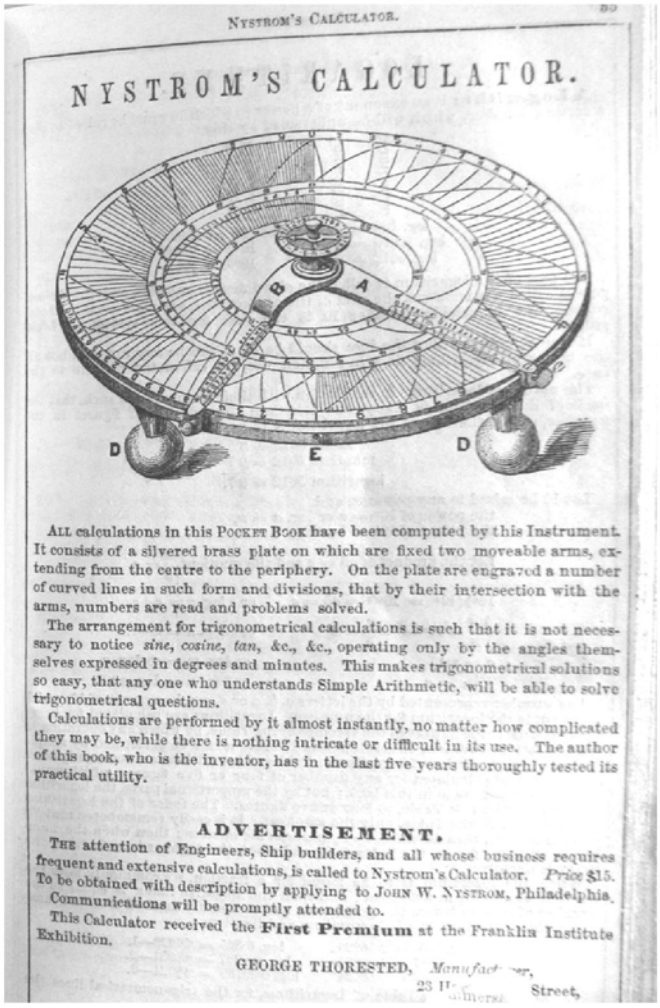
The Nystrom Calculator—The First Patented American Slide Rule

Conrad Schure



NYSTROM'S CALCULATOR.

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ALL calculations in this POCKET BOOK have been computed by this Instrument. It consists of a silvered brass plate on which are fixed two moveable arms, extending from the centre to the periphery. On the plate are engraved a number of curved lines in such form and divisions, that by their intersection with the arms, numbers are read and problems solved.

The arrangement for trigonometrical calculations is such that it is not necessary to notice *sine, cosine, tan,* &c., &c., operating only by the angles themselves expressed in degrees and minutes. This makes trigonometrical solutions so easy, that any one who understands Simple Arithmetic, will be able to solve trigonometrical questions.

Calculations are performed by it almost instantly, no matter how complicated they may be, while there is nothing intricate or difficult in its use. The author of this book, who is the inventor, has in the last five years thoroughly tested its practical utility.

