

from the *mémoires* that would otherwise be unavailable to English speakers.

The writing, while scholarly, is refreshingly free of jargonistic phrases and catch words. It is unusual to find an academic book that is not only informative, but a good read; *The Commerce of Cartography* is such a book.

I am enthusiastic in recommending this book to anyone who has an interest in cartography, whether applied or historical.

Plotting the Globe: Stories of Meridians, Parallels, and the International Date Line

Avraham Ariel and Nora Ariel Berger

Westport, Connecticut and London: Distributed by Praeger Publishers, 2006.

235 pages with maps, pictures, and illustrations (all black and white) \$49.95 hardcover.

ISBN 0-275-98895-3

Reviewed by Fritz C. Kessler

*Department of Geography, Frostburg State University
Frostburg, MD.*

Plotting the Globe cleverly intertwines the stories of dozens of colorful individuals who, through greed, personal gain, political advancement, adventure, and, of course, scientific pursuit helped explore and establish three imaginary circles: the Prime Meridian, International Date Line, and Equator. The individuals and their intriguing stories are woven together into a narrative that on the one hand traces the history of how these circles came into existence, and the other hand, describes how simple ideas, such as a Prime Meridian, could cause considerable international and personal turmoil.

The adage (attributed to Admiral Grace Hooper, the Grandmother of the programming language COBOL) "one measurement is worth a thousand expert opinions" succinctly summarizes the human endeavors that are related throughout this book. The reader is introduced to numerous instances where the supposed accurate measurement taken by one scientist was subsequently refuted and replaced by another measurement that was deemed more accurate by yet another scientist. The authors point out, however, that in most cases each new measurement gained 'accuracy', but the results were never accurate.

Opening the book's front matter, the reader is introduced to a passage from Lewis Carroll's *The Hunting of the Snark* that illustrates the humanistic irony that is echoed throughout the book. The Table of Contents, which follows, organizes the book's material into four

parts: The Meridians, The Prime Meridian, The International Date Line, and The Equator. Next, a Preface briefly describes the book and relates the maritime experience of the lead author. The Acknowledgements wrap up the preliminary matter and illustrates the breadth of information gathered in researching this book.

The Introduction lays out foundational material about the key imaginary lines used to define our world. The section begins with the authors emphasizing that this book is not a "textbook on the history of cartography or exploration" (p. 1), but rather a narrative on the great circles of the Equator, Prime Meridian, and International Date Line and how and by whom they were discovered and the legacies these circles have imparted, and continue to impart, on society in general. The authors further illustrate that the book will not appeal to members of the Flat Earth Society; a society that claims there is insufficient proof that the Earth is spherical and whose principles are lightheartedly denounced. The authors' writing then changes to a more serious tone as they present a concise overview of the Equator and other, smaller, circles of latitude. Longitude is discussed next, highlighting the Prime Meridian and the International Date Line. The information on these imaginary lines helps form a basic level of understanding on which the remaining chapters of the book build.

Part 1 discusses The Meridians and is divided into three chapters. The first, entitled "The Lemon or Orange Debate", examines the great debate between Jean Dominique Cassini (Cassini I) and Sir Issac Newton over whether the Earth was shaped like a prolate spheroid (Cassini's lemon) or an oblate spheroid (Newton's orange). In the opening paragraphs of this chapter, Jean Picard's experiment with pendulum motion is highlighted as the catalyst for the prolate/oblate debate. However, the primary focus of the chapter is on the history of the Cassini Dynasty and their impressive contribution to French cartographic pursuits, and pointing out how, in spite of irrefutable quantitative data, Jacques Cassini (Cassini II) continued to support his father's stance that the Earth was a prolate spheroid.

The second chapter, "What is the Shape of the Earth", tells the tale of two expeditions that would cement the conclusion to the prolate/oblate controversy. The first of the expeditions, to what today is Ecuador, led by Godin, Bouguer, and Conamine, and the other, to Lapland, under the direction of Pierre-Louis Moreau de Maupertius, are each discussed in considerable detail emphasizing the personalities involved. Another component of this chapter is an overview of the meridian survey that took place in Africa under the auspice of Abbé Nicolas Louis de Lacaille. Jules Verne's recently discovered novel *The Adventures of Three Englishmen*

and *Three Russians in South Africa* makes its way into this section and presents an interesting glimpse into Verne's perspective on the adventure of measuring a meridian in Africa's Kalahari Desert.

