A Global Forum for Naval Historical Scholarship

International Journal of Naval History

Volume 2 Number 1 April 2003

Bill Carter and Merri Sue Carter, **Latitude: How American Astronomers Solved the Mystery of Variation** (Annapolis: Naval Institute Press, 2002), Pp. 168, $24.95.

Reviewed by Steven J. Dick, Historian, U. S. Naval Observatory

---

In 1995 Dava Sobel published her surprise bestseller Longitude: The True Story of a Lone Genius Who Solved the Greatest Scientific Problem of His Time. Now we have Latitude, which may not be a bestseller (though the Naval Institute Press did launch the career of Tom Clancy), but tells a story that has its own dramatic moments. The authors are the father-daughter team of Bill and Merri Sue Carter, respectively a retired geodesist from the National Oceanic and Atmospheric Administration (NOAA) and an astronomer at the U. S. Naval Observatory. They are workers in the field, and their technical background, inside knowledge, and keen historical sense combine to provide an accurate, readable and compelling story.

Longitude was the 18th century story of how John Harrison constructed the first accurate chronometer in the search of a solution to the age-old problem of finding the longitude. Latitude is the late 19th century story of how Seth Carlo Chandler found a variation in the latitude, an astronomical problem that until recently had nothing at all to do with navigation. Latitude is not at all about how ships determined their latitude for navigation, a relatively simple problem compared to longitude, since the altitude of the pole star gives the latitude wherever it is visible. Rather, as the subtitle suggests, the book is about the <u>variation</u> of latitude, a problem at a very different level of accuracy. Whereas a sailor with an eighteenth century sextant was happy to measure celestial objects from the deck of a ship to several arcminutes for latitude and longitude, variation of latitude amounted to a few tenths of an arcsecond, and was barely detectable with the best astronomical instruments of the late 19th century. It was thus not a navigational problem, but an astronomical and geodetic one: astronomers noticed their painstaking observations of star positions – and nearly everything else based on absolute astronomical measurements – changing after all other effects had been accounted for. Geodesists were concerned that their geodetic control networks were in error. This unsettling mystery eluded the best efforts of many famous astronomers during the 19th century, only to be resolved by an American amateur astronomer and a German professional astronomer. Therein lies a priority dispute that makes the story even more dramatic.

The American amateur was Seth Carlo Chandler, an actuary who moved to Boston in 1876, became associated with Harvard College Observatory a few years later, and designed and built an "almucantar," an innovative instrument for measuring precise star positions. Using his observations with this instrument, and historical observations, Chandler concluded in 1891-92 that variation of latitude existed with two superimposed periods of ten and 14 months. Meanwhile the German astronomer Karl Friedrich Küstner had announced in 1888 that variation of latitude existed, but he was unable to determine its period. The Carters argue that, although Küstner detected a change in latitude for a specific observatory, Chandler deserves the credit for first revealing the true nature of the phenomenon.

Another intriguing element in the discovery is the reconciliation of observation with theory. Theory predicted that a variation of latitude with a period of 306 days, about 10 months. But Chandler's observations showed such variation over a period of 427 days, about 14 months. Undaunted by theory as a professional astronomer might be, Chandler made his claim nevertheless. The discrepancy was soon explained by the astronomer Simon Newcomb, who showed that the 14-month period could be explained by assuming a non-rigid, elastic Earth. This is especially ironic, because Newcomb's failure to find any variation of latitude in the 1860s brought such studies to a virtual halt. The Carters describe Newcomb's role in two delightful chapters that bring to life this period of Naval Observatory history, where Newcomb worked until becoming Superintendent of the Nautical Almanac Office in 1877. A dispute between Newcomb and Chandler over changes of variation of latitude over time adds additional color to the story.

Today variation of latitude, known as polar motion, is determined a thousand times better than a century ago when it was discovered, and the pole is known to have complex motions with periods ranging from a few hours to decades. While the Earth's pole wanders only over a relatively small area the size of a tennis court, this motion is an essential part of Earth Orientation Parameters whose measurement is supported by agencies such as NASA, NOAA the Naval Observatory, as well as international agencies. And at the greatly refined levels of navigation with GPS today, it turns out to be an essential to navigation after all, a point the Carters bring home with a gripping fictional prologue.

At a meeting in Sardinia in 1999 on the occasion of the first observations in the worldwide network of polar motion stations, the disagreements and tensions over the priority of discovery were still obvious, with the Carters pressing their case for Chandler and the German author of a paper on Küstner not even mentioning Chandler. Who said history is dead? Latitude takes an honored place in the tradition of science writing that brings complex but important issues to the public.

The Editors
International Journal of Naval History
editors@ijnhonline.org