

different valleys the location of the line is often a very difficult matter, especially when there are two or more possible routes. Usually, however, the location will include the lowest summits and highest low points, such as river-crossings, etc. Hence the elevations of summits and sags and the distances between them, together with the constructive character of the country, must be determined. Low ruling grades are always desirable, whether the road is to be for sleighs, wagons, traction engines or locomotives. Where there is a prospect of the road being sold later on as a link in a railway system, it is well to spend considerable time and money in securing the best possible location. A few hundred dollars spent on preliminary surveys will in such cases be repaid an hundredfold. For such work as this it will, of course, be necessary to use transit, level and stadia rod.

Logging by Cable.

In the large timber of the Pacific coast and the cypress swamps of the South the long logs are hauled in to the railway or other landing place by bull donkey engines. A light line pulls out the heavy cable to be attached to the log, or string of logs, which are then drawn in by the winding-in of the heavy cable. Often each log is capped by a steel cone so it will come more easily around obstructions and through soft mud. In the case of cypress, the logs are generally snaked out to canals along which they are then rafted — the bull donkey being mounted on a scow which is anchored or snubbed at convenient points along the canal. Where a cableway skidder is used, the head spar is the mast of the scow and the tail tree off in the swamp a convenient distance.

In the more mountainous districts, the cableway skidder is an exceedingly useful device for the bringing in of logs, pulpwood, tan bark, etc., to the railway or other road at a minimum cost. In many cases it is the only practical method of yarding the timber at all; as for example, where it is in 'pot holes', across deep ravines, or up slopes where the construction or cost of roads or slides would be prohibitive. Even in country where it is easy to construct railways, the cableway skidder is coming largely into use. The principal objection to it, from the forester's standpoint, is the damage done to the young trees by the swaying and dragging of the logs as they are being hauled in; but it is an open question whether the extra growing space due to the non-construction of roads and the saving in cost of building and maintaining them do not balance the injury done to the young crop.

Loaders.

For the loading of logs on cars, several devices are in use. The Barnhart loader moves on a pivot in all directions and will load from 600 to 800 logs a day, provided they are within 100 feet of the track. As each car is loaded, the machine pulls itself along rails laid on the cars and loads the next one. In the Decker Loader, the empty cars are pulled forward beneath the loader. In other cases a turn of cable round the log on a raised platform rolls it onto the car as the cable is tightened up by means of a drum or 'spool.'

From what has been said, it will be seen that every forester should be a first-class logger and be constantly on the alert to utilize the engineering skill which has been developed in the logging business. Not only this, but he should be on the lookout for new methods, which usually means the adaptation of old ones to new problems.

Other Problems.

Besides removing the timber in as cheap a manner as possible, the forester must also consider the future condition of the property. The ordinary logger is a mere exploiter, who has no concern whatever for the future, and is generally frank enough to tell you so. The forester, on the other hand, is very much concerned with the problem of leaving the tract in the best possible condition for the growth of the timber left standing and for its removal when mature. This generally means the laying out of a permanent system of roads, the disposal of the debris incident to lumbering and the suppression of undesirable trees. In other words, he must practice silviculture, if he is to increase the amount and quality of the timber grown. Herein lies the most important part of his work—work calling for a full knowledge of his subject and the exercise of rare judgment and skill.

Another phase of the forest engineer's work is to be met with in the management of protection forests, which do so much to equalize the stream-flow. With the transformation of waterpower into electric energy all over this continent it will at once be recognized that the maintenance of as even a flow as possible is a matter of very great importance.

In southern Alberta there is also a field for the forester with some knowledge of irrigation engineering problems. In my opinion, every forester should know how to gage a stream quite as well as the ordinary civil engineer. This knowledge would enable him to bring in accurate information long before it would be obtained in the ordinary course of events.