The third chapter is titled "How Long is One Meter", and it traces the efforts of Jean Baptiste, Joseph Delamber, and Pierre François André Méchain to establish the length of a meter as determined by measuring the length of a meridian quadrant (e.g., 0° to 90° N). Their endeavors eventually led to the formalization of the metric system when seventeen nations signed the 1875 Paris Treaty of the Meter. As illuminated in this chapter, modern measurements tell us that the length of the meter is not 1/10,000,000 of a meridian quadrant but is closer to 1/10,002,290. This measurement, of course, is an average value at best, and any meridian quadrant will give different results depending on the chosen meridian, furthering the adage of Admiral Grace Hooper.

Part 2, "The Prime Meridian", is comprised of the next five chapters. The fourth chapter "From Hipparchus to Pulkovo" discusses the early history of using various meridians as the origin for longitude prior to the establishment of the Prime Meridian at Greenwich. The chapter illuminates the confusion that engulfed society when there was no internationally agreed upon Prime Meridian. This confusion is further highlighted in that many countries, mostly as a sense of national pride, used the line of longitude that passed through their own observatories as the Prime Meridian. In some cases, Russia, England, France, and other countries chose different observatories as the location of the Prime Meridian for different maps, often without any explanation that justified the selection. For example, the Prime Meridian selected for Russian nautical charts variously used the observatories at Greenwich, Pulkovo, or Ferro while their land maps used the observatories at either Ferro, Pulkovo, Warsaw, or Paris.

Chapter five, or "Greenwich – the Ultimate Prime Meridian", traces the interesting characters of John Flamsteed, Edmund Halley, James Bradley, and George Airy, and the personal accounts that shaped their professional careers. It is interesting to read how four out of the seven Astronomers Royal felt compelled to physically move the location of the meridian at Greenwich – each attempting to improve on accuracy. Flamsteed established the first meridian at Greenwich. His friend, turned adversary, Halley established the second meridian at Greenwich 73 inches east of Flamsteed's original location. Bradley established the British prime meridian a further 436 inches eastward, and Airy moved the final adjustment in the world's prime meridian 19 feet further east.

The chapter "Greenwich Goes International" follows, and details the international recognition the need for a universal Prime Meridian and the difficulty

that ensued in establishing just one meridian as 0° longitude. With the European nations embroiled in nationalistic conflicts, the United States hosted the International Meridian Conference in 1884, in Washington, D.C. This historic conference sought agreement between twenty-five nations, with the United States, in the end brokering the resolution specifying that the Prime Meridian passes through the Royal Observatory at Greenwich, England. Twenty-two nations approved the resolution.

The seventh chapter, entitled "1984 beats 1884 – GPS", reviews the influence that GPS has on coordinate locations, especially longitude. GPS coordinates are periodically adjusted for continental drift, a concept not contemplated by George Airy and his predecessors. Attention is also given to the evolution of WGS84 and its relationship to terrestrial reference systems such as ITRS2000 and ETRS89. In fact, according to the WGS84 datum, the current position of the Prime Meridian lies about 336 feet to the east of 0° longitude established by George Airy.

"Time and Tide Wait for No Man, Especially at Greenwich" (chapter 8) presents an overview of time and how time is influenced by longitude. The authors point out how time calculation is a modern problem first encountered on a large scale with the expansion of the railroads. The fluctuations in Earth's rotation that impact the calculation of time are examined with considerable flair. The establishment of Coordinated Universal Time to address these and other issues is also reviewed. The authors add interesting anecdotes on various customs that celebrate the passage of time (e.g., lowering the time ball from the top of the Royal Observatory in Greenwich at 1:00 p.m.).

The three chapters of Part 3 examine the International Date Line. The first of these, "The Paradox: Lost by Magellan, Found by Fogg" describes various attempts at circumnavigating the Earth. Explorers such as Ferdinand Magellan and Sir Francis Drake are used to illustrate how a day is lost or gained while sailing around the world. For instance, when, in 1522, Magellan's ships sailed into Sanlúcar de Barrameda, Spain his crew thought the day was Saturday although they heard the bells summoning the parishioners to Sunday service. They had 'lost' a day during their east-to-west voyage as they crossed the yet to be established International Date Line. On the other hand, in Jules Verne's *Around the World in Eighty Days*, Phileas Fogg wagered a sizeable sum of money to prove he could sail around the world in eighty days. Fogg thinks he has lost the bet as he arrives in London on a day he believes to be Sunday, day 81. In fact, on his west-to-east voyage, Fogg 'found' a day, thereby arriving on Saturday and winning the wager.

