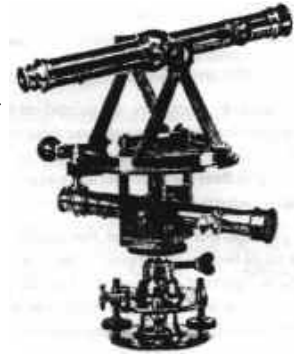


AMERICAN RAILROAD GONIOMETER

by Dale R. Beeks

Expansive growth of American railroads during the 2nd quarter of the 19th century prompted the development of innovative instrument designs. The challenge of laying out long distance preliminary surveys for these railroads spurred William J. Young, a young and ambitious instrument maker in Philadelphia, to develop several new survey instruments. The most notable was the surveyors transit, introduced in 1831. Young also introduced a lesser known instrument, the railroad goniometer; an instrument designed specifically for railroad surveying.



The American Railroad Journal of 1833 includes advertisements and testimonials introducing both engineering and surveying instrument makers and the instruments they offered. Within these advertisements are those by Ewin & Hartte of Baltimore and William J. Young. Young states:

"The subscriber manufactures all kinds of instruments in his profession, warranted equal, if not superior, in principle of construction and workmanship to any imported or manufactured in the

United States; several of which are entirely new: among which are: an Improved Compass, with a telescope attached, by which angles can be taken with or without the use of the needle, with perfect accuracy - also, a Railroad Goniometer, with two telescopes - and a Leveling Instrument, with a goniometer attached, particularly adapted to Railroad purposes."

Young's railroad goniometer incorporates two non-transiting telescopes with independent motions, mounted above and below a silvered, divided horizontal circle with opposed verniers, on a common vertical axis. The flat centered limb is mounted on a standard 4-screw leveling base. The "...Improved Compass with telescope attached..." is now better known as the transit. Young intended the goniometer to be a more accurate form of instrument than the transit. This is evident from construction details including more accurate level vials, silvered verniers and circles, and the inclusion in the goniometer of two opposing verniers to the transit's single vernier.

The origin of the railroad goniometer form is not known. Instruments with equivalent functions were developed in both France and England during the late 18th century. A centralized lower verifying telescope was in use in England during the latter half of the 18th century to insure the stability of astronomical transit instruments. Illustrated in George Adams Geometrical and Graphical Essays (London 1791) are Jesse Ramsden's improvements of the English pattern theodolite; including an offset lower telescope. Throughout the 19th century many examples of the English theodolite were fit with an offset lower telescope, later to be known as the "watch" or verifying telescope. During use, an occasional look through the lower telescope would verify if the instrument was still in the original position. In 1862, San Francisco instrument maker John Roach built a large transit instrument with a centralized lower telescope. The lower telescope of instruments with vertically aligned coaxial telescopes, such as Roach's transit and Young's

railroad goniometer, could be used for backsight alignment, setting of chords, as well as verification of the setup.

Currently, three railroad goniometers are known to exist within private collections. Two of these were made by William J. Young. One is an incomplete example signed, "Wm J. Young Maker, Philadelphia". The other is signed "Wm J. Young Maker Philadelphia and incorporates a compass with a 4 3/4" straight needle and a short vertical arc capable of reading to 5 minutes. A letter from William J. Young within the Clements Library at the University of Michigan is dated July 27th 1847. Young states, "This week we will have J.M. Brooks' goniometer finished...". Young probably continued to manufacture the railroad goniometer by special-order for many years. The firm of Young & Sons tried to revive the application of the goniometer through advertising as late as 1909.

The third railroad goniometer in extant is signed, "William Ewin, Baltimore Md." It stands 12 1/4" tall and is fit with a single silvered vernier. It is complete with the case which carries the business cards of "F.O. Leffingwell, Civil Engineer, County Surveyor" and Roadmaster on the Chicago branch of the Illinois Central Railroad. Leffingwell died in 1857.

William Ewin first came to public attention in 1833 when, in partnership with Isaac Heartt, he began to manufacture mathematical and optical instruments. As Heartt was a retired sea captain, it is not surprising that Ewin & Heartt traded "At the sign of the Quadrant". Like Young, However, Ewin & Heartt quickly recognized the market potential of the new railroads. Their advertising adjacent to Young's within the American Railroad Journal reads: "Ewin & Heartt at the sign of the quadrant, No. 53 South Street, one door North of the Union Hotel, Baltimore, beg leave to inform their friends and the public, especially engineers, that they continue to manufacture to order, and keep for sale every description of instrument....."

William Ewin continued in partnership until Heartt's death in 1836. The last records for Ewin were in 1840-41, listing him as a mathematical instrument maker, 53 South Street Baltimore.

It is probable that Young's original goniometer design was adapted from an English or French form with which he was already familiar. It appears from the few examples extant that the railroad goniometer was not the instrument of choice by most railroad engineers; The transit instrument being recognized as the preferred instrument. An American treatise on railroad layout dated 1837 states, "The transit is an instrument invented and manufactured by W.J. Young of Philadelphia. It is in many aspects more convenient to use than the Goniometer or the theodolite....." The railroad goniometer became an instrument with undesirable sophistication - ingenious, but not commercially successful.