

# Reminiscences of an Old Surveyor

## Measuring Angles & Directions

### *Part I*

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I have been surveying for around half a century. When I started surveying, the equipment used was little different from the equipment used by surveyors for over 200 years. In fact, many surveyors used the equipment left to them by their grandfathers and fathers. In these present times, I believe most surveyors replace their equipment every ten years or less.

This is the second article on surveying equipment and procedures that are now relegated to history. I believe I am the last generation of surveyors to have practiced the profession using what is now historical equipment and procedures. I believe it helpful for the modern surveyor, when retracing boundaries, to know what the previous surveyor used. Perhaps it will provide a better explanation for the precision of the record measurements and how far to look 'afield' for the monuments after applying the record measurements to the site.

I will say that my first experience measuring directions and angles was as a Marine with the 2<sup>nd</sup> Topographic Pla-

toon. We used Wild T-2s and even T-3s most of the time. Occasionally, we had to use Wild T16s or transits when doing some construction layout. Once I departed from the Marines and went into private practice, my employers mostly used compasses and transits. One employer did have a theodolite.

Wild T-2s and T-3s were very rare among private surveyors, so I will not take up much space on paper discussing these remarkable instruments. The T-2s could measure an angle to the nearest second of arc using a micrometer. The T-3 could measure to the nearest tenth of a second of arc. With the T-3s I have sighted targets almost 30 miles distant. While the T-2s had optical plummets, the T-3s that we used did not. The T-3s required a plumb bob suspended under the instrument in order to put the instrument over the control station. Many of these instruments had an inverted image. What I mean is that the object viewed was upside down when looking through the scope optics. Setting the zero on the instrument required some finesse that I will not describe for

the reason I have previously stated.

The common instrument to measure angles and directions at the time I began surveying in private practice was the transit. All surveyors, even the modern surveyor, has probably seen a transit - usually on the table at the historical equipment booth found at the annual professional meeting. Transits can be very handsome with their shined brass or the black and brass contrast.

I did use the compass often, though not the large compass employed by Washington, Lincoln, Jefferson and the other surveyors in the 1700 and 1800s. The compass I employed in years past was a smaller version compass. They were known as the Sipe's compass, named after F. Henry Sipe. Henry was licensed surveyor #1 in West Virginia. He was a fine gentlemen that I had the pleasure to know and had many conversations with before his departure from the living.

The compass was used during my early years to perform a reconnaissance to set up the boundary survey and look for

evidence in the field. At the time it was thought the best way to follow in the footsteps of the original surveyor is to use the equipment employed by the original surveyor. I still think this to be true but time constraints of the modern survey practice have curtailed or eliminated much of the reconnaissance practiced in the past using the compass. Of course, using a compass for reconnaissance work was often coupled with a tape that was dragged along making no effort to correct for slope and such. I suppose many of the original surveyors did not concern themselves with slope corrections either. It is through this effort that original corner monuments were found along with old blazes and wire remnants on the ground and in trees. Resting stones for split rail fences could often be found by the diligent surveyor. These objects and discoveries were all marked for inclusion in the traverse that followed the reconnaissance.

The compass I used was mounted on a wooden pole known as a Jacob's staff. The end of the pole was metal. This end was pushed into the ground. The vanes or pointing columns of the compass were raised to reveal the face of the compass. The top of the Jacob's staff was swayed until the bubbles on the compass indicated the compass was level. At this point the needle was released to float and point toward the magnetic north or the machete, tape, pocket pen, or other metal held too close to the compass needle as so often occurred.

Speaking of local attrac-

tions to the compass needle, I will state that more than a few times, I used the compass to locate a buried pin under the ground by slowly moving the compass across the ground surface and looking for a twitch in the compass needle. I will remind my younger colleagues that metal detectors were not available when I first began practicing surveying. I will elucidate in some later article on the dip needle that preceded the metal detector.

Having released the compass needle from its mechanical constraints, the surveyor would wait for the needle to settle down. The compass needle was a contrary pointer much like a five year old with too much energy. I often voiced my thoughts to the needle in order to hurry the needle toward a decision. The needle always ignored my advice.

Once the needle decided to rest without skittering, the compass could then be rotated to read the bearing that was desired. At some point during a survey-apprentice's first acquaintance with a surveyor's compass the user realizes that east and west are reversed on the face of the compass - the east mark being to the left of north and west being to the right of north. This is not a design flaw. This allows the compass reading to be made directly off the pointing of the compass. I suppose I can try to explain how this works but I believe an explanation would be better understood if left to the person that is at the historical survey equipment display to explain this layout by actually showing the results using an actual compass.

The direction was then set on the compass. The vanes of the compass were sighted through in order to spy some object to align with and the measurements made with the tape to reach the object selected. Once the far object was reached, the compass was uprooted from the ground and the surveyor headed for the object to repeat the process. Woe be to the compass operator who did not collapse the vanes and did not fasten down the needle or brake the needle before uprooting the compass. Failure to fasten the needle would cause the pivot or spindle to be bent and the compass to err in its next pointing or perhaps not to point at all.

It is my experience and observation to state that the very best compass could measure the arc to the nearest quarter of a degree. The compass I used for reconnaissance would measure to the nearest degree. I will speak no more on the vagaries of the compass and the magnetic needle since those probably deserve their own article. It is worth mentioning that many compasses had a personality of their own such that two compasses placed over the same point and pointed toward the same object could vary in their direction by as much as a degree or so. In early texts explaining the subject of surveying with the compass, the surveyor was cautioned to know the temperament of their compass. Many states had laws requiring the surveyor to set their compass over a designated stone and point to another stone in order to check the peculiarity of their compass.