

the tract it may suffice to estimate the yield of a few sample acres, find their average and multiply by the total acreage. Usually, however, the timber is not uniform, and it is necessary to estimate the lower slopes of a mountain separately from the upper, the north slopes separately from the south, and the water-sheds, swamps and other special types separately also. To meet this difficulty, the plan of estimating the timber on sample areas aggregating a given percentage of the whole tract has been devised. If properly distributed they give a very close average for the timber on the whole tract.

#### Sample Plot Methods.

Many methods have been devised for the proper location and rapid laying out of sample plots. Usually they are laid out in the form of circles, squares or rectangular strips, and in area generally vary from one-quarter of an acre to a whole acre. A quarter acre circle has a radius of 19.62 yards, and an acre circle a radius of 39.24 yards. In the form of a square, each edge of the acre is 69.57 yards, and of the quarter acre 34.78 yards.

In open stands of timber one of the quick methods is to travel in parallel lines a quarter of a mile apart and stop every quarter of a mile to lay out an acre (with a radius of 39 yards or a side of 69 yards), and estimate the timber upon it. This would give us 16 sample acres equally spaced over each square mile, and, therefore, represents one-fortieth, or  $2\frac{1}{2}$  per cent., of its area. With a little practice the estimator soon learns to judge whether a tree is within 39 yards or not of the centre of the circle where he stands. Another plan is to place a flag at the centre and walk through the timber within 39 yards of it, making the estimate by eye, by counting trees, or by measuring. Returning to the flag he can then pick up his compass direction, pace a quarter of a mile, and estimate the next acre. In dense stands it is not easy to see all trees within 39 yards, and it is preferable to use either half-acre or quarter-acre circles instead, with radii of 24.75 yards and 19.62 yards, respectively. For rough estimating it is customary to use circular plots, but for more accurate work square plots are preferable, because they are generally laid out more carefully. They may be laid out by either pacing or measuring their sides and turning the corners with a magnetic compass or a cross-staff head.

#### The Estimation of Forty Acre Squares.

In fairly even aged timber growing on land comparatively easy to travel, it is often a good plan to block out forty acre squares here and there and estimate all the timber on each "forty." Each edge of a "forty" is 440 yards long, and it is advisable to blaze the boundaries so the estimators will know when they come to them. For convenience in estimating, the large square is usually divided into 16 smaller squares of  $2\frac{1}{2}$  acres each, and, therefore, with edges 110 yards long. Starting at any given corner of the "forty," say the south-east, a flag is placed at the centre of the first small square, each edge of which will then be 55 yards from the flag, and can be easily located by eye measurement or by pacing. The estimator then goes through the timber on the square, records his estimate, returns to his flag, and goes on to the remaining squares in the order indicated by the diagram.

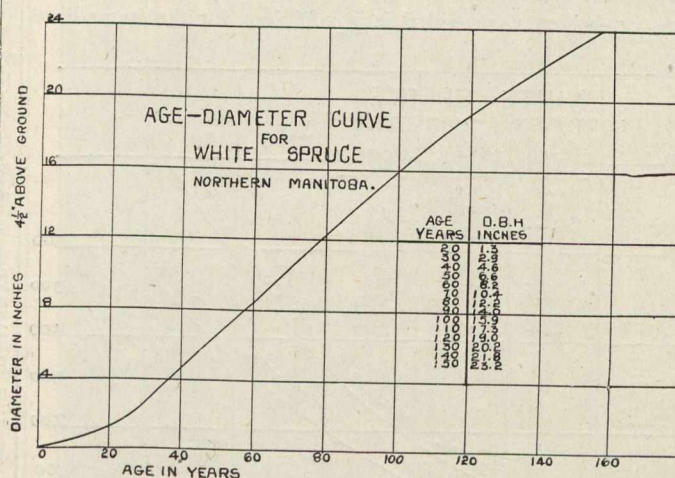
Having determined the amount of merchantable timber, it is a good plan to prepare on transparent tracing cloth a map showing its location and the character of the growth. Such a map can be laid over the one showing the topographical features of the tract, and thus show at a glance the relations between the two. Furthermore, we may represent on the tracing cloth the extent and location of each year's cutting, and thus have a complete record of the work done from the beginning.

#### The Dominion Forest Survey, or Strip Method.

When it is necessary to get an accurate estimate of the amount of timber on a very large tract of land, and also to obtain a clear notion of its topography for mapping purposes, the most satisfactory method is to run parallel strips across it every quarter of a mile. Strips  $\frac{1}{4}$  of a mile apart and 4 rods wide cover 5 per cent of the tract. If only  $2\frac{1}{2}$

per cent. is required, they may be placed half a mile apart, or else made only two rods wide. The advantages of the strip method are: (1) It gives data which enable us to show the topography of the region; (2) It enables us to map the distribution of the different forest types; (3) It gives a good average of all the timber on the tract, and (4), when combined with studies in volume, it enables us to predict the growth per acre per year in cubic feet, cords, board feet, or any other desired unit of measurement.

During the last three years this method has been used by the Dominion Forest Survey parties sent out to the Forest Reserves in Manitoba for the purpose of getting accurate information regarding the topography, distribution of forest types, kind, location, amount and condition of the standing timber, to make studies of the rate at which it is growing, to study the amount and character of the reproduction, note the effect of the forests upon stream flow, devise means for protecting them against fire and timber thieves, and other matters necessary to know if they are to be put under proper management and preserved from absolute destruction. During the past summer I had charge of a party of twelve men collecting information of this sort in some of the unsurveyed townships along the eastern side of the Riding Mountain Reserve, in north-western Manitoba. This reserve contains over a million acres nearly half of which have been burned over in recent years. The timber remaining consists of aspen, "balm," or balsam poplar, white and black spruce, Jack pine, some larch or "tamarack," patches of scrub oak, and, along the streams, some green ash, "Manitoba maple" or box elder, elm, etc. In



another year it is expected that the survey of this reserve will be completed, that all squatters will have been peaceably removed, that an efficient system of fire ranging will be in force, and that at least part of the reserve will be put under management designed to make it a constant producer of wood crops.

#### How Measurements are Obtained.

In running out the strips a magnetic compass is used to keep them parallel, and the distances are measured either by pacing or by dragging a light "chain" four rods, or 66 feet, in length. The ordinary "link" chain used by land surveyors is seldom used for this work because it is constantly getting tangled up in the undergrowth and fallen branches, and thus delays the progress of the party. A light, well-tempered steel tape slips easily along the ground, and is, therefore, very much preferable. The great advantage of chaining over pacing is that we do away with the necessity of counting paces and get a much more exact measurement of distances. Each party usually consists of four men, viz.: A compass-man, who keeps the direction, drags the tape and keeps the silvicultural notes; two caliper-men—one on each side—to measure the diameters of all trees within two rods of the tape; and a tallyman to record diameters, to keep a record of distances chained, and to note changes in elevation and other data required to sketch in the topography of the country traversed. The caliper-men measure the diameters of the trees at "breast height," or  $4\frac{1}{2}$  feet above the ground. The reasons for this are: