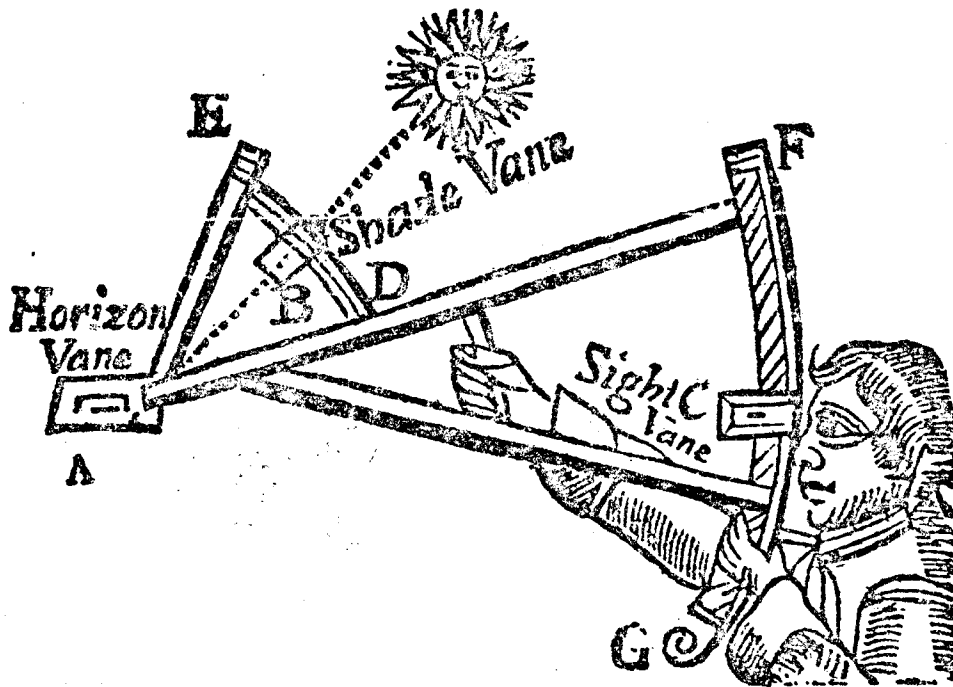


Historical Technology

Catalog 108



SAUL MOSKOWITZ INSTRUMENT ENGINEERING

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(617) 631-2275

Instrumental Navigation circa AD 1700

The mariner of the 17th century, sailing into the early years of the 18th, still relied upon instruments of navigation which were old in his father's time. New ideas were not readily accepted. Of all the innovations of Edmund Gunter (1581-1626) only his scale, the forerunner of the slide rule, came into common usage. Most navigators depended upon the compass and (at best) but three sighting instruments: the cross staff, Davis' quadrant or back staff, and the nocturnal. The day of the marine astrolabe was already past, Robert Hooke's "Instrument for taking Angles at one Prospect" was never to be and Isaac Newton's quadrant of double reflection had to wait until it was re-invented by John Hadley.

The more sophisticated ship's captain may also have included a Gunter's quadrant, an universal ring dial and a pair of globes, particularly the latter. An extended discussion on the use of the celestial and terrestrial globes for the solution of many problems of navigation may be found in one of the leading English navigational texts of the period, James Atkinson's "Epitome of Navigation; OR A Short and easy Methodical Way to become a COMPLETE NAVIGATOR". (A typical pair of such globes, taken from Plate XVII of the 1723 edition of Stone's translation of Bion are shown below as fig. 1.)

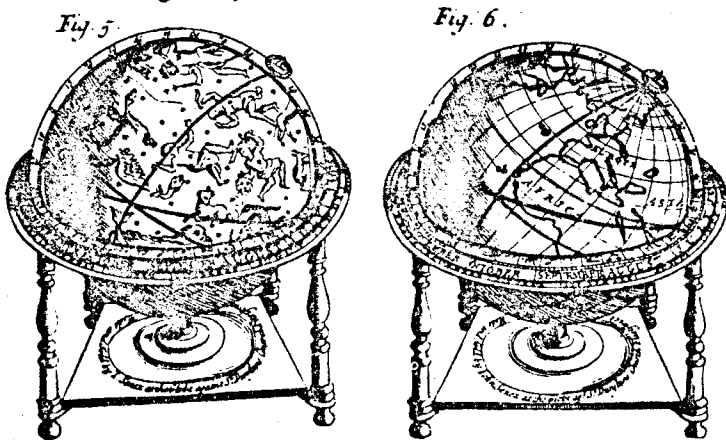


fig. 1

Atkinson (3rd edition, 1698) describes the construction of each globe and then explains how one may find the "Latitude of any place upon the Globe", the "Longitude", the "Distance of any two Places", the "Angle of Position of Places; that is, the Angle, the Arch of a Great-Circle, passing through two given Places, makes with the Meridian of either of them", "two Places being given; to find their Romb or Course of Bearing or sailing from one to another", the "Day of the Month given; to find the Sun's Place in the Ecliptick", the "Sun's Declination", the "Sun's Right-Ascension", the "Declination, and Right-Ascension of a Star", the "Hour of the Night by the Altitude of a known Star", and all the other problems which we would probably solve by tables and formulae derived from spherical trigonometry and could solve quite nicely by coordinate rotations and transformations. Clearly "both globes" was a technique for computation; other instruments were needed to obtain the basic data.

Atkinson discusses the compass and magnetic variation in some detail. Rules are presented on

how to use celestial sightings to determine the variation (the difference at any point between true and magnetic North) and then to set Wakely's rectifier (fig. 2) so that a true course may be steered. The rectifier, consisting of a fixed

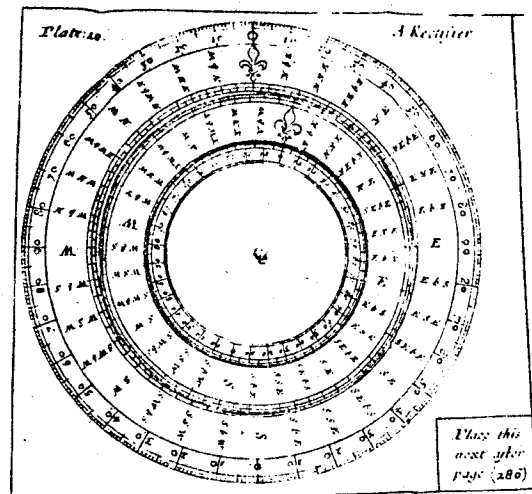


fig. 2

compass rose with a second compass rose rotating within, was the invention of Andrew Wakely about mid 17th century and described by him in his "Mariner's Compass Rectified" (first published in 1664). After his death (1665?) his apprentice and successor James Atkinson, revised and republished this work (editions appearing from about 1694). Thus it is not too surprising to find the following about instruments in Chap. XI of Atkinson's own book:

"An Observation is the finding either of the Sun's or Star's Meridian Altitude (at Sea) with a Quadrant, or with a Cross-Staff."

"A Quadrant is an Instrument whereby only the Sun's Altitude at Sea is found."

"A Cross-staff, or Fore-staff, is an Instrument whereby Mariners find either the Sun, or Star's Altitude. The particular Description of these Instruments I here omit, having done it largely in the Mariner's Compass Rectified; to which I refer the Learner, and now will shew how to find the Latitude after you have observed, which is called working an Observation ..."

After all, why sell one book when you may sell two? It is to Wakely's book then that we turn for actual descriptions of the more common instruments .

"The Mariner's Compass Rectified" went through many editions, first revised by Atkinson and then, in the first part of the 18th century, by William Mountain. Here, I will refer to the edition of 1750 (fig. 3) because I have not yet been able to acquire earlier copies for detailed study. However, since it seems that there were no major text revisions during this interval, little is lost by this choice. Three celestial sighting instruments are described within it.

The cross-staff, an improved version of the Kamal of the Arab world, although long in use was not a particularly well conceived instrument. The illustration from Wakely (fig. 4) reveals

on the vane from the upper edge of the cross, and the horizon all as one line. In Wakely's words:

"This is only used with the Sun, and for this Purpose the Ten-Cross hath another Piece of Wood or Ivory put cross it; so that the lower Edge of this Cross Piece lieth even with the middle of the Square Hole in the Ten-Cross, which also answers to the middle of the Thickness of the Staff."

"There is also a Plate of Brass with a Hole in it, and so fitted, that it will slide on and fit the Ends of the 90, 60, or 30 Cross: These two Things added to the Fore-staff makes it fit for a backward Observation of the Sun, which is thus,..."

If you read the instructions for use of this instrument in Wakely you will realize that it must have been rather difficult to use and would not have been too accurate. Back sightings could have been particularly cumbersome; possibly providing the motivation, and starting point, behind the development of the back-staff, or Davis quadrant (about the year 1595). Here again we refer to Wakely's book for an illustration (fig. 5) and a contemporary description of this instrument and

Wakely's book contains a list of references and titles, including 'The Art and Mystery of Navigation', 'The Art and Mystery of the Compass', and 'The Art and Mystery of the Gunner'. It also includes a table of contents and a list of subscribers.

