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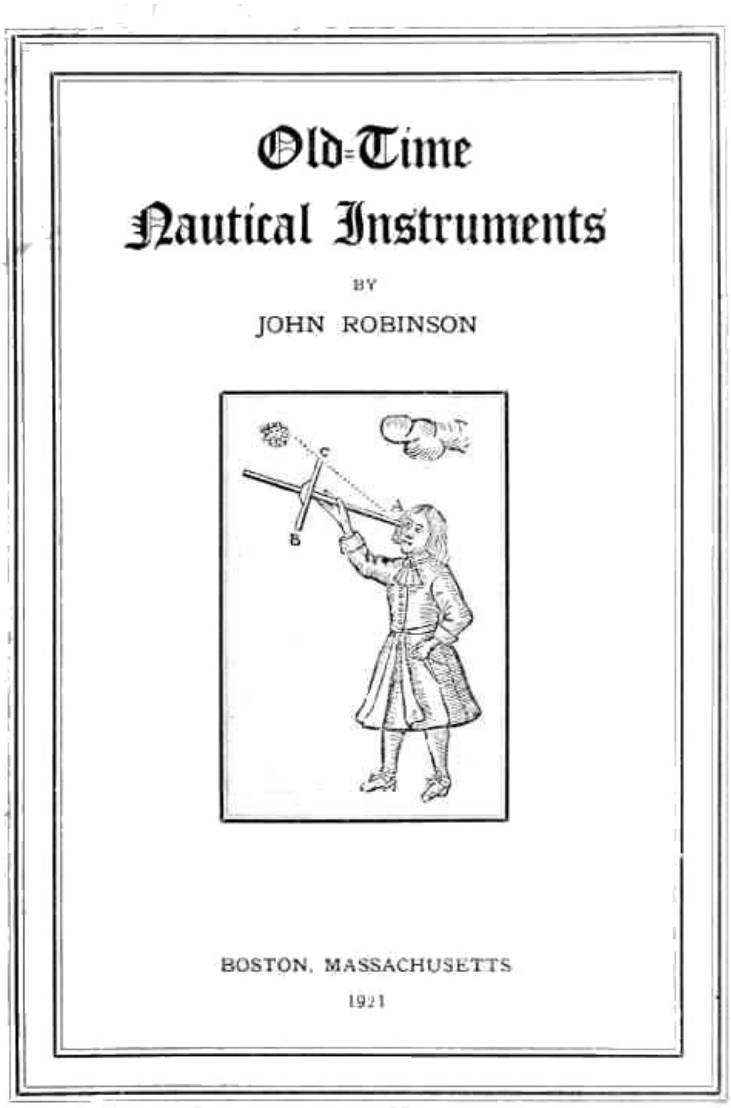

Old-Time Nautical Instruments

BY

JOHN ROBINSON

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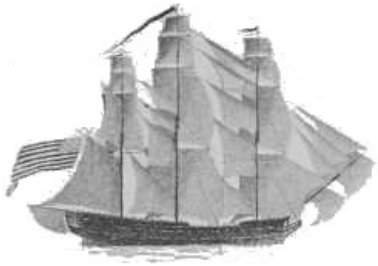


SHIP GRAND TURK, 1786

OLD-TIME NAUTICAL INSTRUMENTS

By John Robinson

Curator of the Marine Room, Peabody Museum, Salem, Mass.

WHAT sort of instruments did the Colonial ship-masters carry? What did they have on the *Mayflower*? What did Columbus use? And, to come down to comparatively recent times, what instruments were available and were actually used on the vessels during the commercial-marine activities following the American Revolution and up to the time of the appearance of steamships?

These questions are often asked, not only by landsmen but by seafaring men as well. The ship-master of today uses instruments so different from those of Colonial times, or even of the earlier years of the nineteenth century, that unless he has a penchant for research he knows nothing about the earlier ones and certainly not how to use them if by chance they come to his notice. Holding in his hand a Davis quadrant, the skilful navigator of Salem's last square-rigger, the ship *Mindoro*, which passed out of service in 1897, said to the writer:—"I have no idea how to use it and I do not believe that there is a ship-master sailing out of Boston today who does." The Davis quadrant was in common use all through the eighteenth century and probably later. It is figured and explained in a book on navigation in 1796. There are two in the Peabody Museum collection in Salem, dated respectively, 1768 and 1773, and an undated one in the collection is certainly older. Only the student of the history of navigation can explain them or their uses. The English navigator, John Davis, the inventor of this quadrant, in his "Seaman's Secrets", printed in 1594, gives a list of instruments which should be taken on ships, but it is to be feared few vessels carried them all or that owners were able to provide them. It included,—sea-compass, cross-staff, chart, quadrant, astrolabe, instrument to test compass variation, horizontal plane sphere, and

paradoxical compass.

