

the ground, traversed by the lower line of sight, than it is in the strata a few feet above traversed by the upper line of sight. This causes a difference between the actual rod-reading to a reading in a perfectly homogeneous atmosphere. The reading varies during the day, the rod intercept being least at mid-day and greatest in the morning and evening.

The stadia field books are specially prepared for the work. At the top of the left-hand page, blanks are left for the date of the survey, and for giving the location of the lake. The remainder of the page is ruled into columns. In the first column is entered the designation of the point sighted on, numbers being used for stations and letters for side shots. The stadia interval read on the rod is put in the second column, the bearing in the third, the vertical angle in the fourth, and in the fifth column the corrected distances are entered. The rest of the page is left for remarks. The right-hand page is ruled in cross-section on a scale of ten chains to an inch, and is used for making sketches or rough plots of the body of water being traversed. The column of corrected distances is entered up at night, if there is not sufficient time in the field. Corrections for the stadia intervals are taken from the cards supplied by the Department. Distances read on the slope when the vertical angle exceeds $1^{\circ} 30'$ for station courses, and 3° for side shots are reduced to the correct horizontal distance by means of the stadia slide rule.

After the proper corrections and entries have been made in the field books, the traverse is plotted on specially prepared drawing paper. This is a smooth, heavy paper, cross-sectioned on one side on a scale of ten chains to an inch, and with horizontal parallel lines on the other, spaced one chain apart. The traverse is plotted on a scale of ten chains to the inch and the plotting is done by means of the stadia protractor, which is a semi-circle of celluloid, having bearings marked from 0° to 180° , and in the same direction from 180° to 360° . There is a pin-hole in the centre of the circle, and the straight edge of the protractor has a scale of ten chains to the inch reading both ways from the centre to 43 chains.

The allowable closing error in a traverse is $1\frac{1}{2}$ per cent. on the surveyor's own work, and 5 per cent. when closing on a section or quarter-section corner.

The stations are first plotted and the closing error, is not in excess of the above mentioned limit, is then distributed among the courses of the traverses.

In plotting the side shots the protractor is pinned by a fine needle to the corrected position of the station, the north and south points are marked, and the various recorded bearings are turned off, and at the same time the corresponding corrected distances are scaled off on the straight edge of the protractor. The outline of the lake in this way can be rapidly and accurately plotted.

It is necessary that the traverse should be plotted before leaving the locality in which it was made so that any mistakes or errors found may be corrected.

A full description is given in the field book, at each instrumental station of the lake, the lake shore, and the surrounding country, and at the end of the traverse notes a complete general description is given of the character and topography of the lake.

These descriptive notes form a basis for the classification of the lake into one of five general classes. These are:—

- 1st—Lakes that have entirely dried up.
- 2nd—Shallow lakes likely to dry up.

3rd—Lakes which do not dry up, but which have shore lines subject to large variation—say, 10 to 20 chains.

4th—Lakes which do not dry up, but which have shore lines subject to moderate variations—say, 5 to 15 chains.

5th—Lakes whose shore lines do not change. This class includes deep, permanent lakes with well defined shores.

These different classes are treated in different ways in compiling the township plans. No deduction of area is allowed for class 1 and 2 lakes. Class 3 and 4 are dealt with by selecting the aliquot parts of legal subdivisions which more nearly include the land more or less permanently covered by water. In class 5 lakes the areas are taken to the bank of the lake.

The accuracy of these stadia surveys is highly satisfactory, and is more than sufficient for the purpose in view, namely, the determination of the water areas. Errors of 1 per cent. in closing a traverse, even under unfavorable conditions, are rare. An extreme degree of accuracy that requires a slower rate of work is not desired in this class of survey. However, if conditions are favorable, the closing error in a long traverse is generally less than 1 in 1,000. The error in closing on section corners is seldom over 2 per cent., and is generally under 1 per cent. High closing errors are generally due to mistakes in the original survey. In townships recently subdivided, or in which resurveys have been made, the closing errors are usually small.

Under favorable conditions, a distance of half a mile can be read accurately to a fraction of ten links. Long courses give the best results, and short courses should be avoided as much as possible. Within the half-mile limit, the allowable distance for accurate reading depends on the conditions under which the reading is made. Forty chains may be read more accurately at some times than fifteen chains at others.

On bright days the rod cannot be read accurately against the sun for any distance. This distance is, of course, much shorter when looking across water than in looking across land. This should be carefully kept in mind in directing the course of the traverse. If possible, a lake should be approached from the south-east in the morning, and from the south-west in the afternoon. The side shots may then be read with the sun shining on the surface of the rod.

The main hindrance to accurate reading is "boiling," or heat waves in the atmosphere. When this is extreme, the rod, even at as short a distance as ten chains, has the appearance of an attenuated barber's pole, and it is impossible to get an accurate reading on either foresight or backsight.

Another common difficulty is "floating" or "dancing." Here the image of the rod, although clearly defined, floats in the object glass so that the stadia hairs cannot be fixed long enough to get an accurate reading. This is most common when looking across water. High winds spoil the accuracy of the readings, and wind storms on the open prairie are sometimes so violent that it is impossible to read the rod at all. Long readings taken with the sky as a background, or with a very dark back-ground, such as a sheltered bushy bay, are inaccurate. The greatest natural difficulties are high reeds on a soft mud bottom, and dense overhanging bush, and when these are found combined on the same lake, the mileage made that day will be small. The transit should be set up as far out from the shore as possible, and the