemes for futurity, he appears to have…imputed to the astronomers at the Prime Meridian Conference sundry things of which they were not guilty, according to all the authentic reports that have been published. I repeat that they never said one word about an universal civil time."[43] Rightly, Beckett pointed out that there was no intention on the part of most IMC delegates to alter time measurement for the public. Beckett further complained about Lockyer's assertion that telegraph companies were going to change to universal time, and that this is what would force the public to change as well. Beckett saw no foundation for such claims.[44]

While Beckett was absolutely correct in his argument that no change in civil time was intended by astronomers at the IMC, it does not change the fact that a significant population believed that a change to civil time was imminent. Lockyer was not alone in this belief. On the same page as some of the criticisms of Lockyer was an article citing the influx of new patents for twenty-four-hour watch dials.[45] Perhaps the best way to describe the mood is that it was one of uncertainty. No one knew for sure whether civil time would change or not, and this uncertainty sparked a lively debate. The pages of the *Horological Journal* in the months after the IMC were chock-full of arguments from both sides, and hints that people were betting on one side or the other, securing patents for new

[42] L.C. Sanders, "Beckett, Edmund [formerly Edmund Beckett Denison], first Baron Grimthorpe," *Oxford Dictionary of National Biography* (2004). http://www.oxforddnb.com.libaccess.lib.mcmaster.ca/view/10.1093/ref:odnb/9780198614128.001.0001/odnb-9780198614128-e-30665?rskey=C3IWzy&result=2
[43] "Twenty-Four O'Clock," 90.
[44] "Twenty-Four O'Clock," 91.
[45] "Jottings," February, 1885, 78.

watch dials in the hopes of cashing in on any imminent change, if it came about. One contributor was perturbed by this. Watch dial patents were part of a larger debate in the period about patent laws and free trade, and how much should intellectual property be protected. 1884 saw the highest number of English patent applications ever, due to recent changes in the application process.[46] The contributor felt that it was almost too easy now, and "it would be an intolerable interference with trade if every little simple device that would suggest itself to the minds of most men after a few minutes' thought were be allowed to be patented...for instance, several people have applied for a patent to secure the placing of a second hour circle, with numbers from 13 to 24, on watch dials."[47] But the contributor was not against the notion of twenty-four-hour time itself. They were simply opposed to the idea that a few quick-thinking entrepreneurs would dominate the market and reap all the profit from the time reform, because they were the first in the patent office door. The contributor wanted all clock-makers to have an equal shot at implementing universal time into watches and clocks for the public. "Some few horologists," they continued, "speak contemptuously of the proposed universal time as simply a passing craze, but the inconveniences and perplexities arising from the use of local time in foreign communications are so great, and are becoming so increasingly apparent, that the establishment of some such system by civilized countries cannot be far off; and it ill becomes Englishmen to throw cold water on the project," since the IMC's chosen prime meridian lay within Britain.[48]

[46] "Jottings," February, 1885, 78.
[47] "Jottings," February, 1885, 78.
[48] "Jottings," February, 1885, 79.

The *Horological Journal* was full of contributors who, like Fleming, believed that a change to twenty-four-hour universal time was inevitable. They had been following the North American time reform movement closely. The journal had published a description of the adoption of time zones on American railroads in 1883.[49] While the IMC was in session, the *Horological Journal* followed it closely, writing in November 1884 that the IMC had established a universal day, and also showed "indications that the ridiculous custom of dividing the civil day into two periods of twelve hours each…will shortly give place to the more natural method of treating the day as a whole…The change must come, but the public require leading a little."[50] Clockmakers, the author argued, must take the lead, and create new watches that adapt to this new twenty-four-hour system.

These sorts of proposals continued in the December issue as well, where a watchmaker named Thomas Wright discussed the impact of the IMC's resolutions on the clock trade. Wright was unsure whether public timekeeping would change immediately but seemed quite confident that eventually universal twenty-four-hour time would become the norm. In response, he suggested that English clockmakers should begin creating new mechanisms for clock striking.[51] A Swiss reader replied to Wright, offering another method of changing the dial on watch faces to accommodate twenty-four hours.[52] In January, the journal also pondered the question of whether church bells should strike

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[49] "New Standards of Time in the United States," *Horological Journal,* XXVI, No. 304 (December, 1883): 53-54.
[50] "Jottings," *Horological Journal,* XXVII, No. 315 (November, 1884): 39.
[51] Thomas Wright, "Bracebridge's Local and Mean Time Watch," *Horological Journal* Vol. XXVII, No. 316 (December 1884): 45.
[52] E. Storer, "Twenty-Four-Hour Dials," *Horological* Journal Vol. XXVII, No. 317 (January, 1885): 69.

up to twenty-four hours, or other possible ways of signalling the change.[53] A different author noted that clocks striking up to twenty-four in the late evening hours might “occasion a considerable disturbance to nervous or sickly persons.”[54] These annoyances were overcome in Italy, the author went on, where twenty-four-hour time was already in use, by dividing the hours of the day into four parts of six hours each.[55] Such accommodations might be made in England too, the writer suggested. Indeed, the striking of public clocks at night was already a question of debate. In March of 1885, one clock’s chimes in Hastings was silenced between 11PM and 5AM, “on the ground that they are a public nuisance.”[56]

Another contributor, J. Haswell, in the January 1885 issue, summed up the general feeling among the watchmaking community about the whether universal time would be used by the public. Its adoption, he said, was “more or less probable.”[57] Another column agreed, writing that “The determination of astronomers to begin the day at midnight will materially hasten the general adoption of the rational style of reckoning. Officials of the leading railway companies have already been making inquiries with a view to the introduction of the system.”[58]

The vicar of one church in London, St Mary Magdalene’s in Munster square, took the initiative to make the change himself, instead of waiting for it to happen elsewhere. He used twenty-four-hour notation to list the times of the Christmas services, quipping to

[53] “Jottings” *Horological* Journal Vol. XXVII, No. 317 (January, 1885): 66.
[54] “Division of the Day in Southern Italy,” *Horological* Journal Vol. XXXVII No. 318 (February 1885): 75.
[55] “Division of the Day in Southern Italy,” *Horological* Journal Vol. XXXVII No. 318 (February 1885): 75.
[56] “Jottings” *Horological* Journal Vol. XXVII, No. 319 (March, 1885): 87.
[57] J. Haswell, “Twenty-Four-Hour Dials for Watches,” *Horological Journal* Vol. XXVII No. 317 (January, 1885): 63.
[58] “Jottings,” January, 1885, 65.

his apparently frequently-absent congregation that "as a little reflection will be necessary to make them out, you are sure to remember them."[59]

The furor over the imminent time change calmed down a little bit in March of 1885, when the *Horological Journal* finally learned that William Christie, the Astronomer Royal, had acted prematurely by changing the clocks at Greenwich Observatory to match civil time, and that most other astronomers had refused to adopt the change. The resistance to the change was spearheaded in America by Simon Newcomb. The *Horological Journal* reported that Christie was apparently "called to account for his precipitate action in the matter," presumably by the Board of Visitors, who oversaw the Observatory's functions, though the article did not specify.[60] This revelation was followed by an opinion piece by Edmund Beckett, who had previously criticized Lockyer's overenthusiasm about the apparently imminent changes to civil time. Beckett attempted to pour more cold water on the question, writing that in order for the civil day to be changed to match the Universal day, marked by twenty-four-hour time pieces, a new act of parliament would be required.[61] Beckett was right in principle, though not necessarily in practice. For example, most of Britain's cities had been using Greenwich time for about thirty years before it became legal time in 1880. Norms of behaviour concerning time tended to precede legislation, not follow it. The same had the potential to be true in this case: if the use of twenty-four-hour clocks became the norm, it is likely that

[59] "The New Time-o'-Day," *Horological* Journal Vol. XXVII, No. 317 (January, 1885): 70.
[60] "Jottings," March, 1885, 88.
[61] "Jottings," March, 1885, 88.

law would be changed to meet that new norm, whether immediately or down the road. Parliamentary action, then, was not a requirement for reform.

Beckett's editorial, along with the news that Christie had acted out of step with his fellow astronomers, did not deter everyone in the watch and clock making community from thinking that change was imminent. One prominent watchmaking firm, Kendal and Dent, in an attempt to show their "practical belief in the new order of things," offered a 100 pound prize for an essay contest administered by the Balloon Society.[62] The topic of the essay, taking its lead from Lockyer's youth lectures, was "Universal time, or our future Watches and Clocks."[63] The same company had recently put out a design for a watch dial which showed both 12 and 24 hours, in an attempt to win over converts who were confused by the extra hours on the dial.[64]

The *Horological Journal*'s editors, not wanting to wade into the debate too deeply, took a neutral stance on the question of universal twenty-four-hour time, writing "Whichever way the matter may eventuate, the Patent offices will be the richer for the twenty-four-hour proposal."[65] The *Journal* explained that ninety applications had been received by the English patent office on the subject, and that three times as many were submitted in the United States. If a change was to happen, then there would be money to be made. Everyone wanted to "secure the monopoly of what each one believes to be the only true solution to the problem."[66]

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[62] "Jottings," March, 1885, 88.
[63] "Jottings," March, 1885, 88.
[64] "Combined Twelve and Twenty-Four Hour Watch," *Horological Journal* Vol. XXVII, No. 318 (February, 1885): 75-76.
[65] "Jottings," March, 1885, 88.
[66] "Jottings," March, 1885, 88.

These debates over twenty-four-hour time were particularly vitriolic among members of the British watch and clock trade in the 1880s. British firms were afraid of failing in the face of cheaper, mass produced competitors, and of innovations by foreign watchmakers.[67] These economic troubles were part of a global economic depression the began in 1873, the effects of which were in Britain right through until the 1890s. In the clock making trade, careful track was kept of foreign competition from Switzerland and America in particular. In March of 1886, the British Horological Institute and the City and Guilds Institute held a joint meeting in London to consider "the cause of the present depression of the watch trade, and how far it has been brought about by the hallmarking of foreign watch cases."[68] Members of parliament were invited, in the hopes that they could be induced to pass legislation to ease the crisis, whether through free trade or its counterpart, protectionism. The Institutes' blamed an influx of foreign watches, which they claimed were "imitations" of their British counterparts.[69]

But other observers looked closer to home for the cause of the depression in the watch trade. Some suggested that British clockmakers were failing because they refused to modernize. "Times have changed, and the tactics of our grandfathers no longer avail. Those who rely on them may expect a gradual but none the less sure extinction of their trade."[70] In London's Clerkenwell district, where many of the country's best watchmakers worked, the mood was gloomy. One observer wrote that "manufacturers here [in

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[67] David Landes, *Revolutions in Time: Clocks and the Making of the Modern World* (London: Harvard University Press, 1983), 287-90. See also *Horological Journal* Vol. XXVII, No. 318 (February, 1885): 77.
[68] "Depression of the Watch Trade," *Horological Journal* XXVIII, No. 331 (March 1886): 97.
[69] "Depression of the Watch Trade," 97.
[70] *Horological Journal* Vol. XXVII, No. 318 (February, 1885): 77.

Clerkenwell] hesitate to put sufficient capital into their businesses."[71] Their products still used "obsolete" key winders, because Clerkenwell watchmakers refuse to upgrade their production process.[72] Clerkenwell tradesmen, they claimed, were themselves to blame for their own failures. More observant contributors realized that the depression was not localized, pointing out that some American watchmakers were facing similarly dire times.[73]

In either case, the outlook was grim for Britain's clockmakers.[74] They therefore grasped at whatever they could to get an edge, which explains the high number of patents for twenty-four-hour clock dials when the subject came up for discussion after the IMC. The shift towards twenty-four-hour time, should it occur, promised to end the depression. Such a change would rescue the industry, as the entire population of the country retooled their clock faces and watch dials. As a supposed panacea for their economic troubles, watchmakers were understandably entranced by the idea, and the *Horological Journal* continued to publish information on twenty-four-hour clocks and their use.[75]

But the watch industry was not the only one which saw the proposed time reform as an opportunity for economic gain. New publications and tools were developed and printed to help both specialists and ordinary people sift through the confusion over universal time. Some of these were sensationalist in nature, making grandiose claims about solving complex problems. One publication, *Vo Key's Royal Pocket Index Key to Universal Time* proclaimed itself to be "The Greatest Discovery Ever Made on Time:

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[71] *Horological Journal* Vol. XXVII, No. 318 (February, 1885): 77.
[72] *Horological Journal* Vol. XXVII, No. 318 (February, 1885): 77.
[73] *Horological Journal* XXVIII No. 331 (March 1886): 103.
[74] An 1895 editorial declared watchmaking "A Dead Industry." *Horological Journal* (November 1895): 31.
[75] "Automatic 24-Hour Dial," *Horological Journal* XXVII, No. 323 (July 1885): 149.

Universal Time."[76] That 'discovery' was the idea that each watch face could be imagined as a flattened representation of a globe, with the hours marking various meridians. Using this concept, the pamphlet provided tables and charts by which the reader could use their watch to determine the time at any major city worldwide. Vo Key's index was far from the only pamphlet of its type. This sort of attempt to monetize time reform was common. Some were tailored more specifically to certain tasks, such as the *Universal Lamp Time Chart*, which helped the reader determine when to light or extinguish streetlamps or vehicle lights, depending on their longitude and time of year.[77] In some cases, time tables were included within a wider range of reference material. *Martin's Tables, or, One Language in Commerce*, is one such example, where an explanation of standard time was included in a larger reference book explaining the Metric system of weights and measures.[78] Tools of a similar nature were available across the spectrum of utility, from Almanacs to railway timetables. Their publication shows a desire to cash in on the public's misconceptions and confusion surrounding the IMC, universal time and its twenty-four-hour notation, and standard time abroad. But it is harder to discover how well these things were received, or who actually purchased these tools, be it a pamphlet or a twenty-four-hour watch dial. Most of the discussion about universal time for civil use was abstract, a possible future innovation rather than a new norm. The IMC's creation of Universal time based on the Greenwich meridian was never supposed to impact the public, and in large part, it did not. But at the same time, as we have seen, that was not for

[76] *Vo Key's Royal Pocket Index Key to Universal Time upon the Face of Every Watch and Clock* (London: Express Printing Co., 1901?), 8560.A.47, British Library (BL).
[77] *Universal Lamp Time Chart*, 1898, 74.1865.C.18, BL.
[78] *Martin's Tables, or, One Language in Commerce* (London: T Fisher. Unwin, 1906).

lack of trying on the part of entrepreneurial visionaries, futurists, watchmakers, and engineers. So what prevented universal time from reaching a wider audience? And how were these barriers circumvented?

The answer to the first question is largely technological. Distributing accurate Greenwich time to the public before the radio was expensive and difficult. Telegraph lines were the main method of distribution, and these commonly ran parallel to rail lines. If you wanted to know Greenwich time in Britain, then, your best chance would be to check the clock at the local train station. This was the most accessible way to access the correct time by far, which put urban residents at an advantage over rural ones, though, as we saw in a previous chapter, with some money and knowhow, you could purchase your own transit instrument and make your own observations to determine local time, converting it to Greenwich time by referring to an almanac. But this was out of reach of most of the population, both because of its expense and because of the time it required to do. It was unwieldy.

By the 1880s, a time distribution service had existed for several decades via the Post Office, arranged by Astronomer Royal George Airy. This system worked by connecting a master clock at the observatory via wire to a slave clock at the Post Office headquarters. The master clock was corrected several times per day (just before 10AM and 1PM, when the time signals were sent out by the Post Office), using transit observations made by the observatory's staff with a telescope aligned directly along the meridian. The slave clock would thus show the same time as Greenwich time, within a fraction of a second (as close as technology and human error allowed), and the Post

Office would use that to send out a time signal, via telegraph, daily or twice daily, to other offices around the country (an hourly time service was also available, but only within London itself). By sending the time signal immediately after the master clock had been corrected, it ensured the least possible errors in time.[79] Even still, the signal to post offices was done by hand, meaning that, while reasonably reliable, it was not perfect.[80] Also connected to the master clock was Big Ben at Westminster, and a public clock on the outer wall of the observatory in Greenwich Park. Of course, the Observatory's primary purpose was to provide the Admiralty with accurate time signals, and chronometers (accurate, expensive watches) with which to measure that time at sea. For this purpose, a time ball had been constructed on the observatory roof in 1833, which dropped at 1PM precisely each day in full view of ships on the Thames River. The public, if they were in the area, could also use the time ball, but this was a fairly limited audience. In addition, the Observatory held regular competitions with the local clockmakers in Clerkenwell as to whose chronometers kept the best time. These prizes gave prestige to the clockmakers, while ensuring that the best possible timekeepers were supplied to the Navy's ships.[81]

When the Post Office first began exploring the possibilities of revenue from selling the time, there were some revealing discussions about what kinds of customers would buy, and how much to charge. The Engineer in Chief wrote that as "applications for time signals are becoming more frequent every day," the Post Office ought to set a

[79] William Ellis, "Description of the Greenwich Time Signal," *Greenwich Astronomical Observations* (1879): 7, BL.
[80] William Ellis, "Description of the Greenwich Time Signal," *Greenwich Astronomical Observations* (1879): 10-11, BL.
[81] Advertisements of the rating competitions were published in the *Horological Journal*.

regular pricing system, as had previously been done with companies that had ordered private telegrams.[82] He suggested that the price ought to be made prohibitively high, so that only large companies could afford them. Smaller businessmen and "shopkeepers who wish either to save the expense of a transit telescope or simply to advertise themselves" were a pain.[83] They would grumble at every small increase in cost. "We find in practise that these men constantly haggle as to price, and it is this unnecessary haggling or bargaining that appears to me so undesirable for the Post Office."[84] On the other hand, the Chief Engineer did not believe that any significant revenue would be brought in by the time service, and shared the opinion of George Airy that the time should be displayed publicly for free in the window of every major post office, rather than sold, thus avoiding the trouble of all these applications for private time signals altogether. The Engineer concluded that "if the signal were thus exhibited at the post office, those who wish to have the luxury of the private signal at their own houses could not object to pay these charges."[85] The implementation of a free time signal at each post office was not implemented immediately, leaving Greenwich time a luxury for those few who could afford it.[86]

By the 1880s, the demand for the Post Office time signal had grown significantly. Free public times signals did exist in some post offices, but this was not the norm. In Cambridge, for example, large crowds gathered at the post office daily to hear the time

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[82] Engineer in Chief R.S. Culley to Frank Scudamore, November 10, 1870, Time Signals, Post 30.2536, BT Archives (BT).
[83] Engineer in Chief R.S. Culley to Frank Scudamore, November 10, 1870, Time Signals, Post 30.2536, BT.
[84] Engineer in Chief R.S. Culley to Frank Scudamore, November 10, 1870, Time Signals, Post 30.2536, BT.
[85] Engineer in Chief R.S. Culley to Frank Scudamore, November 10, 1870, Time Signals, Post 30.2536, BT.
[86] Frank Scudamore, Response to Engineer in Chief, November 10, 1870, Time Signals, Post 30.2536, BT.

signal called out it was received on the wire. In May 1881, the crowd gathering to hear the time had grown so large that it was a nuisance. As a result, the clerk discontinued the practise, because the crowds were "interfering with the business of the office."[87] One regular visitor, Rev. J. B. Pearson, wrote to the Post Office in May of 1881 to complain about the end of the service. Pearson owned a chronometer for the purposes of his own amateur astronomical observations and was allowed once every two weeks to get it corrected at the Cambridge observatory. However, this was not often enough for it to maintain the correct time, he complained, "on account of the irregularities even a good chronometer is liable to from the variations of temperature."[88] The post office calling out the time thus allowed him to correct it more often.

The Postmaster General, upon inquiring to his staff about Pearson's request to receive the time, was told that Pearson "makes no commercial use of such information, and…makes a liberal use of the telegraphs. Perhaps he might be obliged with what gives us no trouble."[89] Unfortunately for Pearson, the Postmaster General was unwilling to give him special treatment. His priority was not to distribute the time to the public, but rather to eliminating the crowds which had been getting in the way of those who needed to do actual business: paying customers sending telegrams, packages, and letters. Pearson was refused and was told that if he really wanted the correct time, he could pay to rent a wire directly to his home, where he would receive the time signal daily - a hefty expense for an

[87] J.B. Pearson to Post Office Secretary, April 25, 1881, Time Signals, Post 30.2536, BT.
[88] J.B. Pearson to Post Office Secretary, April 25, 1881, Time Signals, Post 30.2536, BT.
[89] Postmaster General to J.H. T[illeg.] Postmaster Cambridge, April 29, 1881, Time Signals, Post 30.2536, BT.

individual.[90] It was also suggested that the university might pay this fee for him to have the time sent to a university building, costing 14 pounds a year if the building was within half a mile of the post office (the price varied somewhat depending on the distance).[91]

Rev. Pearson was not ready to pay for the time signal himself, nor was he able to convince anyone at the university to pay it: both the Philosophical Society, of which he was the Treasurer, and the Cavendish Laboratory, turned him down.[92] But he was not ready to give up so easily. In July, he wrote back to the Post Office reframing his proposition in the language of public good. Once a week the time should be called out to the public, as had been done before, but be done across the country in every post office as a regular service for anyone. Pearson's proposal, of course, failed to answer the Postmaster General's concern that the crowds would get in the way of people trying to send letters or telegrams. But Pearson believed access to Greenwich time was a public service worth providing. "I think that this, if generally done, not only here, but in places where there are first class watchmakers…would be of much service."[93] Pearson went on to explain that even though many post offices had public clocks outside their buildings, set to Greenwich time, these seldom had "second-fingers," leaving a want of accuracy for astronomers and watchmakers.[94] Time accurate to the minute might be good enough for most of the public, but a weekly announcement of the time would be useful to those who required more precision.