[Pg 2]

SIXTEENTH CENTURY SPANISH ASTROLABE
Full size. From Museum of Fine Arts, Boston.

UNIVERSAL RING-DIAL
Diameter 3-1/2 inches. Owned by Mr. Parker Kemble.

No one knows exactly what instruments Columbus took with him on his voyage in 1492. He undoubtedly had an astrolabe and a cross-staff. The astrolabe was devised during the first [Pg 3] millennium and Arabian astronomers had perfected it as early as the year 700. It is really the basis of all future instruments of its class,—cross-staff, quadrant, sextant. Some of the most beautiful astrolabes preserved in museums are those made for the Persian astronomers in the sixteenth and seventeenth centuries. Columbus probably used the form devised by Martin Behaim which had been adapted for use at sea about the year 1480. Observations with the astrolabe required three persons, one to hold the instrument plumb by the ring, another to sight the sun and adjust the arm, and the third to read the scale. With these difficulties observations were, of course, far from accurate, but approximate time and latitude could be obtained. Another device was the ring-dial, or universal ring-dial as the old works on navigation called it. This differed from the astrolabe by having adjustable rings with the hours and scales engraved upon them. Both of these instruments are now rare.

No original cross-staff is known to the writer in any collection in this country. It consisted of a rod thirty-six inches long on which another of twenty-six inches was centered and arranged to slide up and down at right angles to it. By sighting from the end of the longer rod and moving the

sliding bar until the sun was seen at one end of it and the horizon at the other, the figure on the scale at the junction of the rods indicated the sun's altitude and from this the latitude was obtained. [Pg 4]

SEVENTEENTH CENTURY MARINER USING A CROSS-STAFF
From Seller's "Practical Navigation," London, 1676

SEVENTEENTH CENTURY MARINER USING DAVIS' QUADRANT
From Seller's "Practical Navigation," London, 1676

Based on this instrument, by laying out the circle on a table, John Davis, the explorer, devised his quadrant in 1586. At first the observer used it by facing the sun, as the cross-staff had been used, but a better form was made later where the observer had the sun at his back. This instrument has been called by sailors "jackass quadrant" and, supposedly from its shape, "hog-yoke." In early books on navigation it is called "sea-quadrant." The earlier form used by the observer standing back to the sun had a solid "shade vane" which slid along the smaller arc of the instrument. By adjusting this a little short of the supposed altitude of the sun and sighting the horizon through the minute hole in the "sight vane" until it was seen through the "horizon vane" at the apex of the instrument, and then gradually moving the "sight vane" along the larger arc until the shadow of the "shade vane" met the horizon line, the sum of the degrees on the two scales indicated the sun's altitude. This was really the second form of the Davis quadrant. In the third, the solid "shade vane" was replaced by one with a low-power lens inserted in it arranged to focus on the "horizon vane," thus approaching the idea of the reflected sun in the Hadley quadrant and the sextant. A most interesting instrument, half-way between a cross-staff and the Davis quadrant, is illustrated in Seller's book on navigation published in 1676. He calls it a "Plough." Above, it has the small arc of the Davis quadrant with the sliding rod of the cross-staff below. These were, of course, imperfect instruments, but still a great advance over previous devices to obtain time and latitude. [Pg 6]

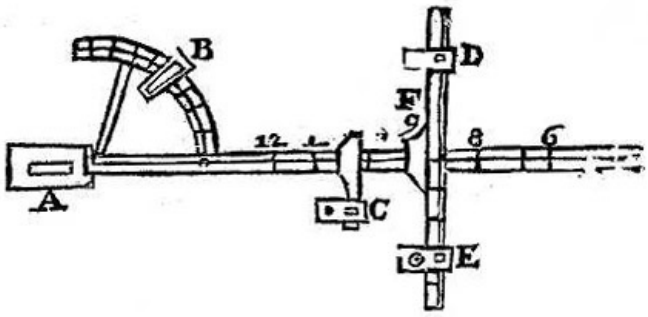
SECT. III.

