

LAND SURVEYING IN FORESTRY

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THE importance of a knowledge of land surveying to the forester cannot be over estimated. In every branch of woods work surveying plays an important part, for an accurate survey is essential as a basis for the proper handling of any forest tract, be it large or small. It is obviously impossible to estimate timber without a more or less definite idea of area, both of the whole tract to be covered and of the various subdivisions which may be made to facilitate the estimate. The same principles are applicable in nearly all scientific forest work, either on a small scale, as in sample-plot or yield-table studies, or on a large scale, as in reconnaissance work.

That branch of surveying which deals with the re-location of old surveys and the retracing of lines run through the woods many years ago is a science in itself. The knowledge necessary to do this work well cannot be gained entirely from books. A man must have his book learning and his college engineering training supplemented by actual experience in the woods. I have seen township and lot lines run in the woods by a competent city surveyor. This man had had much experience in the city, but the lines which he marked out in the woods were in many cases several rods away from the true lines.

It is interesting to note the difference between the United States Government surveys in the West and the much older and more primitive surveys — some of them made in colonial times — in the eastern states. Before going further I will state that my observations are based upon personal experiences, in the West in the Sierra Nevada mountains of California, and in the East in the Adirondack region of New York State.

The Government surveys of the West differ from the state or private surveys of the East in that they are much more regular and systematic. Let us compare the map of California with

that of New York. We see at a glance that in the western state base lines and reference meridians have been located to which the various township and section lines are referred. The whole state, with the exception of regions occupied by impassable mountain ranges, is divided into more or less regular rectangles. All lines are based upon the *true* north and south meridian.

In New York, on the other hand, the map is cut up by lines running in every direction. This is due to the fact that large grants of land were made to different persons, and these grants were sub-divided under different systems. All lines are referred to the *magnetic* north. Some of the meridians run north and south, while others — the so-called “ten o'clock” and “four o'clock” lines — run some thirty degrees east of north and west of south. This results in the large number of triangles and “gores” seen on the map. Inaccurate work by the original surveyors is the cause of irregularities both in the West and in the East.

Whatever the system of surveys under which the country was first laid out, the duty of the man in the field, who is trying to re-locate the old lines, is the same. That man must endeavor to reproduce on the ground the line of the original survey. It matters not if that survey was carelessly run out and the corners wrongly set. If the original line blazes and corner monuments can be found, they serve to definitely locate the old survey.

The graft which existed in some of the United States Government surveys is a matter of history, and it is well known that there are thousands of acres of land in California that were never surveyed on the ground at all. Field notes were “faked” and maps made in the city of San Francisco. However, where the lines were run out in the field they were usually run by transit and the corners fairly well monumented and witnessed. It may be noted here that the government surveyors in the West paid most of their attention to marking the corners, while the lines between the corners were only marked at infrequent intervals. In the old Adirondack surveys, on the contrary, the lines were carefully marked out, while the corners were merely marked on trees or wooden stakes which soon decayed.

As a rule, the government survey corner consists of either a squared stake surrounded by a pile of stones, or a square stone

with or without other stones around it. In the case of township or section corners there are four witness trees, one in each quadrant around the corner. Each witness tree bears a blaze facing in towards the corner, and the number of the section in which the tree stands is scribed in the blaze. In the case of quarter-section corners there are two witness trees, one in each section bounded by the line in which the corner stands. The original field notes contain the distance and direction from the corner to the various witness trees. In case the corner has been destroyed or overgrown with vegetation, its position can be determined from the witness trees.

The corners of the old Adirondack surveys consist usually of stakes or standing trees blazed on four sides and scribed with the proper township and lot numbers. From two to six witness trees are marked. The witness mark is three horizontal notches one above another close to the ground, and facing in towards the corner. The old field notes seldom refer to the witness trees.

The best instrument for retracing the government survey lines is a light mountain-transit. Copies of the field notes of the original survey should be obtained and the course of the line to be run computed. The start must, of course, be made from a corner the location of which has been previously ascertained. A random line should be run on the computed course as far as the next section corner. The proper correction must then be calculated from the length of the line as chained and the length of the right angle offset from the line to the corner, and the true line run out and properly marked. If original line trees are found between the two corners, the true line should be made to run through or near them, even though this may mean substituting a crooked line for a straight one. This matter will be taken up more in detail in the discussion of Adirondack lines.

The problem of retracing a line in the Adirondack forests is somewhat different. In the first place, a compass is more suitable for this work than a transit. Either the so-called "Pocket Vernier Compass" ($4\frac{1}{2}$ " needle) or the "Railroad Compass," both manufactured by W. & L. E. Gurley, are satisfactory instruments. They may be used with jacob's-staff or tripod.