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[90] Postmaster General Instructions on J.B. Pearson Request, May 7, 1881, Time Signals, Post 30.2536, BT.; Post Office to J.B. Pearson, May 12, 1881, Time Signals, Post 30.2536, BT.
[91] Post Office to J.B. Pearson, May 12, 1881, Time Signals, Post 30.2536, BT.
[92] J.B. Pearson to H. Fawcett, Postmaster General, July 28, 1881, Time Signals, Post 30.2536, BT.
[93] J.B. Pearson to H. Fawcett, Postmaster General, July 28, 1881, Time Signals, Post 30.2536, BT.
[94] J.B. Pearson to H. Fawcett, Postmaster General, July 28, 1881, Time Signals, Post 30.2536, BT.

What Pearson failed to understand is that to civil servants like the Astronomer Royal and the Postmaster General, access to accurate Greenwich time was not a public right. Universal time as directed by the IMC was for use by professional astronomers, railwaymen, and telegraphers, and navigators, not for ordinary civilians. Anyone outside those categories was not entitled to receive it without a fee. Time, at least, authoritative, scientific time, was a privilege.

The Postmaster General explained to Pearson that even if the time was only called out one day a week, the trouble with the crowds would "be still experienced on that one day, and experienced probably to an intensified degree. Not only so, but the Department would soon have to forego the revenue which it derives from Watchmakers who now pay annually for a current sent direct from Greenwich; and I cannot see my way to recommend that this revenue should be given up."[95] The letter went on to explain that the Post Office signal was done by hand, and was therefore less accurate than the signal which could be purchased, which arrived direct from Greenwich observatory itself by wire.[96] Pearson at last conceded the point, writing that if he was in future to carry out any astronomical observations that required such precision, he would pay the fee for the private time signal. At the moment, however, "the extra accuracy secured would hardly be equivalent to the expense."[97]

Pearson was not the only one complaining about the restriction of public access to Greenwich time via the post office in Cambridge. Horace Darwin, son of Charles Darwin,

[95] H. Fawcett to J.B. Pearson, August 2, 1881, Time Signals, Post 30.2536, BT.
[96] H. Fawcett to J.B. Pearson, August 2, 1881, Time Signals, Post 30.2536, BT.
[97] J.B. Pearson to H. Fawcett, August 11, 1881, Time Signals, Post 30.2535, BT.

owned a company in Cambridge that manufactured scientific instruments. The younger Darwin, like Pearson, had relied on the time being called out at the post office to set his instruments, before the practice was discontinued. He wrote at the end of 1881 to suggest an electric solution to the problem, namely, a "simple needle galvanometer" could be placed outside every post office, and that the 10 O'clock time signal be passed through it each day, in full view of the public.[98] Darwin reasoned that the time signal sent out each day across the nation, with its thousands of miles of cable, and the time wasted by clerks to pass it on, must be "of considerable expense to the country," and yet so few people had access to it.[99] Installing public signals would make the expense worth the cost. Darwin's need for Greenwich time was self-serving, but like Pearson, he framed it in terms of civic utility. The Post Office was unreceptive. It could not supply every city and town with this service because of the cost. Nor could they supply Cambridge with this special access, because then all towns across the country would want it. Like Pearson, Darwin was told that if he wished, he could pay the fee, like everyone else, to have the time signal sent directly to his home or business.

Internally, the Postmaster General did consider Darwin's idea, asking his Engineer-In-Chief to estimate the cost of implementing these electric signals in the major towns across Britain.[100] The estimate came in at £7410 for initial installation, and then £1065 each year for maintenance.[101] At that moment in 1882, the Post Office was making approximately £1400 a year from renters buying private or corporate time signals.

[98] H. Darwin to H. Fawcett, December 31, 1881, Time Signals, Post 30.2536, BT.
[99] H. Darwin to H. Fawcett, December 31, 1881, Time Signals, Post 30.2536, BT.
[100] H. Fawcett, Note Concerning Reply to H. Darwin, January 12, 1882, Time Signals, Post 30.2536, BT.
[101] Edward Graves, Engineer in Chief, to H. Fawcett, February 10, 1882, Time Signals, Post 30.2536, BT.

Providing a free time service would probably mean losing most of those paying customers, as well as incurring an additional £1065 in yearly expenses for maintenance.[102] It was not a smart business decision.

These requests from Darwin and Pearson show that there was a demand for an accurate public time service. There were enough people in Cambridge who wanted access to Greenwich time that they clogged the post office each day. It is impossible to say if this demand was just as fervent elsewhere, but at the very least there was a heavy demand for public time signals in areas that housed heavy concentrations of scientific professionals, like the university town of Cambridge, or places with a significant clockmaking trade, such as the Clerkenwell district of London, or the town of Coventry in Warwickshire. Like modern day academic publishing, Greenwich time as a scientific tool was available, but for a price. Behind a hefty paywall, the audience who could afford the correct time was relatively small. There was now a hierarchy of times. Accurate universal time, restricted by cost, was available to only a few. Greenwich time that was available for free was only accurate to the minute, unless you happened to live or work close enough to a see a time ball, a time gun (like the one set up by Charles Piazzi Smyth in Edinburgh) or hear the chimes of Westminster Palace. The implementation of the time service was following the prescriptions of the IMC: universal time was for specialists; civil time was not to be updated to match the new standard.

Astronomer Royal William Christie, the ultimate authoritative source for Greenwich time, believed that this was exactly as it should be. The public time service

[102] Submits Report of Engineer in Chief on cost of time signals to Postmaster General, February 21, 1882, Time Signals, Post 30.2536, BT.

was, to him, a luxury, and a distraction from the real work of the observatory. In the summer of 1888, the debate over whether Greenwich time was an essential public service or a disposable luxury came to the fore in what was essentially a labour dispute.

The work done at the observatory had been increasing in recent years, while the number of staff to carry out that work had not increased to match.[103] When Christie asked the Admiralty Board for the money to hire new staff, his request was denied, and he was told to put his house in order (financially).[104] In response, Christie threatened to cut any and all "extraneous work, such as the supply of time-signals."[105] "It appears to me," Christie wrote, "that a condition of [the time-signal's] maintenance must be that arrangements shall be made to enable the proper work of the observatory to be carried on and suitable developed."[106] In other words, Christie was holding Greenwich time hostage until the Admiralty found room in their budget to pay for more observatory personnel.

The Postmaster General, Henry Cecil Raikes, was not immediately made aware of Christie's threat, and it is fairly clear, given the evidence, that Christie's goal was not actually to destroy the Post Office's time service, but rather to use it as leverage to increase his budget. It was a bluff. In the meantime, while waiting to see if his game would pay off, Christie tried to find other ways to cut costs. The previous year, he had asked the Post Office to take over the maintenance of the wires connecting Greenwich to the Post Office, which were old and in need of repair, work which would cost around

[103] See William Christie, *Report of the Astronomer Royal to the Board of Visitors of the Royal Observatory*, June 2, 1882, 20, RGO17.1.4, Royal Greenwich Observatory Archives, CUL.
[104] William Christie to William Preece, July 9, 1888, RGO7.254 Royal Greenwich Observatory Archives, CUL.
[105] Christie, *Report*, 1888, 20.
[106] Christie, *Report*, 1888, 20.

£150.[107] That request had gone unanswered, but in the spring of 1888, it was brought to the fore again. It was a fairly reasonable request. After all, unlike in America, where observatories made income from their time service, in Britain all revenue from the time service went to the Post Office, not the observatory. As such, it made sense for the Post Office to take on the cost of maintaining the wires. The Treasury agreed, and all parties seemed happy. That was when Postmaster General Raikes learned of Christie's threat to end the time service. He was baffled.

William Preece, the Post Office engineer who was about to carry out the repairs to the wire as agreed, wrote to Christie in confusion. "The PMG [Postmaster General] has been frightened by your [decision]…, and won't allow me to proceed with the work as long as the supply of time signals is in question…what is to be done?"[108] Christie responded that he was waiting on a decision from the Treasury: the ball was in their court.[109]

What followed was an interesting display of politicking and subterfuge. Preece, ostensibly merely an engineer, became the unofficial messenger between the Astronomer Royal and the Postmaster General. On June 9th, Christie wrote a private note to Preece, explaining the reasons why the time service had to be cut, blaming the admiralty for not providing adequate funding to the time service staff at the observatory. Christie also somewhat eased his threat, suggesting to cut London's hourly time signals and the

[107] William Christie to the Secretary of the Admiralty, June 27, 1887, Greenwich Observatory, Post 30.523C, BT.
[108] William Preece to William Christie, June 13, 1888, RGO7.254, Royal Greenwich Observatory Archives, CUL.
[109] William Christie to William Preece, June 20, 1888, Greenwich Observatory, Post 30.523C, BT.

national 10AM signal, but that the 1PM signal would remain in use for everyone.[110] The next day, Preece asked Christie for permission to show the private letter to Raikes, with the intention that it might convince him to put pressure on the Admiralty to pay up.[111] In other words, this was no longer an attack on the Post Office by the Observatory; both branches of the civil service were teaming up to pressure the Admiralty Board and the Treasury. Upon seeing Preece's note, Raikes, relieved that Christie's intention was really to challenge the Admiralty and not to ruin the Post Office, acceded to help in the scheme. He asked for an official copy of Christie's complaints to use in his own letter to the Admiralty. Christie, pleased to have Raikes as an ally in his struggle, wrote up an official government memo for Raikes, repeating the complaints he had previously shared with Preece privately.[112]

Raikes performed his role marvellously, acting as if he was shocked by Christie's actions. To some extent it is likely Raikes' frustration was real. They were uneasy allies. But at the same time, Raikes' aim was to secure the future of the Post Office's time service, and the best way to do that was to help Christie acquire adequate funding from the Treasury. So Raikes wrote to the Secretary of the Admiralty in protest. "I think it is imperative to call the attention of the Secretary at once to the serious nature of the proposal of the Astronomer Royal."[113] Raikes continued that if they could not get the time

[110] William Christie to William Preece, July 9, 1888, RGO7.254, Royal Greenwich Observatory Archives, CUL.
[111] William Preece to William Christie, July 10, 1888, RGO7.254, Royal Greenwich Observatory Archives, CUL.
[112] William Christie to Henry Cecil Raikes, July 12, 1888, RGO7.254, Royal Greenwich Observatory Archives, CUL.; A copy can also be found in: Greenwich Observatory, Post 30.523C, BT.
[113] Henry Cecil Raikes to the Secretary of the Admiralty, July 10, 1888, Greenwich Observatory, Post 30.523C, BT.

from Greenwich, they would have to get it from the next closest observatory, Kew. But that seemed absurd. “For what purpose was Greenwich observatory established, if it was not for the production of accurate time for national and imperial objects, and what object is of more consequence to the Government than the distribution of accurate time throughout the three kingdoms to every post office and railway station! It appears to me that if the Astronomer Royal has failed to convince the Treasury of the need for more assistance, or more financial support he should knock off some other work of less national consequence than the proper distribution of time.”[114] Raikes ended the letter by expressing the hope that the Admiralty would pressure the Treasury to give Christie what he wanted.

After hearing no response, Raikes wrote to the Admiralty again in late July. He began with a history of the time service. The Electric and International Telegraph Company, formed in 1846, had commenced it under George Airy, in agreement with the South Eastern Railway Company, decades ago. When the Post Office later acquired the sole rights to telegraphs, they inherited the Electric and International Telegraph Company’s time service contracts. Repeating his earlier letter, Raikes then explained the vital importance of the time service both to shipping and civil timekeeping, in hopes that they would ensure its continuance.[115] He also explained that should the 10AM signal be cut, the immediate result would be a chorus of complaints from customers having to switch to the 1PM signal, as it was far more expensive, at £27 per year (telegraph lines

[114] Henry Cecil Raikes to the Secretary of the Admiralty, July 10, 1888, Greenwich Observatory, Post 30.523C, BT.

[115] Henry Cecil Raikes to the Secretary of the Admiralty, July 23, 1888 [See also Post Office Memo, CABP to Raikes, July 19, 1888], Greenwich Observatory, Post 30.523C, BT.

were less busy at 10AM, whereas 1PM was peak time, making the opportunity cost of running the 1PM signal higher. The Post Office built that cost into the higher 1PM price). Raikes' letter concluded with a reference to Greenwich's growing symbolic role after the IMC. As one of his aides put it: "Of all the arguments which can be adduced for the maintenance of Greenwich observatory, I cannot help thinking that the one which appeals most directly to the popular mind is that the correct time of day is there ascertained and made known."[116]

Raikes again got no response, but it had the desired effect. The Admiralty's attention was drawn to the time signal's importance. They wrote to Christie in early August demanding an explanation. Why, they asked, are you going to "discontinue a service that was established by your predecessor in the interests of the Public, and especially of the Shipping interests of England, and has been continued for so long a period. Their lordships…will be very unwilling to sanction the abridgement of a system that is so eminently calculated to improve navigation, and by means of which the chronometers of Her Majesty's Ships are now principally rated [Raikes had pointed out that watchmakers who made chronometers for the navy used the time signals to set their instruments]."[117] Christie offered up a lengthy reply. He began by reaffirming that he would feel perfectly happy to continue the time service, if the Treasury would only supply the proper funds required. Christie then suggested that the 1PM signal would suffice for the shipping interests of Britain. Time balls, time guns, and chronometer rating

[116] Post Office Memo, CABP to Henry Cecil Raikes, July 19, 1888, Greenwich Observatory, Post 30.523C, BT.
[117] Lords Commissioners of the Admiralty to William Christie, August 7, 1888, RGO7.254, Royal Greenwich Observatory Archives, CUL.

could be done just as well at 1PM as at 10AM, despite what the Post Office said. "This appears to be a question of Post Office revenue rather than of the interests of the public."[118]

Though Raikes and Christie were collaborating to pressure the Treasury to pay up, it was an uneasy alliance, and neither hesitated to attack the other if it served the cause. In mid-September, Raikes, still waiting for a response from the Admiralty, wrote again to point out that the time signal had failed several times in recent weeks. The line and apparatus was in dire need of repair, and the Post Office had already agreed months ago to take on the cost of fixing it. But they would not do so while the future of the time service itself remained in question.[119] This backfired. At long last, on October 1st, the Admiralty had had enough. They sent two letters. The first was to Raikes, telling him that time service would continue, no matter what Christie said, so he should go ahead and fix the apparatus.[120] The second was to Christie, telling him they would not allow the signal to be stopped. "The issue of such a signal from the Royal observatory is a duty in direct correlation with the objects for which the observatory was established."[121] They went on to reject Christie's financial claims, pointing out that both they and the Post Office were

[118] William Christie to the Secretary of the Admiralty, August 11, 1888, RGO7.254, Royal Greenwich Observatory Archives, CUL.
[119] Henry Cecil Raikes to the Secretary of the Admiralty, September 11, 1888, Greenwich Observatory, Post 30.523C, BT.
[120] Evan Macgregor to Henry Cecil Raikes, October 1, 1888, Greenwich Observatory, Post 30.523C, BT.
[121] Lords Commissioners of the Admiralty to William Christie, October 1, 1888, RGO7.254, Royal Greenwich Observatory Archives, CUL.

making arrangements to improve the timekeeping apparatus, and hoped that these improvements would reduce the labour connected with the time service.[122]

An aggrieved Christie, unwilling to give up, responded on October 12th. The letter went into detail about the workings of the apparatus, taking care to point out how much work it was to operate the 10AM signal. "The Mean Solar Clock which is used for sending out the time signals is necessarily a complicated and delicate piece of mechanism and requires to be corrected by means of astronomical observations immediately before an accurate signal is sent."[123] It was corrected just before 10AM and 1PM daily (except Sunday, when only the 1PM got a correction). Christie went into a lengthy description of how the complicated corrections were made, comparing the clock to observations made with the transit instrument the night before. He pointed out how skilled one had to be to make the corrections without mistakes in such a hurry between 9AM and 10AM. Correcting the clock itself (which was only one part of the process) could take from ten to twenty minutes, and the chance of making a mistake was high.[124] Christie then explained that the 1PM signal was more accurate, because they had more time to ensure no mistakes were made, or to compare to other clocks in the observatory in the event of cloudy weather. Christie then argued that almost all naval time signals around the country used 1PM, as it was more accurate. In summation Christie made two things clear: first, that "the 1PM signal is the only one which it is admirable to use for navigation or other

[122] Lords Commissioners of the Admiralty to William Christie, October 1, 1888, RGO7.254, Royal Greenwich Observatory Archives, CUL.
[123] William Christie to the Secretary of the Admiralty, October 12, 1888, RGO7.254, Royal Greenwich Observatory Archives, CUL.
[124] William Christie to the Secretary of the Admiralty, October 12, 1888, RGO7.254, Royal Greenwich Observatory Archives, CUL.

purposes where the greater accuracy and certainty are required."[125] Second, "the 10AM signal is a subsidiary signal liable to error on weekdays and not available on Sundays. It is doubtless convenient for the commercial distribution of time by the Post office, but it is unsuitable for purposes of navigation or for the rating of chronometers."[126] Therefore, he concluded, only the 1PM signal fell within "the objects for which the observatory was established."[127]

The Admiralty was not happy with his insubordination. They replied on December 1st, writing that instead of discontinuing the 10AM signal, attempts should be made to improve it.[128] They also corrected Christie's assertion that most naval time signals used the 1PM signal. In actual fact, most time signals around the country, though they fired at 1PM, were set using the 10AM signal. Most chronometer makers also relied on the 10AM signal, because the cost was less expensive. Given this, the poor quality of the 10AM signal was of real concern. "My Lords regret that you are obliged to speak in regard to the accuracy of the 10AM signal in such a disparaging tone…their Lordships would certainly be glad to hear that this Signal could be made more trustworthy."[129] They wanted to improve it without adding to the labour of the staff, asking if a new, separate clock might suffice.

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125 William Christie to the Secretary of the Admiralty, October 12, 1888, RGO7.254, Royal Greenwich Observatory Archives, CUL.
126 William Christie to the Secretary of the Admiralty, October 12, 1888, RGO7.254, Royal Greenwich Observatory Archives, CUL.
127 William Christie to the Secretary of the Admiralty, October 12, 1888, RGO7.254, Royal Greenwich Observatory Archives, CUL.
128 Lords Commissioners of the Admiralty to William Christie, December 1, 1888, RGO7.254, Royal Greenwich Observatory Archives, CUL.
129 Lords Commissioners of the Admiralty to William Christie, December 1, 1888, RGO7.254, Royal Greenwich Observatory Archives, CUL.

There the correspondence ends, the whole affair having lasted eight months, from May to December 1888. It is unclear if any new equipment was purchased, and Christie appears to have lost his case for new staff, at least in the short term. However, in the long run he achieved his goal. In his report for 1889, Christie wrote that the workload continued to increase on all his staff. New computers had been hired, but not enough supervisory staff.[130] In 1891, Christie seems to have gotten his wish for more staff, though its implementation was slow. He reported that "the promised addition to the staff, which should strengthen the supervising power, has as yet resulted only in the appointment of another Second-class Assistant."[131] The next year, in 1892, even more were hired.[132]

The time signal crisis of 1888, although ostensibly a simple labour dispute, brought to the fore questions about the nature of the Greenwich time service. Christie, like the delegates he picked to go to the IMC, Adams and Evans, felt that Greenwich time (in its most accurate form, under the guise of the Universal day) was a tool for the use of navigation and astronomy alone. Watchmakers might use it too, but only because the best of them also made chronometers for the Navy. So when Christie threatened to end the time service, he meant it as a direct attack on the Admiralty. What he did not count on was that the Post Office relied on Greenwich time just as heavily as the Navy. The Post

[130] William Christie, *Report of the Astronomer Royal to the Board of Visitors of the Royal Observatory,* June 1, 1889, 21-22, RGO17.1.4, Royal Greenwich Observatory Archives, CUL. It is likely that this lack of funds is what led Christie to hire educated female computers, including Annie Russell, who were older and more reliable than the boy computers, but could be paid much less than the full time male staff.
[131] William Christie, *Report of the Astronomer Royal to the Board of Visitors of the Royal Observatory,* June 6, 1891, 19, RGO17.1.4, Royal Greenwich Observatory Archives, CUL.
[132] William Christie, *Report of the Astronomer Royal to the Board of Visitors of the Royal Observatory,* June 4, 1892, 23, RGO17.1.4, Royal Greenwich Observatory Archives, CUL.

Office made use of the time internally to keep its telegraphy service in order. But it also secured revenue from selling the time to whomever was willing to pay for it. Though the market for accurate universal time was small and specialized, it was larger than Christie imagined, and it was growing.

Of course, this still meant that there was a hierarchy of times: only the wealthy would be able and willing to pay to keep their clocks ticking on time to such an exact degree. Yet there was enough of a private market, beyond just astronomers and clockmakers, for entrepreneurs to invest in the business of selling time. New companies began to spring up selling Greenwich time. Of course, these companies could not sell the time signal directly. The Post Office had a near monopoly on access to the time signal direct from Greenwich. Furthermore, those who rented the time from the Post Office had to sign an agreement which stipulated that "No Electric Time Current or Signal communicated under the terms of this agreement to the said apparatus for the purpose of recording or showing the true Greenwich Mean Time shall be made use of by the said Renter except for his own business or private affairs."[133] In other words, the renter could buy Greenwich time for their personal use, but they could not then sell that time to anyone else, at least not without "the written licence or consent either special or general of the Postmaster General."[134]

But private firms did exist that found themselves interested in selling the time, and made agreements with the Post Office allowing them to do so. One of the first of these

[133] Post Office Telegraphs Articles of Agreement, March 31, 1884, Synchronisation Etc. of Clocks by Electric Current, Post 30.531, BT.
[134] Post Office Telegraphs Articles of Agreement, March 31, 1884, Synchronisation Etc. of Clocks by Electric Current, Post 30.531, BT.

was Barraud and Lund, a company involved in clockmaking that, in the 1870s, organized a service which synchronized clocks to Greenwich time.[135] Technically, this was not the same as the telegraphic time signal. Instead, it consisted of a master clock at the company's headquarters, which was kept on the correct time by using the Post Office signal. This master clock, by way of electric currents, would hourly correct any clocks connected to it by wire. Customers could thus purchase one of these special clocks, and have it connected to the master clock.