The Description and Use of the Plough.

The Description of the Plough.

This Instrument was antiently in use amongst Mariners, although at this day it is not so commonly used as formerly; it consists of a Staff having a small Arch, and three Vanes.

The Figure of the Plough.



The Staff is about two foot and a half long, or three foot at the most; at the Center-end of which is erected a small Arch, that is divided into 85 degrees; on the side of the Staff are set off the Graduations proper to the Plough, beginning at five or six degrees, and encreasing to ten degrees towards the Arch, every degree being divided into single minutes.

The Vanes are a *Horizon-Vane*, as A, and *Shadow-Vane*, as B, (to be used as in the Quadrant) and a *Sight-Vane* moving upon the Staff, as at C.

The

PAGE FROM "PRACTICAL NAVIGATION,"
BY JOHN SELLERS, LONDON, 1676

DAVIS QUADRANT

"Made by William Williams in King St. Boston." An ivory plate has "Malachi Allen 1769." Mahogany, 24 inches long, convex glass in the shade vane; fine example of cabinet work. In Peabody Museum, Salem.

The Davis quadrants are usually made of ebony, rosewood, or other dark woods, with boxwood scale arcs and could be made by expert wood-workers. The numerous examples preserved attest

the skill of the old cabinet-makers, for they are never warped or twisted while their jointing is a Chinese puzzle. Probably the *Mayflower* carried a Davis quadrant and quite likely an astrolabe, and of course, a compass, for the compass had been in use for two centuries.

Whether the compass was independently invented in Europe or was borrowed from the Chinese is uncertain. The old marine compasses were set in gimbals. The magnet was a thin bar attached, usually with sealing wax, to the under side of the compass card, the whole mounted in a thin bowl of turned wood. These were the compasses of the eighteenth century. There is one in the Salem collection inscribed,—"Benjamin King Salem in New England", with the date "1770" cut in the box; another has the mark of Benjamin King, 1790. A surveyor's compass, wooden throughout, including wooden sights, is inscribed,—"Made by James Halsey near ye draw bridge Boston." The liquid compass first suggested by Francis Crow in 1813 and improved by E. S. Ritchie of Boston, has largely displaced the older devices.

The "nocturnal", used at night, as its name signifies, appeared at an early date, exactly when it does not seem possible to say. One in the Salem collection is marked,—"Nathaniel Viall 1724". By adjusting the movable discs to the date on the scale for the day of the month, sighting the north star through the hole in the center and then bringing the arm against the "guard stars", the hour was indicated with reasonable accuracy. Good pictures and descriptions of the nocturnal may be found in old books on navigation.

In 1730, John Hadley in England and Thomas Godfrey in Philadelphia, independently invented the octant, known for nearly two hundred years as Hadley's quadrant. Both Hadley and Godfrey received awards for their devices. Although called quadrant in this country it is generally known elsewhere as octant, which is the better name, for the instrument represents but one eighth of the circle. By the principle of reflection, however, it covers ninety degrees and the scale is so marked. The Davis quadrant with its two arcs does represent one fourth of the circle and for that instrument the name is correct. [Pg 7]

The Hadley was a great improvement over the Davis quadrant and other older devices for finding latitude. By moving the arm the sun is reflected by the mirror at the apex and "brought down" to the horizon line and the eye is protected by colored glasses of various degrees of density through which the sun's rays shine. Catching the sun the instant it is on the meridian (noon), the scale indicates the altitude by which the latitude was figured with the Bowditch Navigator, used for more than one hundred years by American seamen, or Moore's before that and numerous others back to the early eighteenth century. The Hadley quadrant is still used in its modern form with telescopic eye-pieces although the sextant—one-sixth of the circle and by reflection one-third—is a more accurate instrument and also may be used to make lunar observations to obtain longitude, a complicated and difficult matter, so difficult that the authors of the older works did not even take trouble to explain the process, for only the most expert could make this observation, nor were the results satisfactory.