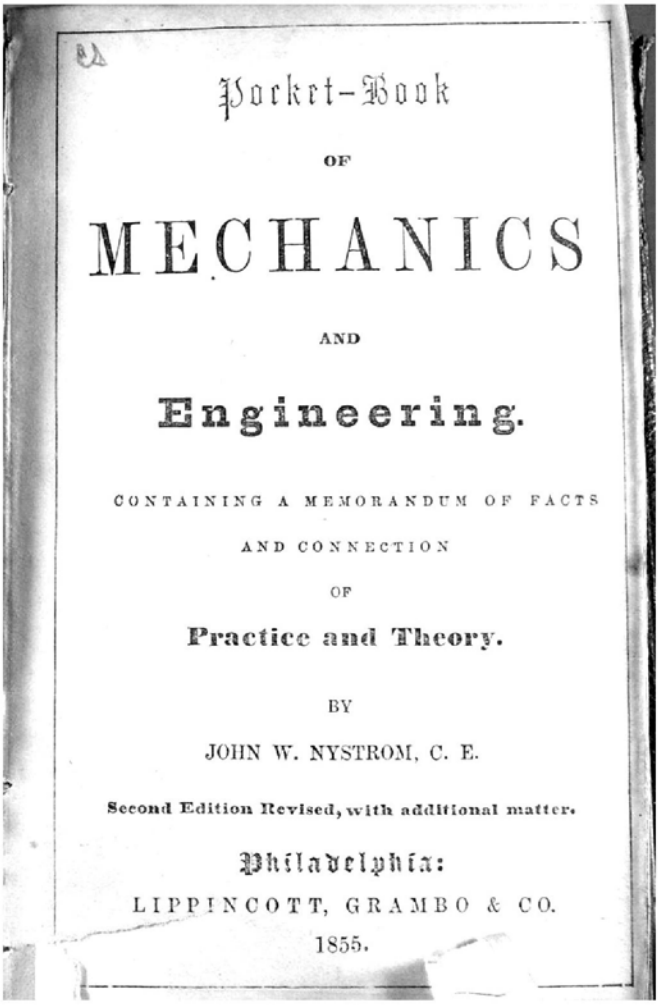
ADVERTISEMENT.

THE attention of Engineers, Ship builders, and all whose business requires frequent and extensive calculations, is called to Nystrom's Calculator. *Price* $15. To be obtained with description by applying to JOHN W. NYSTROM, Philadelphia. Communications will be promptly attended to.

This Calculator received the **First Premium** at the Franklin Institute Exhibition.

GEORGE THORESTED, *Manufacturer*, 23 [illegible] Street,

Figure 1. Picture of the Calculator in Nystrom's Book.



Pocket-Book

OF

MECHANICS

AND

Engineering.

CONTAINING A MEMORANDUM OF FACTS

AND CONNECTION

OF

Practice and Theory.

BY

JOHN W. NYSTROM, C. E.

Second Edition Revised, with additional matter.

Philadelphia:

LIPPINCOTT, GRAMBO & CO.

1855.

Figure 2. Title Page of Nystrom's Book.

Introduction

Some years ago I chanced upon a great little Engineer's Handbook at a local flea market for the princely sum of one dollar. Flipping through the pages of this nicely preserved leather-bound volume, I discovered a drawing of a very interesting circular slide rule. The caption beneath the illustration proclaimed that every calculation necessary to the compilation of this 1850s Engineer's Handbook had been done by a "Nystrom Calculator." This proclamation was made by the author/inventor John W. Nystrom. I became intrigued by this unusual calculating device and decided that it might make a very interesting addition to my then fledgling collection of slide rules and calculators.

That search, which began with the expenditure of one dollar for the *Pocket-Book of Mechanics and Engineering* (Figure 1), was to last for almost thirty years, during which time I had acquired many beautiful and wonderful examples of the slide rule and calculator makers' art. But, woefully, no Nystrom!

Much to my dismay, I did learn just how rare and how scarce Nystrom's calculators were. Research shows that apparently less than one hundred of these magnificent devices were ever sold, and that was in large part why I never encountered one, until last year when an exquisite example became available to me. It was one of those circumstances when the cost becomes a secondary issue. To me, it was what some collectors refer to as the "Holy Grail" of slide rule collecting.

I know of only four other Nystrom Calculators: the patent model, tucked away in a storage cabinet at the Smithsonian in Washington, D.C.; one in the Arithmium

Museum in Bonn, Germany; one in The University of Mississippi Museum in Oxford, Mississippi; and one other in private hands.

Because of the foregoing information, I believe that although the Nystrom Calculator/Slide Rule is not unique, it is definitely important and rare in Slide Rule history.

About the Inventor

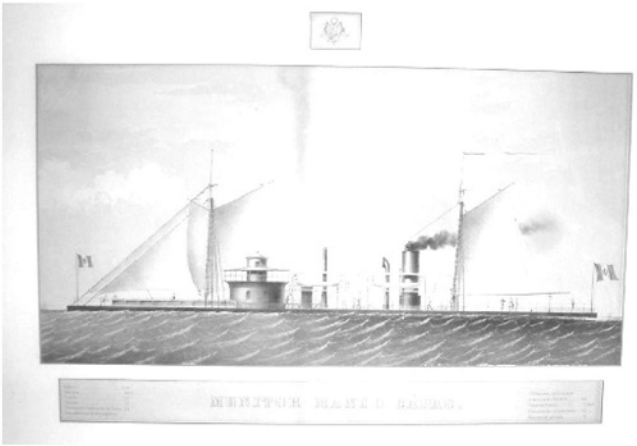


Figure 3. Picture of the Monitor Ship.

