3 feet at stake 300, the depth at the outlet remaining 5 feet as before. Joining the dots made at these three places we obtain a new ditch bottom No. 2, with a change of grade at stake 300, the grade of the upper section being 2 2-5 inches in 100 feet, and of the lower section 14 inches in 100 feet. This is a much more desirable bottom than that shown by the dotted line, the deepest digging being a shade less than 4 feet, and the shallowest 2 feet 6 inches. The average saving in digging by using bottom No. 2 rather than No. 1 would be almost one foot throughout the entire length of the drain. In case the second trial did not give us a satisfactory bottom we would make still further trials till a satisfactory one was found. A similar profile may be made for any drain, once the elevations at the different stakes are known. There is one critical point in each drain, viz: the outlet; knolls and basins, where they occur, are also critical points—we must choose grades that will not require us to go too deep in the knolls nor too shallow in the basins. When striking the grades we consider first the critical points—the others will look after themselves.

(11.) To determine the grade on a section of drain when the depth is different at the two ends of the section, we proceed as follows: Subtract the elevation of the ground surface at the two ends (this gives the fall. on the surface), and then add or subtract the difference in depth, according to which end is the deeper. For example, the upper section of the drain in Fig. 10: 14 minus 13 feet 6 inches equals 6 inches, hence in the ground surface there is a fall of 6 inches; but the drain is six inches deeper at stake 300 than at the upper end, hence the fall in the ditch bottom is 6 plus 6, which equals 12 inches in 500 feet; hence the fall per 100 feet equals 12 inches divided by 5, which equals 2 2-5 inches.

With methods for finding the fall along the ditch and of determining its grade, we are ready to deal with the construction of the individual drain, but before passing to that we shall consider the more extensive and involved problem where a general survey is needed before construction is begun.

SURVEYING FOR COMPLETE DRAINAGE SYSTEMS.

To be sure many of our Ontario farmers have long had methods of laying out individual drains, and during the last few years many have adopted those just described, but when it comes to the planning of a general system for 50 or 100 acres, a system composed of several miles of drains, every part of which must fit in with every other part, the grades of which must be sufficient for effectively draining all low spots, and yet not require too deep digging in knolls, the depths of which must, nevertheless, be great enough in flats to protect the tile from frost, the outlets for which must be ample and free—when it comes to the planning of such a system, many of which are imperative in almost every county if proper drainage is to be secured, few, if any, have been or are now in a position to undertake such work intelligently, and for obvious reasons: Firstly, because some knowledge of surveying and mapping is needed, and