A FIELD TELEMETER FOR APPROXIMATE SURVEYING¹

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In the construction of a map on a large open scale there are generally numerous details in the neighborhood of each station which must be located by some approximate method of surveying. To estimate the distances to the points is not sufficiently accurate and to occupy each point by a man with a stadia rod may in some cases be impracticable and in any case involves a large expenditure of time. The problem presented is an ideal one for the self-contained base range finder as developed for military fire control but such an instrument is expensive and furthermore involves the labor of an additional man in carrying it from station to station.

To meet these demands the very light portable device shown in the illustrations was designed. Each instrument consists essentially of a small telescope mounted on a base and with a slow motion screw affording a limited motion in azimuth. When the two instruments are clamped, one at each end of a stadia rod, the whole constitutes a simple self-contained range finder with the stadia rod as a base. Although the angular measurements are necessarily approximate with such a simple piece of apparatus yet the long base enables the requisite accuracy to be obtained for the short distances at which it is intended to be used.

The method of using the instrument is illustrated in Fig. 1. The length AB represents the stadia rod which serves as the base of the triangle. The two telescopes are at the two vertices C and D. After clamping the telescopes on the rod their optical axes are brought into parallelism by means of the slow motion devices on each instrument. The entire assembly comprising the stadia

¹ Published by permission of Director, Bureau of Standards. This instrument was designed and constructed by the Bureau of Standards, at the request of the Topographic Branch, U. S. Geological Survey, Department of the Interior.

rod and the two instruments is then rotated in azimuth as a unit until the telescope C bearing the fixed crosswire is brought upon the target. By means of the micrometer the angle m is measured and from this the distance to the target can be determined by reference to a table computed in advance giving range in terms of the reading of the micrometer screw.

FIG. 1
Fundamental range finding triangle

Some special means is necessary by which the telescopes may be brought into parallelism and for this a device commonly used in the self-contained range finder is adopted. This is shown in Fig. 2. The two penta prisms E and F are placed in front of the telescopes and are of such thickness that they transmit light to the lower half of each objective. On the outer face of each penta prism there is cemented a positive lens as shown at G and H. The focal lengths of these lenses are equal to the distance between the two instruments when clamped on the stadia rod, i.e., 11 feet for the pair of instruments which have been constructed; and each lens bears a vertical mark. If the eye of the observer is placed in the upper half of the exit pupil of either telescope the mark carried on the lens of the other instrument will be in focus. When each instrument is directed so that its cross-wires coincide with the mark on the other instrument the two lines of sight will be parallel if the sum of the deviations of the two penta prisms is 180 degrees. If the penta prisms are not so matched the departure from paral-

lelism can be determined once for all and applied in the calibration table. It should be noted that this method of adjustment is independent of any displacement of the penta prism since any such displacement affects the alignment of both instruments equally. This arises from the fact that the black mark serving as target is carried by the lens. Consequently a shift of the lens moves the target for one instrument and moves the lens through which the other instrument views the target. These two effects compensate each other exactly.

FIG. 2
Method of adjustment

In use the complete assembly will generally be supported at each end on tripods which will ordinarily be available and the observations will be made simultaneously by observers at each end of the stadia rod. The adjustment for parallelism is readily made before each observation. The penta prisms remain in front of the objectives when the observations are made upon a remote target, the upper half of each objective being used in the latter case. It was found convenient to place two washers with spherical surfaces between the base of each instrument and the stadia rod in such a manner that they form a simple ball joint with a restricted range of motion. By means of the ball joint any trouble due to sagging or twisting of the stadia rod is eliminated. It is necessary that the setting for parallelism and the setting on the target be

made at the intersections of the cross wires and the use of the ball joint greatly facilitates this adjustment.

FIG. 3
Instrument mounted on stadia rod

With careful work under favorable conditions, it has been found that the error of angular measurement may be kept under thirty seconds. The corresponding range errors for different ranges will be as follows:

Range	Error
Ft.	Ft.
1000	13
2000	53
3000	119
4000	211

The telescopes which were used in the sample instruments have objectives 20 mm in diameter and magnify 5.5 times. Appropriate plates are mounted on the stadia rod for the attachment of

the instrument and a base length of 11 feet is provided. Fig. 3 shows one of the instruments on the end of the stadia rod and Fig. 4 shows the pair of telescopes. The penta prisms are at E

FIG. 4
The pair of instruments

and F. The slow motion screw by which the telescope is brought into parallelism is shown at I.

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