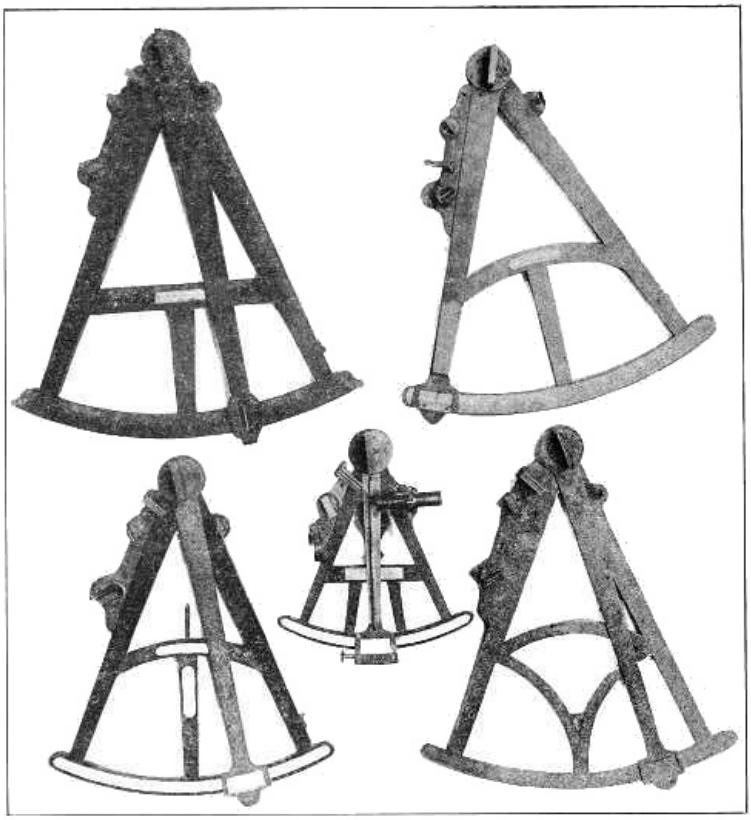
The sextant was devised about 1757 and as now made is framed wholly of metal. To prevent corrosion, the scale, which is minutely divided, and has a "vernier" with a magnifying glass to show divisions of minutes, is made of gold or platinum in the best instruments. A half-circle has been devised and is exceedingly rare. An example in the Salem collection was made before 1818. A curious double-jointed dividers accompanied it and the entry in the museum catalog reads,—"used to correct a lunar observation for longitude." A full "circle of reflection" is also sometimes used, more often on land than at sea. This is a beautiful instrument and is not often met with in collections or in use. All of these instruments are similar in character and may be traced, as previously stated, to the ancestral astrolabe.

NOCTURNAL

"Nath'll Viall 1724." Boxwood, arm seven inches from centre to tip. In Peabody Museum, Salem.

The early Hadley quadrants were huge affairs made of wood with an arm twenty-four inches in length. Today they are more generally of metal with arms from ten to twelve inches. Using the

sextent or Hadley quadrant the observer stands facing the sun, but old Hadley quadrants were made with a “back sight” so that they could be used like the Davis quadrant, thus making two independent observations the average of which would ensure greater accuracy.



HADLEY QUADRANTS (OCTANTS) IN PEABODY MUSEUM, SALEM

1. “Made by John Dupee 1755 for Patrick Montgomerie.” All wood, ebony, arm 22 inches long.

2. “Made by Ino. Gilbert on Tower Hill London for Hector Orr Augt. 6, 1768.” Ebony, arm 20 inches long.

3. “Norie & Co. London.” Ebony and brass, *ca.* 1840. Arm 11-3/4 inches, telescopic eyepieces, used by Capt. John Hodges.

4. “Spencer Browning and Rust London.” Ebony frame, brass arm 17 inches, ivory scale, pencil inserted in cross piece, *ca.* 1800, used by Capt. Henry King.

