THE FIRST SURVEYORS' TRANSITS, 1852-1862

Robert C. Miller

William J. Young, who made his first transit in 1831, considered it as an engineering instrument, to be used by civil engineers for laying out railroads, bridges etc.[1] Transits might have been used in land surveys, but their use was limited by their price ($130 compared to about $30 for a vernier compass), and by the fact that it was much easier to rerun old lines with a vernier compass.

A transit adapted for the needs of land surveyors appeared on the market in the early 1850's. In this instrument, as developed by Richard Patten and/or W. & L. E. Gurley, the standards and telescope are attached to the lower plate, and the needle ring and compass card which form the upper plate are attached directly to the lower motion. The result of this arrangement, and *the distinguishing feature of this transit*, is that when the lower plate is clamped and the telescope rotated in azimuth, the needle ring and compass card remain stationary. A divided circle with verniers is attached to the upper plate, so that the angle between the upper and lower plates may be measured. The surveyors' transit appears to have evolved from Burt's 1840 solar compass. In that instrument, the solar apparatus is aligned with the meridian using the lower motion and clamped; the sights are then aligned with an object and its bearing measured with the graduated limb.

Patten advertised a "Theodolite Compass" for measuring angles, with or without the magnetic needle, in 1852, describing it as "the most perfect compass, for a engineer or surveyor, ever made."[2] They explained further that:

> The Sight revolves around an Arch of Silver, on the outside of the Compass Box, furnished with Clamp and Tangent Screws, for slow Motion. In measuring angles from the Magnetic Meridian, you set the Needle at (|) on the Compass Rim, then turn the Sights to the object, when you get the bearing to single minutes, or whatever the angle or bearing may be.
>
> To use it as a VARIATION COMPASS, you set the line of Sights out of the line of the (|) on the Compass Rim, to the amount of the Variation; then run by the Needle, with all the courses corrected for Variation, &.
>
> Or you may use it for Measuring Angles, as a THEODOLITE, independent of the Magnetic needle.

Gurley devoted 3½ pages of their 1855 *Manual* to a "Surveying Transit," claiming that it had "all the excellencies of the Rail Road Compass, for surveying," and "the advantages of a Telescope, with those which arise from its attachments." The text pertaining to the rail road compass added that "The movement of the vernier plate with the sights attached around the compass circle, gives the surveyor the power of laying off the variation of the needle, while the graduated circle enables him to take horizontal angles with great accuracy, and minuteness entirely independent of the needle."[3]

By 1856 the Gurleys were calling the instrument a "Surveyors' Transit." The accompanying text, enlarged to 6½ pages, notes that "We made the first of our Surveyors' Transits about three years ago, and, from that time to this, have found their sale continually increasing, and those that have been in use satisfying invariably the best expectations of the purchaser." The description is still rather general, but does state that:

> THE VERNIER PLATE, which carries the verniers and telescope, is made to move with perfect ease and stability, around the graduated circle or limb attached to the compass box, thus allowing the telescope and verniers, to be set to any variation of the needle, and to turn off horizontal angles in any directions.

The 1857 edition offers a surveyors' transit with a 5 inch needle, in addition to the 4-inch and 5½-inch models listed before. It also notes that "In place of the single tangent screw, we have, in all our later instruments, substituted the double tangent movement." This refers to the opposed screws for the fine adjustment of the lower motion commonly found on the early Gurley instruments.

The text of the 1858 and 1859 editions are virtually the same, except for the addition of a paragraph describing the shifting tripod head and the deletion of the paragraph stating that the surveyors' transits first made about three years ago. I was unable to examine a copy of the sixth edition. In the 1862 edition the text is modified to reflect the use of a variation plate, and a conventional transit with a variation plate is illustrated.

