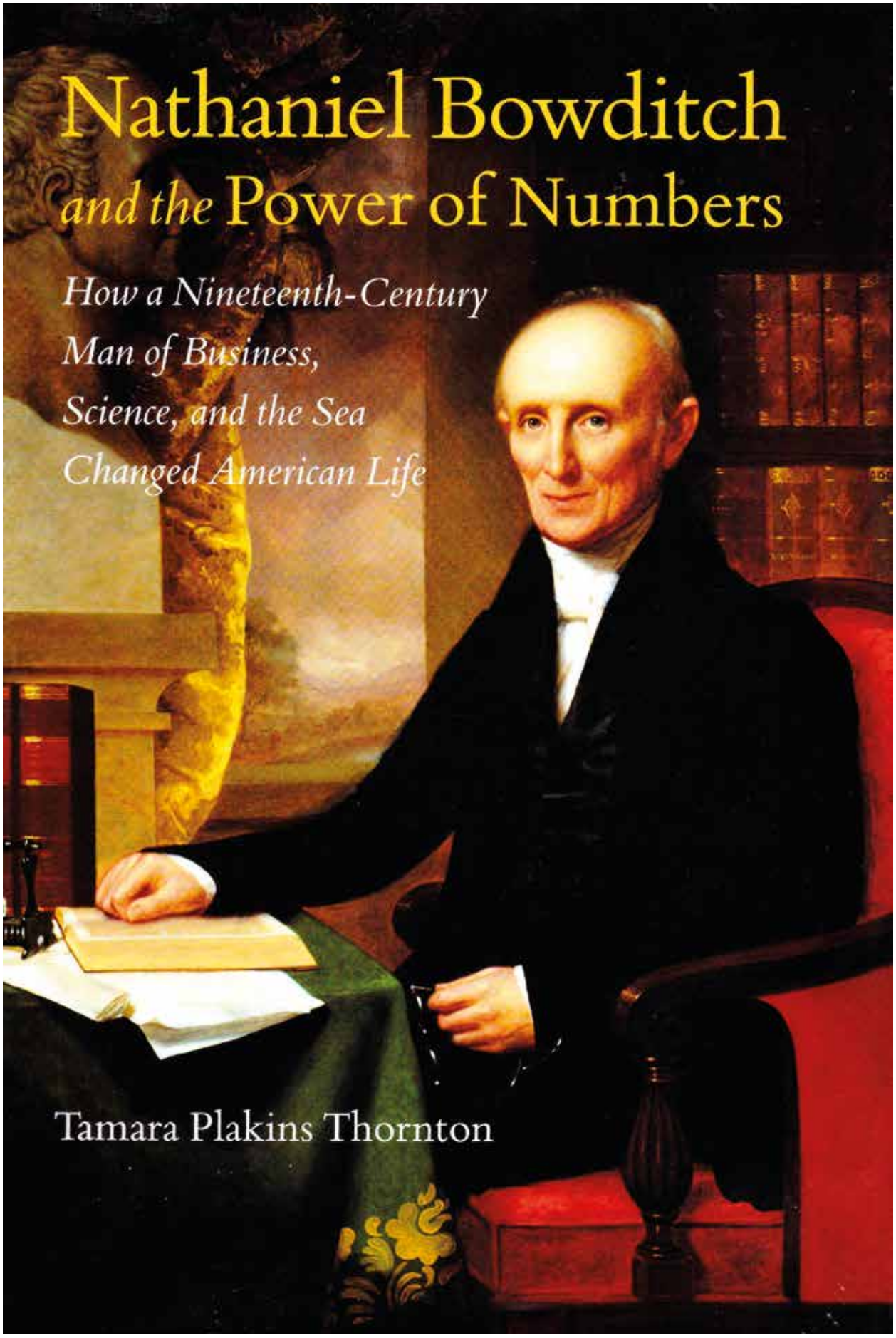
Nathaniel Bowditch
and the Power of Numbers
How a Nineteenth-Century Man of Business, Science, and the Sea Changed American Life
Tamara Plakins Thornton

Nathaniel Bowditch

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A long time ago in a galaxy far, far away, when I started work as a survey cadet in 1962, I began computing traverse closures. I soon learned about the Bowditch rule as the means of eliminating closing errors; it was enshrined in the 1959 Survey Regulations, where Section 22 read;

> ***Elimination of close*** *– In new traverses forming a complete surround or traverses connecting two standard blocks or two triangulation stations, where these have been adjusted to conform with the "geodetic triangulation", the closing error is to be eliminated by the Bowditch rule, by distributing the closing error according to the following:*
>
> - *As the total length of the traverse is to the length of each line, so is the whole error in latitude or departure to the correction of the corresponding latitude or departure, each correction being so applied as to diminish the whole error in latitude or departure.*

Heady stuff for a young cadet, I think I was just taught what to do, rather than trying to decipher that clause in the Survey Regulations. The firm I was working for was engaged in large scale land development projects, where there would be a number of adjoining traverse circuits within the property, so as to be able to peg each point on the subdivision.

A more senior cadet in the firm, Ron Goodwin, told me that on that type of job, you should first look at the traverse leg that was common to two adjoining circuits, and if a correction in that line would improve the close in both circuits, then that correction should be applied first before applying the Bowditch rule to the balance of the circuit. I don't think the plan checkers ever noticed this minor but sensible departure from rule.

There was an almost identical provision in the 1972 rewrite of the Survey Regulations at Clause 22, but by the time of the 1998 rewrite, with the advent of computers capable of more sophisticated adjustment techniques, the corresponding provision at Clause 28 read;

> ***Misclosures*** *– Misclosures must be distributed by a systematic adjustment acceptable to the Chief Surveyor.*

At the time I first learnt of the Bowditch rule – with so much to learn as a cadet in so many subjects – I never had the time or inclination to ponder where the Bowditch rule had come from. Fast forward forty years or so, having become a keen golfer, I often watch the television coverage of the US PGA Tour tournaments. I noted the emergence of a young Australian professional on the Tour, Steven Bowditch. That was the first time I had seen the name again, and I did wonder if he might be a descendent of the originator of the Bowditch rule, but never had the opportunity to enquire further.

Then in the latter part of last year, I read a news report that an underwater drone operated by a US Navy survey ship in the South China Sea, had been abducted by the Chinese. I believe that the drone was returned without incident, but was interested to read that that ship that had been operating the drone was the USNS Bowditch. This aroused my curiosity and some investigation soon led me to Nathaniel Bowditch.

What a man. He was born in Salem, Massachusetts in 1773, and was based there until 1823, when he moved to Boston. He then lived in Boston until his death in 1838. His father came from a family of several generations of seafarers. His father had originally learned a trade as a cooper, but then also became a sea captain. However in 1775, at the start of the American Revolution, his father's ship was captured at sea by the British. He was held prisoner in Halifax until he escaped in 1777. His father never went back to sea, and on his return to Salem worked in his cooperage business.

Nathaniel started in what was then called a Dame school at the age of three. A Dame school was generally a small school run by a woman, often in her home. The teacher is reported as saying he was the best scholar she ever had. At age seven he started at a more conventional primary school. He asked the teacher to let him try to solve a complex mathematical problem and when he solved it, the teacher accused him of cheating and getting help to solve it. But he soon demonstrated that he could solve the problems on his own, and in today's term would be called a child prodigy.

But at age ten, his father made him leave school to work in his cooperage business. That started a long period of self-teaching. At age twelve his father indentured him for nine years as a bookkeeping apprentice to a ship chandlery business near the Salem harbour. The job also provided board and lodgings, and the owners of the business encouraged him to continue his studies at the end of the working day. There were also a number of men of learning and science in Salem who mentored him and gave him access to their libraries.

At age fourteen he began to study algebra and two years later taught himself calculus. He found many texts

on mathematics by the likes of Isaac Newton which were in Latin, so at seventeen he taught himself Latin, and two years later taught himself French. He also developed an interest in navigation under a former Royal Navy survey master. On completion of his indenture in 1794 he worked with a sea captain on a survey of the Salem foreshore. It was reported that he had been paid twenty-seven pounds, a considerable sum in those days, for his work, so the survey would have been extensive.

In 1795 at the age of 22, he went to sea on the first of four voyages as the vessel's clerk and captain's writer. These were long voyages, to Spain, Portugal, the Philippines, Indonesia and Reunion Island. During this time at sea he became intensely interested in the mathematics of celestial navigation and very soon became de facto navigator on the voyages. In those days navigators used the English almanac, "Moore's New Practical Navigator ", prepared with assistance from the British Astronomer Royal, Nevil Maskelyne.

Moore's work was known to contain errors, and Bowditch set about trying to recompute all Moore's tables and rearrange the work. However the task became so extensive, he decided to write his own book, and to put down in the book *"nothing I can't teach the crew".* In 1802 his Bowditch's Practical American Navigator was published, and it soon became known as "the sailors bible". An important element of his publication was an improved method of observing 'lunars' to determine longitude. Bowditch's method allowed a mariner to determine his longitude by measuring the angle between the moon and specified stars. His publication include tables with precalculated corrections for parallax and atmospheric refraction.

Whilst John Harrison's marine chronometer appeared in the mid-1700s, they were extremely expensive and not in common use on vessels until the 1830s. Bowditch's fifth and last voyage was as master and part owner of the ship. On that voyage it is reported that every man of the crew of twelve, including the ship's cook, became competent to take and calculate lunar observations and to plot the position of the ship.

He returned from that last voyage in 1804, having married in 1798 and eventually fathering eight children, further risky sea voyages were not considered. He resumed his mathematical studies and entered the marine insurance business, becoming what is regarded as America's first insurance actuary. In 1799 Bowditch had been elected to the American Academy of Arts and Science and in 1802, following publication of his almanac, Harvard University awarded Bowditch an honorary Master of Arts degree.

He published numerous articles on lunar observations, naval charts of several harbours, and papers on the orbits of comets. Bowditch's translation of Pierre-Simon de Laplace's 'Traite de Mecanique Celeste', an advanced mathematical treatment of the working of the solar system, was completed in 1818. By 1819 his international reputation had grown to the extent that he was elected as a member of the Royal Societies of Edinburgh and London, and the Royal Irish Academy.

By 1823 Boston had grown to a much larger commercial centre, and following his move there that year, he became increasingly involved in insurance, trusts and investment management. He is said to have applied the rigorous logic of mathematics to the operation of the businesses he was involved with, rather than the laisse faire approach that prevailed in a lot of businesses at that time. Following his death in 1838 a memorial statue of him was erected through public subscription in the Mount Auburn Cemetery where he was buried.

Coming back to the Bowditch rule, it is reported that it was devised by Bowditch as a proposed solution to the problem of compass traverse adjustment, which was posed in the American journal "The Analyst "in 1807. That publication described him as a surveyor, navigator and mathematician.

The following books on Nathaniel Bowditch have been the source of most of the material in this article;

Memoir of Nathaniel Bowditch, by Nathaniel Ingersoll Bowditch (his eldest son), 1840.

Carry on, Mr Bowditch, by Jean Lee Latham, 1955. This is a fictionalised account of Bowditch's life up to the time of his first sea voyage, aimed primarily at younger readers.

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it means to make and use a measurement, I am surprised and disappointed at the lack of statistical context for any of the large number of charts and graphs presented by the Commission. Of the many trends reported and discussed, for example, none are accompanied by a statistical test to show at what level they have significance. This is a little bit ironic. In some places the report criticises (rightly, in my view) testimony to the commission that was not itself contextualised. Perhaps they should enrol in an online statistics paper. There is one on at Massey right now.

References

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