THE
Mariner's Compass
RECTIFIED:
Containing TABLES, showing the True Hour of the Day, the true bearing, and the true Course of the Ship; with the true Time of the Rizing and Setting of the Sun and Stars; and the true Height of the Compass, when the Sun and Stars are set up. And 13 tables of altitudes. All which Tables are Calculated from the Equations on the 6^d part of Lalande's Op.
With the Description and Use of these Instruments used in the Art of Navigation.
Also a TABLE of the Latitudes and Longitudes of Places.
By ASTLEY WAKELY, Mach.
Carefully Corrected, and very much Enlarged, with many useful Additions.
By T. Mudge, Teacher of the Mathematics.
LONDON:
Printed by R. and T. Moore, at the Crown, in Pall-mal, where you may buy the Copy of the Book, 1753.

fig. 3

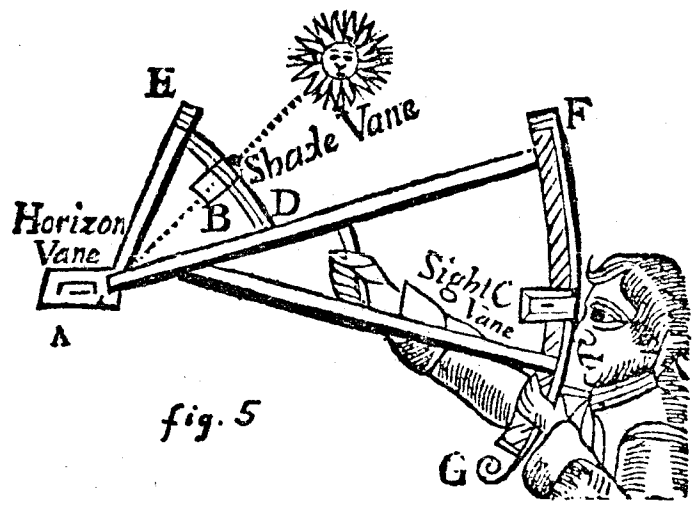


fig. 5

its use, as much to place the reader in the frame of mind of the period as to give him a detailed understanding of the technology.

"This Instrument (called a Quadrant, first invented by our Countryman Capt. Davis, and thence called Davis's Quadrant) is of a very commodious Form; at present the most general approved Instrument at Sea, for observing the Sun's Meridian Altitude."

"The Form of it (as in the Figure prefixed) may be of any Radius or Length, between 18 Inches and 3 Feet; but the most general now made, are Quadrants of 24 Inches Radius, with one Arch 65 degrees, the other 25 degrees, and a Glass in the Shadow Vane."

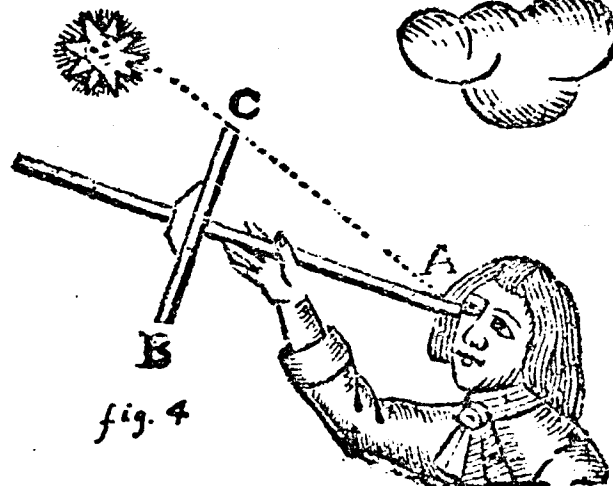
"The principal Parts are three Vanes and two Arches; on which Arches the degrees both together make 90 d. from whence it hath the Denomination of a Quadrant."

"The Horizon Vane (mark'd in the foregoing Figure A, and with it's Name) respects the Horizon in time of observing: That which

that the navigator had to observe both the horizon and the sun simultaneously even though they were separated by a significant angle. He also had to squint. There was no filter between the observer's eye and the sun, a rather uncomfortable situation. Wakely provides further information.

"The Fore-Staff, so called from the Posture of the Observer in using it, whose Face is towards the Thing observed generally, though for the Sun, it's so contrived (for preserving the Eye) to be used backward. It's called also a Cross-staff from it's Form; being a Square Staff with three or four Pieces of Wood across it, which are called Crosses."

"The Staff is usually about 30 Inches, or 3 Foot long, and more than half an Inch square, having four Sides, each graduated unequally, like a Scale of Tangents: To each of them belongs a distinct Cross; though sometimes the shortest Cross is made to serve two Sides of the Staff; that is, the Breadth is for the Ten-Cross, and the Length for the



Thirty-Cross. Besides this, it hath two Crosses more, the longest is the Ninety-Cross, the other is the Sixty-Cross...."

"It's common and ordinary at Sea, to take the Meridian Altitude of the Sun or Stars with this Instrument, and by it find the Latitude the Ship is in."

Back sightings may be taken by the observer turning the instrument, and himself, around so that the cross is attached at the near, or eye end and causes a shadow of the Sun to fall upon a vane at the other end of the staff. An observation is made when the eye placed at the lower edge of the cross sees this edge, the Sun's shadow

gives the Shadow marked B, is the Shadow Vane, and that through which you are to look for both Shadow and Horizon marked C, is termed the Sight Vane: And all these are noted in the Figure by their Names."

"Of the two Arches. The lesser noted DE, is called the 60th Arch, because it did heretofore contain no more than 60 Degrees, and is so numbered in the Figure, but now it often contains 65, and sometimes 70 degrees: This Arch is of small Radius, being so designed that the Shadow Vane used in it, being at so small Distance from the Horizon Vane, on which its Shadow (in time of observing) is to fall, might be more visible to the Eye of the Observer."

"The Greater Arch, GF, is called the 30th Arch: it's of a large Radius, that it might contain the lesser Divisions of a degree; and being of a competent Breadth, thereon are usually described 9 Concentric Circles, intersecting with three Diagonal Lines in each degree, making each Intersection two minutes of a Degree."

"The Great Arch is divided on the Limb into Degrees by long Strokes, each again subdivided into Six equal Parts by shorter Strokes; each small Division being 10 Minutes, and are numbered from the lower End G, with 5, 10, 15, & c. upwards to F, where it ends in the Line ADF, either at 20, 25, or 30 degrees: The Figures always at F and D together make 90, as in this Figure."

A major difficulty in the use of this instrument was maintaining it in a plane containing the sun and perpendicular to the horizon while trying to achieve the necessary triple superposition, all from the rolling deck of the ship. If this perpendicularity was not achieved, then the measured angle would be in excess of the true angle, and hence in error. It is my belief that more than one man was needed for the practical use of this instrument.

The last of the celestial sighting instruments listed in Wakely was the Nocturnal (fig. 6).

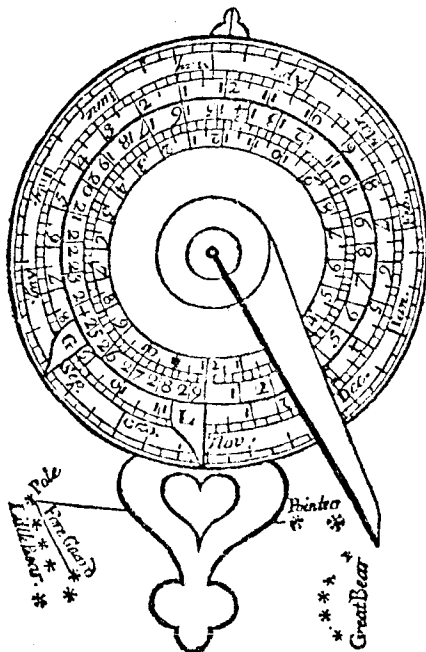


fig. 6

It served two purposes. One could find local time at night by the orientation of the stars of the Large Dipper (Great Bear) or the Small Dipper (Little Bear) in relation to the horizon due to their apparent rotation about Polaris (the North Star) after correcting or setting it for the time of the year. Similarly, the orientation of Polaris with respect to the true pole could be determined. Thus a sighting of the altitude (angle) of Polaris above the horizon would yield the latitude of the ship upon the subtraction, or addition, of the correction factor obtained from an observation with the nocturnal. The origins of this instrument are lost in antiquity, yet Wakely describes it as still in use by the mariners of his time.

"1. The Nocturnal consists of three Parts; the first termed the Unmoveable Part, is the broadest and greatest; on which is a Handle to hold it by, in time of Observation, or using it."

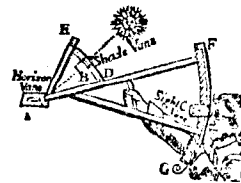
"On the foreside of which, in the outermost Circle, are the twelve Months, and each Month subdivided into its respective Days ... Within the Circle of the Months is a Circle divided into 24 equal Parts or Hours, each Hour divided into Halves and Quarters; used to find the Time of Full Sea or High-water."

"On the Back-side of this Part, are the 32 Points of the Mariner's Compass, South Uppermost, and East on the Left-hand: to each Point is set the Declination of the North-Star, above or under the Pole; which is known by Und. for Under, Abo. for Above."

"2. The second moveable middle Part hath two Circles on it; the outermost is divided into the 29 Days and a half of the Moon's Age; the innermost is divided in 24 equal Parts, or Hours, each Hour subdivided into Halves and Quarters; this Part hath a Tooth, or short Index proceeding from it, with the edge continued in a Right-line from the Center, which is to be set to the Day of the Month when used: Some have two Indices, marked G on one, and L on the other; G standing for Great Bear, and L for Little Bear; signifying the Nocturnal is made for both Bears; and may be used for either."

"3. The third and moveable Part is called the Index; it is uppermost on the Foreside of the Instrument, having one Edge proceeding in a Right-line from the Center, (which in time of Observation) must be turned to the Guards: Through all three Pieces, in the Center of the Instrument, is a Hole, through which you are to see the North Star, when the Index is turned to the Guards."

So stood the technology of navigation when the Longitude Act was passed by the English Parliament in 1714. For what happened then, you may find my little book listed at the end of this catalog of some interest.



CONDITION OF INSTRUMENTS

All the instruments in this catalog are intended for display purposes only. However, they are generally functioning although almost certainly not to their original accuracy. (When they are, please do not worry. We will be the first to let you know.) After all, some wear does take place over the years. Condition is given as accurately as possible although old repairs are usually not noted. Missing parts from cased instruments are noted, except for pocket magnifiers, small tools, etc. which are almost always lost. All instruments in this catalog are in nice condition. Where necessary, they have been properly restored. None are offered in an "as is" condition. Descriptions of condition may even tend to be slightly pessimistic.

REFERENCE BOOKS

The following have been employed in the researching of the items in this catalog:

(Brewington) M.V. Brewington, "The Peabody Museum Collection of Navigating Instruments", Peabody Museum, Salem, Mass., 1963.

(Bedini) S.A. Bedini, "Early American Scientific Instruments and Their Makers", Smithsonian Institution, Washington, D.C., 1964.