In 1882, Barraud and Lund was broken up, and the clock synchronizing part of the company reformed into the Standard Time and Telephone Company (later simply the Standard Time Company, or STC). This new company had Barraud and Lund's rights to use the Post Office time signal to sell their synchronized clocks transferred over to them.[136] The STC developed their own base of customers. They were able to sell the time much cheaper than the Post Office, costing renters about £4 per year, but of course the renter also had to pay for a special clock up front as well. The STC had to be careful not to step on the Post Office's toes. In 1888, the Post Office was in the process of getting lawyer opinions as to whether the STC's business model was even legal. Under the 1869 Telegraph Act, the Post Office had a monopoly on the sending of messages via telegraph. However, the lawyers ruled in favour of the STC, stating that the clock's electric current did not count as a message. Other more traditional clockmaking companies offered to tune, wind and correct their customer's clocks and the STC was essentially doing the

[135] David Rooney, *Ruth Belville: The Greenwich Time Lady* (London: National Maritime Museum, 2008), 62.
[136] See Synchronisation Etc. of Clocks by Electric Current, Post 30.531, BT.

same thing. It did not matter whether the tuning was done by hand or by wire.[137] Indeed, one lawyer suggested that the master and slave clocks could be considered two parts of the same machine. In which case, no 'message' of any kind was being sent.[138] The Post Office let the matter drop, and the STC kept selling its synchronized clocks.

They were not the only ones. Similar companies popped up through the 1880s and into the 1910s, trying to cash in on the growing demand for accurate, authoritative, time. Some of these companies claimed Greenwich's newfound authority for their own, such as the firm which unsubtly named itself Greenwich Time Ltd.[139] Other companies, instead of hitching their wagons to Greenwich directly, instead attempted to emphasize their progressive modernity, choosing suitably futuristic sounding names like the Magneta Company, Synchronome, and Remelec.[140] All of these companies took pains to appeal to their customer's desire to appear modern and up to date. The Magneta Company, for example, relied on expert testimonials and technical jargon to sell their synchronized clocks, including a recommendation from William Preece, the Post Office engineer.[141] Others appealed to the ideals of modernity and progress more directly. As one Synchronome pamphlet put it, "The nineteenth century with all the wonders it has

[137] Question of Infringement of Postmaster General's Rights, Counsel's Opinion and Opinion of the Law Officers of the Crown, 1888, Synchronisation Etc. of Clocks by Electric Current, Post 30.531, BT.
[138] Question of Infringement of Postmaster General's Rights, Counsel's Opinion and Opinion of the Law Officers of the Crown, 1888, Synchronisation Etc. of Clocks by Electric Current, Post 30.531, BT.
[139] Greenwich Time Company Advertisement, 1911, Synchronisation Etc. of Clocks by Electric Current, Post 30.531, BT.
[140] See Silvanus Philips Thompson Collection, SPT/65, Institute of Engineering and Technology Archives (IET).
[141] Magneta Company Advertisement, 1906, Silvanus Philips Thompson Collection, SPT/65, IET.

wrought has one scientific disgrace. We still depend for time-keeping upon clocks which require weekly winding and all of which unblushingly tell a different lie."[142]

But Synchronome had the answer. Their electric clocks were supposedly "indispensable in: institutions, hotels, banks, offices, &c., factories, and everywhere where loss of minutes means loss of pounds to the employer, and of great value in every household. In schools, a special instrument is added for the control of bells which are automatically rung in the class-rooms at pre-arranged times."[143] In a similar vein, an advertisement for the Greenwich Time Ltd. proclaimed that "a cure for unpunctuality, and the host of other tragedies that are supposed to follow the possession of inaccurate timepieces, has been discovered at last."[144] Later in the pamphlet, the company connects their time service to utilities, writing that "it is now possible to have a service of Greenwich time laid on in the home like gas or electric light."[145] This attempt at normalizing the time service as a basic utility service was part of a broader attempt by these companies to broaden the customer base: where the Post Office had sold time mainly just to clockmakers and amateur astronomers, these companies targeted offices, public buildings, banks, schools, factories, and even the homes of the wealthy.

The Magneta Company got some free advertising from appearing in a piece titled "the Romance of a Daily Newspaper" about the *Daily Mirror*, a 'lady's penny' which had survived low circulation early in its life to become a booming success later on. The

[142] Synchronome Company Advertisement, Undated, Silvanus Philips Thompson Collection, SPT/65, IET.
[143] Synchronome Company Advertisement, Undated, Silvanus Philips Thompson Collection, SPT/65, IET.
[144] Greenwich Time Company Advertisement, 1911, Synchronisation Etc. of Clocks by Electric Current, Post 30.531, BT.
[145] Greenwich Time Company Advertisement, 1911, Synchronisation Etc. of Clocks by Electric Current, Post 30.531, BT.

Mirror's offices featured Magneta's synchronized clocks, helping to keep the presses running on time.[146] Magneta clocks serviced several other newspapers, as well as hospitals, the Royal Mint, various postal buildings, and the Ritz and Savoy hotels.[147]

Synchronome pitched its advertisements to companies running steamers and large ocean liners, as well as a specialized timer for "racecourses, motor tracks, and athletic clubs."[148] Of course, who they advertised to is different from who actually purchased these clocks. Actual customer lists include private homes, colleges, breweries (including Guinness), naval barracks, industrial firms, factories, insurance company offices, telephone companies, and city councils.[149]

The expansion of the customer base beyond clockmakers and astronomers is reflected in the advertisements of these companies. One unique Synchronome advertisement, for example, targeted the homes of wealthy individuals. Taking the form of a picture-book modelled on the children's nursery rhyme 'The House that Jack Built,' the ad tells the story of 'Jack,' a house owner who synchronizes the clocks in his home and reaps various benefits from the decision, such as a newfound punctuality. The caption under a photo of men rushing for a train leaving a station quips that, "This is the train Jack caught in the morn/and left his neighbours all forlorn/cursing the day that they were born/as they thought of their key-wound clocks with scorn/compared with the time that's

[146] *Advertising News*, June 2, 1905, Silvanus Philips Thompson Collection, SPT/65, IET.
[147] Magneta Company Advertisement, 1906, Silvanus Philips Thompson Collection, SPT/65, IET.; Some Recent Installations, Silvanus Philips Thompson Collection, SPT/65, IET.
[148] Electric Time Service, Synchronome Company Advertisement, Undated, Silvanus Philips Thompson Collection, SPT/65, IET.
[149] Electric Time Service, Synchronome Company Advertisement, Undated, Silvanus Philips Thompson Collection, SPT/65, IET.; Some Extensive Premises in Which Synchronome Time-Services are Established, Undated, Silvanus Philips Thompson Collection, SPT/65, IET.

uniform/all over the house that Jack built."[150] Another line of the poem establishes that the new house clocks regularly "woke Jack's slavey up at dawn," slavey being derogatory slang for a female domestic servant.[151] This inclusion references the ubiquity of domestic servitude in Victorian and Edwardian Britain. More importantly, it establishes that, on the one hand, only upper class customers could afford these clocks, but on the other hand it is a good reminder that working class Britons, though not paying customers, were nonetheless exposed to the new synchronized Greenwich time in places of employment.

Like other ads, The House that Jack Built also emphasized Synchronome's modernity, spending time describing the pioneering inventor of the system and the mechanisms that run it, as well as assuaging fears about the dangers of electricity in the home, pointing out that the clock batteries were "hardly sufficient to kill a fly."[152] The final stanzas shake their metaphorical fists at the backwardness of inaccurate clocks (in fact, the accompanying image is of 'Father Time' shaking his fists at mismatched clocks). "These are the clocks at sixes and sevens/which cost so much and lie – oh heavens!/that have to be wound and are never right/so should not be found in anyone's sight/no wonder that Jack has put them in pawn/and gone in for time that's uniform/all over the house that Jack built."[153] The ad was reaching out to new customers by playing up the anger and confusion over timekeeping that was so evident in contemporary newspapers.

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[150] The House that Jack Built, Synchronome Company Advertisement, Undated, Silvanus Philips Thompson Collection, SPT/65, IET.
[151] The House that Jack Built, Synchronome Company Advertisement, Undated, Silvanus Philips Thompson Collection, SPT/65, IET.
[152] The House that Jack Built, Synchronome Company Advertisement, Undated, Silvanus Philips Thompson Collection, SPT/65, IET.
[153] The House that Jack Built, Synchronome Company Advertisement, Undated, Silvanus Philips Thompson Collection, SPT/65, IET.

In some cases, government legislation created new customers for Greenwich time. For example, the Licensing Act of 1872 limited the time of day it was legal to sell alcohol, making pub owners into customers of the time sellers. One such pub was the Crown Tavern in London, which purchased the time from the STC in 1884, for a short period at least.[154] Legislation concerning the well being of factory workers also spurred industries to adopt Greenwich time. In one case, the Oldham Master Cotton Spinners' Association requested permission from the Post Office to distribute the time to its members (factory owners). They wanted, in essence, to "do for their members what the Greenwich Time Ltd. offer in London."[155] This was more than simply requesting to have the time delivered to them. They wanted to become a time distributing centre themselves, specifically for the Cotton Spinning Industry. The reason for this request had to do with avoiding punitive measures from government inspectors for making their workers work overtime. "For many years complaints have been made by our members, in regard to prosecutions by the Factory Inspector for alleged overtime, that the clocks by which the Factory time is regulated vary very much and that in consequence they are on occasion the victims of injustice."[156]

The Post Office rejected the Association's request. Allowing it to distribute the time to members would mean creating a competing time service, taking business away from the Post Office itself. The Post Office suggested instead that individual factories

[154] Standard Time Company to the General Post Office, May 2, 1884, Synchronisation Etc. of Clocks by Electric Current, Post 30.531, BT.
[155] District Manager of Telephones, S.E. Lanc, to Post Office Secretary, July 15, 1914, Synchronisation Etc. of Clocks by Electric Current, Post 30.531, BT.
[156] Secretary of the Oldham Master Cotton Spinners' Association to the District Manager of Telephones, S.E. Lanc, December 4, 1913, Synchronisation Etc. of Clocks by Electric Current, Post 30.531, BT.

could purchase the time direct from the Post Office if they wished. Besides, the Greenwich Time Ltd. and the STC only operated within London and existed before the Post Office had begun its own time distribution scheme. Allowing these two companies to compete with the Post Office was one thing, creating new competitors outside London like the Cotton Spinners' Association was another.[157]

One final customer base that the Post Office and private companies like the STC, Greenwich Time Ltd., and Synchronome were vying for was the owners of public clocks. Clocks visible from the street were common outside businesses, government buildings, and churches, but there was no guarantee that these clocks were accurate. As a Post Office memo put it in 1913, "There is no doubt a public need for synchronization of clocks – especially those in the streets. It is obvious from the public clocks along Fleet Street and the Strand that some more efficient means of regulating them is desirable."[158] An extract from the *Daily Express* around the same time wrote "There will be no defence in near future for anyone who has charge of a public or office clock which fails to keep time," because the Post Office was planning on offering lower rates for their service.[159] The British Science Guild, in 1908, was also unhappy that there was "no general system by which the public is provided with the means of getting exact standard time…The Committee are strongly of opinion and think it highly desirable and important that arrangements should be made so that a number of public clocks in different districts of London and other large towns and perhaps the clock at a telegraph office is smaller towns

[157] Post Office Secretary to District Manager of Telephones, S.E. Lanc, 25 July 1914, Synchronisation Etc. of Clocks by Electric Current, Post 30.531, BT.
[158] Post Office Memo for the Postmaster General, January 4, 1913, Synchronisation of Clocks, Post 30.2042B, BT.
[159] *Daily Express*, April 26, 1913.

and villages should at certain hours be automatically corrected to agree with the true standard or Greenwich mean time."[160] Clockmakers, too, complained of public clocks being left to falter. One clockmaker, worried about his reputation, wrote to the *Horological Journal* that owners of public clocks had a duty to "keep the clock regularly wound and in good repair, so that the clockmaker's reputation should not suffer."[161] Apparently the author had noticed one public rail station clock which was always wrong, and was worried that the clockmaker would be blamed for its failure, rather than the true culprit, the inattentive owner. Complaints of this nature were widespread in the early 1900s, and some synchronization companies began pushing for legislation that would make it illegal for a public clock to show the incorrect time. Such a law would force owners of public clocks to pay one of these companies to ensure the accuracy of their clocks.

While the synchronization companies stood to gain the most from fixing public clocks, they were not the only ones to complain about them. Complaints about inaccurate clocks were widespread, as intimated to some degree earlier in this chapter. But it was the added pressure from the synchronizers that brought the debate into the limelight, a debate which was fought out in *The Times* and other major newspapers throughout early 1908. The secretary of the STC wrote to *The Times* in January, suggesting that "the irregularities of London's public clocks are directly responsible for an immense amount of financial loss, in addition to the inconvenience already admitted…In the present state

[160] British Science Guild, Report of Committee on the Subject of Synchronisation of Clocks in London, and in other parts of Great Britain, August 1, 1908, Synchronisation of Clocks, Post 30.2042B.
[161] Viator, "Public Clocks," *Horological Journal* XXVII No. 324 (August, 1885): 171.

of affairs every man's time is his own, and no inducement exists for the expenditure of the very small sum which synchronization involves."[162] A flurry of other letters followed, some supporting and some rejecting the idea of synchronizing all public clocks by legislative coercion.

The debate culminated in a lecture given by one of the directors of the STC, St. John Winne, to the United Wards Club in London on March 4th, 1908.[163] Winne's lecture was a response to the series of vitriolic letters to *The Times* about the fact that public clocks were always wrong and could not be relied on. He covered a lot of ground but emphasized the need to rid London of all the 'lying public clocks.' Winne suggested passing new legislation making it a requirement for all public clocks to be synchronized. Of course, his company, the STC, was sure to make a profit from this proposal, as they were in the business of synchronizing clocks.

Perhaps the most significant part of the lecture, however, was a brief aside concerning one of Winne's competitors, one who has not yet appeared in this chapter. In a similar vein to the tone taken by synchronization advertisements, Winne lamented the backwardness of regular clocks, while lauding the miraculous modern advances made in telegraphy and electrical time signals that made synchronized clocks possible. In his effort to disparage anything unmodern, he provided an example of an old method of accessing Greenwich time, which the STC were meant to replace.

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[162] "Lying Clocks," *The Times,* January 1908, Time Signals, Post 30.2536, BT.

[163] See Minutes of the United Wards Club, March 4, 1908, Vol. 1, MS11723, London Metropolitan Archives (LMA).; Minutes of the Committee of the United Wards Club, February 199, 1908, Vol. 2, MS11724, LMA.; "The Time of a Great City," *Transactions of the United Wards Club* No. 81 (March 13, 1908): 1-4, Vol. 1, MS21483, LMA.; St. John Winne, "The Time of a Great City: A Plea for Uniformity," (March 4, 1908), Silvanus Philips Thompson Collection, SPT/65, IET.; Rooney, *Ruth Belville.*

> "It may be interesting and amusing to some of you to learn how Greenwich mean time was distributed amongst the clock and watch trade in London before the present arrangements came into vogue…A woman possessed of a chronometer obtained permission from the astronomer royal of the time to call at the observatory and have it corrected as often as she pleased. She then made it the business of her life, until she reached a great age, to call upon her customers with the correct time, and on her retirement this useful work was, and even today is, carried on by her successor, still a female, I think."[164]

Some of Winne's audience, which included several clockmakers, were aware of the women he was talking about. One audience member, Daniel Buckney, who worked for a prominent clockmaking firm, Dent and Co., responded to Winne confirming the truth of Winne's story. Buckney was furious with Winne, as were most other clockmakers in the room. The suggestion that public clocks needed to be synchronized carried with it the implication that clockmakers were inept, and assembled clocks which could not keep the time. So the clockmakers were keen to say synchronization was unnecessary. Their responses to Winne's lecture were negative overall, but they did join him in being dismissive of the women Winne mentioned, because they were also in the business of correcting the error of clocks. Buckney stated "it is quite true, a lady did do it [delivered Greenwich time], and another took her place, but I may say that that lady calls at our establishment to see whether she has the correct time (laughter)."[165] Buckney then continued, also insulting Winne's company: "Another thing I should like to point out, and that is, that the synchronizing company receive the signal from Greenwich by our

[164] St. John Winne, "The Time of a Great City: A Plea for Uniformity," (March 4, 1908): 9, Silvanus Philips Thompson Collection, SPT/65, IET.
[165] St. John Winne, "The Time of a Great City: A Plea for Uniformity," (March 4, 1908): 23, Silvanus Philips Thompson Collection, SPT/65, IET.

standard clock. (renewed laughter)."[166] There was clearly competition between the people making the clocks, and the people synchronizing them. But more important is the way in which Winne talked about his competitors, these unnamed women.

Winne made the women objects of ridicule. He labelled their time service 'unofficial.' And he also made sure to describe their business in the past tense, stating that time used to be distributed by them before electricity allowed for it to be done by modern ingenuity. He was presenting them as things of the past, something anti-modern, and his own electric clocks as the way of the future. According to one newspaper report about the lecture, Winne also made an underhanded comment suggesting that the women used their feminine wiles to gain permission to enter the observatory each week, permission that "perhaps no mere man could have got."[167] Winne was doing his best to discredit the women, his competitors, and was more than willing to evoke negative gender stereotypes to do so.

Who were these women that Winne was so eager to discredit? The newspapers covering Winne's lecture in 1908 were eager to find out and hunted them down for an interview. Who they found were a mother and daughter, Maria and Ruth Belville (I will use their first names throughout this chapter to distinguish mother from daughter). Maria had passed away in 1899, but Ruth was still in business. There is a good record of both of them. Maria Belville's husband, John Henry, worked at Greenwich observatory in the 1830s. He was tasked with setting up a service by which a chronometer was corrected to

[166] St. John Winne, "The Time of a Great City: A Plea for Uniformity," (March 4, 1908): 23-24, Silvanus Philips Thompson Collection, SPT/65, IET. By this he meant that Dent and Co. had built the master clock in Greenwich observatory, which the post office used to distribute the time to the STC.
[167] "Lady Who Conveys the Time" Unnamed Paper Clipping, 1908, RGO7.96, Royal Greenwich Observatory Archives, CUL.

the right time at the observatory and was then carried around town to the various watchmakers and businesses who desired to know the accurate time. Maria Belville took over this task from her husband after his death in 1856.[168] As a single mother with a young daughter, Ruth, she sometimes brought Ruth along. In fact, one of her husband's wealthy friends offered to give Ruth an education, but Maria declined, saying that she had her own small income, and didn't want her daughter to be taken away from her. So Ruth stayed with her mother, and the two of them continued the time service Ruth's father had begun.[169]

The number of customers the Belville family served varied considerably in the century between the 1830s and 1930s in which they sold the time. Ruth states that her father had over 200, while she herself maintained around 50 toward the end of her career.[170] Most of these customers were watchmakers, but included factories, some shops in the fashionable parts of London, and the houses of millionaires.[171] These numbers do not include a number of secondary customers. Ruth wrote later in her life that she remembered visiting a large clock firm in Clerkenwell with her mother. When Maria and Ruth were on their way out after delivering the time, they passed three or four people coming in, watches in hand. These people, Maria explained, could not afford the

[168] Mrs E. Henry Belville (Maria) to George Airy, August 31, 1856, RGO6.4, Royal Greenwich Observatory Archives, CUL.
[169] Ruth Belville, "Some Account of John Henry Belville and the Distribution of G.M.T. to Chronometer Makers in London," 1938, RGO74/6/2, Royal Greenwich Observatory Archives, CUL.
[170] Ruth Belville to Mr. Lewis, January 22, 1910, RGO7.96, Royal Greenwich Observatory Archives, CUL.; "Selling the Time to London," *Evening News*, April 3, 1929.
[171] "Selling the Time to London," *Evening News*, April 3, 1929.

Belville's fee, and paid that firm a smaller fee to take the time second hand after they had got it from the Belvilles.[172]

The Belvilles' charged about £4 a year for a subscription, which was just slightly more expensive than the STC, but still much less than the Post Office.[173] In 1892, when Maria retired, her daughter Ruth took on the position, and continued to sell the time to her customers into the late 1930s. Curator David Rooney, working with the National Maritime Museum, has done an excellent job of mapping out the route that the Belvilles would have travelled to reach each of their customers in a day.[174] Some of their route was done on foot, but they relied on multiple methods of transportation. In the early years, Maria used boat taxies on the Thames to make her rounds. Later, when more of London's rail infrastructure was in place, she rode on trains, trams, and busses.[175] Even still, making their rounds would have been a long and tiring day of travel, especially for Ruth, who later in her career moved out of London to a smaller town, and had to commute in before commencing her rounds. That being said, the Belvilles did not sell the time every single day, but rather once a week, on Mondays. Nonetheless, the business would have made up a significant portion, if not the majority of, their income.

Interestingly, both Maria and Ruth's census records say nothing of their time distribution business.[176] Maria lists schoolmistress as her occupation in the census, while

[172] Ruth Belville, "History of the Belville Time Service," Untitled and Undated (possibly 1916), RGO7.96, Royal Greenwich Observatory Archives, CUL.
[173] Rooney, *Ruth Belville,* 62.
[174] Rooney, *Ruth Belville.*
[175] "Telling the Time as an Occupation," *Daily News and Leader*, April 29, 1913.
[176] Maria Belville, *Census Returns of England and Wales, 1841, 1861, 1871, 1891*, The National Archives of the United Kingdom (NAUK).; Ruth Belville, *Census Returns of England and Wales, 1861, 1871, 1881, 1891, 1901, 1911,* NAUK.