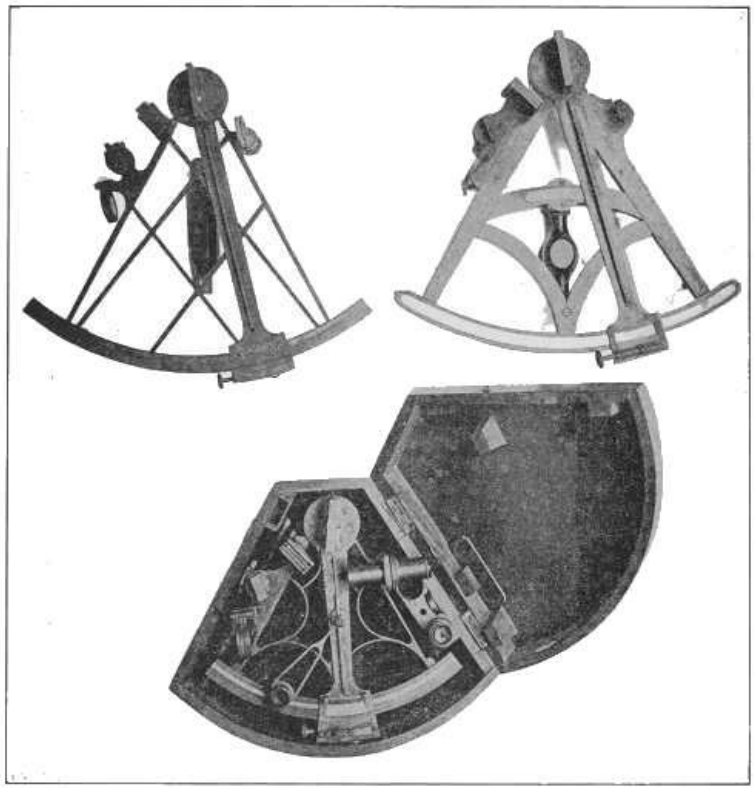
5. “J: Urings London.” All brass, arm 20 inches, back sight broken off, *ca.* 1780, rare.

To obtain the ship’s latitude with comparatively good results was an easy matter with the quadrant and its fore-runners, but the great problem for centuries was how to find the longitude, now universally and quickly obtained by the chronometer and simple observations in the morning or at noon. Spring clocks and watches appeared about 1530 but they were unreliable and of no use on long voyages. Sand glasses like those of the old Colonial churches were used on ships and so conservative is the British mind that some were in use on British naval vessels as late as 1828 and one authority states as late as 1839. Greenwich Observatory was established in 1675 and a Royal Commission was soon appointed with authority to award prizes for important inventions in aid of navigation. A prize of £20,000 was finally offered for a time-keeper that should meet certain requirements which practically meant absolute accuracy. In 1767, John Harrison produced the chronometer, based on the principle of an invention of 1735, and eventually he received the reward. Chronometers were so expensive and so hard to obtain that few New England ships had them until more than a half a century later. Other devices were tried to obtain longitude by lunar observations and by Jupiter’s satellites, but these observations were too difficult to be of practical use. Today, fine watches serve for short trips and chronometers are carried by nearly all vessels making long voyages. [Pg 9]

That so important an instrument as a telescope or spy-glass is rarely mentioned in books on navigation or in sea journals seems strange. It is exceedingly difficult to obtain information of any being taken to sea, although one would think a spy-glass would be about the first aid on shipboard especially when skirting the coast. Telescopes did not become of practical use, even if the principle had been known, until they were made in Holland in 1608. It is at least certain that Columbus did not have one and probably there was none on the *Mayflower*, although its passengers had recently come from Holland where telescopes were invented a few years before. So far no references to them have been found in a rather casual examination of old log-books.

In the Marine Room Collection of the Peabody Museum at Salem, is a spy-glass four feet long, octagonal in form, two and one-half inches in diameter, with a short focusing tube. It was taken

from a British prize vessel off the coast of Ireland, in 1779, by Capt. James Barr in his Salem privateer. Another glass of similar form, but longer and with a mahogany case, was used on a United States naval vessel about 1815. The spy-glass, familiar to everyone, in two or three sections, was used at sea through the first half of the nineteenth century and is often seen tucked under the left arm, in the portraits of ship-masters brought home from foreign ports. Many of these were excellent instruments, especially those from Dollond of London. There is also in the Salem collection a rude telescope or spy-glass five and one-half feet long with a copper case about three inches in diameter looking precisely like a section from a house water-conductor. It focuses by a small upper sliding section, fitted like a stove funnel. This glass was brought from Nagasaki, Japan, by a Salem ship-master about 1865. It had been used there to observe vessels coming into the harbor. It may be Dutch and it is evidently very old.