Little is known about John W. Nystrom, who conceived of and designed the Nystrom Calculator. He was born in 1824 in a small town in Sweden. After receiving his engineering degree from The Royal Technological Institute in Stockholm, he emigrated to the United States and settled in Philadelphia in 1841. He sought employment upon his arrival and soon became a valued employee of R.F. Loper. He embarked on a career primarily focused on nautical engineering and specializing in propulsion systems for steam vessels. The complicated and repetitive calculations required for propeller and propulsion designs were facilitated by keeping these design details in a pocket notebook, which in turn evolved into the development of a calculating device and the aforementioned *Pocket-Book of Mechanics and Engineering.* His Pocket-Book was first published by Lippincott, Grambo & Co., Philadelphia, in 1854 (The author's copy is a second edition published in 1855). The book had more than twenty editions from 1854 through 1895. His Calculator was first presented at the Franklin Institute in Philadelphia in 1849 and received the first U.S. Patent for a Slide Rule (#7961) on March 4, 1851. Nystrom is also credited with several other patents, primarily in steam propulsion, propellers, steam engines, and navigation.

Nystrom became a United States citizen in 1854. During our Civil War he became an assistant Secretary of the Navy, applying his knowledge of propulsion systems and propeller designs to the new "Monitor-style" of warships. He resigned his naval position reportedly because of a dispute over the necessity for technical education for midshipmen and officers of the Navy. Subsequently, he spent a number of years outside the United States advising both the Russian and Peruvian governments on their operation and deployment of steam-propelled ships. Figure 3 is a recently acquired mid-nineteenth century lithograph of a Peruvian Navy Monitor-style warship (the "Monitor Manco Capac") typical of that period. Nystrom accepted an invitation from the Peruvian government to consult with and train their Navy on the strategic and tactical use of the Monitor-type ships being used for their ongoing battle with neighboring Chile. It has not been verified, but it is just possible that the ship pictured in Figure 3 may have been purchased from the U.S. government and renamed the "Manco Capac" under the Peruvian flag. After several years abroad, he returned to the United States and spent the majority of his remaining years in Philadelphia, where his address was given as 31 Union Street. During this period Nystrom was also quite active in the affairs of the Franklin Institute in that city. He died in Philadelphia in 1885, at the age of 61.

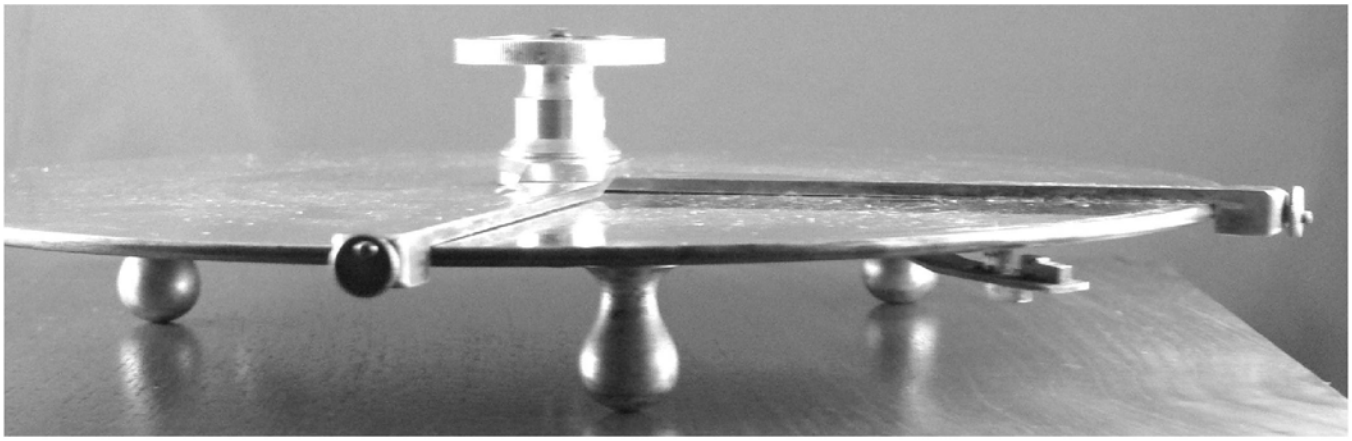


Figure 4. Profile view of the Calculator.

