

Mr. Howard. topographer, two hand-levelmen and two rodmen. Each hand-levelman carries a book in his pocket, or in his left hand, and records the contours. His hand-level is fastened on a 5-ft. stick. The rod is 10 ft. long, and is divided every half foot, with the foot marks painted in large figures, beginning with 0 at the center of the rod.

The advantage of the 5-ft. stick and the 10-ft. rod and its numbering is evident. If the elevation of the station is 518, the first contour to be taken on the upper side is 520. The hand-level on its 5-ft. stick is held at the station, and the rodman, measuring the distance with his rod as he goes, goes up the hill until the hand-levelman reads 2 on the rod (2 ft. below the center of the rod). The rod is then 2 ft. higher than the center. The rodman calls out the distance from the center line, and the hand-leveller jots down in his book the contour and distance. Next, if the ground is still rising, the hand-levelman proceeds up the hill with level and stick until he can just read the top of the rod. He is then at Contour 525; and the rodman measures up to him as before, calling out the total distance from the center stake. The rodman then continues to measure up the hill until the hand-level reads the bottom of his rod. The rodman is then at Contour 530.

By this method each contour is located on the ground on each side of every station as far out as necessary. The hand-leveller keeps his notes of contours and distances in fractional form like ordinary cross-sections. The plus at which a contour crosses the center line is found in the same way. At each station the hand-levelmen call out to the topographer from the books the distances of the contours from the center line at their last station, and he locates the points by scale on his sheet. By the time his men have cross-sectioned one station, he should have drawn in on his sheet the contour lines up to the preceding station. One good topographer, with two hand-levelmen and two rodmen, will generally keep up with a transit party. The breaking up of the whole corps for one day at each camp to help out the topography party, as suggested by Mr. Lavis, is to be avoided if possible.

As a general thing, all distances of contour lines from the center line should be measured by the rodman with his rod. On hillsides it is a convenient method, and even on flat ground a rodman can measure distances quite rapidly with a little practice, turning the rod over end for end as he goes. Occasionally, a tape should be used for measuring distances, but, if used to any extent, one or more extra men should be added to help out. This is the case when the line is in the center of a bottom, with a creek on one side and the foot of a hill on the other, the distances to both of which are to be accurately determined. In a rolling or flat country, where an error of 10 ft. in distance would not be material, the distance of the con-

tours from the center line can be stepped, as recommended by Mr. Lavis; and in a still flatter country the location of the contours beyond the distance stepped may be estimated, for such information as they may give; but they should be recorded in the book in brackets, and only dotted on the sheets.

Contours, in general, should be taken for 200 or 300 ft. on each side, where the ground is flat, and sometimes farther; or to an elevation of 25 or 30 ft. above or below the center line on steep ground. On rough ground they should be taken on each side at every 100-ft. station. On flat ground they can be taken at every second or third station. It is desirable, of course, to have the preliminary line run as nearly as possible on the ground to be occupied by the location, as the topography becomes less accurate the farther it is from the center line; and the more ground to be covered sideways, the less will be covered lengthways, along the center line, in the course of a day's work.

Topography parties should work somewhat slowly in the beginning, until they can avoid mixing contours, and have formed habits of accuracy. They can then begin to develop speed. It is of the greatest importance to get the work started right. The writer knows of a recent case, in a mountainous country, in which, on account of faulty topography, and other inaccuracies, the work of one or two parties for two or three months had to be thrown away, and the work done over again.

All topography is drawn in on the sheets in the field during the day and inked in at night. These sheets are the map. They should not be allowed to get wet, consequently, a little time is sometimes lost in drizzling weather; or, until the rain stops, topography can be taken in a book and afterward transferred; but, in any case, the topographer cannot do much work in the rain.

In general, there is no advantage in taking topography in a book. The contour lines can be drawn in more accurately on the sheets in the field, and there is no difficulty in keeping the sheets reasonably neat and clean. Besides, it is quite an undertaking to transfer topography from a book to a map. But if the engineer likes maps in large rolls, he has only the trouble of replatting the center line, as the topography can be transferred more rapidly from the sheets to a map than from a book to the map. The sheets constitute a contour map and detailed record of the results of the survey, and should be carefully preserved.

On these sheets the location is projected. After a satisfactory projection has been made, both as to line and profile, the next step is to take off the notes for running in the location on the ground. The same mechanical accuracy is necessary as in platting the line. There should be noted the position of each P. C., P. T., and P. C. C.,