

sary to know exactly the amount of growing stock, and the rate at which it is increasing, so that it may not be removed at a faster rate than it is being replaced. To lay out roads to the best advantage, whether for destructive lumbering or for the purpose of deriving a sustained yield, it is necessary to have exact information regarding the topography of the tract, and before it is possible to put it under proper management it is necessary to know its silvicultural condition. Thus it appears that the forest engineer who would make a complete survey of a tract of timber must be familiar with the methods of plane and topographic surveying, so that he may properly mark the boundaries of his timberland and prepare an accurate map showing the size and location of the various ridges, gullies, swamps, lakes, streams and other topographical features that will determine the location and character of the necessary roads, dams, bridges, etc. He must also be able to estimate the amount of standing timber and know how to make accurate studies of its rate of growth. Without this information he would not know how much timber it would be safe to remove at each cutting, without diminishing the value of the property.

From this it will be seen that the essential difference between a forester and an old-time lumberman is that one makes provision for the production of future crops, the other does not. Heretofore, it has not been considered necessary to make such provision, but the truth is rapidly being forced home upon us that if we are wise in our day and generation we must speedily correct the error of our ways and make a determined effort to get our forest areas managed in a less suicidal manner than in times past.

#### TOPOGRAPHIC METHODS.

In a rough way every logger is his own topographer, and has acquired his knowledge by cruising, but unfortunately it is apt to be inaccurate, is easily forgotten and cannot be transferred to his successor, who has to acquire his knowledge of the locality all over again. Thus, to the man who directs the conduct of a large business from a central point, an accurate map showing the topography of the tract is simply invaluable, because its topography very largely determines the course of all woods work. The essential features of such a map are that it clearly indicates the positions of ridges and streams, the shape and steepness of slopes, the areas of valleys and lakes, and the grade of roads that it may be necessary to build.

#### METHOD OF COLLECTING DATA.

The method of securing the necessary data for such a map is somewhat as follows:—

From points of known elevation, along railways, etc., a line of levels is run to the ponds and other suitable places well