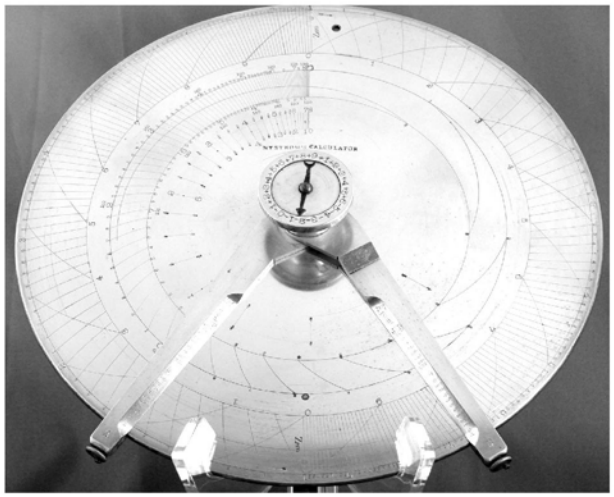


Figure 5. The Entire Nystrom. Same as on the Cover.

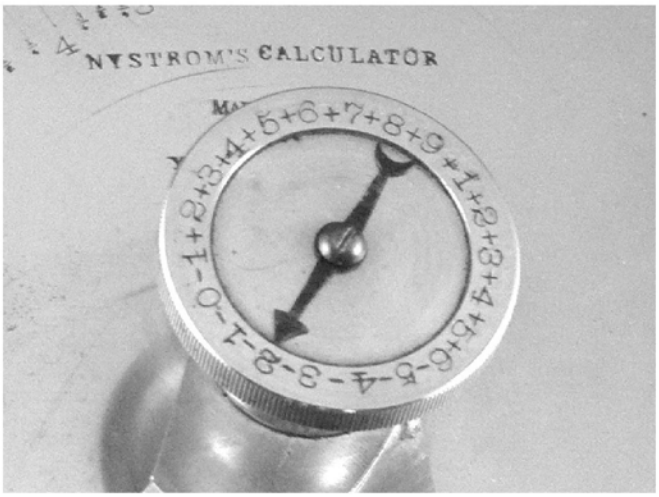


Figure 6. Detail of the Center Knob Showing the Counter.

