

cases even less, will give a reasonably accurate basis for an estimate of the whole. On smaller areas, or where the conditions which show much variation, it is necessary to cruise at least ten per cent of the area.

THE FIRST STEP IN A SURVEY.

In conducting a forest survey the first thing to do is to establish an accurately measured base-line. If a convenient surveyed line does not exist it is necessary to run one out, leaving marks at every five or ten chains to which the cruised strips can be tied.

The survey should be laid out so that the strips run at right angles to the ridges and streams, otherwise misleading tallies, which do not represent average conditions, will be secured. The width of the strips will depend on the nature of the forest. In open woods the cruiser may be able to see for a chain on each side of the line, but in dense spruce woods he may be able to see only a rod on each side.

The cruising party may consist of two to four men. In large timber two men may suffice, but in small, dense timber it is better to have three or four. The party is guided by a compass-man who, in addition to maintaining the direction with a hand-compass, keeps track of the distance travelled and usually takes notes on the topographical features. The distance is sometimes measured by pacing but usually by means of a tape-chain attached to the compass-man's belt, the end of each chain being marked by a scratch on the ground, blaze or broken twig. In two men parties the cruiser watches the rear end of the chain and tallies the diameter at breast-height and the height class of each tree in the strip. The height class can be recorded in different ways but it can, perhaps, be most readily expressed by the number of logs of a certain length that the tree will cut. When more than two men are used, the additional men call out the sizes of the trees within the strip to the rear chain man who acts as tally-man. The diameters, in some cases, are measured by calipers, but usually the cruiser's eye soon gets trained to estimate the size with sufficient accuracy.

Tally sheets should be changed with each change in the forest type so that when all the cruising lines are completed the boundaries of the various types such as heavy timber, light

timber, muskegs, burns, etc., can be mapped in and the areas of each determined.

The total volume can be obtained with greater accuracy by working up the volume on each type separately than by lumping all the samples together and applying the average to the total area. The greatest source of error in timber estimating has always been in the area to which the detailed estimates are applied. Most of the old "experienced" cruisers can tell with remarkable accuracy the amount of timber which can be cut on a given area, but the variability of the stand in almost every forest area necessitates as much care in estimating the areas of the various types as in estimating the amount of timber on the areas cruised.

TELLING A TREE'S CONTENTS.

Long experience in checking estimates by cutting has enabled many cruisers to tell the contents of a tree with great accuracy especially in types with which they are familiar. The judgment of estimators is not always reliable and it has been found much safer to base the estimates of the stand on actual tree tallies and volume tables which give the average contents of trees of various diameters and heights. These volume tables are based on the actual measurements of a large number of trees. Unfortunately, very little has yet been done officially in Canada in preparing volume tables, but the United States Forest Service has published tables for the species of trees found here and with some adaptation to local conditions these can be used in Canada. Most Canadian foresters engaged in this kind of work have, however, developed volume tables of their own.

The ordinary strip survey supplies data for a good working map and, if elevations are taken frequently with an aneroid barometer and checked up faithfully with known elevations on the base-line, a contour map can be made which will be of great value in laying out logging operations.

It must be remembered that the accuracy of the survey depends on the proportion of the area actually cruised and, though a five per cent cruise may give a reasonably accurate idea of the total stand on a large area, it is almost sure to be found deficient in detail when applied to a small area as a basis of a small logging operation.