Ruth listed her position as governess. This does not necessarily mean that the time business was secondary to their primary professions in their eyes. But its likely that governess or schoolmistress was a more respectable position to write in a government census than 'purveyor of time.' It is also likely that they feared losing their special permission to access to Greenwich time if they announced themselves to the wrong government body. After John Henry's death in 1856, they were not in any way employees of the observatory. The Astronomer Royal knew of their weekly visits to the observatory and their time distribution business, but it is possible that his superiors, the Admiralty Board, did not. The closest Ruth came to revealing her business in the census was in 1901, where she listed her profession as "living on own means," but she did not include any specific details.[177]

Seen in this light, their reticence isn't surprising. Both Maria and Ruth Belville relied for their livelihood entirely on the goodwill of the Astronomer Royal at Greenwich. One word from him and their special access could be denied. It was a precarious living and bringing too much attention to their unique access could rock the boat. Indeed, the fact that they had this access was unorthodox in the first place. When Maria's husband died in 1856, she applied to the Astronomer Royal, George Airy, to ask if she might receive a pension from the Admiralty as a widow of their employee.[178] The Admiralty denied the request, as the spouses of civil servants were not entitled to a pension.[179] Maria persisted, however, first asking if the observatory might buy her husband's scientific

[177] Ruth Belville, *Census Returns of England and Wales, 1901,* NAUK.
[178] Mrs. E. Henry Belville (Maria) to George Airy, August 6, 1856, RGO6.4, Royal Greenwich Observatory Archives, CUL.
[179] George Airy to Maria Belville, August 11, 1856, RGO6.4, Royal Greenwich Observatory Archives, CUL.

papers and collection of weather journals.[180] This request was denied too, although she did eventually find a buyer. Airy's letters make it clear that he did want to help Maria, but that these decisions were out of his hands.[181]

Maria last hope was that Airy would allow her to take over her husband's time business. She wrote "I am encouraged by your goodness to advance another petition. Being engaged to take the Greenwich time to 67 of the principal chronometer makers in London I have to request admission once a week to the clocks in the observatory in order to test my own regulator – it would inspire those who have taken up the widow of their esteemed friend with additional confidence if you could accord me this favour."[182] This was something Airy could agree to without having to ask the Admiralty. And so Maria was allowed in.

But her position was insecure. A few weeks later, she was accused of breaking into the observatory unannounced and leaving the gate unlocked. Airy assumed she had a key that her husband had not returned, and had used it to get in. He demanded she return the key, and only access the grounds via the main gate by asking the porter.[183] Maria wrote back apologetically, saying she had no key, and that she had found the gate open.

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[180] Mrs. E. Henry Belville (Maria) to George Airy, August 6, 1856, and August 21, 1856, RGO6.4, Royal Greenwich Observatory Archives, CUL.

[181] The Admiralty to George Airy, September 3, 1856, RGO6.4, Royal Greenwich Observatory Archives, CUL.; George Airy to Maria Belville, September 4, 1856, RGO6.4, Royal Greenwich Observatory Archives, CUL.

[182] Mrs. E. Henry Belville (Maria) to George Airy, August 31, 1856, RGO6.4, Royal Greenwich Observatory Archives, CUL.

[183] George Airy to Maria Belville, November 3, 1856, RGO6.43, Royal Greenwich Observatory Archives, CUL.

Someone else must have forgotten to shut it.[184] Airy confirmed with his staff that John Henry's key had been returned, and then let Maria off the hook.[185]

Thirty-six years later, when Maria retired, Ruth wrote cautiously to the new Astronomer Royal, William Christie, for permission to carry on her mother's business.[186] Permission was granted, and she continued her mother's business.[187] Again, though, there was trouble. Maria's retirement caught the attention of the newspapers, who published a story about the Belvilles. The *Daily Graphic* article had to explain why the Belville service existed at all, given the existence of the Post Office time signal. The journalist wrote that "it is a well known fact that" the Post Office's time signal via telegraph wire "is not to be relied on."[188] The observatory staff were not happy with the insinuation that their time signal which they sent to the Post Office was inaccurate. The chief assistant of the observatory wrote in to the paper to complain, saying that Post Office time was perfectly accurate. The Belvilles' time service, he indicated, was merely an artifact of an older age, before telegraphic arrangements had been made. "Her present usefulness, I believe, is in supplying the approximate time to those who find the Post Office charges too high," he wrote.[189] It was an attack on the quality of the Belvilles' service, suggesting that her clock was only 'approximate.' Instead of complaining, however, Maria wrote quickly to the observatory and apologized profusely, making it clear that the paper's

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[184] Mrs. E. Henry Belville (Maria) to George Airy, November 3, 1856, RGO6.4, Royal Greenwich Observatory Archives, CUL.
[185] George Airy to Maria Belville, November 3, 1856, RGO6.43, Royal Greenwich Observatory Archives, CUL.
[186] Ruth Belville to William Christie, June 10, 1892, RGO7.254, Royal Greenwich Observatory Archives, CUL.
[187] H. Turner to Ruth Belville, June 12, 1892, RGO7.254, Royal Greenwich Observatory Archives, CUL.
[188] "Greenwich Mean Time," *Daily Graphic*, October 31, 1892.
[189] H.H. Turner, "Greenwich Mean Time," *Daily Graphic,* November 1, 1892.

misstatements about the quality of the Post Office time signal did not come from either her or her daughter.

Given the precariousness of her access to the observatory, Ruth Belville must have been incredibly nervous in 1908 when she again became the centre of media attention. After the STC director St. John Winne gave his lecture to the United Wards Club, there was a sustained media interest as newspapers tried to hunt down Ruth Belville for an interview to talk about her and her mother's time selling business. The headlines were sensationalist. The *Daily Express*'s first headline, like Winne, talked about Ruth's time service as a thing of the past: "Woman Who Sold the Time," the headline read.[190] But then the reporter found Ruth herself, and requested an interview and a photo. Their second headline moved into the present. "Woman Who Sells the Time: Strange Profession of the Belville Family."[191] So although the headline changed to the present tense, it now talked about the Belville's job as a "strange" one, something out of place, an anachronism in the modern world. Other newspapers followed this lead. *The Maidenhead Advertiser* labelled her job "a unique position", while the *Kentish mercury* wrote "Greenwich Clock Lady: Romance of a Regular Visitor to the Observatory."[192] Here, again, the word romance invokes a sense of nostalgia, as if Belville was out of place and time.

Let us take a step back for a moment and consider the language. Why did the papers consider selling the time a "strange trade" or a "strange profession"? Coverage of

[190] "Woman Who Sold the Time," *Daily Express*, March 7, 1908.
[191] "Woman Who Sells the Time: Strange Profession of the Belville Family," *Daily Express,* March 9, 1908.
[192] "Greenwich Clock Lady: Romance of a Regular Visitor to the Observatory," *Kentish Mercury*, March 13, 1908.

Winne's lecture, the STC's synchronizing business, and the Post Office time signal did not use the same language of 'strangeness.' No one accused Winne of being an anachronism. And yet the newspapers considered selling the time to be a strange profession when it was done by Maria and Ruth Belville.

There are two explanations for the tone. The first relates to gender. Belleville's character was being attacked in part because her profession fell outside accepted gender roles. This perception of abnormality prompted attacks against her morality, such as the suggestion that she seduced the Astronomer Royal to access the observatory. Belville's respectability was questioned much in the same way that suffragettes' morality was questioned in the same period. Timekeeping in the era of Greenwich Mean Time was considered a science, and science, beyond certain specific fields, was a masculine pursuit. The Belvilles were not welcome in the new 'profession' inhabited by the electrical clock engineers at the STC.

The second explanation for the 'strangeness of the Belville time service concerns Edwardian notions of modernity. Selling the time was not strange when it is done using electricity, but it is strange when it is done by hand. The Edwardian vision of progress was one in which new technologies did not just supplement old methods, they replaced them entirely. There was no room for the Belvilles alongside the STC. The contrast between the coverage of the STC and the coverage of the Belvilles reflects a patriarchal and unchallenged belief in progress, the separation of spheres, and the pre-eminence of a vision of modernity that valued technological solutions to everyday problems. Winne's rhetoric, echoed in the newspapers, capitalized on these values to undermine the

Belvilles. It turned the Belvilles into a spectacle rather than a serious competitor in the time synchronization business. Winne and the papers focused on both gender and imagined temporal spaces to delegitimize the Belvilles, pushing them back into an imagined past. The female time saleswomen were backwards, remnants of the past, oddities, inaccurate, unscientific. In contrast, Winne and the STC with their electric wires were masculine, modern, forward thinking, scientific, and perfectible.

The stigma was hard to shake. Similar headlines attached themselves to Belville again in 1913. *The Daily News and Leader* published a story called "Lady who has Inherited a Strange Trade."[193] Another 1913 newspaper, *The Observer*, again relegated Belville's time service to the past, writing a story about "The Belville Tradition."[194]

But Ruth did resist. In a few places, there are rare glimpses past the modernist filter of the STC and the newspapers, and Ruth speaks in her own voice. And it is quite the contrast. Ruth absolutely rejected the narrative of Winne and the papers who relegate her to the past, and who suggested that her time service was less accurate or just approximate. She told her local newspaper, the *Maidenhead Advertiser*, that despite what Winne claimed, the biggest clockmaking firms "will have nothing to do with synchronized time or any other means of communicating the time," besides herself.[195] To these firms, her method was altogether the most reliable, and she had earned herself some loyal customers. Ruth also publicly replied to the newspaper which had called her profession a 'tradition.' She wrote:

[193] "Lady who has Inherited a Strange Trade," *Daily News and Leader,* April 29, 1913.
[194] "The Belville Tradition," *The Observer*, August 24, 1913.
[195] "Maidenhead Lady Who Distributes the Time: A Unique Position," *Maidenhead Advertiser*, March 11, 1908.

> "Sir, my attention has been called to a paragraph in the article headed "The Correct Time" in the number of *The Observer* for the 24th instant, which is headed 'The Belleville Tradition.' I take objection to the word 'tradition'. Tradition means a thing of the past, that has been handed down orally from generation to generation. My distribution of Greenwich Mean Time takes place at present. The error of my chronometer is…stated on a written certificate; not written and signed by me but by unimpeachable authority. [The] weekly error of my chronometer…seldom exceeds a few tenths of a second. As to synchronized clocks, doubtless they are of service to the general public and possibly to those who sell cheap watches, etc, but to the high class scientific watch and chronometer maker, Greenwich mean time is required to tenths of seconds; and this can be provided by no better means than that of a first-class English chronometer, accurately adjusted and timed to tenths of seconds from the royal observatory at Greenwich."[196]

Ruth was aware of the game Winne and the papers were playing, and she firmly rejected it. She later also wrote privately that "I think the Standard Time Company will not attack me again in public as the result ended in rather a heated discussion at the end of the lecture and the last thing that Mr. St. John Winne wanted was to advertise the chronometer [which she carried] at the company's expense."[197]

One of the more interesting facets of this discussion of the Belville's time service is that she was right about the quality of her service matching, even exceeding, that of Winne's. Her customers could rely on her time service without worrying about telegraph line failures, delays, and interruptions that plagued the STC and the Post Office.[198] The notion that the Belvilles' time service remained relevant in the electrical age was articulated by David Rooney, in a book published by the National Maritime Museum.[199] Ostensibly a biography of Ruth Belville, the book is more accurately a history of

[196] Ruth Belville, "The Belville Tradition," *The Observer,* August 31, 1913.
[197] Ruth Belville, "History of the Belville Time Service," Untitled and Undated (possibly 1916), RGO7.96, Royal Greenwich Observatory Archives, CUL.
[198] Rooney, *Ruth Belville*, 61, 146, 173.
[199] Rooney, *Ruth Belville.*

Greenwich time itself, using the Belvilles' time service as a framing device. The book occasionally borders on being sensationalist, and makes a few unsupported leaps of deduction, particularly where Rooney makes some dubious connections to Jack the Ripper in an effort to intrigue his readers. Nonetheless, his archival research is extensive and thorough. Rooney's most insightful argument, which is not so clear in the book, but is made explicit in an article jointly written with James Nye, is that the Belvilles' time service, far from being backwards and outdated, was considered to be much more reliable and trustworthy than the supposedly modern STC.[200] "New technology", he writes, "doesn't just sweep aside old systems. They coexist far longer than one might expect…From the users' perspectives [the STC's and Post Office's time service] was good but not always good; available but not always readily so; accurate enough for most people most of the time but no more so than Ruth's service."[201]

The records of the Post Office and the Greenwich Observatory corroborate this claim. The wire to the time ball at Deal was occasionally faulty, as was Westminster.[202] The Astronomer Royal had to field as many complaints as the Post Office did about mistakes to the time signal, most often because of problems with the wires.[203] This problem was not unique to London. Charles Piazzi Smyth received many complains about his public signal, the time gun in Edinburgh.[204] The British observatories in South Africa

[200] David Rooney and James Nye, "'Greenwich Observatory Time for the Public Benefit': Standard Time and Victorian Networks of Regulation" *British Journal for the History of Science*, 42, No. 1 (March 2009): 29.

[201] Rooney, *Ruth Belville*, 146, 173.

[202] William Christie, *Report of the Astronomer Royal to the Board of Visitors of the Royal Observatory,* June 5, 1880, 17-18, BL.

[203] See RGO7.253, Royal Greenwich Observatory Archives, CUL.

[204] See A12/54, and A14/65, Charles Piazzi Smyth Papers, ROE.

had similar technical failures.[205] In London, one engineer inspecting the Greenwich time signal wires in 1887 actually went so far as to say that given the poor state of the public time signal apparatus "it is surprising that failures are not more frequent."[206]

The new technology involved in clock synchronization was expensive, and it often failed. Indeed, by the time the technology was wholly reliable, it was becoming outmoded, and was slowly being replaced by the more accessible and less expensive wireless radio signals. A Post Office memo from 1915 proclaimed that "the need for extreme accuracy in time keeping is, comparatively, so small that it is scarcely worthwhile for the department to take up the matter seriously or to expend any large sum of money for the purpose of safeguarding its monopoly. Moreover, the demand for this particular system of time signalling has been diminished by the distribution of standard time signals by wireless from the Eiffel Tower."[207]

Despite whiggish notions of progress, technological advances are never straightforward. Ruth and Maria Belville's hand-carried pocket watch was not replaced by the STC's wires, or even by the radio, at first. Rather they existed in parallel. Of course, the Belvilles' time service could only exist in a place like London, with a high concentration of customers, and direct access to the observatory. The Post Office's wires, on the other hand, opened-up a broader system of time regulation, reaching across all of Britain's cities. Rural timekeeping was more fluid, but the network of wires and rails slowly reshaped the temporal landscape of the country.

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[205] See RGO15.107, and RGO15.108, Royal Greenwich Observatory Archives, CUL.
[206] J.B. Chapman to Mr. Graves, August 5, 1887, Greenwich Observatory, Post 30.523C, BT.
[207] Post Office Memorandum, April 28, 1915, Synchronisation Etc. of Clocks by Electric Current, Post 30.531, BT.

A lot of ground has been covered here. What conclusions can be drawn from the introduction of the universal day, and from the Belville's story? First, we saw that attempts to standardize time globally did not simplify timekeeping. Instead, it created new layers of complexity, confusing the public about whose time was right. Second, access to accurate universal time was hierarchical and unequal. Accurate time was expensive, and urban, and therefore limited to professionals and those who could afford it as a luxury good. And finally, the Belville's time service raises questions about whose time was authoritative, and whose was not? If we look at the language used at the time, clocks not set to Greenwich were not simply showing a different time, they were 'lying.' Yet only a few could afford time that told the so-called 'truth'. In a similar vein, attempts to delegitimize the Belvilles used language that linked authority to both modernity and masculinity, thus relegating the Belville's time service to the imagined past, an object of nostalgia and romance. The received wisdom that all technological progress was good ignored the fact that the watch carried by hand was far more reliable than time carried by wire. The professionalization of timekeeping by companies like the STC and the Post Office was an attempt to reshape the place of time-telling in the modern world.

The story of Greenwich time within Britain has parallels with what post-colonial historians have described as the production of authoritative 'knowledge,' which is used to exert control over colonized peoples. Historian Giordano Nanni explains how clock time, as established by Europeans, was used as a tool of colonization, for example using bells and schedules in residential schools.[208] In the same way, the invention of Greenwich time as the 'true time' undermined the authority of local timekeeping methods, in Britain just as in colonial settings. The Belvilles, to borrow from one of the newspaper headlines that shone a spotlight on them, occupied a 'unique position' with reference to the constructed authority of Greenwich time. On one hand, they were a part of the machine that legitimized the authority of Greenwich; the Belvilles were keen to show that the time that could be purchased from them was indeed the best time, the 'true' time, to the detriment of more affordable versions of public time. On the other hand, just as anarchist Martial Bourdin's attack on the Greenwich Observatory was a rejection of this constructed authority of Geenwich time, Ruth Belville's weekly rounds on foot, carrying a watch, was in some ways just as powerful a form of resistance against the constructed authority of patriarchal modernity and uncritical technological progress.

This chapter has made the case that the inaccessibility of scientific time meant that the majority of the population did not begin using it for decades after it first became available, and even mocked it. Yet at the same time, it could be appealing, not to mention lucrative, to be able to adopt the trappings of scientific time. It allowed them to appear modern, legitimate, and forward thinking. This central tension drove most of the conflict in this period over how and to whom scientific time ought to be delivered. The IMC's 'Universal Day' divided, rather than united people, because of its unequal implementation. The new timekeeping reinforced social inequalities. As we saw with the Belvilles, however, and as we will see again in the next chapter, there was room for

[208] Giordano Nanni, *The Colonisation of Time: Ritual, Routine, and Resistance in the British Empire* (Manchester, Manchester University Press, 2012).

resistance and room to reclaim temporal authority by those outside the scientific community.

Chapter 5: Shaping Norms of Behaviour: Education and Standard Time in North America after the IMC

In North America as in Britain, the resolutions of the International Meridian Conference (IMC) were adopted unevenly, due to the technological limitations and high cost of accurate time distribution. Significant cultural aversion to timekeeping's ever-increasing complexity also slowed its adoption. Distributors and wealthy customers championed accurate timekeeping as a symbol of their modernity, while those unable to pay for the luxury of scientific time mocked its superfluous precision. Yet the comparisons between Britain and North America are not perfect. The United States, for example, provides a good example of a decentralized time modernization, in contrast to Britain's single timekeeping authority at Greenwich. The Canadian example, meanwhile exemplifies the process by which regional authorities were slowly collected into a single body by the turn of the century.

In this chapter, the story of time distribution in North America is told largely through the lens of education. Schools served as the contact point between academic ideas and public usage, and 19th century education was fraught with tension between these two. Which subjects were taught to whom, and by which methods, formed the basis of countless debates. The end of the 19th century saw significant efforts to reform the school systems in most of Canada's provinces (with the possible exception of Quebec). Reform debates centered largely around the language of instruction and religious denominational teachings of public schools. Reformers such as Egerton Ryerson (the Superintendent of Schools for Ontario) supported secularization in education in order to prevent one denomination overshadowing others in public school curricula. Further debates centered around the proper curricula for public schools, whether they should teach academic subjects or more practical industrial and agricultural skills. The MacDonald movement, for example, spearheaded by philanthropist reformers William MacDonald and James Robertson at the turn of the century, attempted to consolidate small rural schools into larger institutions, at which agricultural skills rather than esoteric arts would be the focus of the curriculum. The period also saw education become available to more people than ever before, with school becoming free, and compulsory, in most provinces besides Quebec by 1910, beginning with Ontario in 1871.[1]

Educational reform in this period was often based on middle class assumptions concerning social ills and the rehabilitation of the poor. School reformers of the late 19th century saw education as a way to improve and 'civilize' human societies, pulling street urchins into classrooms, preventing crime, and giving impoverished youth a productive future.[2] Yet reformers were often blind to the notion that their curricula were not neutral, nor evenly available. Class, race and gender shaped the quality of education available to children. In Canada, schools were also colonial institutions. As David Willinsky suggests, imperial education "gave rise to peculiar and powerful ideas of race, culture, and nation that were, in effect, conceptual instruments that the West used both to divide up and to

[1] Philip Oreopoulos, "Canadian Compulsory School Laws and their Impact on Educational Attainment and Future Earnings," Family and Labour Studies Division, Statistics Canada and Department of Economics, University of Toronto, Catalogue no. 11F0019MIE, No. 251 (2005): 8-9.
[2] Bernd Baldus and Meenaz Kassam, "'Make Me Truthful, Good, and Mild': Values in Nineteenth-Century Ontario Schoolbooks," *The Canadian Journal of Sociology* 21, No. 3 (1996). See also Alison Prentice and Susan Houston, Eds, *Family, School, and Society in Nineteenth-Century* Canada (Toronto: Oxford University Press, 1975), 178-182, 281.

educate the world."[3] Curriculum reinforced racial hierarchies. The world: its geography, its history, its land and resources, humanity itself, were all classified, organized, and slotted into an imperial worldview. Schools entrenched imperial hierarchies in students' minds.

The way timekeeping was taught in schools was no less problematic. A particular, western, Greenwich centered time-sense was taught in schools both through curriculum itself, but also through the very structure of the day. Schools were the instrument by which the norms of public timekeeping were cultivated, shaped, and challenged. At higher levels of education, especially in the United States, educational institutions were the literal producers and distributors of accurate time beyond the institutions, via private, university funded observatories. In elementary and high schools, meanwhile, children were taught new time systems via formal curricula in hopes that they would in turn teach it to their parents, raising in time a generation of 'modern' timekeepers. Meanwhile, even when time was not the subject of study, schools instilled a sense of clock time functionally through their schedules and bells. Both curriculum and scheduling failed to be as effective as reformers like Sandford Fleming hoped. Most rural populations remained indifferent to the time changes of the 1880s, though some, including indigenous peoples, used it to their advantage when it suited their needs.

This chapter begins with a discussion of the role of universities in time distribution in the United States, examining their conflict with the US Naval Observatory over the right to sell the time to fund their research. It then turns to a brief examination of

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[3] John Willinski, *Learning to Divide the World: Education at Empire's End* (Minneapolis, University of Minnesota Press, 1998), 2-3.

the time distribution apparatus in Canada. The rest of the chapter then deals with the way that timekeeping was introduced, and contested, in schools across Canada, including the effort of Fleming, then chancellor of Queen's University, to introduce scientific time into the curriculum of elementary schools across the country, and the debates surrounding standard time and education among the Mississaugas of the Credit and the Lunaapeew at Moraviantown in Ontario.