The tenth chapter, which is entitled "The International Date Line – Truth or Myth", presents a revealing

tale of this imaginary line. In this section, the authors argue that the date line is not a single line, but rather an imaginary series of great circles, and is not international, but is in fact subject to spontaneous changes in position. According to the authors, there has been no international agreement on the location of the International Date Line. Part of the myth associated with the 180th meridian are the fictitious Morrell and Byers Islands that were fraudulently reported by Benjamin Morrell and resulted in a kink in the 180th meridian to keep these islands in the same date as the other Hawaiian Islands.

The eleventh chapter, "The International Date Line and the Millennium", relays how countries have manipulated the location of the International Date Line to serve their own purposes. The authors dwell on the 'hype' associated with the new millennium and the erroneous assumption by most people that the new millennium began at midnight on 01/01/00. In actuality, since there was no year assigned as zero, the new millennium began at midnight on 01/01/01. In this section, the authors pose, and in turn discuss, two questions: 1) at which place did midnight first appear on 12/31/99, and 2) where was the sunrise of 01/01/00 first seen?

Part 4 covers the Equator in two chapters. "Crossing the Line" comes first, and recounts the lead author's experience of crossing the Equator as the second officer of the *Yehuda*. Seafaring tradition holds that anyone crossing the Equator for the first time must be inspected by King Neptune and his court. This personal anecdote humanizes the significance of the Equator to mariners.

The next chapter, "Who did it First", intrigues the reader as it tries to determine who was the first explorer to cross the Equator. The authors weigh the merits of the legendary voyages of Hanno and the Chinese Admiral Zheng. Other, more credible accounts, of Prince Henry the Navigator and Diogo Cão crossing the Equator are also discussed. This chapter concludes with a cautionary voice suggesting that while these high-seas adventurers pursued riches and fame, indigenous people often faced unfortunate outcomes and unnecessary hardships as a result.

In the primary author's personal conclusion, "End of the Story", he laments the loss of daring and intrigue from the seafaring profession. Commercial shipping has replaced the adventure once associated with sailing while air-travel has become the norm as a means of travel. The lead author suggests that the ultimate goal of this book is to encourage future generations to explore the unknowns in their own world while adding to the wealth of knowledge accumulated by the individuals whose accounts have been related in this book.

The "End of the Story" segment is followed by a

lengthy "Notes" section that is filled with interesting bits of information about the events and topics presented. The "Internet Sites" section comes next, and presents a two-page listing of various relevant web sites that can prove useful to readers wishing to further explore the topics. The text concludes with an Index containing names, ideas, and places found throughout the book.

The primary strength of this text is its readability. The authors successfully take on, and add a sense of intrigue to, topics that most people would find dry. For example, one would expect an account of the International Meridian Conference of 1884 discussion in Chapter 6 to be rather dull. However, the authors add personal commentary about the representatives of each of the twenty-five nations in attendance and their voting habits. For example, in the voting for Resolution II, the adoption of the Prime Meridian passing through Greenwich, England, San Domingo did not approve. In poking fun at San Domingo's vote, the authors ask "What grudge did that world power have against Great Britain? Was it bad memories of English buccaneers, Britain's historical role in the slave trade, mere muscle flexing to demonstrate black power? Or did the French buy the delegate" (p. 104)? This text is greatly enhanced by the writing style, which is filled with relevant factual material and detailed end notes, but maintains an easy flow throughout the chapters. In another example, after discussing the specifics of adding leap seconds to time as a result of a slowing in the Earth's rotation, the authors reassure the reader that imminent danger "is not about to strike. During the 185 years since 1820, the length of a day has increased by only two thousands of a second. You may finish your beer peacefully and perhaps even head to the fridge for another one" (p. 119).