(Smart) C.E. Smart, "The Makers of Surveying Instruments in America Since 1700", Regal Art Press, Troy, N.Y., Vol. I 1962. Vol. II 1967.

(Taylor 1) E.G.R. Taylor, "The Mathematical Practitioners of Tudor and Stuart England", Cambridge University Press, Cambridge, 1968.

(Taylor 2) E.G.R. Taylor, "The Mathematical Practitioners of Hanoverian England", Cambridge Univ. Press, 1966.

(Billings) Blumberg, Smith & Leeper, "The Billings Microscope Collection", American Registry of Pathology, Washington, D.C., 1967.

(Campbell) J.F. Campbell, "History and Bibliography of The New American Practical Navigator and The American Coast Pilot", Peabody Museum, Salem, Mass. 1964.

(Goodison) N. Goodison, "English Barometers 1680-1860", Potter, New York, 1968.

(Baillie) G.H. Baillie, "Watchmakers & Clockmakers of the World", 2nd Ed., N.A.G. Press, London, 1947.

(Daumas) M. Daumas, "Les Instruments Scientifiques Aux XVII^e Et XVIII^e Siecles", Presses Universitaires de France, Paris, 1953.

(Gould) R.T. Gould, "The Marine Chronometer", London, 1923, reprint, The Holland Press, London, 1960.

(Rees) A. Rees, "The Cyclopaedia or Universal Dictionary of Arts, Sciences, and Literature", London, 1819.

(Bion) E. Stone, trans. & ed. "M. Bion, The Construction and Principal Uses of Mathematical Instruments", London, 1723.

(Karpinski) L.C. Karpinski, "Bibliography of Mathematical Works Printed in America Through 1850", Univ. of Michigan Press, 1940.

(Thorndike) Lynn Thorndike, "A History of Magic and Experimental Science" 8 Vols., Columbia Univ. Press.

(Bradbury) S. Bradbury, "The Evolution of the Microscope", Pergamon Press, London, 1967.

(Gunther) Robert T. Gunther, "The Astrolabes of the World", 2 Vols., Oxford University Press, Oxford, 1932.

(Bobinger) Maximilian Bobinger, "Alt-Augsburger Kompassmacher", Hans Rosler, Augsburg, 1966.

(Zinner) Ernst Zinner, "Deutsche und Niederländische Astronomische Instrumente", C. H. Beck, München, 1972.

(Checklist) Gibbs, Henderson, & de Solla Price, "A Computerized Checklist of Astrolabes", Dept. of History of Science and Medicine, Yale Univ., New Haven, Conn., 1973.

(Mayer) L.A. Mayer, "Islamic Astrolabists and Their Works", Geneva, 1956.

(Wheatland) David P. Wheatland, "The Apparatus of Science at Harvard 1765-1800", Harvard Univ., Cambridge, 1968.

(Thomas) D.B. Thomas, "The Science Museum Photography Collection", Science Museum, London, 1969.

23. William Leybourn, "DIALING: PLAIN, CONCAVE, CONVEX, PROJECTIVE, REFLECTIVE, REFRACTIVE, SHEW-ING Howv to make all such DIALS, and to adorn them with all useful FURNITURE, Relating to the Course of the SUN, Performed, Arithmetically, Geometrically, Instrumentally and Mechanically:" 1st Ed, Awnsham Churchill, London, 1682. Original leather binding 12" h, 8 1/4" w; pgs. (8), 76, 89-187, (13), 189-192, 12, 181-226, 273-330, (the odd pagination is correct and complete), 23 engraved plates (10 of them fold-out). It appears that the frontis portrait did not appear until later issues. Two plates with wear at folds, binding sound (it is almost 300 years old) overall condition fine. Leybourn (1626-1716) was a noted teacher and writer on astronomy, navigation, mathematics, surveying (he was one of the surveyors of London after the Great Fire of 1666), and dialling. His first publication in this last field was his "Art of Dialling" of 1669. The book here, however, is an entirely new work, much broader in scope, and systematically arranged. In addition to the engraved plates there are text diagrams and tables to aid in the actual design of the many different sun dials considered. (postpaid) \$ 290

24. Guiseppe Settele, "MEMORIA SOPRA FORMA DELLE LINEE ORARIE Indicanti le Ore inequali degli Antichi sopra gli Orologj Solari", Luigi Perego Salvioni, Rome, 1814. Rebound in full leather 8" h, 5 1/2" w; pgs. (2), 44, engraved frontis plate, fold-out plate at rear, and engraving of antique sun dial printed directly on the first text page. Very fine condition. A detailed (with mathematics) study of a sun dial of ancient origin. (In Italian.) (postpaid) \$ 60

SURVEYING

25. Buff & Berger, "HAND-BOOK AND ILLUSTRATED CATALOGUE OF THE Engineers' and Surveyors' INSTRUMENTS, Made By ...", Boston, 1898. Original cardboard covers 9" h, 6" w; 150 numbered pages with a great many illustrations of instruments offered in the last year of the partnership. the covers and a few pages, front and back, in poor condition, otherwise contents very good. It is suspected that several of the more impressive instruments shown were more wishful thinking than fact. (postpaid) \$ 12

26. Charles Davies, "ELEMENTS OF SURVEYING AND NAVIGATION, with Descriptions of the Instruments and the Necessary Tables.", Revised Ed, A.S. Barnes, New York, 1856. Original leather binding 8 1/4" h, 5 1/4" w; 222 text pages, 71 and 100 pgs tables, 6 fold-out plates, 4 of instruments: theodolite, level, plane table and alidade, surveyor's cross, surveyor's compass, marking protractor. Binding worn, contents very good. The first edition of this book was published in 1830 and it was issued in at least 15 more editions. (postpaid) \$ 10

27. William Davis, "A TREATISE ON LAND SURVEYING, BY THE CHAIN, CROSS & OFFSET STAFFS, In Four Parts. Also A Description of the Plan and Map Meters. To which is Added A SUPPLEMENT, containing METHODS BY THE PLANE TABLE & THEODOLITE, and Directions, For Conducting Subterraneous Surveys." 5th Ed, Anne Davis, London, 1813. Original board covers with paper backstrip (rough condition) 9" h, 5 3/4" w; pgs. xix, (1), 393, (1), the 9 engraved plates (many fold-out), the frontis portrait plate, and the fold-out table. Pages uncut, contents in fine condition. Taylor 2 indicates that Davis first published this work in 1798. It is possible that he died before this edition was issued because Anne Davis (his wife?) is given as publisher for the long list of books offered for sale at the end of the book. (postpaid) \$ 25

28. (Dietzgen), "Catalog of EUGENE DIETZGEN Co.," 12th Ed, Chicago, 1926, with slip in price booklet dated July, 1927. Original cloth binding 9" h, 6" w; 490 pages with hundreds of illustrations of surveying, engineering, and drafting equipment. Fine condition. (postpaid) \$ 10

29. Thomas Dix, "A TREATISE ON LAND-SURVEYING, IN SEVEN PARTS.", 3rd Ed, Seeley, London, 1808. Original leather binding 8 1/2" h, 5 1/4" w, rebaked; pgs. xii, 180, the 12 engraved plates (one torn) and several hundred text diagrams. Overall condition very good to fine. Taylor 2 lists Dix as fl. 1799-1809 having published the first edition of this book in 1799. The last section is quite interesting in that it describes the use of the pocket sextant for surveying. (postpaid) \$ 30

30. Octavio Fabri, "L'VSO DEL LA SQVADRA MOBILE", Andrea Gattella, Padova, 1673. Early (original?) vellum covers 9" h, 6 1/2" w, minor wear and a few tears, still fine overall condition. Engraved title page, fold-out plate of instrument (dated 1670), 25 engraved plates on text pages, pgs. (2), 9-100, with 2 different versions of pgs. 85-86 bound in after p. 84. The "Squadra Mobile" (1st edition published in 1698) was a portable surveying instrument of Fabri's innovation. Level was determined by a plumb line and a pair of pivoted alidades with peep sights were used for sightings. Readout was on combined circular and rectified scales so that either angles or trigonometric functions thereof could be obtained. The illustrative engravings are actually pictorial works of art. This is a fine and beautiful book written to illustrate a unique instrument. (In Italian.) (postpaid) \$ 135

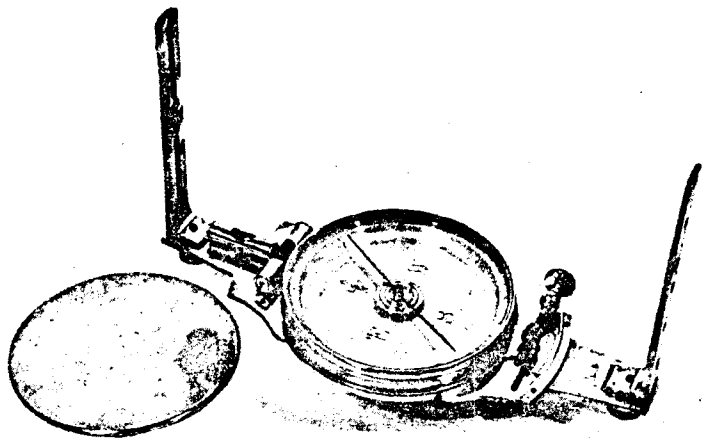
31. Abel Flint, "A SYSTEM OF GEOMETRY AND TRIGONOMETRY: With A TREATISE ON SURVEYING, In Which The Principles of RECTANGULAR SURVEYING, WITHOUT PLOTTING, Are Explained.", (8th Ed, 3rd issue), Belknap and Hamersley, Hartford, 1838. Original leather binding (in nice condition) 8" h, 5" w; pgs. (2), 9-160, 62, 112. Some pages minor spotting, fine overall condition. A highly regarded American book (1st edition in 1804) which was published for over half a century. (postpaid) \$ 16