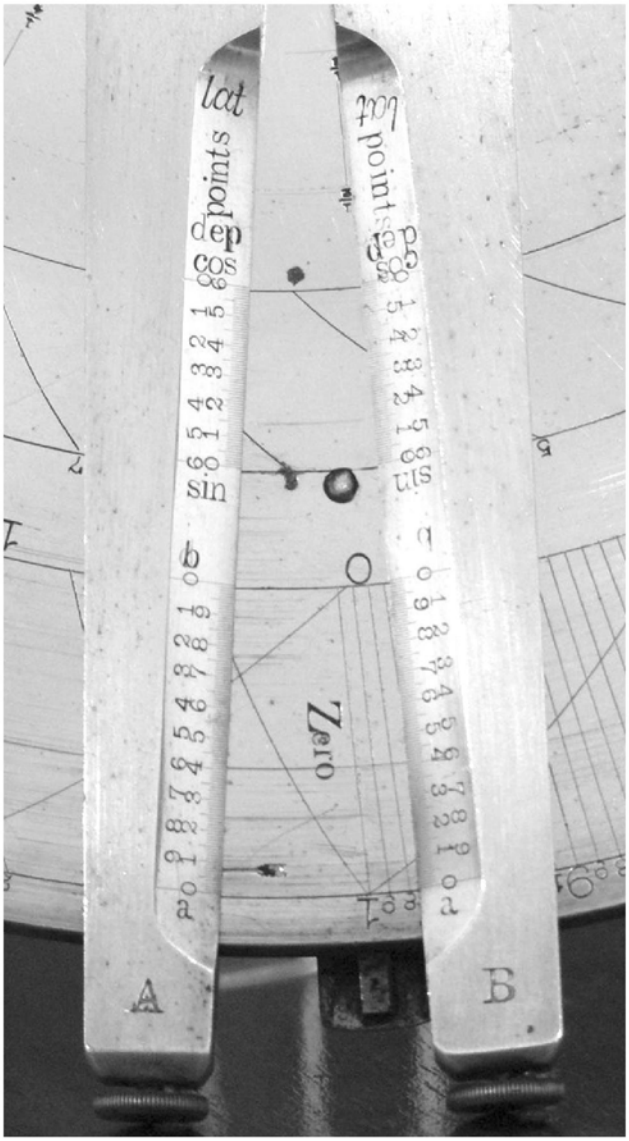


Figure 7. Detail of the Two Calculator Arms.

About the Calculator

The Nystrom is a circular slide rule/calculator. Physically it consists of a silvered brass plate 9.5 inches in diameter and slightly less than 0.125-inch thick. It sits about 1.25 inches high on three ball feet (Figure 3). There are two graduated radial arms (A & B) that can rotate about a central hub (C), that can also lock the two arms such that they can rotate either independently or together (Figure 5). In addition, each arm can be clamped to the outer edge of the main plate. At the top of the central hub there is a small counter which can be turned to keep count of rotations for calculations that exceed one full circle (Figure 6).

The face of the main disk is very finely engraved with four minutely divided circular scales that are intersected by a number of graceful curved lines (which have been described as "diagonals" and as portions of "Archimedian spirals"). These curves permit the measurement of the subdivision of the distance between equal parts by using the subdivisions that are marked on the two radial arms (Figure 7).

The four different scales are labeled on the two arms as: **a, log**[1]**, sin-cos,** and **points** (Figure 7). The "a" scale is utilized for calculations in multiplication, division, involution and evolution, as well as for reducing vulgar fractions to decimals and for interest calculations. The "log" scale can be used for addition and subtraction, for finding the logarithm for a number in the "a" scale, and for the extraction of roots. The scale between the "sin" and "cos" on the arms A & B is for trigonometric calculations, and can be used to find directly the sine, cosine, tangent, or cotangent of any angle, expressed in degrees and minutes. The numbers in the circle "sin & cos" are angles in degrees, and the divisions between "sin & cos" show the minutes, where the line intersects the arm. The "points" scale refers to the points on the nautical compass, relative to the lettered directions on the compass (clockwise from N to S, and then from S around to N).

[1]The word "log" appears on the ends of the arms, and is not visible in the illustration.

