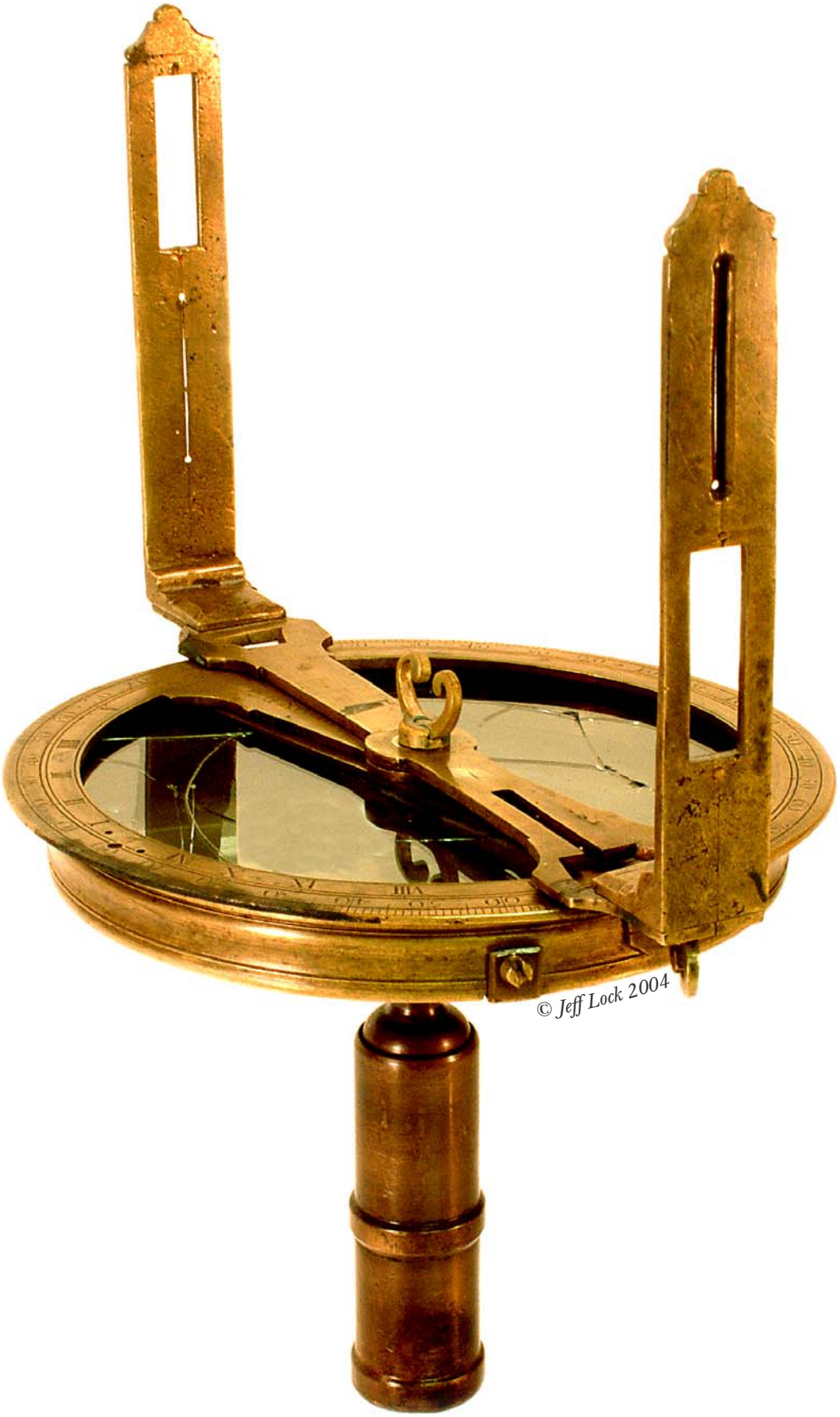

Rowland Houghton's "Theodolate"

This is the first in a series of articles that will highlight and compare four very unusual and seldom-seen survey instruments. Because the terms for some of the instruments are sometimes misused, let's begin by clarifying the definitions of those instruments known as theodolites, common theodolites, telescopic theodolites, and circumferentors.

A theodolite is an instrument with which the angle viewed between two sighted points is to be read off the horizontal circle of the instrument, using the reading in degrees between the fixed sights (normally located at (0° and 180°)and the sights attached to the rotating alidade. Included in this group is the *common theodolite*, a two- or four-vaned instrument with a rotating compass box/alidade assembly that normally has two sight vanes attached at either end (**Figure 1**). Also included in this group is the *telescopic theodolite*, which resembles a common theodolite but also includes a telescope that can be substituted for the two vanes on the moveable compass box/alidade. This allows azimuth angles to be read when the telescope is fixed in the horizontal position. Altitude angles are read from a vertical arc attached to the telescope (**Figure 2**).

continued >

>> By Jeff Lock

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Figure 1 *Common theodolite*

Figure 2 *Telescopic theodolite*

Figure 3 *Circumferentor or surveyor's compass*

A *circumferentor* is more commonly referred to as a surveyor's compass. The reference angles are to be read from the degree scale within the compass box relative to the magnetic needle. The sighting is accomplished via two sight vanes at either end of the alidade, oriented on the north-south line (**Figure 3**).