32. Robert Gibson, "THE THEORY AND PRACTISE OF SURVEYING", 9th printing of 9th Ed, J. & J. Harper, New York, 1828. Original leather binding 8 3/4" h, 5 1/2" w; 251 pages text, 184 pages tables, 14 fold-out plates in rear (a few trimmed just into border), engraved frontis plate of theodolite, Hadley quadrant and azimuth compass. Complete, and except for some foxing, contents and binding in fine condition. Taylor 2 notes that the 2nd edition of Gibson's book was published in 1767, and that he may have been Irish. The 1st American edition is dated 1785. (postpaid) \$ 20
33. "GURLEY ENGINEERING INSTRUMENTS", 32nd Ed, Troy, N.Y., 1922. Original paper covers 9" h, 6" w; 150 pages, with a great number of illustrations of instruments, one in color. Fine condition except for some wear to spine. (postpaid) \$ 12
34. (K + E), "CATALOG OF KEUFFEL & ESSER CO.", 32nd Ed, New York, 1906. Original cloth backed cardboard covers 8 3/4" h, 5 3/4" w; 544 pages, about 400 illustrations. Almost fine condition. (postpaid) \$ 12
35. (K + E), "CATALOG OF KEUFFEL & ESSER Co.", 36th Ed, New York, 1921. Original cloth binding 9" h, 6" w; 492 pages, hundreds of illustrations. Very good condition. (postpaid) \$ 10
36. William Leybourn, "THE COMPLEAT SURVEYOR: CONTAINING The whole ART of Surveying of Land, BY THE Plain Table, Circumferentor, Theodolite, Peractor, And other INSTRUMENTS.", 3rd Ed, George Sawbridge, London, 1674. Original leather binding (front hinge 2/3rds cracked, otherwise very good) 12" h, 7 1/2" w; pgs. (18), 429, the engraved frontis portrait, title page in red and black, 5 engraved plates (although the 4th edition has 6, this appears to be correct because they correlate to text call outs), and many text woodcut figures. Generally very good to fine condition except cover as noted. Leybourn (see Item 23) first published this work in 1653 with editions in 1657, 1674 (this one), 1679, and 1722. The last section of the book "Containing the LEGAL PART OF SURVEYING:" is a reminder that then, as now, the technical merits of a situation were not the only considerations. Aaron Rathborne's work at the beginning of the century and Leybourn's in its second half were the two most important books on Surveying published in 17th century England. (postpaid) \$ 185
37. John Love, "GEOAESIA: OR, THE ART OF SURVEYING AND Measuring of LAND Made EASY. ... AS ALSO How to lay out New Lands in AMERICA, or elsewhere: ...", 7th Ed, J. Rivington & J. Richardson, London, 1760. Rebound in full leather 8 1/4" h, 5 1/2" w; pgs. (18), 196 text pages with many woodcut figures, 64 pgs of tables. Contents very good with some pen and ink notations and some foxing. The 1st edition was published in 1688 just after Love returned from surveying in America. There were editions through the end of the 18th century with two published in the United States. (postpaid) \$ 70
38. L. Puissant, "TRAITÉ DE GÉODÉSIE, OU Exposition des Méthodes Astronomiques et Trigonométriques, appliquées soit à la mesure de la terre, soit à la confection du canevas des cartes et Plans," Courcier, Paris, 1805. Early (original?) leather backed board covers 10 1/4" h, 8 1/4" w; pgs. xxiv, 319, (1), (43) tables, (1), plus the 10 large fold-out engraved plates. Fine condition. The engraved plates depict design details and complete assemblies of a de Borda double telescope repeating circle. Such an instrument was quite capable of the accuracy required for the establishment of a basic geodesic grid, as well as astronomical observations as was shown by Bowditch when he used a less accurate de Borda reflecting circle to establish the orbit of a comet. Only in England was de Borda's instrumentation slighted. This book describes and evaluates (mathematically) the various methods used for taking data and the accurate calculation "relativement à la mesure de la terre". After the first two sections which provide an introduction to the subject, fully 260 pages of the last section (Livre III) provide the details of "Opérations Géodésiques" including a description of, and methods for the use of the de Borda circle. This is an important book. (In French) (postpaid) \$ 145
39. Daniel Schwenter, "GEOMETRIAE PRACTICAE Tractatus IV. ... auss einem Standt das Land zu messen ...", Simon Halbmanern, Nuremberg, 1627. Rebound in full leather 8" h, 6 1/4" w; pgs. 83, (5), 38 woodcut diagrams in text. Fine condition. Schwenter (1585-1636) became professor of Hebrew at the University of Altdorf (Germany) in 1608, then professor of oriental languages in 1628 and professor of mathematics in 1628. He is best known for his "Deliciae Physico-Mathematicae" of 1636. This earlier book on surveying, self contained with its own title page and pagination appears to have formed part of a more extensive work on applied geometry. (In gothic letter German.) (postpaid) \$ 95

GEORGE ADAMS, INSTRUMENT MAKER TO THE KING

Here, we continue and complete our offering of the major books by both the George Adames which was begun in Catalog 107. Taken together they form one of the most comprehensive works on the description and use of scientific instruments of the late 18th century ever published. Indeed, the younger George Adams was probably the most literate of all the great British instrument makers.

40. George Adams (Jr.), "GEOMETRICAL AND GRAPHICAL ESSAYS, Containing a Description of the Mathematical Instruments used in Geometry, Civil and Military Surveying, Levelling and Perspective;" 1st Ed, Printed for the Author by R. Hindmarsh, London, 1791. Original board covers 8 3/4" h, 5 3/4" w, pages uncut; pgs. xvi, 500 (including the 15 pg priced catalog of instruments made and sold by the author), the engraved frontis plate, and the 32 engraved fold out plates. Fine condition. George Adams, Jr. (1750-95) was instrument maker to George III and the Prince of Wales (later George IV). This book could be considered the complement of his "Astronomical and Geographical Essays" of 1789. (postpaid) \$ 195



242. VERNIER SURVEYOR'S COMPASS - American, last 3rd 19th c, signed "W. & L. E. Gurley/Troy, N. Y.". Bright brass, 6 1/2" d silvered compass dial with 5 3/4" needle, base 15 1/2" long, crossed bubble levels, screw-on sight vanes 7 1/2" h, 7" d brass compass cover. Overall ht 10". External 1 arcmin vernier for setting in the magnetic variation. Original dovetailed mahogany case 16 1/2" long, 8 1/4" w, 4" h in poor condition; the compass is fine to very fine.

W. & L. E. Gurley is one of the few remaining American surveying instrument makers of the hundreds founded in the 19th century. Jonas H. Phelps and William Gurley were partners from 1845-1851 at which time Lewis E. Gurley joined the firm. However Phelps & Gurleys lasted only 1 year to become (in 1852) W. & L. E. Gurley, the name they have to this day. Throughout

this time they produced instruments unique in appearance and of particular elegance. This design saw little change over the years and often the best way to date a particular instrument is, primarily, by the case. This compass is no exception to the rule. The 1873 Gurley catalog points out that the external vernier was available only on the 4" needle compasses and that the 5" and 6" needle models were now being made with scales inside the dial only. Yet their 1902 catalog depicts a 6" needle compass with an outside vernier and practically identical in appearance to the 4" version in the 1873 catalog and the one offered here. It is believed that the one here probably dates from c. 1875-85.

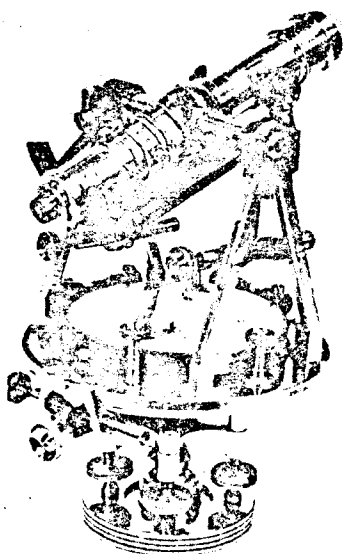
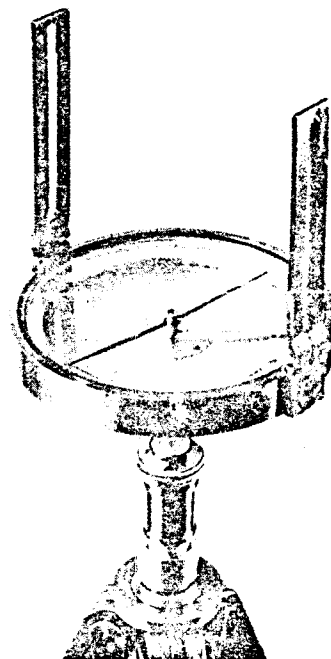
(20 lbs UP, REA)

\$ 265

243. SURVEYOR'S POCKET VERNIER COMPASS - American, 4th qtr 19th c, signed "W & L. E. Gurley, Troy, N. Y.". All brass, still retaining original lacquer finish, compass 5 3/4" d, 4 1/2" needle, folding sight vanes 4 1/2" h. Silvered dial, with inset bubble levels 1 1/4" long, and outer ring (divided by half degrees). Outside edge of compass cylinder engraved with scale and 1 arcmin vernier for setting in the magnetic variation. Universal ball joint. All original except for tripod coupling which is a modern replacement. Original mahogany case 8" w, 6 1/2" deep, 2" h. Also the original tripod with mahogany legs 38" long. All in very fine condition. This is another example of the fine instruments produced by probably America's best known maker of surveying instruments.

(15 lbs UP, REA)

\$ 225



244. THE LIGHT MOUNTAIN TRANSIT - American, c. 1915, signed "W. & L. E. Gurley, Troy, N. Y./1380". Bright brass with silver inlay scales, silvered compass dial, and some black oxidized fittings. Overall ht. (with telescope horiz) 10 1/4" including 4 screw leveling base, telescope 8" long with rack and pinion eyepiece focusing and 4 1/4" bubble level, the base plate 6 1/2" d. The compass of 4 3/4" d with 4" needle is fitted with an internal vernier for the variation, the 5 1/2" d azimuth readout circle is fitted with opposing 1 arcmin verniers, and there is an optional 2 1/2" rad vertical arc with 1 arcmin vernier. The instrument is in extremely fine display condition with the eyecap and azimuth tangent screw spring loading missing and the vertical arc locking knob a replacement. No case.