William Gillespie's popular surveying manual published around 1860 noted that the surveyors' transit "can be used precisely like the vernier compass to allow for the magnetic variation, and thus to run out a line with true bearings" or "to run out old lines, allowing for the secular variation." It "may also be used like the common engineers transit."[4]

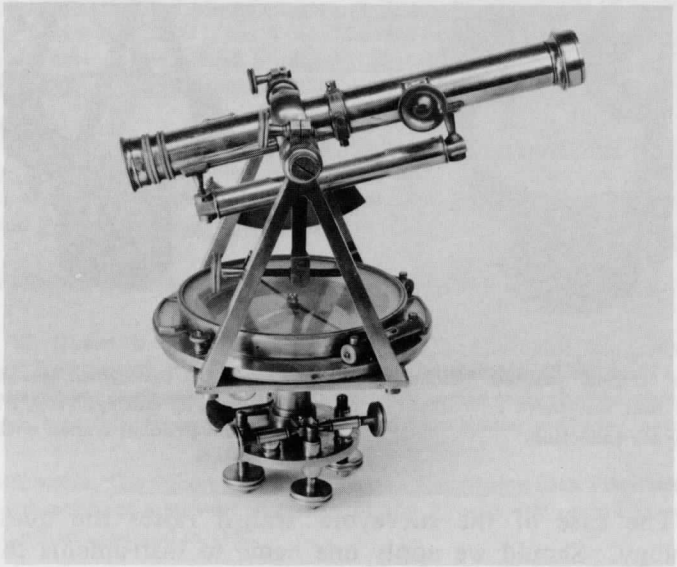
Pre-1862 surveyors' transit marked "W. & L. E. Gurley / Troy N.Y." When the telescope of this instrument is rotated, the outside of the compass box and its glass cover are stationary, as are as the needle ring and compass card. The vertical circle is missing. Private collection.

Surveyors' transit marked "Jas. W. Queen Phild[a]. / Warranted." While this resembles two of the known Gurley instruments, and was made by that firm, its interior details are significantly different from those of the Gurley instrument to the left. Private collection.

In 1859 James. W. Queen & Co. of Philadelphia offered a selection of instruments for surveyors and engineers, most of which were made by Gurley.[5] The Queen *Catalogue* described the "Surveying Transit" as an instrument "in principle very similar to the Railroad Compass, differing from it mainly in the substitution of the Telescope, with its appendages, for the ordinary sight." With a needle 5½ inches long and with the tripod head attached, the instrument weighed from twelve to thirteen pounds.

William Schmolz of San Francisco sold "Transit instruments, from the best makers in Philadelphia," but boasted that "none of them give as much satisfaction" as those made by his own hand.[6] Schmolz was particularly proud of his improved instrument in which "the standards are attached to the lower instead of the upper plate, as is the usual method." With this design, he explained, "the *true course* is read off at once, instead of obtaining it by constantly adding or subtracting the variation, thus avoiding a great deal of labor and removing the great liability of committing mistakes by the old method." Schmolz

further explained that "The great advantage of this construction, especially in surveying ranchos, where such a multiplicity of courses is required, must be obvious at once, to every surveyor. The large number of instruments of this kind recently sold by the manufacturer is enough to prove their superiority." Two Schmolz surveyors' transits are known. The first has an eyepiece typical of the period 1852-1862, while the eyepiece of the other resembles Kubler and Seelhorst's patent (#69,450), and thus probably dates from 1867 or later.

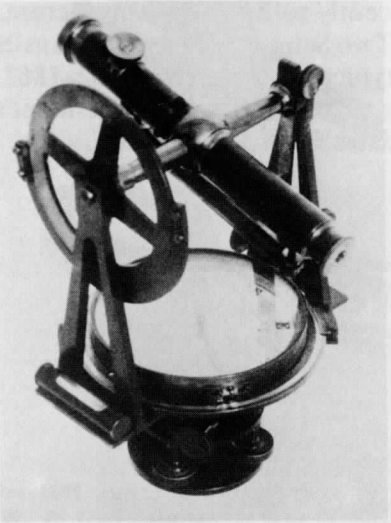


Surveyors' transit marked "W[m] Schmolz San Francisco 605". Private collection.

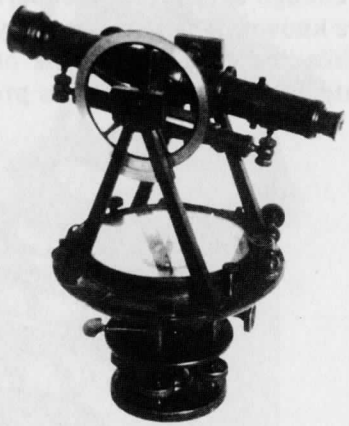
Two other surveyors' transits are known, one signed "Edmund. Draper / 240 / Philadelphia" and the other signed "Hugo Harttmann / Maker / Philadelphia." It is probable that more transits have survived than the nine listed here, having been mistaken for ordinary transits. These special instruments can often be recognized by noting that the clamp and tangent screw are located on the underside of the plate. There are exceptions, however, and the only positive method of identifying these instruments is to clamp the lower motion and note if the needle ring moves when the telescope is rotated in azimuth.