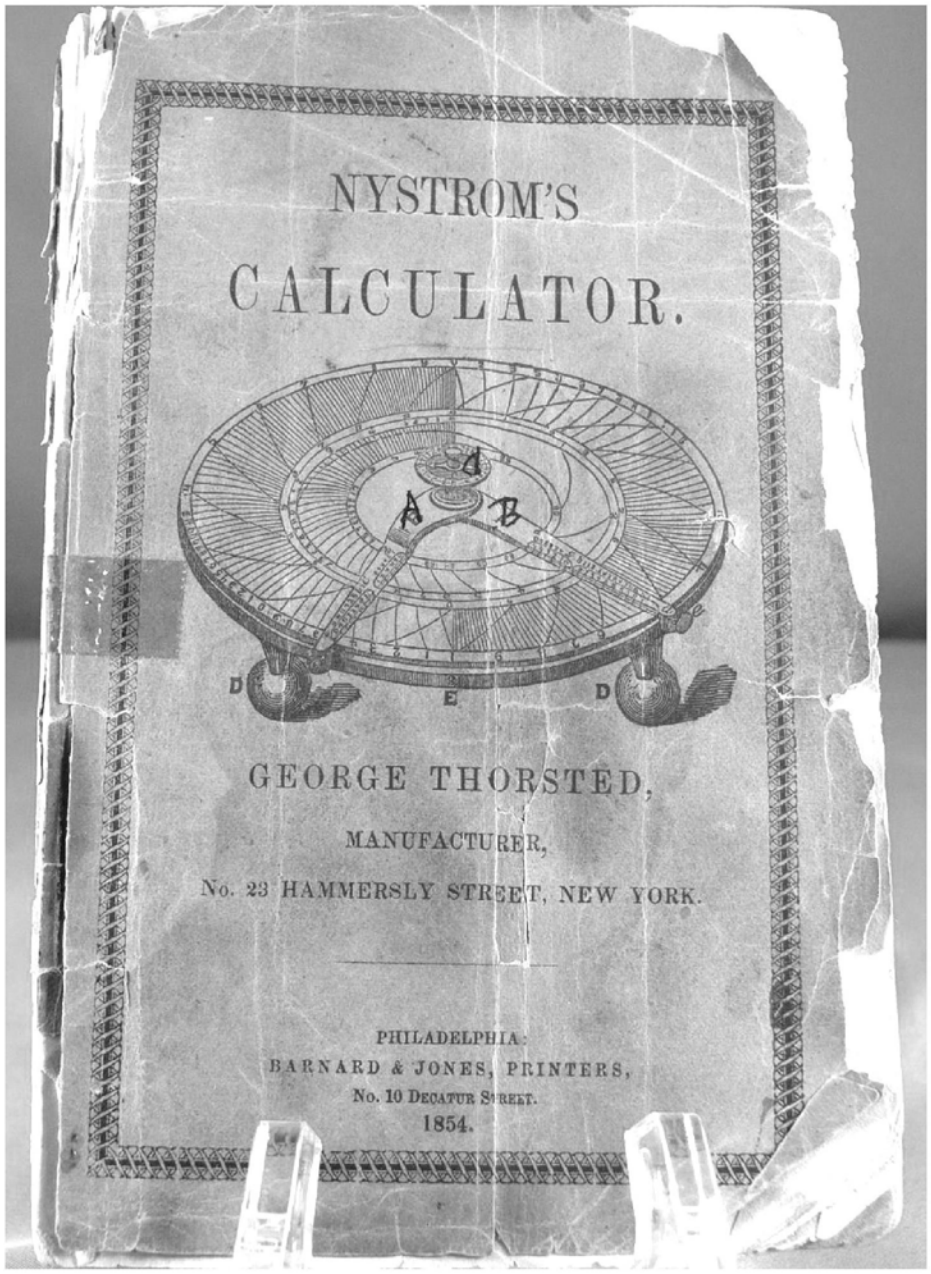


Figure 8. The Calculator Manual.

Much of the 42-page instruction booklet (Figure 8) has to do with using the Nystrom Calculator for solving various problems in navigation and plane sailing. Included in this section on navigating are the following:

- Finding the departure and difference in latitude
- To find the distance
- To find the latitude
- To find the course
- To find the difference in longitude
- To find how many miles per degree longitude in different latitudes
- To find the true course and distance between two places in different latitudes
- To find the apparent time by an altitude of the sun

Another shorter section of the instruction manual covers the use of the Nystrom for calculations in mechanics and deals with: levers of several varieties, pulleys, power of steam engines, horsepower calculations, lateral strength, and hydraulics.

Provenance

The manufacturing history of the Nystrom is vague, but apparently Nystrom made, or had made, several of the instruments for his patent application and exhibits. The original manufacturer was George Thorsted of 23 Hammersly Street in New York. We have no knowledge of just

how many Nystroms were made by Thorsted, but at some point the manufacture was transferred to Young & Sons shops in Philadelphia; however, the instruction booklet continued to carry Thorsted's name on the cover, and also carried the name of James W. Queen, 264 Chestnut Street, Philadelphia, on the back cover as the distributor. Again, we do not know how many Nystroms were made by either Young or Thorsted. We do know that the one surviving example by Thorsted carries #122 as its serial number, and the three production examples by Young have serial numbers in the upper seven hundreds. From this scant sample, we can postulate that perhaps Thorsted started with serial number one hundred, and Young started with serial number seven hundred and fifty, and the best guesstimate is that neither firm made more than fifty instruments.

