SOLAR OBSERVATION FOR TRUE DIRECTION

REDUCED TO A SIMPLE PROCESS

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THE civil engineer of today is not content to let his surveys be run on assumed direction because he knows that any uncertainties, which can be eliminated, should never have to be reckoned with during the prosecution of the engineering work.

Therefore, the surveyor's compass, which, for many years, has given approximate direction,—good enough for certain types of surveys,—is nevertheless inadequate to meet the present demands for direction on the earth's surface.

Christopher Columbus, on his voyage westward from Spain, was confused, so the story is related, by the queer actions of the compass needle in mid-Atlantic, because he did not fully understand the variation of the declination when so far from home. The result was inevitable. Land was sighted much father south than Columbus had calculated.

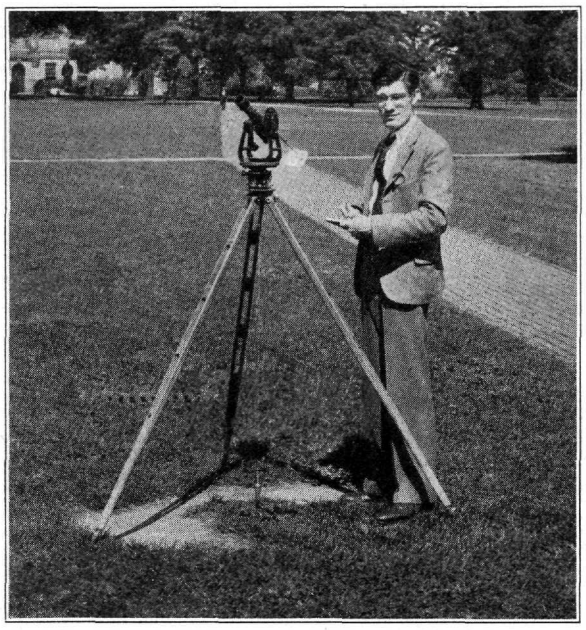
Now then, let us discard the compass, and use the modern engineer's transit. The problem is simply to sight at some object, whose direction is known or can be calculated, then turn a horizontal angle from that object to the line whose direction is required.

For many years, Polaris, or the North Star, seemed to be the answer to the surveyor's problem of direction finding; but due to the inconveniences encountered in the field work, such as artificial illumination of the cross wires, the object on line, also the scales and verniers, the condensation of moisture under the vernier plates, the trip out to the line at night, and the general idea of working "in the dark", Polaris has given way to the Sun, which offers a much more convenient target to sight during the regular day's work in the field, on the survey.

The older methods of Solar work seem to stress the matter of speed in observing; also a number of pointings to make certain that no blunder had occurred in angle readings. Of course it is true that if a number of pointings are made, say 6, 8, or 10 and then averaged, the instrument man must work fast and therefore incur the possibility of making mistakes in reading horizontal and vertical angles.

The new method, which is the result of several years research in Solar observation work, eliminates entirely the necessity for speed, because it has been proven that 2 pointings, together with a new scheme for reading the horizontal and vertical angles, is equal in accuracy to 6, 8, or 10 pointings averaged by the old method.

This fact is substantiated because the Sun travels less than one-half as far during one observation by the new method as it does during one observation by the old method, thereby reducing the error of "travel"; since any average presupposes the sun to "travel" in a straight line,—so the shorter the travel the less the "travel" error. For example, the old method averaged 6, 8, or 10 pointings and called this average one observation. The new method calls for 2 pointings, but the angles are checked by two different methods; and since the angles, especially the vertical angles, are regarded as the weak points in the field procedure, this objectionable feature is eliminated and the cause for speed in reading is also eliminated. The result is that the sophomore civil engineering student is able to make field observations without working under a strain and knows that the angles read in the field have been checked at the time of the observation, thereby relieving him of any uncertainty.



ROBERT J. CARROLL
Made 800 Observations

This angle check is something new in the field of transit work and not only gives the inexperienced instrument man a certain degree of confidence in his readings but enables the recorder to check the readings at a glance, as seen below. The angle is first read in the regular way, like (1)

Horizontal Angle			Vertical Angle		
(1)	212°	40′	(1)	41°	12′
(2)	227	10	(2)	55	42
(3)	201	50	(3)	33	18

then the next two readings are obtained by using the ends of the double vernier as new index marks for reading. The result is that a constant difference of 14° 30′ shows between (1) and (2) and a constant sum of a full degree ending in 9 shows between (2) and (3).

The system is quickly grasped by any transitman and soon the 3 readings are made very easily.

A simple device to enable any transitman to make observations on the Sun or on Polaris by the new method has been perfected by the author.

This attachment clamps on the horizontal axis of the transit. It carries an adjustable arm which holds a card at the proper focal distance behind the eyepiece of the telescope. The Sun's image is focused on this card.

The observation on the sun is greatly simplified by this device, because the transitman does not observe the sun through the telescope; a procedure which requires a special eyepiece.

A Solar observation, carefully made, requires less than 10 minutes of time, and is the means of determining true direction on the earth's surface.

If the Pole Star is observed at night, the attachment is clamped on the horizontal axis of the transit with the card at the objective end of the telescope, where it transmits a soft light down the barrel of the telescope to illuminate the cross wires, when a flashlight is trained on the card.

R. J. Carroll, graduate civil engineering student has used this device for his thesis work on Solar observations. He has made hundreds of observations through the winter, spring, summer and fall, at different times of the day, under favorable and adverse weather conditions, and with various types and makes of transits.

Mr. Carroll has convinced himself that accurate results may be obtained by Solar observations, and that ample opportunity is afforded the transitman to run his surveys on true bearings, determined from Solar observations, rather than assume direction from the compass, because he realizes that 19 months work on a base line on the Ohio State University campus, during which time almost 800 observations were made to try all of the different methods, has proven very conclusively that Solar observations for true direction have been reduced to a simple process.