The experience of schooling, and students' understandings of timekeeping, differed by context. Urban populations acculturated to scientific time more readily than rural populations, who dismissed its relevance to their lives beyond the schoolhouse. Indigenous children and their parents, meanwhile, experienced the implementation of timekeeping in the colonial environment of both residential and day schools, but also found ways to adopt and repurpose it to their own uses.

Education was one of the most ubiquitous processes through which civil society engaged with time management. As a place where the findings of science, combined with the ideological beliefs of the political regime, filtered into the consciousness of the general public, schools are ripe subjects for examining what has been one of the central tensions of this dissertation, the disconnect between the scientific production of knowledge, and the practical use of (or rejection of) that knowledge by civil society.

As we saw in the previous chapter, the 1880s-1910s was a period in which time measurement consisted of a confusing mess of competing systems. People of all backgrounds were led to believe that the adoption of Greenwich time for scientific purposes at the IMC meant that it was to be adopted by everyone. This gap between intent and understanding was exacerbated by the challenges of distributing accurate Greenwich time. Distribution was expensive and consequently limited, and so created a hierarchy of times, in which Greenwich time was a luxury for the wealthy, and a specialized tool for the professional, but was not widely available to the public. Most of the public, should they even desire it, were dependant on the uneven chance of living near an accurate public time signal or working for an employer who wished to instil punctuality.

This reality was true for the United States as for Britain, but the details differed. In some ways, the situation was even more muddled in the United States. Britain had the luxury of 'owning' the Prime Meridian. In Britain, universal time was Greenwich time, which was national time, which was legal time. These categories did not line up so neatly in America. Universal time as established by the IMC was not so easily adopted for public use. Instead, subsidiaries of Greenwich time were derived to approximate local time more closely. Under railroad reformer William Allen's direction, the railroads adopted a series of one-hour time zones in 1883 to account for North America's unwieldy East-West expanse. But this was, at first, mainly a specialized time for travellers. As we saw in previous chapters, it was not clear whether or not the public was meant to adopt railroad time in everyday life, and many did not. Whole cities continued to use their local time instead of railroad time, as did most rural areas.[4] The federal government, meanwhile, maintained a laisse faire policy towards the subject. As Ian Barkty points out,

[4] Rural areas were also the most hesitant to adopt daylight savings time when that innovation gained popularity a few decades later. See Jarrett Rudy, "Do You Have the Time?: Modernity, Democracy, and the Beginnings of Daylight Saving Time in Montreal, 1907–1928," *Canadian Historical Review* 93, No. 4 (2012):531-554.

"the railroads, by adopting their own Standard Railway Time, virtually ended congressional interest in public timekeeping."[5]

With this multiplicity of times across a vast geography, constructing a single unrivaled temporal authority in America was difficult. When it comes to time distribution, this is perhaps the most significant difference between Britain and the United States. While Britain's time-telling infrastructure was highly centralized, being based entirely on the observatory at Greenwich (and Dublin for Ireland), authoritative time-telling in the United States was diffuse. There was no equivalent to the Astronomer Royal to be the face of American time-keeping (the Superintendent of the US Naval Observatory in Washington eventually gained some semblance of authority, but in no way did this official have the status of Airy or Christie at Greenwich). Finnish astronomer Anna Molander, writing to an employee of the Greenwich Observatory in 1909, explained that the state of astronomy in the United States was very different than that of Britain, because "there are in this country [America] so many private observatories."[6] In the 19th century these private institutions measured time for America, each independently of the other. And these private institutions were almost all universities, forming a direct link between higher education and timekeeping practices.

University observatories began distributing the time to paying customers as early as the 1860s. Beside the US Naval Observatory in the nation's capital, which sent the time to New York by wire and operated a time ball in Washington D.C., scientific time in

[5] Ian Bartky, *Selling the True Time: Nineteenth Century Timekeeping in America* (Stanford: Stanford University Press, 2000), 2.
[6] Anna Molander to Greenwich Observatory, June 23, 1909, RGO7.140, Royal Greenwich Observatory Archives, Cambridge University Library (CUL).

America was produced overwhelmingly by academic institutions.[7] Some of the most active academic observatories to do so were at Harvard University, the University of Cincinnati, and the Alleghany Observatory at the University of Pittsburgh.[8] Each developed its own time distribution systems, which functioned alongside companies analogous to the Standard Time Company, the Greenwich Time Ltd., and Synchronome in Britain, which began to emerge in major city centers in America, such as New York's Self-Winding Clock Co., which distributed the time calculated at the US Naval Observatory to customers willing to pay a fee of $12 a year.[9]

But unlike Britain, it was the observatories, not just the distribution companies, which were profitable in America. Being a producer of knowledge, in this case a producer of accurate, authoritative time, was an opportunity for making money. In Britain, Greenwich had a near monopoly, but it never saw the profits, because the Post Office reaped any income earned selling the time. In America, by contrast, each university observatory competed with each other for customers. Selling the time subsidized research, as income from time distribution went toward supporting the scientific activities of the researchers themselves. As a result, academic astronomers had more of a stake in cultivating and preserving a customer base. While Christie had felt perfectly comfortable threatening to end the Greenwich time service altogether, calling it "extraneous work," in

[7] U.S. Naval Observatory to John White, February 4, 1882, Superintendent's Office Outgoing Correspondence, Box 1, The Records of the U.S. Naval Observatory, Library of Congress (LOC).

[8] Carlene Stephens, "Before Standard Time: Distributing Time in 19th Century America" *Vistas in Astronomy* 28 (1985): 116. The Dudley Observatory, not related to a university at the time, also had a time service.

[9] Stephens, "Before Standard Time," 117.

American universities that same type of time distribution service was considered essential to the observatories' continued well-being.

The reliance of university observatories on their time services for research funding led to a conflict in 1883 between the Naval Observatory and the observatory of Washington University in St. Louis. The catalyst for this conflict was the 1883 decision by American and Canadian railroads to adopt time zones. In order to ensure the smooth transition, William Allen wrote to the Superintendent of the Naval Observatory on October 6th, 1883, informing him of the plan and asking for his cooperation.[10] Allen was worried the Superintendent might refuse, as in the past the Observatory staff had preferred to use the meridian of Washington, not Greenwich.

Allen need not have worried. The time zone plan had the potential to simplify time distribution for the Naval Observatory. Although officials would have preferred to introduce a single universal time instead of twenty-four different time meridians, they considered the time zone system a "move in the right direction."[11] As far as they were concerned, the new railroad time zone system was a temporary solution, one that would inevitably be "subjected to criticism and a better plan evolved from it."[12] But in the meantime, they would support it. The Naval Observatory Superintendent not only agreed to distribute zone time for the railroads, as requested, he also promised that "unless there

[10] William Allen to Superintendent of the Naval Observatory, October 6, 1883, Letters Received, PC42, Entry 7, Box 49A, Records of the United States Naval Observatory, RG78, National Archives of the United States of America (NAUSA).
[11] Robert Wilson Shufeldt to Edwin Leigh, October 15, 1883, Miscellaneous Letters Sent, PC42, Entry 4, Vol. 5, Records of the United States Naval Observatory, RG78, NAUSA.
[12] Robert Wilson Shufeldt to Edwin Leigh, October 15, 1883, Miscellaneous Letters Sent, PC42, Entry 4, Vol. 5, Records of the United States Naval Observatory, RG78, NAUSA.

be some unexpected opposition, [I will] try to secure the immediate adoption of the same time as the local time for the whole section in which it is to be used by the railroads."[13] In doing so, the observatory would be relieved of the task of calculating the numerous local times which it currently had to provide. As the Superintendent explained, "By the proposed plan of having standards differing by one hour, it is made possible to furnish the mean time of each standard meridian by a single time signal; for the signal which marks noon of the 75th meridian, would mark the hour of eleven for the meridian of 90 degrees, and so forth."[14] One time signal for all meant far less work for the astronomers.

In fact, the Naval Observatory officials were so enthusiastic about the plan that they announced that they would "furnish the time, free of charge, to any other telegraph company [besides Western Union, to whom they already supplied the time] that will bring a wire to the Observatory."[15] This declaration, offering telegraph companies and railroads free access to the time signal, was repeated by a Naval Observatory representative at a meeting of railroad managers in Chicago later in October, and it was this declaration that angered academic astronomers.

The most outspoken opponent of the Naval Observatory's move was a professor of astronomy at Washington University in St. Louis, Henry Pritchitt. Pritchitt had been part of the international project to document the 1882 transit of Venus, travelling to New Zealand to observe the phenomenon. Astronomical expeditions like these were expensive,

[13] Robert Shufeldt to William Allen, October 15, 1883, Miscellaneous Letters Sent, PC42, Entry 4, Vol. 5, Records of the United States Naval Observatory, RG78, NAUSA.
[14] Robert Shufeldt to William Allen, October 15, 1883, Miscellaneous Letters Sent, PC42, Entry 4, Vol. 5, Records of the United States Naval Observatory, RG78, NAUSA.
[15] Robert Shufeldt to William Allen, October 15, 1883, Miscellaneous Letters Sent, PC42, Entry 4, Vol. 5, Records of the United States Naval Observatory, RG78, NAUSA.

and he relied on the profits from his observatory's time service to fund his work. Upon his return to St. Louis, he found that income in jeopardy. Railroad managers who had previously purchased the time from his observatory in St. Louis were threatening to take the time from the Naval Observatory instead, unless Pritchitt offered to provide it free of charge.[16]

Pritchitt's knowledge of what had been said at the railroad meeting in Chicago was second-hand. As he understood it, the Naval Observatory had announced that "the time signals would be sent free over the entire United States from the Naval Observatory, that the sending of the signals from the observatory was an essential part of the standard time scheme and that for certain reasons the Naval Observatory was the one above all others which should do this work."[17] The Naval Observatory's representative, according to Pritchitt, had given the railroad managers "impressions very unjust to the private observatories of this country."[18] "Such statements as these" he continued, "are unworthy [of] the national Observatory and unjust to those private observatories which have at great expense of money and labor built up time-services in various parts of the country."[19] Why, Pritchitt demanded, was the Naval Observatory, which was funded by the government, setting itself up to compete with the private observatories who relied on the income for their scientific work? The observatory at Harvard University, Alleghany

[16] Henry Pritchitt to Robert Shufeldt, October 16, 1883, Letters Received, PC42, Entry 7, Box 49A, Records of the United States Naval Observatory, RG78, NAUSA.
[17] Henry Pritchitt to Robert Shufeldt, October 16, 1883, Letters Received, PC42, Entry 7, Box 49A, Records of the United States Naval Observatory, RG78, NAUSA.
[18] Henry Pritchitt to Robert Shufeldt, October 16, 1883, Letters Received, PC42, Entry 7, Box 49A, Records of the United States Naval Observatory, RG78, NAUSA.
[19] Henry Pritchitt to Robert Shufeldt, October 16, 1883, Letters Received, PC42, Entry 7, Box 49A, Records of the United States Naval Observatory, RG78, NAUSA.

Observatory (University of Pittsburgh), the Washburn Observatory (University of Wisconsin-Madison), and the Morrison Observatory (Pritchett College, Glasgow), among others, all stood to lose the same benefits from the Naval Observatory's plan.

The superintendent's reply to Pritchitt was defensive. He did not deny the statement apparently made by his representative, but tried to underplay the significance of the announcement. "The Naval Observatory does not propose to make any changes in its time service beyond such as are necessary to conform to the new standards of time, should they be adopted…The Naval Observatory has distributed time daily by telegraph for twenty years… no charge has ever been made for this work by the Observatory."[20] The Naval Observatory had always provided the time to Western Union for free, argued the superintendent. Any railroads wishing to access the time made arrangements with Western Union, rather than the Naval Observatory directly. Pritchitt had already been competing with the Naval Observatory for years. What had changed, however, was that the adoption of standard time had been good advertising for the Naval Observatory, costing Pritchitt his customers.

The Naval Observatory's intentions may not have been insidious, but its actions had consequences. Pritchitt wrote again a few weeks later to make clear the harm that had been done. "I fear that a considerable part of our income has been permanently cut off and it certainly has been cut off for the present."[21] Pritchitt did not pursue the Naval Observatory's right to continue its practice of giving the time to the telegraph company

[20] Robert Shufeldt to Henry Pritchitt, October 18, 1883, Miscellaneous Letters Sent, PC42, Entry 4, Vol. 5, Records of the United States Naval Observatory, RG78, NAUSA.
[21] Henry Pritchitt to Robert Shufeldt, October 26, 1883, Letters Received, PC42, Entry 7, Box 49A, Records of the United States Naval Observatory, RG78, NAUSA.

for free, but he did take issue with the other insinuations made by the representative at Chicago. First, that the Naval Observatory was somehow "better fitted" to deliver the time than private university observatories; second, that the Naval Observatory could send the time anywhere in the USA accurately and regularly; and third, that it was essential to the new standard time scheme that the time be sent by one observatory only. Pritchitt asked the superintendent whether these statements, which he had heard second hand, were actually the official position of the Naval Observatory. If they were not, then Pritchett could tell his recently lost time service customers that they were mistaken.[22]

The Naval Observatory's reply was unrepentant. "I considered my reply to your first letter as a complete answer to your questions," the Superintendent wrote.[23] The Naval Observatory had been asked to provide the time signal in cooperation with the standard time scheme, and it would do so to anyone who made the proper arrangements with a telegraph company. The letter concluded, "While I regret that the distribution of time from the Observatory may diminish your revenue derived from such work, I cannot on that account withhold the cooperation of the Observatory in a matter of so much public importance."[24] Pritchett and the other educational institutions were out of luck.

Of course, the Naval Observatory did not immediately become the center of US timekeeping in the way that Greenwich did in Britain. Universities continued to sell the time to various customers even after the switch to standard time. Timekeeping in the

[22] Henry Pritchitt to Robert Shufeldt, October 26, 1883, Letters Received, PC42, Entry 7, Box 49A, Records of the United States Naval Observatory, RG78, NAUSA.
[23] Robert Shufeldt to Henry Pritchitt, October 29, 1883, Miscellaneous Letters Sent, PC42, Entry 4, Vol. 5, Records of the United States Naval Observatory, RG78, NAUSA.
[24] Robert Shufeldt to Henry Pritchitt, October 29, 1883, Miscellaneous Letters Sent, PC42, Entry 4, Vol. 5, Records of the United States Naval Observatory, RG78, NAUSA.

United States continued to be highly decentralized. But over the next few decades the ability of private observatories to operate their own time signals profitably declined rapidly. In 1888 there were at least twelve private observatories selling the time, but four years later in 1892, that number was down to eight, and, according to Barkty, "the remaining ones were all worrying about their long-term survival."[25] Pritchitt managed to struggle on, taking up his grudge against Western Union and the Naval Observatory again in the early 1890s, but there was no going back.[26] Bartky has collected data on the approximate end dates of time services in the United States. The majority of the private observatories wound down their service by 1900. Only a few lasted until the First World War and beyond. But the Naval Observatory's eventual prominence is clear.[27]

In America, accurate standard time as a scientific tool, as well as a source of academic funding, eventually lost out to the notion that accurate time was a public good. But that transition came late, and met with significant resistance. In an interesting reversal from Britain, government institutions in America were the instrument of establishing free timekeeping (though access was still far from universal), rather than enforcers of a paywall like the British Post Office. Instead, it was American academic institutions that claimed, and fought hard to keep, the right to educate the public on proper timekeeping, for a price. Private universities, in the business of selling knowledge to the affluent classes and business interests, intended to act as the gatekeepers of temporal knowledge, but were eventually undermined by the drive to make the time free and universal.

[25] Bartky, *Selling the True Time*, 181.
[26] Bartky, *Selling the True Time*, 187-88, 199-200.
[27] Bartky, *Selling the True Time*, 211-212.

Canadian timekeeping practices mirrored the developments which had occurred in both America and Britain. The same confusion existed as to which time was to be used by whom, and how the reforms in 1883 and 1884 were meant to be implemented. In all three countries, the relationship between public time and scientific time was equally unclear. As for the problem of distributing accurate time, Canada in 1884 resembled the United States more than Britain. Where Britain had a single authoritative producer of temporal knowledge in the Greenwich Observatory and the Astronomer Royal, accurate time in the United States and Canada was far more decentralized, in large part because of geographical realities.[28] It was only after the turn of the century that Canadian timekeeping began to be consolidated under the Dominion Observatory, established in 1905. Until then, some producers of time claimed to be more correct than others, especially when railroad standard time entered the equation in 1883, threatening the authority of local time.

The case of Canada further demonstrates the uneven nature of access to accurate time. In Britain, (and in America before the Naval Observatory wrested control from the universities) obtaining accurate time was costly. The general public had little desire to access it, and little opportunity to do so even had they wished it, except in urban centers via their place of employment, or by chance, should they happen to live nearby a public time signal (which, as demonstrated in the previous chapter, were highly unreliable). Its inaccessibility led to significantly differing opinions about temporal authority. Proponents of standard time, Sandford Fleming included, hoped that education might be the vessel

[28] A centralized timekeeping authority would eventually evolve in Canada, but not until the 20th century.

through which public opinions about timekeeping might be consolidated under the banner of standard time.

In Canada, the actual distribution of time was not so directly tied to educational institutions as it was in the United States. Government run observatories, not universities, were the primary distributors of time to Canadian cities. But timekeeping and schools interacted in a different way, facilitating the education of the public about the various methods of time measurement. Before diving into that subject, some context about how time distribution worked in Canada is in order, because whether the public understood standard time or not was a moot point if they could not access it.

Distributing accurate standard time across all of Canada required regional coordination. Like the United States, Canada's distribution system was highly decentralized until the turn of the century. As a relatively new conglomeration of smaller colonies, Canada was home to quite a few independent time signals. Quebec, Halifax, Montreal, Vancouver, Saint John, Toronto, Fredericton, Kingston, and Victoria all boasted their own timekeeping observatories at some point during the second half of the nineteenth century.[29] At Montreal, from 1870, Director Charles Smallwood operated a time ball at the city's wharf for shipping, which dropped daily, Sundays excepted. Montreal also gave "time to the city by means of the fire alarm telegraph wires," and transmitted local time to the Post Office in Ottawa.[30] Meanwhile, the Toronto

[29] Malcolm Thompson, *The Beginning of the Long Dash: A History of Timekeeping in Canada* (Toronto: University of Toronto Press, 1978), xii.
[30] Annual Report of Charles Smallwood, Director of the Montreal Observatory, 1870, RG6, A1, Vol 10, Library and Archives Canada (LAC).

Observatory operated time signals for Toronto, while overseeing the time service of the observatories in Montreal, Quebec, and St. John.[31]

Eventually, in 1905, the new Dominion Observatory in Ottawa took over the role of being Canada's primary time signal, subsuming the other observatories under its direction. The history of the rise of the Dominion Observatory has been told by Malcolm Thompson, who worked at the Dominion Observatory from 1929-1970. On top of connecting the time services by wire across the country, the Dominion Observatory also very quickly set up a sophisticated time distribution service for the Ottawa area, for government buildings in particular. Synchronized clocks were installed in Parliament buildings, and by 1907 the system included 227 clock dials, with plans to extend it to the Post Office and the Mint.[32] The Dominion Observatory operated a time gun and time ball in Ottawa as well.