Let us suppose a surveyor wishes to retrace the lines of a lot

in the woods, one side of which is in the township line. He should start his survey at one of the two corners in the township line, and we will suppose that he knows the location of one of these corners. Since the lines are run on magnetic bearings very little computation is necessary to calculate the course of the line. The original bearing and the date of the original survey known, it is a simple matter to determine the present bearing of the line. In the Adirondack region the magnetic variation has been increasing at the rate of about three minutes a year for the last one hundred and fifty years, and as a compass is to be used it is sufficient to calculate the bearing of the line to the nearest fifteen minutes.

The compass is set up at the starting point, and the correct course of the line, as calculated, turned off. So far the procedure has not differed materially from that followed in running out the lines of a city lot; but from now on the surveyor will need to call upon his knowledge of woodsmanship for guidance. He must examine every tree along the line to locate the original line trees. The line which he wishes to follow has probably been surveyed several times. Some of the newer lines have been blazed by lumbermen who merely followed through from corner to corner with a pocket-compass and marked convenient trees. The task of our surveyor is to distinguish the blazes of the first surveyor from amongst the maze of newer blazes. In the case of a line surveyed a hundred years or more ago this requires a sharp eye and a knowledge of what a very old blaze looks like. In our north woods forests the spruces and the hemlocks show plainest the marks of the old surveys. I have cut into trees of these species and found blazes a hundred and thirteen years old. The only sign of a blaze on the outside of the bark was a slight irregularity in the surface, which upon minute examination showed the mark of an axe blade. Of the hardwoods, the birches show the old marks the best. The maples and beeches are the worst trees of all in this respect. Even on the birches it is difficult to discover a very old mark. The mark is often more easily distinguished when one is fifteen or twenty feet away from the tree than when one examines the bark closely. I once found a blaze one hundred and ten years old on a birch

tree by standing some distance away from the tree and directing my axeman to move his hand up and down the trunk until he covered the mark. From where the axeman stood the mark was not distinguishable; but upon chopping into the tree we found the blaze about four inches beneath the surface of the bark.

When the surveyor comes upon a tree which he thinks bears the original blazes he should chop out a blaze and count the number of annual rings formed since it was made. In this way he can ascertain the exact year of the survey of which that blaze is a mark; and by reference to his field notes he can tell whether or not that is the original survey. In retracing these old lines care should be taken to note the chainage from the corner to each line tree. After a few of the original blazes have been chopped out the surveyor will find that he can distinguish them from the newer marks by their external appearances.

It frequently happens that a line run on the computed course swings away from the old line after following it for a short distance. If the surveyor finds that this is the case he should offset at right-angles and set up as nearly as possible on the old line. He should mark his trial line plainly by stakes, but should not mark any trees if he can avoid it. When he has run his trial line through to the next corner he must go back and mark the correct line, following as nearly as possible the line of the original trees.

The line as finally marked will oftentimes be far from straight. Most of the old surveys were run without regard to any local attraction of the compass needle. The compassman would sight ahead and locate a tree in line; then he would pick up his compass and walk up to that tree, setting up again on the farther side of it. The chainmen and axemen followed him, the latter marking out the line. Unless the local attraction was very strong indeed no backsights were taken. The result was that, where there were only a few degrees of local attraction, the line would swing around in a large arc, resuming the proper course after the area of "local" was passed.

It is of the utmost importance to endeavor to find some trace of the original corner or its witness trees. The latter will often be found lying half rotten upon the ground; but by examining

them closely one can usually find the old marks even though they be hidden under the moss and decayed wood. In case all marks of the original corner are missing, the surveyor must re-locate the corner. He will frequently be able to fix its position by prolonging the four lot lines until they intersect. It sometimes happens that all four lines have to be entirely re-run and chained in order that the location of the corner may be definitely established. I have known a competent wood surveyor to spend two days in locating the corner from which he wished to start his survey.

One thing which the surveyor should bear in mind is the importance of marking his lines and corners in a plain and permanent manner. Line trees should be blazed at frequent intervals. Corners should be clearly witnessed, and the corner monument should contain two or three stones if there is any rock within reach.

In the foregoing lines I have tried to give an idea of a few of the problems which the woods surveyor must prepare to meet when he goes out into the field. His task may seem difficult, but when he thinks of the men who went over the same ground a century or more ago, he is bound to be infused with the spirit of those men who went out fearlessly to do their work in what was then a vast wilderness. The field notes of some of the old surveys make interesting reading, and show us some of the difficulties and dangers encountered by the men in the field. It is to perpetuate their work that we are sending our surveyors into the woods today.