SEXTANTS IN PEABODY MUSEUM, SALEM

1. “Bradford London.” Brass frame and silver scale arm 14 inches long, *ca.* 1815, used by Capt. George Bailey before 1840.

2. “L. Bleuler, London.” Ebony frame, ivory scale, brass arm 14 inches long, *ca.* 1820, came from Plymouth, Mass.

3. “G. Gowland 76 Castle St. Liverpool.” Used by David Livingstone in his African explorations and after his death sold at Zanzibar by order of the Royal Geographical Society and bought by Capt. William Beadle, of Salem, and used on some of his voyages.

The speed of a vessel was first obtained by throwing overboard a floating subject at the bow and noting the time elapsed when it passed an observer at the stern. From this the log line with “knots” was derived, with the fourteen and twenty-eight seconds sand glasses to record speed. A [Pg 11] “knot” indicates a geographical or sea mile which has been standardized at 6080 feet; the land or statute mile is 5280 feet, therefore, if a vessel is said to be sailing at the rate of thirteen knots, a railroad train going at the same speed would be running at the rate of fifteen miles an hour. The term “knot” is used solely to indicate rate of speed; the distance covered is always stated in nautical or sea miles. “Heaving the log” meant throwing out from the stern of a vessel a small float attached to a line running from a reel held clear of the rail, the float remaining stationary in the water. At the instant the log is “heaved” a sand glass is turned. On the line are knots (hence the term), pieces of marline or rags tied through the strands and spaced the same fraction of a mile apart,—above forty-six feet and six inches,—which twenty-eight seconds is the fraction of an hour,—about one one-hundred and twenty-eighth. Therefore, using a twenty-eight seconds glass and checking the line the instant the sand runs out, the number of knots and fractions paid out on the line will at once indicate the number of sea miles per hour which the vessel is going. This, of course, is doubled if the fourteen-seconds glass is used, which is done when the vessel is going very fast.

The old log lines have been superseded by many forms of the “patent log” and the museum is indeed fortunate which possesses an original log line, reel and float in perfect condition. There is an excellent example in the museum collections of the Marblehead Historical Society. Once discarded, the lines were soon used to tie up packages and the reels and floats were thrown

away. The patent log with its revolving blades, now universal, was devised by Humfray Cole in 1578; it was improved by various persons from time to time but, strange to say, did not come into general use for nearly three centuries. The rotating blades in the water record the rate on an indicator on the vessel which may be read at any time. So far, the earliest reference to the use of a device of this sort among our New England navigators is the "Gould's patent log" used by Captain George Crowninshield on his famous yacht *Cleopatra's Barge* during the voyage to the Mediterranean in 1817.

Charts were made in very ancient times but they were crude and almost useless. The first nautical maps appeared in Italy at the end of the thirteenth century, and it is said that Bartholomew Columbus brought the first one to England in 1489. The close of the sixteenth century saw many map makers at work, including Gerard Mercator whose name is perpetuated in the familiar scale charts in our geographies known as "Mercator's projection" which were the sea charts in general use. Globes were carried on ships in preference to charts in the early days and what is known as "great circle" sailing was evolved from them. Davis describes it in 1594 and it is possible that Cabot knew of the theory a century before. Such a simple instrument as a parallel ruler was not invented until late in the sixteenth century and tables of logarithms and Gunter's scale by which navigators make all their calculations were not known until the year the *Mayflower* sailed.

During the first century following the settlement of New England it is probable that the small coasting and fishing vessels were navigated by dead reckoning and not venturing far beyond the sight of land a compass was the only instrument carried. But the larger vessels sailing from Boston, Salem, Portsmouth, Newport and other ports on voyages to the West Indies, England and Spain, it would seem should have carried instruments with which observations could be made to [Pg 12] obtain their approximate position. Mr. George Francis Dow has searched the early probate records of Essex County coast towns between 1634 and 1680, a period of nearly fifty years, and finds but thirteen references to nautical instruments in inventories and wills. Sometimes they are listed as "marriners instruments" and in one case a quadrant is valued at £1. Robert Gray of Salem, who died in 1661, possessed a "quadrant, a fore-staffe (cross-staff), a gunter's scale, and a pair of Compasses." John Bradstreet, who died at Marblehead the previous year, owned "3 small sea books" valued at £1. 6s. The inventory of the estate of Jonathan Browne of Salem, who died in 1667, discloses a "fore-staff," and that of the estate of John Silsby of Salem, taken in 1676, lists "marriners instruments and callender, 14s."