My Nystrom Calculator has its serial number 777 (and condensed operating instructions) on the back of the main plate. It has traveled extensively during its 150-year life. An accurate time track for this 150-year journey does not exist, but it is known that much of its life was spent in the surveying world, participating in the historic surveys of the western parts of the United States. We know this because there is documentation on at least some of the previous owners after it left Young & Sons shops in Philadelphia in the late 1850s.

The Nystrom is arguably the first serious and sophisticated slide rule/calculator designed and made in the United States. It was the culmination of Nystrom's design efforts, begun in the 1840s and first exhibited at the Franklin Institute's annual fair in 1849, where it received a "First Premium", the Institute's highest award. When, in 1851, the U.S. Patent Office granted patent #7961 for the Nystrom, both the *Journal of the Franklin Institute* and *Scientific American* published articles of high praise for the ingenuity of Nystrom's calculating marvel. In fact, the *Scientific American* article hailed this invention as "the most important one ever brought before the public". Despite all of the accolades, the Nystrom was never widely accepted, and one source claims that no more than 100 were ever produced. This may have been because the cost ($15.00 to $20.00) was a huge sum in the 1850s, or because the instrument was never well advertised or marketed.

The Nystrom in my collection is, with the exception of the patent model at the Smithsonian, probably the most pristine and well-preserved of the known examples. This is true primarily because this one is still housed in its original mahogany, dove-tailed box (with the Young & Sons label on the inside of the lid). In addition, the value is considerably enhanced by the fact that it still has its extremely rare and complete manual of instructions (Figure 8).

Examples of the Use of the Nystrom

The instruction booklet accompanying the Nystrom consists of forty-two pages and describes all of the basic functions of the calculator, as well as many of the specific applications for the use of the Nystrom in special-purpose types of calculations. The importance of this calculator for navigational use is best exemplified by the fact that about half of the forty-two pages are devoted specifically to the solution of problems related to plane sailing and navigation.

To solve these problems in sailing and navigation, the operator of the Nystrom uses a combination of the circular scales on the main plate as well as the linear scales on both arms. As an example, suppose we wanted to find the longitudinal distance (referred to as the "departure") and the latitudinal distance traveled, when the course NNE, 1/4E, (or $2\frac{1}{4}$ points) and actual distance of travel (266 miles), are known. First, we would set arm "A" on the actual distance traveled (266 miles) on the outer circle (scale "a"), and set arm "B" on "Zero", then clamp both arms in position by tightening the screw at the hub ("C"). Then by moving both arms together, rotate them until arm B comes to the "Course" at $2\frac{1}{4}$ points (which according to the table used by Nystrom is the equivalent of NNE, 1/4E, or 25 deg 19 min), and arm A indicates a "departure" (longitudinal displacement) of 113.7 miles, on circle a. Then, by moving the arms, still locked together, until arm B comes to the course $2\frac{1}{4}$ points on the latitudinal course scale, arm A shows that the difference in latitude is 244 miles (again on circle a).

As another example, suppose we wanted to know the course to travel if we knew the difference in latitude and the distance between the two places. For the example, let us assume that we know the distance to be 378 miles, and the difference in latitude to be 231 miles. Then to solve for the course heading, we would set arm A to 378, and arm B on 231 miles (both on the outer scale a) and then clamp both arms at C. Next, we would move the arms, in unison, until arm A comes to zero, then arm B would show the course as nearly $4\frac{3}{4}$ points (or 53 deg 26 min) on the inner scale.

About Collecting

Locating this very important instrument has been both exciting and fulfilling, and some would say that this should be the culmination or ultimate goal of a collection. But if one is an avid collector in a field that is so rich in potential treasures, then this find becomes a milestone, regardless of how important, in the never-ending quest to locate an example in the next level of rarity and importance. As ongoing encouragement to all collectors, I offer my good fortune in finally obtaining my NYSTROM, as an example of the fact that you just might find your "Holy Grail" at next week's Antique Show, Swap Meet, or Flea Market. It should not be overlooked that one of the known examples of the Nystrom was originally found at a flea market in California several years ago.

One Other Source

Kidwell, P.A., "Nystrom's Calculating Rule", *Rittenhouse*, 1:4, August 1987