The question of the cost of these time signals, like elsewhere, was a matter of some importance. Unlike the private observatories of the USA, Canadian observatories charged no fee for their time service work. This fact irked some of the astronomers at the Toronto Observatory in 1909, whose time service was quite extensive. They wrote to the Astronomer Royal at Greenwich, asking "what charge, if any, you make to the City of London or any private corporations for giving the time. Our Time Service in Toronto is assuming very large proportions and heretofore we have made no charge, a service which

[31] Memorandum on the transfer of the Toronto Observatory from the Marine to Interior Department, 1892, RG15 Vol 669, LAC.
[32] R.M. Stewart, "The Time Service at the Dominion Observatory" *Journal of the Royal Astronomical Society of Canada* 1 (1907): 97, 99, 102.

today is being somewhat abused."[33] If the Toronto astronomers were hoping to find a precedent for charging for the time service, they were disappointed by the Astronomer Royal's reply, who pointed out that any income from the time service in Britain was collected by the Post Office, not the observatory.[34]

Quebec City also had a robust time service. As an important port, time signals for the harbour were vital to the city's economy. By 1856, the observatory was already set up for a time signal, consisting of a small transit room for observing star transits and ball tower at the Citadel in Quebec. But Edward David Ashe, the observatory's superintendent, was not content with that. He wanted to expand its function to include longitudinal determination, meteorology, and the observation and discovery of "celestial phenomena," in essence turning Quebec's simple time observatory into a world-class multipurpose astronomical observatory.[35] The Canadian Institute, still a young organization at that point, supported Ashe's request.[36]

The observatory did expand, but as it grew, timekeeping remained central to its purpose. Ashe wrote to George Airy in 1869, asking about applying electricity to the time ball, and received detailed instructions on how to do it, in particular in reference to a cold climate (in winter, the Quebec Observatory did not operate its time ball, relying instead on firing its time gun. Each spring, when the ice cleared and navigating the St. Lawrence

[33] B.C. Webber to Astronomer Royal, Greenwich, September 7, 1909, RGO7.252, Royal Greenwich Observatory Archives, Cambridge University Library (CUL).
[34] The Astronomer Royal, Cambridge, to the Director of the Meteorological Office, Toronto, November 26, 1909, RGO7.252, Royal Greenwich Observatory Archives, CUL.
[35] Edward David Ashe to the Governor General, November 19, 1856, RG93, Vol 82, Quebec Observatory, LAC.
[36] Petition of the Canadian Institute to Erect and Endow a 'National Canadian Astronomical Observatory,' March 18, 1857, RG93, Vol 82, Quebec Observatory, LAC.

was possible again, the time ball was put back into operation).[37] Edward David Ashe's son, William Ashe, took over the observatory in the mid 1880s, continuing his father's focus on meteorology and exploratory astronomy. But the younger Ashe occasionally neglected the time signal, and he was scolded in 1888 for taking his transit measurements too often by the sun, not correcting the error of his instruments carefully enough, and not taking star transits often enough.[38] Like in Britain, where the time signals were very often wrong, complaints about the Quebec Observatory's inaccuracies were common.[39]

Just as in other countries, there were also questions as to the nature of the time service. Was it a public good that ought to be made easily accessible, or a commodity to be restricted to professionals and paying customers? In Canada, this debate played out in the form of a dispute over advertising, and whether the government ought to pay for ads concerning the time service's existence and the nature of its use. In 1889-90, the Department of Marine and Fisheries set about researching how much other countries spent on such advertisements. They wrote to their British and American counterparts, asking if their governments paid to advertise their time signals to the public.[40] The US Naval Observatory replied that newspapers there reported the time signal service free of charge, since it was of great interest to a large number of readers.[41] The British Admiralty's reply gave the impression that their time signals were not advertised much at all, though mariners could purchase a pamphlet describing the time signals at major ports

[37] William Ellis to William Ashe, April 16, 1869, RG93, Vol 82, Quebec Observatory, LAC.; R. Stupart to Arthur Smith, January 9, 1895, RG93, Vol 82, Quebec Observatory, LAC.
[38] Andrew Gordon to William Ashe, February 16, 1888, RG93, Vol 82, Quebec Observatory, LAC.
[39] See Edward Ashe to Mr. Smith, October 20, 1879, RG93, Vol 82, Quebec Observatory, LAC. William Ashe to P. Garneau, May 16, 1888, RG93, Vol 82, Quebec Observatory, LAC.
[40] Deputy Minister of Marine, Memo, December 31, 1889, RG12, Vol 1231, Meteorological Service, LAC.
[41] Chief Signal Officer to William Smith, January 17, 1890, RG12, Vol 1231, Meteorological Service, LAC.

worldwide.[42] The Department of Marine and Fisheries took from these correspondences that "it is not customary to pay for the advertising of time ball notices."[43]

The Department also learned that in the United States, the Western Union Telegraph Company distributed time for free from the Naval Observatory. Armed with this information, the Department of Marine and Fisheries reached out to the Canadian Pacific Railway Telegraph, who agreed to do the same, free of charge, in Canada.[44] A few weeks later, however, the telegraph company withdrew its offer, after learning that the time signal would be sent at noon, a peak traffic time.[45] The Great North Western Telegraph Company also declined, saying that the great distances involved would mean "it would be difficult, if not altogether impossible, to perform the Service at all to your satisfaction…I am sure it would only lead to disappointment and dissatisfaction to all concerned."[46] Just as with the STC in Britain, time delivered by modern technology was not always the most reliable.

Nonetheless, the producers of time had to find a way to establish public confidence in their ability to deliver it. In 1891, after a shipmaster complained in the *Morning Chronicle* about the lack of temporal data available to mariners, William Ashe, Director of the Quebec Observatory, wrote to Charles Carpmael, Director of the Toronto Magnetic Observatory and Superintendent of the Dominion Metrological Service at the

[42] Evan MacGregor to the Board of Trade, January 25, 1890, RG12, Vol 1231, Meteorological Service, LAC.
[43] Memo to Minister, February 17, 1890, RG12 Vol 1231, Meteorological Service, LAC.
[44] Charles Carpmael to William Smith, March 12, 1890, RG12, Vol 1231, Meteorological Service, LAC.
[45] Charles Hosmer to Charles Carpmael, March 27, 1890, RG12, Vol 1231, Meteorological Service, LAC.
[46] H.P. Dwight to Charles Carpmael, March 28, 1890, RG12, Vol 1231, Meteorological Service, LAC.

Department of Marine and Fisheries, requesting to advertise the time signal in the newspapers.[47] As Ashe pointed out:

> The present system seems to be most unsatisfactory, in which there is no advertisement whereby shipmasters coming to the Port can tell that there is a Time Ball and the hour at which it is dropped. This advertisement is a matter of secondary importance in harbours which are largely frequented by Steamships, as they, voyaging constantly to and fro between the same points, learn all necessary details in connection with the Ports visited. In the case of this Port, the vessels visiting which are largely sailing ships, and the Masters not of the most intelligent class perhaps, the usefulness of the time service is to some extent lost, on account of this lack of information.[48]

Mr. Smith, a skeptic at the Department of Marine and Fisheries, believed the notice in the *Chronicle* was a ploy to get the department to pay the newspaper $25 a year for the advert. As far as he was concerned, the shipmasters were informed of the time ball directly by an agent, which was superior to a newspaper anyways.[49] An agent was sent to investigate, and he reported back that while the ad might be useful, he saw no reason why the time signal should be given special treatment over other matters important to shipmasters.[50] But the question of distributing information about the time signal remained open until 1894, when the Director of the Meteorological Service in Toronto instructed Ashe's successor at the Quebec Observatory, Arthur Smith, to begin publishing notices in the newspaper when the time ball was wrong, along with the error, so that it could be corrected.[51]

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[47] William Ashe to Charles Carpmael, July 18, 1891, RG12, Vol 1231, Meteorological Service, LAC.

[48] William Ashe to Charles Carpmael, July 18, 1891, RG12, Vol 1231, Meteorological Service, LAC. With an almanac, a sextant, a clock set on Greenwich time, and a trained crew member, an observatory time was not needed. The trained crew member might have been missing on those poorer classes of sailing vessels.

[49] Memorandum on the Time Ball at the Citadel, Quebec, July 29, 1891, RG12, Vol 1231, Meteorological Service, LAC.

[50] Charles Carpmael to unknown, August 17, 1891, RG12, Vol 1231, Meteorological Service, LAC.

[51] R. Stupart to Arthur Smith, July 7, 1894, RG93, Vol 82, Quebec Observatory, LAC.

Even with systems of distribution in place, timekeeping in Canada continued to be a contentious topic. Astronomers and railroad officials claimed that standard time based on Greenwich was authoritative, but this claim met with resistance and was limited by the challenges of distribution. The 1883 implementation of railroad standard time evoked mixed reactions. Proponents like Fleming were overjoyed. For others, particularly in rural areas, the change was hardly noticed. For many it was not a change at all, as local time continued to be used in places beyond major cities and railroad stations. The Massey Manufacturing Company, a noted manufacturer of agricultural machinery, published an article in their circular, *Massey's Illustrated*, explaining standard time to rural customers a few months after standard time's initial adoption. It proclaimed that "one of the events of the age is the arrangement of the 'Standard Time,' an achievement which this generation may well be proud of. We suppose our rural friends, who are not so tied to exact time, have not noticed the change like the town and city folks, who are not guided in their daily pursuits by the sunrises and sunsets but must move promptly to the minute."[52]

Standard time was largely an urban phenomenon. In Toronto, according to *The Truth* newspaper, it took just a week for people to become accustomed to the time change, writing that "there was some confusion Sunday last, but everything is now serene and most people don't know the difference, except that the mornings are a little longer dark after six o'clock, and the evenings vice versa."[53] Students at the University of Toronto were informed about the time change by their student newspaper, *The Varsity*,

[52] *Massey's Illustrated,* January, 1884.
[53] *The Truth*, November 24, 1883.

which joked that students might make the best of the change by spending the extra time with their sweethearts:

> Undergraduates who have engagements for next Sunday evening to accompany young ladies to church, are reminded that it will be necessary to pass a given point 17’, 34” earlier than formerly, as the Standard Time comes into operation at noon on that day. It is equally important, however, to remember that for the sake of old times they may leave the family residence after church at 17’,34” later than the apparent time on the parlor clock, which the thoughtful small brother will doubtless set on the new method.[54]

Although the change itself affected urban centers more than rural areas, the actual process of changing the clocks on that Sunday in November of 1883 was clearly a trivial one, easily understood and carried out simply enough. What complicated it was that other times did not immediately disappear. Standard time now existed alongside the other times, rather than replacing them entirely, leading to a lack of clarity for decades to follow. One inquirer to the Quebec Observatory in 1896, for example, was still unsure whether the time gun at Quebec was fired according to standard time or local time.[55] A decade of use had not yet entirely solidified the supremacy of standard time in Canada.

Between the rural population who did not have much use for standard time, and those urban dwellers who made the change more readily, there were some who were well aware of the time change, but were vocally opposed to it, finding it both confusing and frustrating. In chapter one, we briefly discussed how Fleming received a series of complaints from one such critic, G.W. Wicksteed, who was the Law Clerk of the House of Commons. Wicksteed was not against the railroads using standard time, but he

[54] *The Varsity,* November 17, 1883.

[55] Bloomfield Douglas to the Director of the Quebec Observatory, May 6, 1895, RG93, Vol 82, Quebec Observatory, LAC.

preferred that local time continue to be used for daily life and for the purposes of governance. In particular, he was concerned about the role of timekeeping in maintaining fair elections.

Wicksteed kept up a polite but lively debate with Fleming in the years following the introduction of standard time. In 1885, he wrote a particularly lengthy missive complaining about the problematic nature of the arbitrary one hour time difference at certain lines of longitude.[56] "We have no natural time zones, but five divided by invisible lines," wrote Wicksteed, comparing the situation in Canada to that in the United Kingdom, where the Irish Sea separated Dublin time from Greenwich time.[57] These arbitrary lines used in North America, he continued, were "very hard to find (as you know) even by men of science…And yet on one side of such lines it is late day, and on the other side by law night. A returning officer on our side of such a line in our county of Essex, would have to close his office an hour sooner than his deputy on the other side – and yet each of them are bound by law to close at the same hour, and a man may lose his election by having some of his votes received before or after the legal hour."[58] Wicksteed was surely overstating the actual threat to the democratic process, but he was right to raise the question of time and the law. What time was legal time? There were cases where it mattered. Malcolm Thompson points out a case in London, Ontario from 1893 in which the legal hours for serving alcohol came into question.[59] Two bars had stayed open until

[56] Ironically in a letter about keeping time correctly, the letter is dated February 31st, 1885, a date that should not exist by most western calendars. G.W. Wicksteed to Sandford Fleming, February 31, 1885, Vol 53, Fleming Papers, MG29 B1, LAC.
[57] G.W. Wicksteed to Sandford Fleming, February 31, 1885, Vol 53, Fleming Papers MG29 B1, LAC.
[58] G.W. Wicksteed to Sandford Fleming, February 31, 1885, Vol 53, Fleming Papers MG29 B1, LAC.
[59] Thompson, *Beginning of the Long Dash,* 34.

10 pm solar time, rather than standard time, earning themselves a half an hour extra serving time.[60] According to the *Ottawa Free Press*, the magistrate ruled that "all authorities were in favor of solar time, and without some act to legislate Standard Time the other must govern. He therefore dismissed the case. The effect of the judgement will be to allow bars to remain open nearly half an hour later Saturday nights, as well as every other week night."[61]

Wicksteed published some of his own concerns in the *Ottawa Citizen*, reiterating his concerns about the possibility of election fraud, but also about the legal implications of the time change. He wrote, "Our criminal law defines 'night' to be 'the time between nine o'clock in the evening and six o'clock in the morning on the next succeeding day.'"[62] As the time zone system created one hour jumps at each line, court cases would become complicated, because "the law draws very important distinctions between crimes committed in the night or in the daytime."[63] Wicksteed expanded on this argument in the *Legal News* in 1885, where he explained that 'Burglary' was defined specifically as a crime occurring in the night only. Similarly, insurance claims and mortgages might run into timing problems on either side of a meridian line.[64] Wicksteed was not alone in his concern. A contributor to the *Quebec Daily Mercury* wrote the following diatribe against the 1883 implementation of railroad time zones:

> It seems, indeed, amusing that so absurd an innovation should be so quietly received, not only by our country cousins across the line [America], but also by

[60] *Ottawa Free Press*, May 31, 1893, RG12, Vol 1220, Meteorological Service, LAC. Fleming used this case to try and pass legislation on a legal time, to avoid more confusion of a similar kind.
[61] *Ottawa Free Press*, May 31, 1893, RG12, Vol 1220, Meteorological Service, LAC.
[62] *Ottawa Citizen*, undated, Vol 53 20651 Vol 53, Fleming Papers MG29 B1, LAC.
[63] *Ottawa Citizen*, undated, Vol 53 20651 Vol 53, Fleming Papers MG29 B1, LAC.
[64] *The Legal News,* Vol 8, No. 15, April 11, 1885.

> the community at large. Without any apparent participation of the Executive, without any proclamation, or valid sanction of any kind, it is, for a time at least, an established reality, solely by the will and pleasure of a few visionary dreamers, gifted, apparently with an immeasurable capacity for fantastic fancies and baseless speculation. I would not be mistaken. The railway time system, as suggested, is eminently fit and proper for railway purposes – but for these alone. The local time need not have been interfered with. Both systems might, as hitherto, have gone on concurrently. They manage these things otherwise beyond the sea. Even in so simple a matter as the determination of the first meridian, it is with manifold deliberation, with cautious counsel, and with the aid of men of unquestioned position in the world of science, that they advance towards a decision. We may not have authorities of the same calibre on this side of the Atlantic, but fortunately, the question here at issue is one on which any person of ordinary education is competent to judge, and on which even the least instructed may easily become informed. A brief experience of the anomalies and inconveniences attending the new system will probably suffice: and the solution may be safely left to the common sense of the people, a criterion which, in the long run, never fails.[65]

Several things stand out in the anonymous author's letter. Like Wicksteed, the author took pains to point out, quite accurately, the impromptu nature of the time change, with no government sanction or legal framework for using standard time beyond the railroads. International law was just as lacking. The change preceded the IMC by a year, so there was not yet any international precedent for using Greenwich as the baseline for timekeeping. Indeed, the author was clearly aware of the deliberations going on over the Prime Meridian in Europe, though his interpretation of the deliberations by men of science as 'cautious counsel,' is somewhat inaccurate, as we saw in previous chapters. But this appeal to the authority of science, in opposition to 'dreamers' like Fleming and his railroad associates, is intended to paint standard time as intrinsically unscientific. This argument is a fascinating parallel to the events of the IMC. At the IMC, scientists wanted nothing to do with standard time; they wished to establish a universal time for

[65] *Quebec Daily Mercury*, November 20, 1883.

professionals alone, they did not wish to change the timekeeping habits of the public. This author shared that opinion: time reform for railroad professionals and for scientists were fine but forcing the same on the public failed to pass test the of ‘common sense.’

Fleming recognized the weak legal foundation of his innovation, and made multiple attempts to rectify the problem, citing as precedent the British law from 1880, which had made Greenwich time legal time for Great Britain. But he was unable to secure a federal law in Canada affirming the legal status of standard time. In one of his more concerted efforts to get a bill passed through parliament, he was thwarted by the impassioned objections of Major General D.R. Cameron, son-in-law of Charles Tupper, and head of the Royal Military College in the early 1890s.[66] Legal timekeeping would therefore be determined by individual provinces, not by the federal government.

Cameron’s opposition is worth examining. There is an extensive correspondence between Cameron, Fleming, and the Department of Marine and Fisheries over the issue of enshrining standard time as legal time, but Cameron summarizes his position most succinctly in a letter to the Department from November 1891:

1. Neighbours are most concerned in daily routine with sun time.
2. People remote from one another are interested mutually in relative time dissociated from sun time.
3. Zone time satisfies neither directly – i.e. without ever varying calculation.
4. Local time and Universal time immediately and directly satisfy all possible cases.[67]

[66] Thompson, *Beginning of the Long Dash,* 34. See also RG12, Vol 1220, Meteorological Service, LAC.; Volume 47, 50, Fleming Papers, MG29 B1, LAC.
[67] D.R. Cameron to W. Smith, November 30, 1891, RG12, Vol 1220, Meteorological Service, LAC.

Cameron, in other words, agreed with the scientists at the IMC. Universal time should be used for special purposes, and local time for everyday life. Trying to combine the two by using standard time complicated timekeeping for everyone and pleased no one.

Fleming retorted that "Zone time needs no defence. It is not an untried theory or experiment. It has been in daily use in Canada and throughout this continent for nearly nine years."[68] Fleming further admitted that while Cameron may be right in his assertion that many Canadians still used the old method of keeping time, the influence of the railroads and telegraphs surely meant that zone time would soon be universal. "I venture to think that the day is not far distant where no person will dream of using any other reckoning; unless perhaps those persons who are in out of the way places such as the remote ports of the Hudson Bay Company."[69]

Cameron dramatically justified his lengthy impassioned objection to zone time as "an attempt to prevent a national calamity."[70] Charles Carpmael, Superintendent of the Dominion Metrological Service, disagreed with Cameron. Carpmael was one of the key figures in Canada's time service and in astronomy (Carpmael had participated in the transit of Venus observations in 1882).[71] Here, he fully supported Fleming's attempt to make a federal legal time for Canada in spite of Cameron's objection.[72]

These arguments used in the debate over the bill should seem familiar by now. Whether universal time or local time ought to be paramount, with standard time as a

[68] Sandford Fleming to William Smith, May 14, 1892, RG12, Vol 1220, Meteorological Service, LAC.
[69] Sandford Fleming to William Smith, March 21, 1892, RG12, Vol 1220, Meteorological Service, LAC.
[70] D.R. Cameron to William Smith, March 7, 1892, RG12, Vol 1220, Meteorological Service, LAC.
[71] Thompson, *Beginning of the Long Dash,* 27.
[72] Charles Carpmael to William Smith, February 20, 1892, March 2, 1892, RG12, Vol 1220, Meteorological Service, LAC.

compromise between the two extremes, had been thoroughly flogged over and over again. No one seemed to object to the existence of all these types of time; the debate was about which one was authoritative, and to whom. The railroads, telegraphs, and observatories could have all the specialized time notations they wanted, but the public, people like Cameron argued, ought to be let alone to use the local solar time. In the short term, Cameron's view won out. But the unofficial influence of standard time, under the direction of the railroads, was hard to eradicate, and Fleming, in particular, made a concerted effort to advertise standard time to the public. Even after the IMC, standard time based on Greenwich needed to be lobbied for, plugged, advertised, and sold. Fleming worked hard to teach the public about it, and his main target, beyond lobbying parliament to make standard time the law of the land, were children and schools.

It is in this context that our discussion of education in Canada takes place. Having failed to establish a legal framework for standard time, Fleming hoped instead to solidify its primacy through the inculcation of social norms. In other words, if the public could not be coerced to use it, they had to be taught to use it. To overcome the challenges of distributing the time, and of keeping the public informed about relevant sources of time, a massive public education campaign was required.

Public schools were the logical instrument of dissemination. Fleming wrote a pamphlet for the Canadian Institute in 1888 explaining time zones to children, with the express purpose of using it as a teaching tool for schools, titled "Time and its Notation."[73] Fleming, always thinking beyond Canada, also hoped the pamphlet would be used in the

[73] Canadian Institute Memorial, The Uniform Notation of Time by all Nations, 1888, File 4-0-3, F1052, Archives of Ontario (AO).

United States. In fact, he had first written it for the American Metrological Society (AMS) in 1887, but that society rejected it. The AMS' members subjected it to some harsh criticism. Its biggest problem was that it was not well written for an elementary school setting, and lacked the clarity needed to be a proper pedagogical tool. Barnard suggested making it more brief and clear, so that teachers and children might get more out of it. He also pointed out that Fleming failed to include practical examples as teaching aids.[74] William Allen had similar concerns, writing "I fear it would not be utilized by the average teacher, nor be understood by the average pupil. If it were possible to condense the ideas expressed, in about one-third of the space…then I am inclined to think the attention of both teachers and pupils could be secured."[75] Fleming was not used to writing for a young audience.