The authors are also keen to link these many historically significant events to contemporary life. In Chapter 6, the authors point out that the French resisted some of the adopted resolutions of the 1884 conference. In fact, France did not fully recognize the Prime Meridian through Greenwich until 1914 when its nautical charting became compliant. In preparation for the infamous 2000 millennium celebration, the French planted a 600-mile long row of trees, extending from Dunkirk south to the Spanish coast in commemoration of the meridian that Jean Dominique and Jacques Cassini used to counter Newton's oblate spheroid claim. Festivities throughout 2000 included a picnic along the meridian in which there were hundreds of thousands of participants. The French still are irked by the loss of the Prime Meridian and the authors point this out by stating that an "educated Frenchman will tell you that Greenwich is just a line, west of Paris. The very educated will add that it is 2° 20' 14.025" away" (p. 108). Although the authors do criticize the actions and

attitudes of many countries, they do seem to be biased against the French.

As I read through *Plotting the Globe*, I couldn't help but compare it to John Wilford's *The Map Makers*, which was published in 1981 and generally covers the same breadth of material. Both works were written by non-geographers. *The Map Makers* was written by a science correspondent, and the lead author on *Plotting the Globe* became a freelance writer after spending his formative years on his own sea-faring adventures. Neither book is envisioned to be a textbook – rather, both texts present the material in a non-technical fashion that is approachable by the lay person. Thus, those interested in learning the foundations of geography, geodesy, history, or science would likely be among the readership of these books. If both texts appeal to the same audience, then one contrasting comparison that can be made is in reference to the specific content of each work and the way in which it is presented. In *The Map Makers*, Wilford often includes detailed discussions of procedures, such as how Eratosthenes went about measuring the Earth's circumference. In *Plotting the Globe*, Eratosthenes is briefly mentioned but his measurement process is not explained at all. This type of omission represents a missed opportunity to describe how the various characters approached difficult problems. Similarly, in Chapter 13, the lead author gives a personal account of using a mathematical conundrum to test how students in his Merchant Ship Economic class approach and try to solve a hypothetical problem on the Equator, but he does not apply that same curiosity to other topics covered in the book.

Two other points of contention with this book are worth mentioning: the skimming over of important events and the limited discussion of how things work. In *The Map Makers*, Wilford presents the difficulties and accomplishments that John Harrison went through while building his chronometer, an obviously important event. In *Plotting the Globe*, John Harrison is unfortunately mentioned only in passing, and the significance of his chronometer is largely left to an endnote. Without Harrison's timepiece, it is hard to say how long it would have taken for longitudinal positions to be determined, a point which should have been emphasized.

In the Preface, the lead author reports to have been associated with ships and navigation all his life. More specifically, he states that he was reared by the "sex-tant, the chronometer, the magnetic compass, and the hand lead" (p. xi). What a shame then that he didn't include an explanation on the actual use of one of these instruments and of their historical merits. Other procedures, too, such as leveling, measuring a portion of a meridian arc, or dead reckoning are presented without much discussion of "how-to", leaving readers a bit unfulfilled in their quest for knowledge.

Moreover, an explanation of some of these processes would shed light on just how difficult it was to make these measurements and, as a consequence, the reader would appreciate how miraculous it was that these scientists were able to obtain the results they did. It is likely that the authors sought to keep the book as non-technical as possible while still conveying the overall history and the persons involved. However, a few examples and more detail on the mechanics of the measurements incorporated into the text's light-hearted approach would have enriched the reading experience and conveyed to the reader why there have been so many measurements made throughout this book.

In summary, *Plotting the Globe* is an interesting read. The book is filled with stories of human endeavors, personal conflicts, and the quest for knowledge (springing from a variety of the motivating factors). The book relates more about individuals and their efforts than about the mechanics of procedures. The authors do, in fact, in the Preface, stress that the text is a "tribute to the astronomers, explorers, and land surveyors who gave us those lines, measured them, made their derivatives part of our daily lives, and sometimes even died for them." (p. 1). Thus, the reader should expect the focus to be on the individuals and their accomplishments and contributions to meridians and parallels. For those interested by the personal dynamics of exploration, nationalistic pride, scientific pursuits, political angst, and convention in the context of geography, then this text will not disappoint. For those readers that also thirst for details on how the characters actually accomplished these amazing measurements, this book is lacking in telling "how", but still creates a firm foundation from which to seek additional knowledge.

REFERENCES

Wilford, John, W. 1981. *The Map Makers; The Story of the Great Pioneers in Cartography from Antiquity to the Space Age*. Vintage Books/Random House Publications, New York, NY, 414 pages.