According to Gurley, "The Light Mountain Transit, introduced by us in 1876 to meet a demand for a light instrument of the finest quality, has met with a very large sale, and has been universally approved. While it is a Transit of first quality, adapted to all kinds of work which may be required, it is

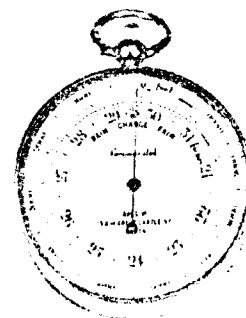
especially fitted for mining or mountain surveying where great portability is desired." This is a beautiful, uniquely American instrument.

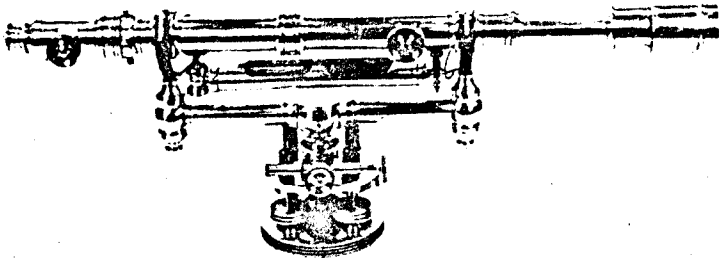
(20 lbs UP, Air Freight)

\$ 325

245. POCKET BAROMETRIC ALTIMETER-COMPASS - English, c. 1885, signed "ROSS LTD/ 13 & 14 GREAT CASTLE ST/LONDON". Two-sided brass case 2" d, 7/8" h. Working aneroid barometer with scale of 21 to 31 inches Hg. Rotating outside ring for altitude setting reading from 0 to 10,000 ft. Magnetic compass on other side with mother-of-pearl compass card (works but requires tapping because of sticking). Fine overall condition.

(2 lbs, UP, PS) \$ 60





246. ENGINEER'S 20-INCH Y-LEVEL - American, c. 1910, signed "W. & L. E. GURLEY/TROY, N. Y." and no. "326". Bright brass, with a few parts in black oxidized finish, 20" min length extending to 25", 8 5/8" h including 4 screw leveling base. Rack and pinion focusing of eyepiece and objective. Bubble 7 1/2" long. The 1902 Gurley catalog notes: "OF THE different varieties of Leveling-Instruments, the Y-Level is universally preferred by American Engineers on account of its easy adjustment and

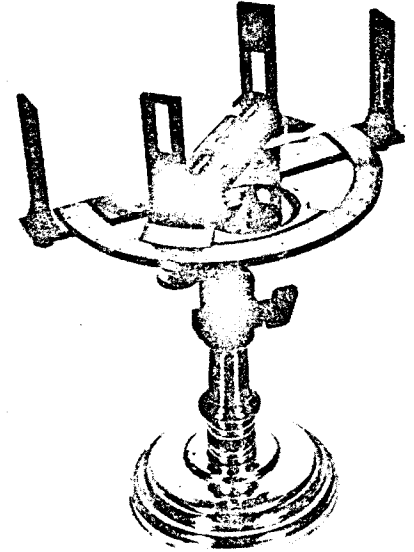
superior accuracy." About 1905 Gurley started to serial number their Y-levels and transits. On the underside of the base one finds an owner's name scratched in with the date 3/14/13 so that we may suppose that it could not have been made later than 1912 and possibly several years earlier. Extremely fine condition. No case.

(20 lbs, UP, PS)

\$ 190

247. AN ELEGANT GRAPHOMETRE - Either English, or French for the English market, 2nd half 19th c, unsigned. All brass in black oxidized and bright lacquered finish with silvered scales, overall ht 8", fixed sight vanes 6 3/4" apart, rotating ones, 4". Readout circle 5" d with arcmin verniers, 2 3/4" bubble level, inset compass 1 1/2" d, 1 1/8" needle, English compass directions. Ball joint staff mounting with locking azimuth rotation. Original oak case 9" h, 5 1/2" w, 6 1/4" deep. Case in fine, graphometre in perfect, mint condition. This form of instrument has been quite popular on the Continent although much less so in English speaking lands, and practically unknown here. (The display base in the photo is not included.)

(10 lbs UP, \$ 8 registered mail) \$ 290

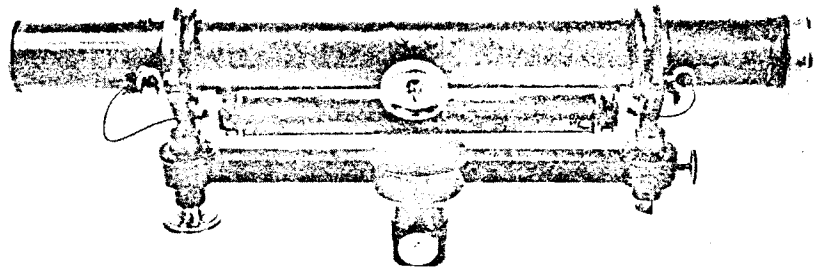


248. IMPROVED SURVEYOR'S CROSS - English, c. 1880, unsigned but probably by Stanley of Gt. Turnstile of London, or their supplier, for the French market. Brass cylinder 3 1/2" d, 4 1/2" h on staff mounting post for 7" overall ht. Silvered compass dial with 2 5/8" needle.

Lower part of cylinder rotates with respect to the upper; sighting slits in both. Inset silver azimuth scale reads to 2 arcmin by vernier. Instrument in very fine condition. No case. This form of instrument almost identical in size to the Stanley signed one in Catalog 107, was designed by William Jones of W. & S. Jones about 1800. It is a general purpose instrument for rapid surveying, with limited accuracy, of small land divisions combining the functions of a surveyor's compass, the simple surveyor's cross, and the theodolite.

(5 lbs, UP, PS) \$ 140

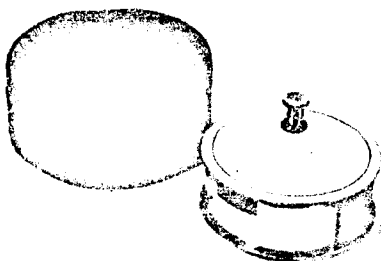
249. SUPERB W & S JONES WYE LEVEL - English, 1st half 19th c, signed "W. & S. JONES. 30 Holborn LONDON". All brass in beautiful black oxidized finish, telescope with rack and pinion focusing 1" d objective, 12 1/4" long, wyes on 8 1/2" separation, overall ht 4 3/4". Bubble level 5 1/2" long and instrument adj by one wye with vertical drive screw. Original dovetailed wooden case 13 1/2" long, 5 1/2" w, 2 3/4" h in sound condition but covered by multiple paint layers; instrument in excellent condition.



(10 lbs, UP, PS)

\$ 185

W. & S. Jones, in business from 1785, moved to 30 Holborn in 1802. Goodison notes that William and Samuel succeeded their father John Jones (1739-87), purchased the stock, library and copyrights of George Adams, Jr. in 1795 and "remained well known as one of the leading and most prosperous firms in the instrument making industry for most of the nineteenth century."

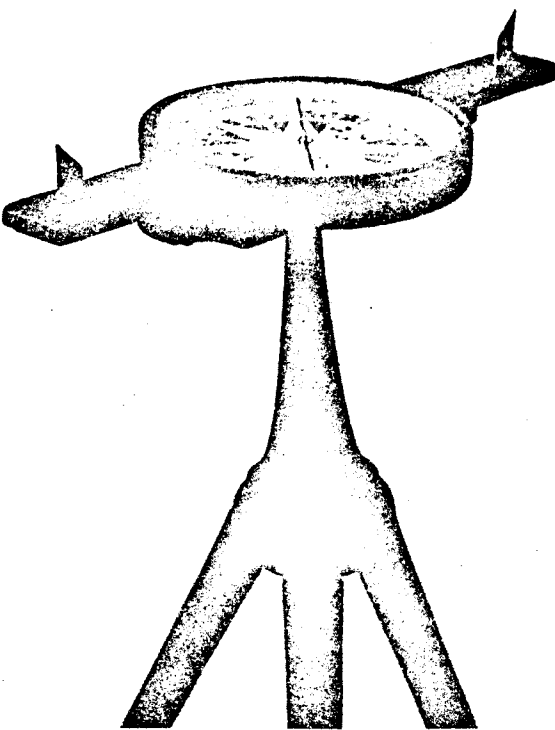


250. SURVEYOR'S OPTICAL SQUARE - English, mid 19th c, unsigned. Brass pocket sextant-like instrument 2 1/2" d, 1" h in original leather case 3" d by 1 1/2" h. The instrument consists of a peep sight, an index mirror set for a 90° angle (with realignment screw) and a half silvered horizon glass (again with adjustments). The adjustment key screws into the cover for stowage. Used by a surveyor for the quick (but accurate) check of the corners of a rectangular subdivision. Case in good condition, with only minor scuffing, and the optical square is in excellent condition.

(3 lbs, UP, PS)

\$ 75

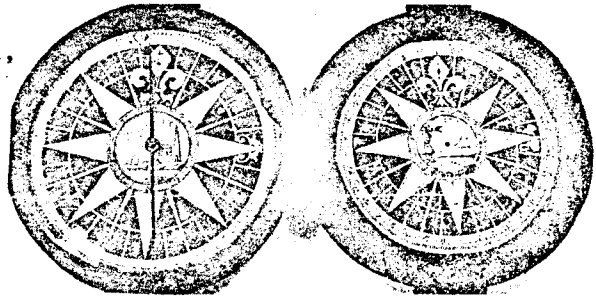
251. EARLY AMERICAN SURVEYOR'S COMPASS - c. 1740, the engraved compass card signed "Made by THOMAS GREENOUGH BOSTON N. England". Wooden instrument 14" long, compass 6 1/4" outside dia, 1 3/4" thk overall. Compass card with sailing boat and lighthouse in center is 5 1/2" d. Compass needle, glass and 1 1/8" h brass sight posts are modern restorations. Original pine compass cover included. The wooden tripod with 47" long oak legs and 7 1/2" h top section was not found with the compass, but is of the period and shows almost identical workmanship, down to the peg joints, and in our opinion was made by Greenough. Extremely fine display condition.