A Historical Perspective

Generally speaking, brass instruments produced in the Colonies were quite rare until the middle of the 18th century. Rowland Houghton's "theodolate," patented in 1735 in Massachusetts, is the earliest brass surveying instrument to be patented and documented. In his book *With Compass and Chain*, historian Silvio Bedini traces the history of the patent given to Houghton in 1735/36 by the Massachusetts Bay Colony. According to the Act recorded in its *Acts and Resolves II*, Houghton's instrument was designed *"for surveying of lands … with greater ease and dispatch than any surveying instrument heretofore projected or made within this province."* There were many circumferentors and semi-circumferentors primarily constructed of wood during this early period, but Houghton was able to obtain a patent due to the accurate simplicity of the design of his instrument.

Rowland Houghton surveyed in Maine and in the Massachusetts Bay Colony. Based on an announcement of Dabney's arrival that appeared in the *Boston Gazette* in July of 1739, Bedini points out that Houghton engaged the English-trained instrument maker, John Dabney, who worked with Houghton in 1739 - 1740, for some of his instrument work. The announcement stated, *"Arriv'd here ... from London John Dabney, junr. who serv'd his time to Mr. Johathan Sisson, Mathematical Instrument Maker to His Royal Highness, the Prince of Wales. Makes and sells all sorts of Mathematical Instruments ... at Mr. Rowland Houghton's shop ... in Boston."* According to Bedini, Jonathan Sisson was "a prominent English maker of surveying and astronomical instruments noted for the precision of his divided scales."

It is possible Dabney helped with the accurate divisions for both the horizontal circle as well as the divisions for the sundial (**Figure 4**). We can only speculate as to the intended purpose of the sundial, the gnomon of which appears to be an easily removed piece that is missing on both known examples of this instrument. The interesting coincidence regarding the sundial is that, despite being manufactured in Boston, it is configured to a latitude of 39° 30', very close to that of the Mason Dixon Line, the correlation of which has yet to be understood. Incidentally, both known Houghton instruments are configured for the same latitude. Upon first consideration, I felt that this sundial was only used for determining approximate local time for the surveyor in the field, but after continued research, it appears that the vertical pin acting as part of the sundial gnomon could have the dual role of also providing the surveyor with a means to determine his true meridian, similar to the manner in which 16th and 17th century mariners developed a compass of variation used in conjunction with an instrument to determine equal altitudes of the sun, therefore allowing the magnetic variation of that location to be factored into the readings.

The interesting aspect of Houghton's instrument was the stationary compass box that allowed the sights and the horizontal circle to rotate independently. The sights would be directed at the first object, then the horizontal circle would be rotated to align the sight mark on the alidade to "00" on the horizontal scale, allowing the movement of the sights to the second object. The angle in degrees separating the two objects could then be read directly in degrees from the horizontal circle. Within the compass box there is no divided circle to read, relative to the magnetic needle. To accomplish the azimuth reading relative to the magnetic needle, the rotating alidade has a slit cut into one side that allows the needle to be aligned with the alidade bisecting the slit when viewed from above (**Figure 5**). Then, if the local variation is factored in,

Figure 4 *The divided circle shows a very sophisticated level of workmanship, both in the metal work as well as engraving and division.*

Rowland Houghton's "Theodolate"

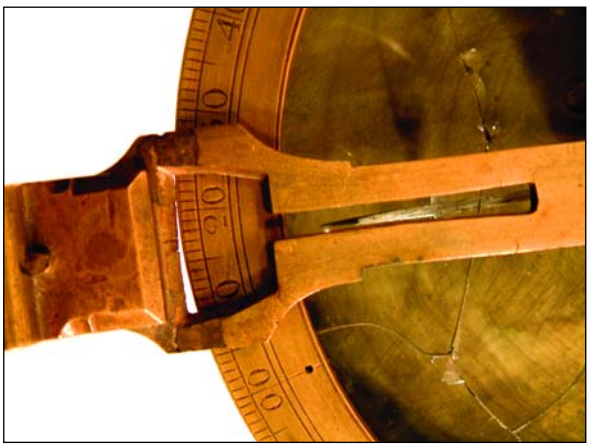

Figure 5 *This slit and window assembly has proven over time to be a structural weak point. Notice the compass needle viewed thru the slit.*

The socket assembly shows the typical diminutive size of the early colonial instruments with the socket plate being made of very thin sheet brass.

the horizontal scale can be rotated to true north, allowing all future readings to be adjusted for variation.

To this date there are only two known examples of this Houghton "theodolate." One is an incomplete version that is housed in the Smithsonian collection, and the other is the one that has been used for the photos in this article.

Careful study has revealed that Houghton's "theodolate" bears many similar characteristics to a recently discovered four-vane theodolite designed by Thomas Greenough of Boston in approximately the same time period. The next installment in this series of articles will feature a comparative analysis of the Houghton and Greenough instruments.

Editor's Note: Articles in this series are part of Lock's forthcoming book, The Art of Colonial Surveying Instruments.

Drawing on 30 years' experience in the restoration field, Jeff Lock has focused on colonial instruments from the 18th century and the techniques that were used for their construction. His continuing research has uncovered unusual instruments that will be discussed in future articles.

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The lathe turning of the vertical side of the compass box shows a degree of sophistication that was well beyond the norm of colonial instruments from this time period. Note tapered screw heads.