In a very detailed inventory made in Salem before a notary publick on Nov. 4, 1702, of the equipment of the ship *Province Galley*, 90 tons, owned by Roger Derby, the only instruments for navigation that appear are "Two Compasses, two ha[lf] ho[ur] glasses, a ha[lf] Watchglass, a ha[lf] minute glass ... a hand lead line, a deep sea lead line."

The *Boston News-Letter*, July 16, 1716, has the following advertisement: "A Parcel of Mathematical Instruments, viz: Quadrants, Meridian Compasses, all sorts of Rules, black lead Pencils, and brass Ring Dials, etc. To be sold by Publick Vendue at the Crown Coffee House in King's Street, Boston, on Thursday next." The same issue has the advertisement of "William Walker in Merchants Row, near the Swing Bridge," who had quadrants for sale.

In looking back and noting the slow process of perfecting all nautical instruments, the wonder is how the old ships were navigated through distant seas without greater loss of life and vessels. The dangers were real during our commercial-marine activities following the period of the Revolution and the early nineteenth century, as attested by reference to old newspapers and letters, and to such records as the Diary of Rev. William Bentley of Salem, where nearly every Sunday some of his parishioners asked for prayers for friends at sea or for the loss of husband, son or brother. The shipmasters of Salem, Boston, Providence, New York and Baltimore, undertaking distant voyages, had few good charts—none for the new regions they visited—they had no chronometers, few had sextants, and their compasses were frequently unreliable. And yet these men—most of them were scarcely past their majority in years—with the courage and enthusiasm of youth, in ships filled with valuable cargoes, entrusted to their care by wealthy owners, sailed into uncharted seas, visited unknown lands, and, all the while rarely reported, finally came safely back, to their everlasting credit and the enrichment of the country.

We do not know exactly what instruments the old shipmasters carried with them on these voyages, but we do know that they were comparatively few and very inferior to those in use today. An idea of the paucity in some instances may be obtained from the story of the ship *Hannah*, condemned at Christiansand in 1810, in the protest of American shipmasters which is now preserved in the New Haven Historical Society collections. It reads: "We, the undersigned masters of American vessels now in the port of Christiansand, having heard with astonishment that one of the principal charges against the American brig *Hannah*, from Boston, bound direct to Riga, and condemned at the prize court at this place, is as follows,—that the said court have pronounced it absolutely impossible to cross the Atlantic without a chart or sextant. We therefore [Pg 13] feel fully authorized to assert that we have frequently made voyages from America without the above articles, and we are fully persuaded that every seaman with common nautical knowledge can do the same."

No doubt many valuable data lie hidden in old log-books and sea journals, early newspaper files, shipping records of old business houses and elsewhere. To anyone with time and the inclination for research a fascinating field is open where material of historical and scientific value may be

found. The writer is not aware that any such investigations have been made or accounts of any published.

Accurate knowledge of the instruments carried by Colonial shipmasters on their voyages to the West Indies or along our coast and across the Atlantic would be of much interest, and still more to know what were supplied by owners or carried as their personal property by masters and supercargoes for the longer voyages to Russia, the Mediterranean, Africa, India, China, and the South Seas. It would be interesting to know, besides this, what had been their experiences with them: the accuracy of observations, how the compass behaved, etc. The early nineteenth century shipmasters were close observers, and in his works on navigation Lieut. M. F. Maury pays them high compliment for the valuable assistance rendered in furnishing notes and observations on currents, shoals, coast lines, compass variations and winds, for the charts and sailing directions which he compiled.

With these things in mind this paper has been prepared, hoping that someone may be encouraged to take up the work systematically. It is a subject which seems to have been neglected, and the results certainly will repay much time devoted to its investigation.

SCHOONER BALTICK, CAPT. EDWARD ALLEN
Coming out of St. Eustatia, Nov. 16, 1765

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