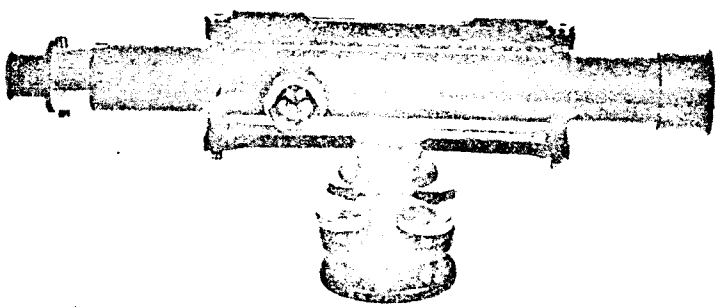
When originally located, a second Greenough compass card with the figure with a Davis quadrant in the center, was pasted over the "lighthouse" card. (This card will go to the purchaser of the instrument.) Bedini shows this card as Fig. 46 and notes that of the five Greenough wooden compasses known to him, "The compass card in each of these five instruments is identical, designed for use in the mariner's compass (see fig. 46)." The bottom compass card here is the only known example of what is obviously his earlier design. 4 of the 5 examples have wooden vanes, the one in the Bucks County Historical Society has brass sights, according to Smart, 6 5/8" h according to Bedini, but it is not known to us what shape they take. The compass here was found without any sign of ever having wooden sights. Rather there were longitudinal slits about 3/4" long each, one of which held the rusted remains of a thin iron blade. Based on this two brass sighting blades of the correct size were made and

fit into the slits. It is believed that this is the correct restoration of what is certainly the earliest known instrument by Greenough.

Thomas Greenough, Sr., (1710-1785) was born and died in Boston, fathered 12 children by 2 wives, and seems to have been a major figure in the commerce of early Boston. He was a member of one of the militia companies in Boston, in 1747 he was listed as 3rd sergeant, and according to Bedini, "He was a firm patriot, held a town office, and was a founder and deacon of the New Brick Church in Boston." Thus the instrument here is significant on several counts; it is the earliest known example of the work of an early and major Boston instrument maker, and it may be, if not the earliest known signed American Surveying instrument, it is no later than the only known instrument by Joseph Halsy (1657-1745), which is shown as Fig. 39 in Bedini. (Joseph Halsy seems to have been the earliest instrument maker in Boston.) This compass is a major find. (25 lbs UP, Air Freight) \$ 675



The Two Greenough Compass Cards

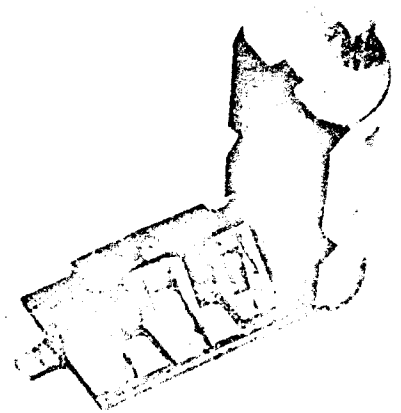


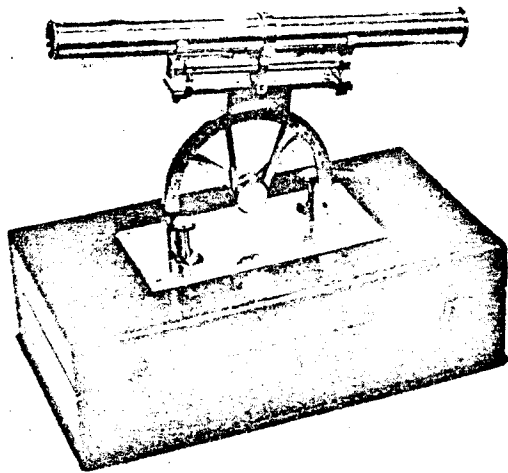
252. NICE ENGLISH LEVEL - 4th qtr 19th c, signed "Stanley, Gt. Turnstile, Holborn, London./345." Black oxidized finished brass 12" long, 5 1/4" h including 4 screw leveling base, 5 1/2" bubble level, rack and pinion focusing eyepiece. Original dovetailed mahogany case 13" long, 4" w, 6 1/2" h. Case in fine, level in excellent condition. This form of English Dumpy level seems to have been one of the basic designs used by Stanley since we find it in various sizes, both smaller and larger. This one is certainly a fine example of English instrument making of the period. (12 lbs, UP, PS) \$ 155

53. UNUSUAL POCKET INSTRUMENT - English, c. 1900, marked "Weldon Range Finder". Brass half cylinder, when closed 1 3/4" d, 2 3/4" long. Opens to show 3 prisms and a tiny box compass (3/8" sq, 1 1/2" long) mounted on inside of flat side. On the outside, under each prism, are engraved 90°, 88°51'15", 74°53'15" indicating the apex angle of each prism. Original leather case 3 1/2" h, 2 1/4" w, 1 3/4" thk. Both in very fine condition. Now the tangent of the difference in apex angles between the 1st and 2nd prism is .02 or 1/50 and between the 2nd and 3rd, .25 or 1/4. The compass was used to establish the base line along which one could measure off a distance which corresponded to either 1/4 or 1/50 of the range to the target. It is not certain, however, how sightings were actually made with the prisms.

(3 lbs, UP, PS)

\$ 85





254. CASE-MOUNTED TELESCOPE - English, 1st half 19th c, unsigned. Bright brass, telescope 10" long x 7/8" d with 3 3/4" bubble level reverses in Y's of 4" separation. Vertical readout circle of 2" rad has 5 arcmin vernier. Instrument 5" h (telescope horizontal) mounts on 3" x 6" brass plate on top of original hand dovetailed mahogany stowage case 11" x 6" x 3 1/2" h. Notches in case suggest that there may have been another item originally but it is not possible to tell what it was. The instrument is complete as shown. The readout circle suggests an early 19th c origin for the instrument as the telescope rides around it. By about 1825, the practice was to invert the circle and attach it to the instrument, placing the pivot point higher and having the vernier on the fixed part of the structure. This is an interesting instrument in extremely fine condition.

(7 lbs UP, PS) registered mail)

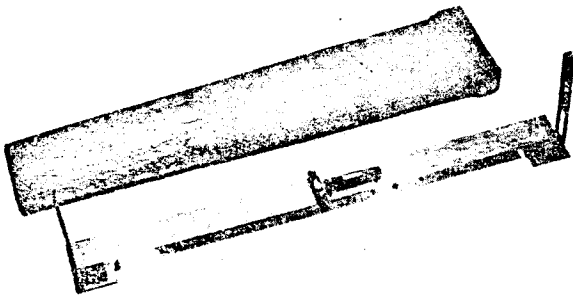
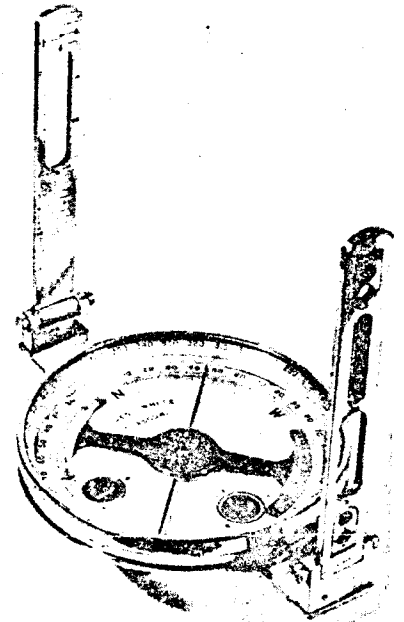
\$ 245

255. MINING SURVEYOR'S BEARING COMPASS - Scottish, 4th qtr

19th c, dial marked "JAMES WHITE/GLASGOW". Brass compass with 6 1/2" d silvered dial, 6" compass needle and 8 1/4" h folding sight vanes located 9 3/4" apart on compass frame. Elevation tangent scales engraved on insides of both sight vanes. With these, heights of distant objects and shaft inclinations can be obtained with direct sightings. This compass has been designed with long sight vanes on a short base just to accommodate the sharp rises in short distances typical of Scottish mines. This compass can also be used to take bearings without reference to the compass needle. The inner bar, with opposing 1 arcmin readout verniers can be locked and the compass rotated through the required azimuth angle just as with the surveyor's transit. In this country, this feature results in an instrument called the "railroad compass". Two circular bubble levels are inset into the face of the compass. Not shown is the original dovetailed mahogany case 9 1/2" w, 8" deep, 4 3/4" h. The case is sound although its surface is in rough shape; the compass is in fine condition. Quite different from the American compass, this instrument would add interest to many a good collection on this side of the Atlantic.

(16 lbs, UP, PS)

\$ 210



256. LEATHER CASED SIGHT VANE ALIDADE - English, 4th qtr 19th c, signed "C. F. CASSELLA & CO. LD./LONDON" and "ROYAL GEOGRAPHICAL SOCIETY".

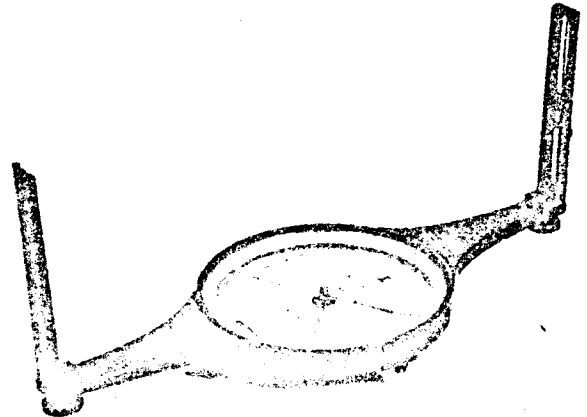
Brass rule 20" long, 2 3/8" w, with crossed bubble levels, 16" divided rule on one edge, 6" long engraved scale with diagonal divisions on face, and 5 1/4" h fold-down black oxidized sight vanes. Original lacquer finish. Leather case 20 1/4" long x 4" w. Case in very good and alidade in fine condition.