To judge from the number of makers and the number of surviving instruments, these early surveyors' transits must have been relatively popular. This popularity diminished markedly, however, after Gurley's introduction of a new surveyors' transit in 1862. This new model, essentially a standard engineers' transit equipped with a

variation plate, was much easier to use and to manufacture, and was soon the only form of surveyors' transit made in the U.S.



Surveyors' transit marked "Richard Patten & Son Baltimore / Warranted".[7] Private collection.



Post-1862 surveyors' transit marked "W. & L. E. Gurley, Troy, N.Y." This is a conventional transit with a variation plate.

The case of the surveyors' transit raises the question of terminology. Should we apply one name to instruments that were originally advertised under different names? And what should we do when the name remains the same but the instrument is changed in important ways? In the absence of institutional guidelines, we should probably rely on common sense and/or common usage.

Young referred to his new instrument as an "improved compass with telescope."[8] The word "transit", which had long been applied to astronomical instruments designed to track objects as they passed over the meridian, was applied to Young's instrument as early as 1837, and by mid-century it had become common in American engineering texts and trade literature.[9] "Surveyors' transit" seems to have been coined by Gurley in 1856 to refer to their instrument,[10] and it was later applied to their 1862 modification. In order to create a generic class of instruments and to avoid ambiguity, I would suggest that curators and collectors refer to the instruments discussed in this paper as "pre-1862 surveyors' transits," and reserve the term "surveyors' transit" for the later instruments, many of which had variation plates.

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1. Alfred Young, "Invention and Introduction of Engineer's Transit," The Engineering News 2 (1875): 129-130 and 154-155; reprinted in Young & Sons, Manual and Price List of Engineering and Mathematical Instruments (Philadelphia, 1875, and later editions).

2. Richard Patten & Son, Manufacturers of Engineers' Instruments to the U. S. Government (Baltimore, 1852), pp. 5-6. Theodolite compasses, probably made by Patten, are also listed in John Jones, Illustrated Catalogue of Mathematical, Optical, and Philosophical Instruments (Baltimore, 1857), p. 70.

3. W. & L. E. Gurley, A Manual of the Principal Instruments used in American Engineering and Surveying (Troy, N.Y., 1855, and after). Four of these Gurley instruments are known, all in private collections. See Historical Technology No. 133, item 106, and Perceptions Scientifica, 1991.

4. William Mitchell Gillespie, A Treatise on Surveying (New York, 1862), pp. 226-227.

5. James W. Queen & Co., Illustrated Catalogue of Mathematical, Optical, and Philosophical Instruments and School Apparatus (Philadelphia, 1859), p. 17. None of Queen's surveyors' or engineers' instruments from this period carry the Gurley name; but many of them, especially those marked "Warranted," are similar to Gurley instruments.

6. William Schmolz, The Surveyor's and Engineer's Companion (San Francisco, 1859). There is no mention of a surveyors' transit of any form in the second issue of this publication, which appeared in 1882.

7. For the meaning of "warranted" see Deborah Warner, "What Does Warranted Mean," Rittenhouse 7 (1992): 1-8. In this case, however, I believe the instrument to have been made by the Pattens.

8. No early advertisements or discussions of the transit, so called, have been found. The early instruments, however, are clearly based on Young's 1830 patent application for "an Improved Compass, with Telescope attached, by which angles can be taken with or without the use of the needle, with perfect accuracy." This patent was issued on January 17, 1832 and reissued, with modified claims, on January 11, 1834.

9. Samuel Mifflin, Methods of Location or Modes of Describing and Adjusting Railway Curves and Tangents (Philadelphia, 1837), p. 9. E. W. Beans, A Manual for Practical Surveyors (Philadelphia, 1854), pp. 18-19.

10. Gillespie, op. cit., explained that the surveyors' transit was "so named by it's introducers, Messrs. Gurley."