Instead of rewriting the pamphlet, Fleming simply turned to a different society to publish it. The Canadian Institute accepted it, and forwarded it to the Governor General, with the intent that it be distributed not only to Canadian schoolteachers, but also that it "be transmitted to the governments of all foreign countries for the information and use of their educational authorities…[as well as to] the Minister or Superintendents of Education in all British Colonies and Possessions."[76] The governor general, the Marquess of Lansdowne, who was nearing the end of his term and was on his way back to London, promised to carry out their request in person, making their case to the imperial

[74] F.A.P. Barnard to J.K. Rees, February 4, 1888, Vol 40, Fleming Papers, MG29 B1, LAC.
[75] William Allen to J.K. Rees, January 9, 1888, Vol 40, Fleming Papers MG29 B1, LAC.
[76] Canadian Institute Memorial, The Uniform Notation of Time by all Nations, 1888, File 4-0-3, F1052, AO.

government in London.[77] Copies were sent to the Netherlands, and most other countries that Britain had relations with, although Bolivia and Venezuela did not receive copies because they had no British Embassies (Venezuela and Britain had cut off diplomatic relations in 1887 due to a territorial dispute, and the Embassy in Bolivia had been replaced with the a joint Embassy in Peru). The copies intended for the Orange Free State had to be forwarded indirectly via the South African Government.[78] After they were received, the acting president of the Orange Free State replied that "our state being wholly surrounded by other colonies and states, no other system of universal time notation can be established than that adopted by our neighbours."[79] Italy and India also received copies, while Hong Kong asked for twenty-five more.[80]

The Canadian Institute also distributed their pamphlet domestically. One of the most favourable responses came from the superintendent of the Ontario Department of Education, who asked for five hundred copies of the pamphlets "for distribution to the inspectors of public schools and the headmasters of high schools throughout the Province."[81] The New Brunswick school board ordered three hundred copies, while the school board of the North West Territories ordered two hundred.[82] The Catholic school

[77] Governor General to Charles Carpmael, undated, File 4-0-3, F1052, AO.
[78] Lord Knutsford to the Governor General, July 23, 1888, File 4-0-3, F1052, AO. For the Netherlands, see British Legation, The Hague to the Canadian Institute, July 3, 1888, File 4-0-3, F1052, AO.
[79] Acting President Orange Free State to Sir Hercules Robinson, September 17, 1888, File 4-0-3, F1052, AO.
[80] Mr. Kennedy to the Marquis of Salisbury, July 8, 1888, File 4-0-3, F1052, AO.; India Office to Colonial Office, July 4, 1888, File 4-0-3, F1052, AO.; Colonial Secretary to the Canadian Institute, November 2, 1888, File 4-0-3, F1052, AO.
[81] Education Department of Ontario to Charles Carpmael, March 27, 1888, File 4-0-3, F1052, AO.; Canadian Institute to the Chief Superintendent of Education, Ontario, May 15, 1888, File 4-0-3, F1052, AO.
[82] Chief Superintendent of Education, New Brunswick, to Charles Carpmael, June 4, 1888, File 4-0-3, F1052, AO.; North West Territories Board of Education to the Canadian Institute, August 9, 1888, File 4-0-3, F1052, AO.

board of Manitoba was less supportive, but did promise to put it before the Board at their next meeting.[83] The Superintendent of the Protestant school board of Manitoba, meanwhile wrote back saying that "as the new time notation is in almost universal use in this province, there will be little difficulty in having it understood…It will not be long before the new system becomes universal."[84] Other provinces did not immediately request further copies, but did distribute the few that the Canadian Institute sent up front for review by boards and teachers.[85]

Other proponents, most more adept than Fleming at pedagogy, attempted to make a living out of creating teaching tools for the new time zones. One Philadelphia publisher sold a 'time chart' for use in schools and mailed it to Fleming in hopes of expanding his customer base to Canadian schools.[86] This time chart fixed the inaccessibility problem that Fleming's own pamphlet had had. It was designed with teachers, students, and the learning process in mind. The advertisement for the time chart included reviews of the product from teachers, and although obviously curated to only include positive reviews, the teachers' responses show how useful the visual aid was in teaching time changes to students in public schools. The visual aid provided in the chart simplified the subject in a way Fleming's pamphlet could not. As one teacher wrote, "Longitude and Time is the most difficult section of the arithmetic to explain," but the time chart made it easy.[87]

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[83] Departement de l'Instruction Publique, Section Catholique, to Canadian Institute, June 2, 1888, File 4-0-3, F1052, AO.
[84] Superintendent of Schools, Manitoba, to the Canadian Institute, June 4, 1888, File 4-0-3, F1052, AO.
[85] David Allison to Charles Carpmael, June 6, 1888, File 4-0-3, F1052, AO.; D. Montgomery to Charles Carpmael, June 9, 1888, File 4-0-3, F1052, AO.; S.D. Pope to R.W. Young, June 13, 1888, File 4-0-3, F1052, AO. Quebec Department of Public Instruction to Charles Carpmael, June 26, 1888, File 4-0-3, F1052, AO.
[86] L. McCaskey to Sandford Fleming, Undated, File 4-0-3, F1052, AO.
[87] L. McCaskey, Longitude and Geographical Time Chart, File 4-0-3, F1052, AO.

Another teacher wrote, "By it [the chart], dull pupils understand at a glance what attempted explanations failed to do."[88] Another, expounding on the difficulty of teaching time zones without visuals aids, wrote that it was "a valuable invention, throwing much light on a dark subject."[89]

Maps were already a common presence in schools, and as early as January 1885, maps for schools which included standard time zones were in print and available to teachers.[90] *The Home and School Supplement*, an illustrated monthly magazine edited by Seymour Eaton, included information for teachers on teaching standard time in several issues. The issue for September 1885 included a page of exercises on standard time, asking students to find the time difference between major cities, or how standard time differed from local time.[91] The March 1886 issue included an advertisement for a standard time map.[92] Educators were certainly not lacking for materials.

Although standard time seemed to be entering the curriculum fairly widely in Canada, Fleming wanted more. He tried to get support from his American peers through the American Society of Civil Engineers, reporting to their annual meeting in 1888 on the question of teaching time in schools. Quoting the Manitoban Education official who had said that use of the new time would surely soon be universal, Fleming argued that teaching it to the next generation was the best way to secure its continued use. Fleming always associated standard time with twenty-four-hour notation, and he conflated the two

[88] L. McCaskey, Longitude and Geographical Time Chart, File 4-0-3, F1052, AO.
[89] L. McCaskey, Longitude and Geographical Time Chart, File 4-0-3, F1052, AO.
[90] *Education Weekly,* January 1, 1885.
[91] *The Home and School Supplement,* September 1885. See also *The Home and School Supplement*, March 1887, and December 1886.
[92] *The Home and School Supplement,* March 1886.

in this report. Where the Manitoban letter had stated that standard time was used by almost everyone, Fleming took that to mean twenty-four-hour time as well. But that was hardly the case. According to one railroad worker, the twenty-four-hour clock system, which Fleming so closely associated with time zones, was not in universal use in Manitoba in the 1880s, but was rather confined to villages, while solar time continued to be in common use for the purposes of farming.[93] Apparently, when given the time in twenty-four-hour notation, "those from the country do not know what to make out of it…the question is generally asked 'what is that by our old time?'"[94]

Nonetheless, Fleming was sure that teaching it to children would bring about reform even in rural areas, as these children, upon learning the new notations, would "carry them to their homes, and thus educate their fathers and mothers…Through the medium of schools it is believed that in a comparatively few years the people will have their minds familiarized with the whole question."[95] Fleming suggested the ASCE forward copies of his pamphlet to the American Bureau of Education, and pressure them to "enjoin teachers to give special lectures and lessons on the subject to the pupils attending the schools."[96] One committee member, Fred Brooks, called Fleming's proposal "beyond the province of the society," but the rest of the committee took Fleming's side

[93] E. Peel to W. Whyte, December 11, 1886, Vol 51, Fleming papers MG29 B1, LAC.; illegible to W. Whyte, December 11, 1886, Vol 51, Fleming papers MG29 B1, LAC.

[94] Mr. McAdam to W. Whyte, December 11, 1886, Vol 51, Fleming papers MG29 B1, LAC.

[95] July Proceedings, Report of the Special Committee on Standard Time, Vol 2, Fleming papers MG29 B1, LAC.

[96] Fred Brooks to the American Society of Civil Engineers, November 3, 1888, Vol 2, Fleming papers MG29 B1, LAC.

over Brooks.[97] In any case, it was clear that standard time by the late 1880s was being integrated into school curricula, although in spite of Fleming's poor pedagogical prose, rather than because of it.

The experience of students, and their reception of Fleming's dense explanatory pamphlet, is harder to get at. What is available suggests a somewhat less positive outcome, particularly in rural areas. This is not to suggest that they did not grasp standard time. Rather they simply had little use for it. Yet rural schools taught the concepts nonetheless, and schools for Indigenous children were no exception. The following section discusses the reception of standard time in schools on two reserves in southern Ontario. The experience of these schools and their communities offer a unique perspective on the reception of standard time. It demonstrates that the vision of modernity embraced by standard time advocates was malleable and open to alternative definitions and uses. Indigenous communities embraced or rejected standard time when it was useful to them, in order to navigate the specific challenges and prejudices they faced.

The schooling of Indigenous children in Canada is caught up in the history of colonial oppression. As historian Jo-Ann Achribald writes, "the beginning of institutional schooling signalled the beginning of the decimation of many First Nations' societies…even though the children were provided with an education which ostensibly was to enable them to 'fit' in to mainstream society, the truth was that they did not."[98] Indigenous children were taught to assimilate, but prejudice ensured that they were never

[97] Fred Brooks to the American Society of Civil Engineers, November 3, 1888, Vol 2, Fleming papers MG29 B1, LAC.

[98] Jo-Ann Archibald, "Resistance to an Unremitting Process: Racism, Curriculum, and Education in Western Canada," in J.A. Mangan, *The Imperial Curriculum: Racial Images and Education in the British Colonial Experience* (London: Routledge, 1993), 107.

allowed to fully integrate as equals. The schools themselves were often oppressive spaces. As J.R. Miller writes, residential schools in particular were "an instrument of attempted cultural genocide."[99] In many places the school system "severed the ties that bound Native children to their families and communities, leaving semi-assimilated young people and shattered communities."[100] These schools had a "hidden curriculum" behind the subjects of arithmetic and language, and this was assimilation.[101]

Some Indigenous peoples, like the Mississaugas of the Credit, managed to stave off the worst of this attempt, keeping their identity while maintaining an imperfect association with the dominant community, using the school system to their advantage where possible. In the mid 19th century, Peter Jones (Kahkewaquonaby), a prominent Mississauga Chief, Methodist, and promoter of education - he was a friend of Egerton Ryerson - wanted "the schools eventually to be run by Indians, to produce duplicates of himself: men and women able to compete with the white people, able to defend their rights in English, under English law."[102] His descendants continued to adapt the system to their advantage as best they could, in spite of prejudice. As such, the Mississaugas of the Credit First Nation maintained a deep interest in education.

By 1884, they had developed strict rules for their schools on the reserve. School teachers enforced attendance with both the carrot and the stick, suspending pupils for truancy, but also providing a small monetary reward to students with the best attendance,

[99] J.R. Miller, *Shingkwauk's Vision: A History of Native Residential Schools* (Toronto; University of Toronto Press, 1996), 10.
[100] Miller, *Shingwauk's Vision,* 11.
[101] Miller, *Shingwauk's Vision*, 193.
[102] Donald Smith, *Sacred Feathers: The Reverend Peter Jones (Kahkewaquonaby) and the Mississauga Indians* (Toronto: university of Toronto Press, 1987), 160, 226.

and a larger prize for parents of those children who attended school regularly.[103] Class time lasted from 9 am to 4 pm, with an hour for lunch and two recesses of 15 minutes. Tardiness and early departures were carefully regulated, as was the ringing of the schoolbell. The teacher was required to ensure that “the school house should be ready for the reception of pupils at least 15 minutes before 9 o’clock a.m.”[104] Most significantly for our purposes, the rules and regulations for 1884 stated that “the time to be used in school work shall be the ‘New Time’ of the 75th Meridian.”[105] Only a year after the introduction of standard time on North American railroads, it was already being employed in the schools of the Mississaugas, eliminating competing time systems from their education.

The introduction of standard time was similarly quick in schools on the Moraviantown reserve in southern Ontario, leading to a heated debate amongst the Lunaapeew people of the Delaware Nation concerning their schools and timekeeping on the reserve in 1886. Moraviantown was home to two schools, known respectively as the ‘mission school’ and the ‘reserve school.’ The mission school “situated on a pleasant site, near the river Thames,” and was funded privately by the Moravian Mission, before eventually being sold to the Methodist Church.[106] Between 1885 and 1898, the teacher was Dora Miller, an English woman who was paid by the Moravian missionary society. The reserve school, meanwhile, had significant turnover in its teachers, going through at least six between 1885 and 1898. This high turnover rate proved significant in the debate that follows about standard time on the reserve.

[103] “Rules and Regulations of the Mississaugas of the Credit,” 16, 19.
[104] “Rules and Regulations of the Mississaugas of the Credit,” 16.
[105] “Rules and Regulations of the Mississaugas of the Credit,” 16.
[106] Inspector’s Report on the Moravian ‘Reserve’ Indian School, June 1885, RG10, Vol 5991, LAC.

Time measurement in Moraviantown, like most places in the 1880s, was in flux. Local solar time was the simplest method, but the Lunaapeew at Moraviantown were certainly aware of the adoption of standard time by the railroads in 1883. The reserve school had its own bell in a belfry on the schoolhouse roof, which was rung regularly on school days.[107] In fact, it was rung so often that vibrations from the bell were apparently causing structural damage, and an inspector recommended moving the bell to its own framework separate from the schoolhouse.[108]

But the bell was not for the students alone. It was also "rung to mark time for the neighbourhood."[109] A lively debate arose in 1886 centered around how the teacher determined the time for that bell. The teacher in 1886 was Daniel Edwards, who had taught at the reserve school since 1877. But members of the council of the Moraviantown reserve wanted to replace him with one of their own bright students, James Stonefish. As the inspector reported:

> There is a desire on the part of the Indian council to remove Mr. Edwards, and employ in his place Mr. James Stonefish, a young Indian who has returned from Nazareth, Penn. I could not recommend that Mr. Edwards be thus summarily dismissed, but as he intends to resign at the close of this year, I advised Mr. Stonefish to try meantime to pass at least H.S. Entrance Exam and to attend the Model School. I should be glad to see Mr. Stonefish in charge of the school after Mr. Edwards resigns but as he has had no training I do not consider him at all equal to the present teacher. I believe that Mr. Stonefish has a good English Education.[110]

The issue of replacing Edwards was a controversial one, and it played out publicly in letters to the editor of *The Indian*, a newspaper based in Hagersville, published by Dr.

[107] Inspector's Report on the Moravian 'Reserve' Indian School, February 1895, RG10, Vol 5991, LAC.
[108] Inspector's Report on the Moravian 'Reserve' Indian School January 1893, RG10, Vol 5991, LAC.
[109] Inspector's Report on the Moravian 'Reserve' Indian School, 1891, RG10, Vol 5991, LAC.
[110] Inspector's Report on the Moravian 'Reserve' Indian School, March 1886, RG10, Vol 5991, LAC.

Peter Edmund Jones (the son of Peter Jones mentioned previously).[111] *The Indian*, which ran for twenty-four bi-weekly issues between 1885 and 1886, was intended to be "a paper devoted to the Aborigines of North America and especially to the Indians of Canada."[112] A correspondence section allowed the airing of grievances from various indigenous communities from around Ontario, including the Delaware Nation at Moraviantown.

When the council moved to remove Edwards from his teaching position, they also moved to ask permission of the Department to appoint their own trustees and teachers, claiming that the inspectors and teachers had failed in their duties.[113] Their specific complaint against Edwards was that he had been arriving late to school, especially in the winter. But not everyone was pleased with their chosen replacement. As mentioned in the inspector's report, Stonefish did not have the same qualifications as Edwards. An anonymous correspondent, who signed with the initial W, wrote to *The Indian* explaining that they did not care who taught at the school, as long as the teacher was qualified. Stonefish, according to W, was not qualified. Furthermore, W claimed, the charges against Edwards' tardiness were unfounded. The members of the council, W wrote, "complain of the teachers arriving late in the morning during winter, yet there is no clock in the school house nor any standard time on the reserve."[114] W, keen to undermine the council's charges against Edwards, made use of the ambiguous nature of timekeeping on the reserve to exonerate Edwards. W then wrote to Lawrence Vankoughnet, the superintendent of Indian Affairs, to complain about the actions of the council.

[111] Donald Smith, *Sacred Feathers*, 239, 244.
[112] *The Indian.*
[113] *The Indian,* May 12, 1886.
[114] *The Indian,* May 12, 1886.

A response to W followed in the early May issue of the newspaper, written by John Noah, one of the council members who had voted to replace Edwards. Noah wrote, "the clever writer of the said article [W] talks at random, irrespective of telling the real truths and facts. Just fancy a man of common sense saying that there is no standard time in Moraviantown? Time, we have the Hamilton railway time regular from Bothwell; we even hear the town hall bell every day, and all our clocks and watches are set accordingly; and this clever man says there is no standard time."[115] Noah went on to explain the council's desire to engage their own teachers. The Council passed this motion "in order to encourage, as much as possible, our own young men of education and ability to devote their time and talents for the good of our fellow Indians."[116] Noah then defended Stonefish, saying that he had received his teaching certificate in Pennsylvania, and was perfectly qualified.

Standard time, and access to it, was being used as the central argument over who had the right to appoint teachers. W suggested that time on the reserve, as regulated by the school bell, was unreliable, and therefore calling Edwards late was impossible, given that he was quite literally the arbiter of time for the community, since he was the one who rang the bell. On the other hand, Noah, a representative of the council, claimed that the reserve did indeed have access to standard time, and did not rely on their schoolteacher for the time, but rather could hear the time signal from the rail station in the nearby town of Bothwell. Noah was attempting to claim some autonomy for the community and was

[115] *The Indian,* June 9, 1886.
[116] *The Indian,* June 9, 1886.

relying on the prestige and legitimacy that came with access to the new, modern, accurate standard time to do so.

But W was not the only critic of the decision to hire Stonefish as the reserve school teacher. A third letter to *The Indian*, published in July, refuted Noah's claim that the reserve had easy access to standard time. The author was James Dolson, a thirty-year-old Lunaapeew man, who had been married to Johannah Hill by the Rev A. Hartman of the Moravian mission two years earlier, in 1884.[117] Dolson wrote:

> Mr. Noah requests you to 'fancy a man of common sense saying there is no standard time in Moraviantown,' and I request you to fancy there is standard time in Moraviantown…For, assuredly, it would be but fancy, as the capacity of the Bothwell bell is but two miles, and the *nearest point* in the reserve is three miles, and the central point [where the reserve school was located] four and a half miles thence; hence the bell cannot be heard by us for a month at a time sometimes; only when the weather and wind are favorable, which is but seldom. Therefore the charge against our present teacher, Mr. Edwards, that he does not always call school, sharp, at 9 a.m., is merely a supposition, a catcall of his enemies.[118]

Dolson's mile measurements to Bothwell are reasonably accurate, but the range of the bell is harder to ascertain, making it difficult to know whether Noah or Dolson was correct. But in this case, knowing who was right is not necessary to be able to draw some conclusions about the whole affair. What is important is that people on the reserve were aware of standard time, and considered it to be authoritative, and thus Noah's assertion that he had access to standard time was also a claim to share its authority. Noah, in his desire to achieve some autonomy for the council and the community, appealed to the constructed authority of standard time based on Greenwich, claiming it for their own.

[117] Johannah Hill in the Ontario, Canada, Marriages, 1801-1928, 1933-1934, Registrations of Marriages, 1869-1928, Series MS932, Reel 46, AO.
[118] *The Indian,* July 7, 1886.

Edwards did leave his position as teacher of the reserve school, but he was not replaced by Stonefish. Stonefish went on to pass his High School Entrance exam and attended Ridgetown Collegiate Institute.[119] Edwards was instead followed by a revolving door of new teachers in quick succession. Like elsewhere in rural Canada and across the globe, standard time and local time would continue to exist side by side in Moraviantown. The teachers who succeeded Edwards would continue to act as the informal timekeepers for Moraviantown, in uneasy competition with the distant toll of standard time from the Bothwell bell.

As is apparent from the above discussions about the limited receptiveness of provincial boards of educations (Manitoba in particular), the proliferation of pedagogical supplements, and timekeeping in Indigenous schools, Fleming's dabbling in educational curricula produced mixed results. While it raised awareness about standard time, it could not enforce its use. People, regardless of nationality, class, race, or gender, used the time that was convenient to them. Many ignored standard time or treated it as a joke. But at the same time, there were people who made use of standard time for their own purposes. Standard time could be, and was, used as a status symbol, allowing its users to appear 'modern.' The Council of the Delaware Nation at Moraviantown used it to make claims about legitimacy, just as school inspectors used clocks as a measure of how westernized a school was. This tactic is not dissimilar to that of St. John Winne in Britain, who advertised his electric time service as modern, condemning Ruth and Maria Belville as unmodern, comparing a masculine, professional modernity with a 'strange,' outdated

[119] Inspector's Report on the Moravian 'Reserve' Indian School, 1888, RG10, Vol 5991, LAC.

femininity. In the United States, conflict arose over the place of government oversight in timekeeping, and the right of universities to profit from their distribution of temporal measurement.

The thread that unites all of these cases concerning standard time is that they all tell a story about power relations and the construction of authority. The delegates at the IMC, regardless of nationality, were privileged persons making decisions often disconnected from ordinary people. Indeed, as we saw, most delegates at the IMC were only concerned with scientific timekeeping. They had no intention of altering public clocks. Yet the decisions they made had ramifications beyond their expectations. Although Greenwich time was not meant to be used by everyone, the association of Greenwich time with authority and 'truth' made it desirable to some, as access to it became a trapping of status or profession. Helped along by promoters like Fleming and Allen, standard time, as a subsidiary form of Greenwich time, became accepted as the ideal form, the categorical imperative, of time measurement for the use of business and travel. But access to it was limited, and its practical application to rural life was negligible, so its implementation was slow. Meanwhile, other forms of timekeeping did not just disappear to make room for it. Standard time did not simplify timekeeping by sweeping away the competition, but rather added an additional temporal standard to operate alongside those already in place.

This chapter demonstrates the role played by educational institutions in imbuing standard time with its perceived authority. This occurred directly, as universities were the distributors of standard time throughout the United States, but also indirectly, through the curriculum imposed on students across North America. Where reformers failed to enforce 'modern' timekeeping by law, they espoused it through education. School schedules and strict truancy laws enforced a 'modern' time sense, which had implications for the perceptions of both class and race, as non-white and poor children were painted with the moral failings associated with a lack of adherence to modern clock-time. Yet modern timekeeping could be claimed by marginalized peoples as well in order to assert their own modernity, as done by the Council at Moraviantown. Education and institutional timekeeping were colonial tools, but they could be subverted, repurposed and challenged. These contradictions are indicative of the larger debate about timekeeping as a whole at the end of the nineteenth century. Greenwich time did not instantly become the basis for a universal, undisputed system of timekeeping like Fleming imagined. Nor would it remain the esoteric professional tool that scientists at the IMC envisioned. Instead, modern timekeeping would be an uneasy compromise between the two, warped by social and cultural contexts - a shifting standard, as messy, diverse, contested, and unscientific, as every other aspect of human life.

Conclusion

This dissertation began by tracing the history of an idea – standard railroad time. That idea had no single point of origin. It was conceived independently by various nineteenth century thinkers around the world. One of those people (not the first) was Sandford Fleming, a railroad engineer, who spent a great deal of time and energy promoting this idea. Fleming did not set out to change the world with this idea. He was a professional engineer, troubleshooting a mild – but industry-wide – inconvenience. He wanted to simplify rail timetables, which were currently inefficient, needing to incorporate dozens of local time systems. Fleming's idea was to reduce the number of local times to a manageable number – just twenty-four for the entire globe.