Casella & Co, founded by Louis Casella in 1848, produced this instrument for use by the Royal Geographical Society of London. Its engraved serial and RGS inventory numbers should permit one to determine on which expedition it was taken to some remote corner of the world; possibly in forbidden Tibet, or in the search for the source of the Nile. This is a fine surveying item which may have been of great historical importance.

(8 lbs, UP, PS)

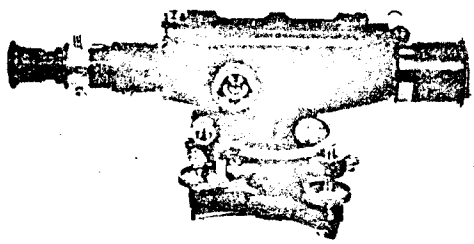
\$ 105

257. THE MODEL 5302 SURVEYOR'S COMPASS - American, early 20th c, signed "KEUFFEL & ESSER CO/NEW YORK". Cast and machined brass in bronzed lacquer finish, silvered dial compass 5 3/4" d with 5" needle, 14" long base with 5" h screw-on sight vanes. Half the ball swivel joint is missing. Original mahogany case 15" x 7 1/4" x 2 1/2" h with name plates of K + E and the U. S. M. A., Department of Practical Military Engineering, at West Point. Case in very good, compass in extremely fine condition.



Keuffel & Esser, founded in 1867, first manufactured surveying instruments in 1885. Their 1913 catalog states: "The Surveying Compasses No. 5300 to 5310 represent the latest construction of these instruments, which we have improved in many features. The compass box is sunk flush with the plate instead of projecting above it. The graduations, to half degrees, are on a raised ring and the needle is of our improved pattern, as described on page 327. One of the detachable sights is graduated and provided with a sliding cross-piece for measuring vertical angles."

(12 lbs, UP, PS) \$ 190

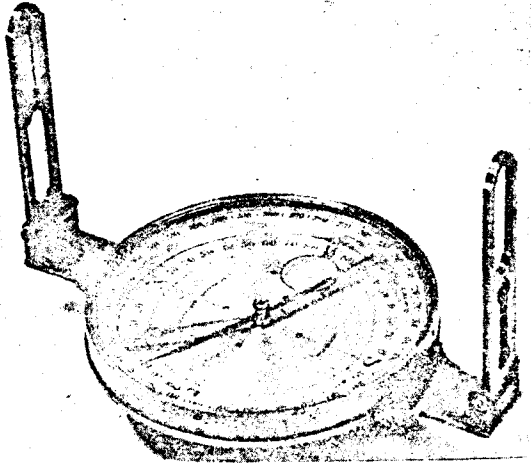


258. ENGLISH LEVEL FITTED FOR TACHEOMETRICAL READING - early 20th c, marked "PATENT/STANLEY, HOLBORN, LONDON/27052/BRITISH MADE". Cast and machined brass in green-black oxidized finish with some fittings in bright lacquered brass 11 1/2" long by 6" h including the 3 screw leveling base. Cross bubble levels 2 1/4" and 4 3/4". Azimuth readout circle 3 3/4" d divided to degrees. Rack and pinion eyepiece focusing. Original mahogany case 13 1/4" x 6" x 7 3/4" h. Case in almost fine and level in near mint condition.

According to the label inside the cover, "The Telescope of this instrument is fitted for tacheometrical [stadimetric] reading, and the points or lines are set 1:100. In taking readings of a distant staff by means of the subtense points or lines in the diaphragm, read every 1/100 foot (or metre) on the staff as being equal to one foot (or metre) of distance from the centre of the instrument, ...". The maker is the same Stanley located at Gt. Turnstile, Holborn during the 19th century.

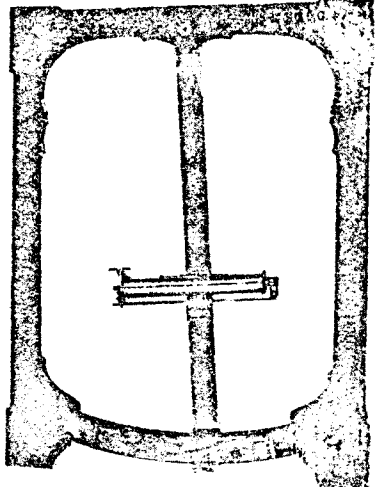
(18 lbs, UP, PS) \$ 145

259. SURVEYOR'S COMPASS BY GARDNER - Scottish, c. 1850, dial face marked "GARDNER & CO. 21 BUCHANAN ST./GLASGOW". Brass compass with 6" silvered dial, 5 1/4" long compass needle and 5 1/4" h folding sight vanes located 9 3/4" apart in compass frame. 1" d circular bubble level within dial face (liquid has leaked out). Edge ring of dial marked in 1° div ccw through 360°, dial face with 10° markings from 0 to 90 to 0 in both directions from North. In dovetailed mahogany case 8 3/4" w, 7 3/4" deep, 3 1/4" h. Case is in good and compass is in very good to fine condition.



Gardner is an old name in Scottish instrument making, first entered in the Glasgow, Scotland Directory in 1787 as "John Gardner, mathematical instrument maker". Remained in the Directory with slight variations of name until 1920. Gardner & Co. was at 21 Buchanan St. between 1839-60. In 1860 they moved to 53 Buchanan St. This instrument shows a very early application of the circular bubble level.

(10 lbs, UP, PS) \$ 195

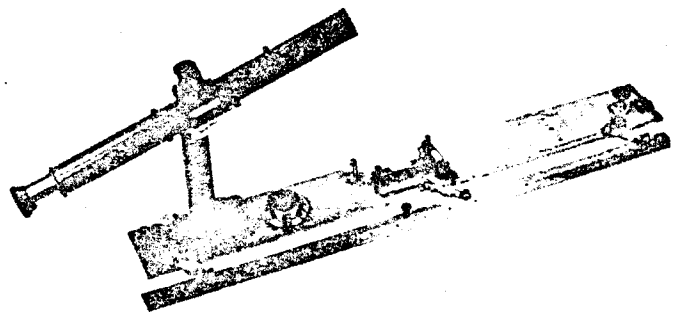


260. LEFEBVRE'S CLITOGRAPHE - French, 2nd half 19th c, marked "NIVEAU de PENTE PARLANT [Leveling Instrument of Excessive Slope]/ou CLITOGRAPHE LEFEBVRE/BREVET D'INVENTION de 15 ANS - S. G. D. G. [patent without government guarantee of quality]". Cast iron frame 13" h x 10 1/4" w, pendulous brass index arm with 3 3/4" adj bubble level, and brass readout scale calibrated in millimeters per meter of slope. Original dovetailed walnut case 13 1/2" x 11" x 1 1/2" thk, badly warped and so only in fair condition. The clinometer is very fine.

It is not certain if this instrument was actually invented by a "Lefebvre" or if the name is in reference to the 18th century instrument maker Étienne-Jean Lefèvre [also spelled Lefebvre] who was noted for his leveling instruments. In either event it is a fine looking, interesting item.

(10 lbs, UP, PS) \$ 115

261. TELESCOPIC PLANE TABLE ALIDADE - English, late 19th c, marked "REEVES'/FOLDING ALIDADE/CARY LONDON" and

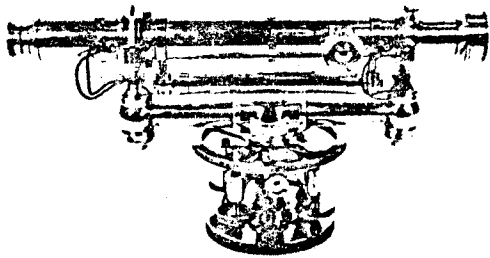


ROYAL GEOGRAPHICAL SOCIETY 23". Lacquered brass parallel rule base 20" long x 3" w closed upon which are mounted a 1 3/4" d circular bubble level, crossed level bubble tubes (a later modification) and the folding black lacquered telescopic sight 11 1/2" long x 7 1/4" h with its own 2 1/4" bubble level and elevation readout scale (10 arcmin vernier). A 1/250,000 mapping scale rule with diagonals is engraved on the surface of the alidade base. Original hand dovetailed mahogany case 4 1/2" x 11" h x 21" long, showing wear but in generally very good condition. There is a place for a box compass which is not present. The alidade is in generally fine condition although there is some spotting of the finish on the base.

Made by a firm of noted instrument makers (established by William Cary in the 18th c) these plane table alidades seem to have been popular with explorers heading to remote parts of the world. They were light in weight compared to the standard transit and permitted maps to be drawn in the field without the need for recording quantities of numerical data. The Royal Geographical Society inscription speaks for itself.

(12 lbs, UP, PS)

\$ 165



262. ARCHITECT'S LEVEL WITH AZIMUTH READOUT - American, early 20th c, engraved "Chicago" and with added "BUFF" nameplate. Bright brass, telescope 13 1/4" long (extended); overall ht 9 5/8" including 4 screw leveling base. Rack and pinion objective focusing and draw tube eyepiece focusing. Bubble level 5" long with 7 1/4" separation between wyes. Azimuth circle 4" d with vernier for 5 arcmin readout. Case marked "Buff & Buff Mfg. Co." is an 11 1/2" cube. Case is sound with rough surfaces, level is in very fine condition.

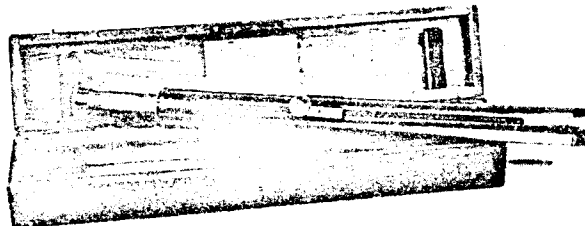
Although not clearly signed by Buff & Buff, they did have a

Chicago sales outlet at one time and the engraved script is similar to that on other Buff instruments. It is possible that this form of level was made to be wholesaled and that the "BUFF" plate was added when they offered it themselves for retail sale. The firm founded by George C. Buff (1837-1923) in 1898, after the Buff & Berger partnership was dissolved, is one of the few surviving American surveying instrument firms and possibly the last not reduced to being just part of some large corporation.

(10 lbs, UP, PS)

\$ 160

263. STADIMETRIC RANGE-FINDING TELESCOPE - French, c. 1860, trade card in case reads, "MAISON LEREBOURS & SECRETAN./SECRETAN,/SUCESSEUR/Opticien/de l'Observatoire & de la Marine/MAGASINS: 13, PLACE DU PONT-NEUF/ATELIERS: 28, PLACE DAUPHINE/PARIS". Brass telescope with original lacquer finish 1 5/8" d x 22 1/2" long, extended. Engraved calibration scale on telescope with rack and pinion set adj crosshairs, vernier readout. Original hand dovetailed walnut case 2 7/8" x 4 1/8" x 20 1/2" long. Case in fine and telescope in very fine condition (although the crosshairs are now lacking).



The firm of Secretan was founded in 1855 upon the death of his partner Lerebours. The trade card seems to date from shortly after this time. The instrument appears to have measured the angular extent of a fixed length on a surveyor's pole by moving a pair of parallel crosshairs longitudinally along the telescope tube until the crosshair separation matched the fixed length. The calibrated readout then gives a direct indication of range.

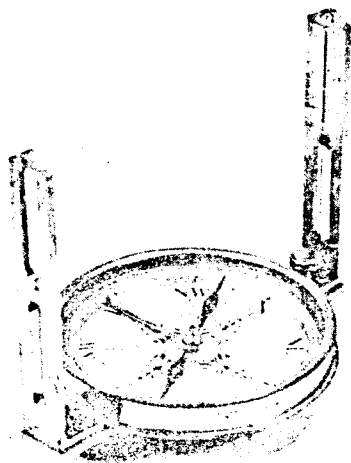
(10 lbs, UP, PS)

\$ 180

264. GREAT LITTLE SURVEYOR'S COMPASS - English, possibly 1st half 19th c, unsigned. Brass with original lacquer finish, compass with silvered dial 4 1/4" d and 3 1/2" needle, base 6" long, and 4 1/2" h screw-on sight vanes. Early (original?) rough pine fitted case 7" x 5" x 2 3/4" h. Case in so-so, compass in very fine plus condition. Too bad that there is no maker's name because this is an extremely well made instrument of an unusual design in that 2 thumb screws hold the compass housing to the sight vane base. Possibly it was intended for use in combination with some more complex instrument.

(6 lbs, UP, PS)

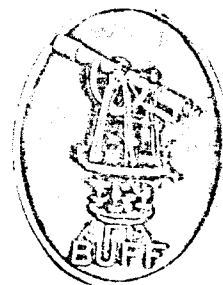
\$ 200



265. BUFF TRANSIT PLAQUE - American, early 20th c. Nickered plated brass oval plaque 4" by 3" showing typical surveyor's transit made by Buff & Buff Mfg. Co. of Boston. An excellent display item for any collection of American surveying instruments; a necessity for the collection with any Buff & Buff instruments. Mint condition.

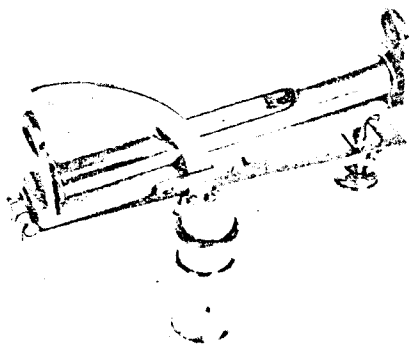
(2 lbs, UP, PS)

\$ 25

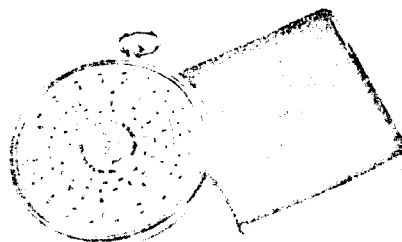


266. EARLY POCKET CLINOMETER - European, late 18th or early 19th c, unsigned. Bright brass, 5" h, 5 1/4" long, 4 1/2" bubble level mounted between 1 1/2" h sight vanes on hinged base, bottom plate 5 1/4" long, 5/8" w. Elevation adj. by vertical screw. Readout on 2 3/4" rad silvered scale divided in degrees between 0° and 60°. An interesting little item in fine condition.

(3 lbs, UP, PS) \$ 115



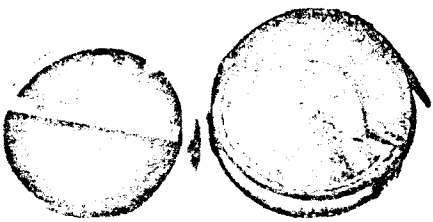
267. NICE LITTLE POCKET CIRCULAR SLIDE RULE - English, early 20th c, marked "THE HALDEN CALCULEX/PATENT CIRCULAR SLIDE RULE". 2 3/8" d with white faced scales on both sides, the inner set rotating with respect to the outer, and rotating glass cursor plates



on both sides (one with a crack alongside the index line). In original aluminum case about 2 1/2" sq which also contains the original 2 1/4" sq, 95 page instruction book. Overall fine condition (except for indicated crack) and working.

(1 lb, UP, PS)

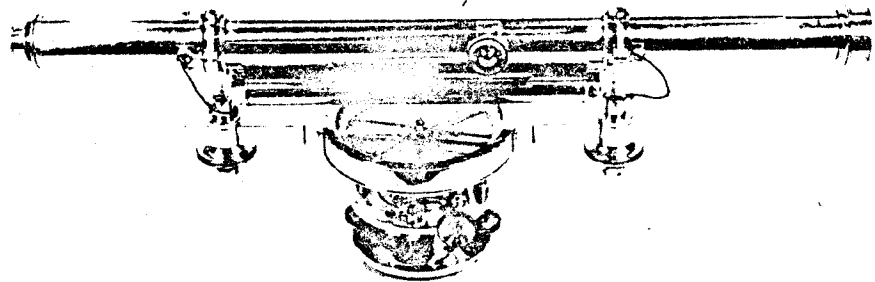
\$ 40



268. PENDULOUS SCALE CLINOMETER - English, late 19th c, marked "WATKIN'S CLINOMETER PATENT 217/ J. H. STEWARD LONDON" and serial "No. 3195". Black oxidized finish brass case 2 3/4" x 5/8" thk with a semicircular scale illumination circle on one side. Peep hole in one edge for viewing target and, by half field mirror, the curved pivoted weighted readout scale. The patent awarded Jan 1, 1884, points out that the mirror has a curved (concave) surface. Thus it acts as a lens enabling the eye to focus on the near scale and distant target at the same time. Original leather case. Case and instrument in fine condition.

(2 lbs, UP, PS)

\$ 45



269. IMPOSING ENGLISH WYE LEVEL - WITH COMPASS - c. 1825, signed "Bate, London". Bright brass, telescope 23 1/4" long extending to 27" with rack focusing of objective and draw tube focusing of eyepiece, standing 8 1/8" h including 4 screw leveling base. Level bubble 10" long with boxwood division scale, 1 1/2" separation of Y's, and silvered dial compass 5 3/4" d with 4 1/2" needle. Extremely fine condition.

Taylor 2 lists Robert Bretsell Bate (fl. 1807-43), "In 1807 Bate was apprenticed, and must have started in business about 1815. Before 1840 the firm became Bate and Son. ... He made the official standard weights for Kater after Edward Troughton had refused to, on account of his age." This surveying instrument is of the highest quality as have been his other instruments we have been able to offer including the Most-Improved microscope (Item 144, Cat. 107) and the Standard Yard (Item 180, Cat. 105).

(25 lbs UP, REA) \$ 395

IMPORTANT REFERENCE BOOKS

There is a packing and shipping charge of 75¢ for the first book and 50¢ for each additional book, with \$ 1 to be added for each overseas shipment.

- a. Brewington, "The Peabody Museum Collection of Navigating Instruments". A valuable reference and now out of print with only 5 left. Price \$ 40 to customers with purchases of at least \$ 125, to all others \$ 85.00
- b. Campbell, "History and Bibliography of The New American Practical Navigator and The American Coast Pilot". \$ 10.00
- c. Gould, "The Marine Chronometer". Originally published in 1923 and still the best reference available. \$ 17.50
- d. Wheatland, "The Apparatus of Science at Harvard 1765-1800". A large (9" by 11") book with over 100 illustrations, 6 in color. In many ways, far superior to the picture books on instruments from France because it illustrates items which one can still find and collect. \$ 20.00
- e. Edmund Stone, "THE CONSTRUCTION AND PRINCIPAL USES OF Mathematical Instruments. Translated from the French of M. BION ... to which are added the Construction and Uses ... those invented or improved by the English". 1972 Reprint of the 2nd Ed of 1758. A folio size book (9 1/2" w x 14" h) with 325 numbered pages and 30 full page plates. This is a reprint of the 2nd, and best English edition, of the best early 18th century book ever published on the design and use of scientific instruments. Limited edition of 500. \$ 40.95
- f. Smart, "The Makers of Surveying Instruments in America Since 1700", Vol. I, 1962 and Vol. II, 1967. 282 pages in total with many illustrations. An invaluable reference on American surveying and navigational instrument makers and now out of print, (only 4 sets left). \$ 85.00
- g. Moskowitz, "THREE STUDIES IN THE HISTORY OF CELESTIAL NAVIGATION * From Simple Quadrant to Space Sextant. * The Method of Lunar Distances and Technological Advance. * The Development of the Artificial Horizon for Celestial Navigation.", cloth bound reprints from "Navigation", the journal of the Institute of Navigation. 49 pages with 44 illustrations. The second title received the Institute's Burka Award in 1971 as the best paper of the year published in "Navigation". \$ 8.50

Please Note That There Is No Return Permitted Of These New Books.