The railroad industry in North America liked the idea. Under the direction of William Allen, these new time zones were introduced in 1883. It was a quick and painless change in most major city centres, and quite a few municipalities even decided to change their local time to match the new railroad time, though others preferred to continue using local time, converting to rail time only when necessary for travel.

Fleming, involved as he was in diverse transnational projects, such as the attempt to establish telegraph cables under oceans to connect the diverse parts of the British empire, was not satisfied with uniting the timekeeping of just one industry on just one continent. He was a global citizen, as much as it was possible to be so in the nineteenth century, and an imperialist (those two identities were not mutually exclusive in his mind). He wanted to extend his idea in width – spreading it worldwide – and in depth –

extending it to other industries and to other facets of civil life. He saw that, although he was solving a railway problem, his solution had applications in other industries.

Standard time required participation on the part of the travelling public. At the very least, they had to understand how to convert their local time to railroad time when they wanted to travel. But would it not be even simpler, Fleming suggested, if everyone just switched to railway time for all aspects of their lives? Here is where Fleming's simple professional troubleshooting evolved into a potential paradigm shift. One system of timekeeping, for everyone, everywhere.

In a different profession on a different continent, another idea was stirring. Among European geographers and astronomers, there were plans in the works for a single, universal time for the globe. This was a smaller idea than it sounds. It was not intended that everyone would use this universal time, only astronomers, geographers, and navigators. Local time would remain the norm for laymen. A universal time would simply mean that astronomers from different parts of the globe, measuring extra-terrestrial phenomena like the transit of Venus, could measure the same phenomenon using an identical notation. They too were engaged in professional troubleshooting.

Both ideas began small. Railway standard time and astronomical universal time could have existed side by side, without friction, without ever acknowledging each other. But that was not to be. The nucleus of this dissertation is about what happened when these two separate ideas, dreamt up by professionals with their own separate networks, and their own spheres of expertise, collided. It is a case study of how temporal knowledge – and authority – was constructed. Like most scientific discoveries, modern timekeeping was not objectively 'discovered,' or 'observed,' or 'invented.' It was historically produced in a "decision-laden" process, to borrow a phrase from Karin Knorr-Cetina.[1] Individuals, working within their specific cultural contexts – not least of which included their professions – shaped modern timekeeping practices. These contexts both limited their scope of action and allowed them to manipulate cultural norms to cement their ideas.

Fleming's ambition to replace local time with standard time for all of civilian life across the globe led him to look beyond the world of engineering. Using his professional network, institutionalized in the Canadian Institute, he corresponded with scientific societies in America – some more reputable than others – who began lobbying the US government. The Institute also reached out to the Governor General of Canada in order to put Fleming's idea before the British government. Fleming's proposal for a global conference to discuss his idea – which required an international agreement on a shared prime meridian – led the British government to turn to its experts on prime meridians – astronomers who measured time for the navy. This brought the two ideas into direct conversation with each other. The timing was also important – European astronomers and geographers were coincidentally in the process of holding their own international meetings in Venice and Rome to discuss their universal time idea. The result was a joint international conference at which both of these entirely different ideas about timekeeping would clash – the 1884 International Meridian Conference (IMC).

Understood this way, it is easy to see that the central conflict at the IMC was between professions, not between nations. The two timekeeping proposals had little to do

[1] Karin Knorr-Cetina, *The Manufacture of Knowledge: An essay on the Constructivist and Contextual Nature of Science* (Oxford: Pergamon Press, 1981), 5.

with each other, and neither side was keen on the ideas of the other. Indeed, astronomers were not keen on sweeping time changes at all, instead focussing narrowly on a prime meridian for determining longitude for navigation, rather than for civil timekeeping (there is a reason it was called the International Meridian Conference, not the International Timekeeping Conference).

Astronomers' concerns at the IMC were products of their own context. The British Science and Art Department had chosen conference delegates based on their opinions on the controversy over the Metric System, not on their timekeeping expertise, because the metric controversy was the current topical crisis in the British scientific community in 1884. And the metric controversy, as demonstrated by the case of Charles Piazzi Smyth, was itself embedded in a larger cultural context of religious belief and the attempt to use science to confirm scripture via archaeology, astronomy, mathematics, and other natural sciences. This in turn was related to a broader context of imperial competition, notions of racial hierarchies, and nationalism. All these factors, discussed in detail in chapter two, alongside the changing boundaries between amateurs and professionals, and various methods of exclusion, inclusion, and legitimization, almost excluded Fleming from attendance at the IMC, despite their seeming irrelevance to timekeeping. These influences also meant that the British astronomers at the IMC repeatedly undermined Fleming, though he was their fellow British delegate, because he came to the table with entirely different goals based on an entirely different set of core assumptions formed in an entirely different context. The astronomers were wary of making any changes to civil timekeeping. They felt that dictating the way the public measured time was well beyond the scope of the meeting and overstepping their mandate. To them, Fleming was a radical. To Fleming, they were short-sighted and they misunderstood the opportunity they had to revolutionize (to simplify) global timekeeping.

At the IMC, Fleming's standard time was soundly defeated. But after the massive lobbying campaign he had carried out to promote his idea, much of the public conflated his idea with the results of the IMC. The two timekeeping ideas had inadvertently become combined. Newspapers confused the universal time for astronomers with Fleming's plan to reshape civil time for the public. No one seemed sure anymore whether the IMC had sanctioned universal time for specialized tasks, or for everyone. Watchmakers began applying in droves for patents which accommodated another of Fleming's proposals, the twenty-four-hour clock, which had also been grafted onto the IMC's universal time resolution.

The conflation of the two very different timekeeping ideas meant that the core assumptions of one idea were applied to the other and vice versa, adding new layers of complexity. The best example of this is the concept of accuracy. Unlike Fleming's standard railway time, astronomer's universal time required consummate attention to accuracy, down to a fraction of a second, to be of any use for the task for which it was intended. So when the public got the idea that universal time was to be used by everyone, some notion of heightened accuracy was parcelled with it. New commercial ventures latched onto this idea, attempting to sell accurate universal time, with variable success, to people and industries which had previously had no need for such temporal precision. These businesses were selling the future – a particular, technologically utopian future.

With temporal accuracy came the promise of progress. Time distribution companies offered the wealthy and the enterprising an alluring chance to associate oneself with cutting-edge modernity, and all of its trappings. Meanwhile, other entrepreneurs like the Belvilles marketed an alternative modernity, one with wider boundaries of social inclusion, yet still tied to the legitimacy of scientific accuracy produced by professional expertise and sanctioned by international diplomatic consensus.

The conflation of the two ideas also meant that neither side was particularly happy about the outcome. A frustrated and overworked Astronomer Royal at Greenwich, whose employees produced the accurate time sold to civilians, threatened to cancel the public time service, claiming it was extraneous to the purpose of the observatory. The Astronomer Royal was still clinging to the original version of universal time – that it was for professional use by astronomers and the navy, not for commodification or for public use (the fact that the profits from the public time service went to the Post Office, not the observatory, likely contributed to his stubborn dismissal of accurate standard time for civil use).

On the other side, Fleming was frustrated by the scaling back of his time scheme. The IMC agreement did not include any synchronized form of civil timekeeping, let alone standard time, and he had a hard time making it law even in North America, where it had found the widest acceptance. Neither Canada nor the United States enshrined standard time in law, while Britain legally adopted Greenwich time as a national time, but not standard time writ large. In spite of all the hubbub surrounding the IMC, local time continued to be the norm in much of the world.

Having failed in the legislatures, Fleming instead tried to convince the public to switch to the new time not by law, but by education, creating curriculum aids for use in public schools. Yet education as a means of altering norms of behaviour met with mixed results. People continued to use the time that was convenient to them. In some cases, like the customers of the Standard Time Company in Britain, or the council of the Delaware at Moraviantown, people claimed ownership of standard time in order to reflect its authority and modernity onto themselves for their own purposes. But others were just as happy to continue using local time and did so for decades after. The unintentional association of standard time with astronomical time's excessive accuracy meant that standard time was not more broadly adopted until wireless technology made the dissemination of accurate time more affordable in the 1920s. By that time, because the IMC had failed to institutionalize standard time as an international norm (only Japan had ratified the agreement, and in any case the agreement did not enforce any change to civil time), the nation-state had become the principal determinant of timekeeping practises, only loosely following longitudinal time zones. The stubborn resilience of nation-state authority in the face of transnational forces throughout the twentieth century is undeniable, as observed by Vanessa Ogle.[2] Yet it would be a mistake to suggest that the nation-state reigned supreme in the construction of temporal practices at the beginning. It was not the only, nor even the most important source of legitimacy which established modern timekeeping as it now exists. As this dissertation has shown, professional and individual identity,

[2] Vanessa Ogle, *The Global Transformation of Time, 1870-1950* (London and Cambridge: Harvard University Press, 2015).

wrapped in a cultural context (which included nationality, admittedly, but not exclusively), made time take the shape that it did.

If there is a single, influential work which initiated scholarly discussions about timekeeping in history, it would have to be Marxist historian E.P. Thompson's 1967 article "Time, Work-Discipline and Industrial Capitalism."[3] Thompson's contribution has not yet been discussed in this dissertation, as it focuses on an earlier time period. Yet questions raised by Thompson are at the root of much that has been discussed, if indirectly, so it is worth delving into, and makes a fitting coda to this dissertation.

Thompson's article is concerned with changing notions of time during the industrial revolution. For Thompson, this change in time-sense was the direct result of technological improvements in the measurement of time, and of the practices of the newly industrialized economy. He paints a picture that involves a stark division between before and after: for most of human history, time had been measured by nature. Fishermen and sailors scheduled their days around the tides, and farmers had to harvest during the correct season. Under natural time, work was task-oriented, and the day was organized around what needed to be done.[4] Work and leisure were not separate from each other. As Thompson put it, under natural time "social intercourse and labour are intermingled – the working day lengthens or contracts according to the task."[5]

In the early industrial environment of the 1700s, however, natural time gave way to a strictly regimented clock time. There was, according to Thompson, an air of

[3] E.P. Thompson, "Time, Work-Discipline and Industrial Capitalism," *Past and Present* 38 (February 1967).
[4] Thompson, 59-60.
[5] Thompson, 60.

superiority about clock time. “To men accustomed to labour timed by the clock,” he wrote “this [natural, task oriented] attitude to labour appears to be wasteful and lacking in urgency.”[6] With the advent of accurate timepieces, employers were able to pay for their employee’s time: they were no longer paying for the completion of a task but for a certain number of hours; hours that they did not want to see wasted. Time became currency.[7] Once established, clock time was not just enforced by employers, but inculcated by social institutions, including schools, which taught punctuality and industriousness, which Thomson calls “time-thrift.”[8] Time measurement itself, Thompson concludes profoundly, became an instrument of labour exploitation.[9]

Thompson presents a powerful demonstration of the significance of time measurement on human behaviour. His argument is largely convincing: Britain’s industrial society changed its worker’s very way of thinking about time, their “time-sense,” in order to contract them into working regular, regimented hours. The clock forced them into “unnatural” patterns of labour by which they could more easily be exploited, as skilled work was replaced with poorly paid unskilled positions. Thompson has been heavily influential, with good reason, but there are problems with his argument. First, his division between natural and clock time is too rigid. It paints the era of natural time as a golden utopia, evoking nostalgia for a simpler life when time neither needed to be nor could be understood ‘properly.’ But time measurement by nature is still time measurement. The change in time-sense required to live by clock time may not be so

[6] Thompson, 60.
[7] Thompson, 61.
[8] Thompson, 84
[9] Thompson, 80.

profound as he believes. As Paul Glennie and Nigel Thrift note, "not owning a timepiece meant neither 'lacking information' nor 'lacking ability' to reckon with time."[10] Clock time mattered, and was understood, well before the industrial revolution. Second, Thompson's argument is entirely technologically and economically determinist. To a point, it is justifiably so. The timed workday would not be possible without accurate clocks, nor necessary without an industrial economy. But technological improvement did not create the demand for time measurement. Quite the opposite: the desire for accurate time measurement led to the development of the technology to do so.[11] As pointed out elsewhere in this dissertation, Glennie and Thrift have insightfully suggested that until recently, "historical notions of clock time have been considerably more sophisticated than the abilities of clocks at those times to deliver on them."[12] In this way, Thompson has reversed the impetus and the result.

Nonetheless, it is hard to argue with Thompson's objective observation that eighteenth century industrialization increased the use of clock-time by the working class. The question becomes how well did they grasp time in the abstract, as distinct from 'natural' time? Vanessa Ogle has recently suggested that they did not really understand it. She shifts the moment of change in time-sense from the eighteenth to the twentieth century. Ogle bases her claim on the fact that even in the beginning of the twentieth century, many could still not disassociate time from nature.[13] In studying the attempt to

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[10] Paul Glennie and Nigel Thrift, *Shaping the Day: A history of Timekeeping in England and Wales, 1300-1800* (Oxford: Oxford University Press, 2009), 132.
[11] David Landes, *Revolutions in Time: Clocks and the Making of the Modern World* (London: Harvard University Press, 1983), 58.
[12] Glennie and Thrift, 40.
[13] Ogle, 47-49.

introduce Summer Time (Daylight Savings Time) to Britain, Ogle claims that many people were baffled by the notion that the time could be determined by law rather than by the sun. They were unable to grasp time in the abstract, and thus their modern time-sense was perhaps not so developed as Thompson supposed.

I think there is a way to bridge the gap between Thompson and Ogle. Eighteenth century industrialization may have caused a shift in time-sense, as Thompson suggests, in which workers moved from task-oriented labour to clock-time driven schedules. This dissertation cannot prove, but does speculate, that late nineteenth century workers lived through a period of similarly disorienting change. By then, workers were used to clock time. But they had the rug pulled out from under them again when they were told that their local clocks, which they had long become accustomed to, were now lying to them. There was now a truer time – a perfect, universal, accurate standard - to which all other clocks must agree.[14] Yet they could not reach it, not easily. Greenwich time was costly and inaccessible to large swaths of the population. If Thompson's new time-sense in the eighteenth century was a means of exploitation, universal standard time might have been a new source of class inequality in the late nineteenth century. Imagine having something so mundane as your ability to know the time taken away. The populace now had to either trust experts to do what before they could do on their own, or reject modern timekeeping altogether, as many of them did. It is no surprise that Ogle came across accounts of baffled twentieth century persons crying foul at government officials – time experts –

[14] Stephen Kern makes a similar case that there was a backlash to the modernization of timekeeping. Stephen Kern, *The Culture of Time and Space, 1880-1918* (London: Harvard University Press, 1983).

who were meddling again with the hours of the day. Sunrise and sunset were at least reliable, and free. No wonder natural, local, time seemed a better option.

But trains cannot run by the sun. Expertise is necessary. This dissertation is not meant as a polemic against experts and expertise in the modern world. In 2018, the dangers of such anti-intellectualism are painfully obvious. But it is meant to demonstrate the ways in which expertise has always been tied up in social and economic privilege and highlight the value of equitable access to information where possible.

In the introduction, I made two claims: that temporal knowledge was shaped, first, by individual agency and professional identity, and second, by debates about the nature of knowledge. We have now seen the process by which that worked. Astronomers claimed that accurate temporal knowledge was a tool for experts, not for use by the public. But their idea became tangled up with Fleming's notion of a universal civil timekeeping system for all, which had gained widespread, though not universal, popularity. The result was a hybrid idea, combining the technical precision of the astronomers with the universality of standard time. Astronomer's professional and diplomatic status as experts and authority figures lent that the new hybrid idea legitimacy, and seemed to render, in theory though not in practice, all other sources of time obsolete. This created a demand for access to accurate standard time, and entrepreneurial capitalists like St John Winne and Maria Belville stepped up to fill that desire, for a price, leading to inequalities in access to the new temporal knowledge. A significant portion of the population did not care. They continued to use the time that was convenient to them. But it led to a debate about the nature of Greenwich time – should it be a commodity, or a tool for experts, or a public good. Fleming advocated for the latter, though he did not necessarily do so out of goodwill – he was as much a self-interested capitalist as Winne. But free, accurate temporal knowledge would benefit his industry (railroads), so he advocated for its implementation across all of society, attempting to use public schools to educate youth in its use. Time as a public good eventually won, but only after technology allowed for it to be disseminated cheaply, undercutting the profits of those who sold time directly, like Winne. Instead, free time aided the flourishing of other industries further up the chain – radio, aviation, railways, and television.

The story of standard time has lessons that can be applied broadly, with implications for the modern, globalizing, (I use both those adjectives hesitantly) world. While this dissertation is about the construction of temporal knowledge specifically, it could be about the production of knowledge in any form and the determinants of legitimacy. Individual agency and concepts of professionalism shape the production of knowledge, as do debates about the nature of knowledge: is it a public good, a commodity, or a specialized tool? The way that question is answered has vast implications.

Though we should be wary of using history predictively, there is a case to be made about these patterns and processes applying elsewhere. The evolution of the internet, for example, might be understood in a similar manner to standard time. At its origin, it was used by experts alone, and was prohibitively expensive, but was sold to wealthy institutions. As it became more affordable – about fifty percent of the global population now has internet access – new industries were built on top of it, such as social media and news platforms. It too was not the result of one inventor but rather was constructed instead out of the interaction between multiple ideas from various contexts. It is not a perfect comparison, but there are profound similarities, and this is not the only possible comparison. Ultimately, the story of standard time offers lessons about how knowledge is constructed, but also about how knowledge is shared and accessed. Shared information, after all, is a powerful force for change. And that is a timely reminder.

APPENDIX

Number of times spoken by each delegate

Name/Country	**Occupation**	**Times Spoken**
Schaeffer/Austria	Diplomat	3
Cruls/Brazil	Scientist	2
Franklin/Colombia	Navy	1
Echeverria/Costa Rica	Engineer	0
Le Faivre/France	Diplomat	19
Janssen/France	Scientist	21
Alvensleben/Germany	Diplomat	4
Hinckeldeyn/Germany	Diplomat	0
Evans/Britain	Navy	6
Adams/Britain	Scientist	19
Strachey/Britain(India)	Diplomat(among other skills)	22
Fleming/Britain(Canada)	Engineer	9
Rock/Guatemala	Surveyor	1
Alexander/Hawaii	Surveyor	0
Aholo/Hawaii	Diplomat	0
Foresta/Italy	Diplomat	1
Kikuchi/Japan	Scientist	0
Fernandez/Mexico	Engineer	1
Anguiano/Mexico	Scientist	0
Stewart/Portugal	Diplomat	1
Struve/Russia	Diplomat	9
Stebnitzki/Russia	Diplomat	0
Kologrivoff/Russia	Diplomat	0
Galvan/San Domingo	Diplomat	1
Batres/Salvador	Diplomat	1
Valera/Spain	Diplomat	14
Arbol/Spain	Navy	8
Pastorin/Spain	Navy	5
Lewenhaupt/Sweden	Diplomat	15
Frey/Switzerland	Diplomat	2
Rodgers/USA	Navy	107 (president/moderator)
Rutherford/USA	Scientist	29
Allen/USA	Engineer	3
Sampson/USA	Navy	15
Abbe/USA	Scientist	8
Soteldo/Venezuela	Diplomat	2
Gormas/Chili	Navy	0

Tupper/Chili	Navy	1
Bille/Denmark	Diplomat	Did not attend
Coppinger/Liberia	Diplomat	0
Weckherlin/Netherlands	Diplomat	0
Rustem/Turkey	Diplomat	4

Delegates by occupation

Occupation	**Number present**	**% of total**
Diplomats	20	48.7
Scientists	7	17.1
Navy	8	19.5
Engineers	4	9.8
Surveyors	2	4.9

Number of times spoken by occupation

Occupation	**Times spoken**	**% of total**
Diplomats	98	43.2
Scientists	79	34.8
Navy	36(excluding President Rodgers)	15.9
Engineers	13	5.7
Surveyors	1	0.4

Countries with a delegate who spoke more than five times

Country	**Delegates**
France	Lefaivre, Janssen
Britain	Evans, Adams, Strachey, Fleming
Russia	Struve
Spain	Valera, Arbol, Pastorin
Sweden	Lewenhaupt
USA	Rutherford, Sampson, Abbe, Rodgers

Note: the breakdown by occupation is somewhat simplified, because these categories occasionally overlap: some naval representatives were also astronomers, etc. S.R. Franklin or Richard Strachey are two examples.

Resolutions passed by the IMC:

1. That it is the opinion of this Congress that it is desirable to adopt a single prime meridian for all nations, in place of the multiplicity of initial meridians which now exist. (This resolution was unanimously adopted.)

2. That the Conference proposes to the Governments here represented the adoption of the meridian passing through the centre of the transit instrument at the Observatory of Greenwich as the initial meridian for longitude. (Ayes, 22; noes, 1; abstaining, 2.)
3. That from this meridian longitude shall be counted in two directions up to 180 degrees, east longitude being plus and west longitude minus. (Ayes, 14; noes, 5; abstaining, 6.)
4. That the Conference proposes the adoption of a universal day for all purposes for which it may be found convenient, and which shall not interfere with the use of local or standard time where desirable. (Ayes, 23; abstaining, 2.)
5. That this universal day is to be a mean solar day; is to begin for all the world at the moment of mean midnight of the initial meridian, coinciding with the beginning of the civil day and date of that meridian; and is to be counted from zero up to twenty-four hours. (Ayes, 14; noes, 3; abstaining, 7.)
6. That the Conference expresses the hope that as soon as may be practicable the astronomical and nautical days will be arranged everywhere to begin at midnight.
7. That the Conference expresses the hope that the technical studies designed to regulate and extend the application of the decimal system to the division of angular space and of time shall be resumed, so as to permit the extension of this application to all cases in which it presents real advantages. (Ayes, 21; abstaining, 3.)

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RGO7.252, RGO7.253, RGO7.254, RGO8.150, RGO15.107, RGO15.108, RGO17.1.4, RGO74.6.2, Royal Greenwich Observatory Archives.

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