SILVICULTURE

By ELLWOOD WILSON, B.A., B.Sc., F.S.F.G.B., etc.

Consulting Forester

There are so many misunderstandings of what silviculture is, that I am going to take a few moments in trying to make clear just what it means and what its bearing and importance are to us in formulating a national economic policy and in industry. It may be said in passing, that forestry, in this country is, to a large extent, basic to our agriculture, for there are many sections where our farmers could not exist without fire wood and without work in the forest.

Everyone knows that agriculture is the growing of farm crops and horticulture the growing of garden crops; silviculture is the growing of forest crops. Good silviculture is the growing of the largest amount of the kind of wood desired, per acre. Nature has given us vast areas of forest but much of it is inaccessible and much of it is not of the kind we want. Often the desired kinds of timber are mixed with other species of lower value or which we have not yet learned to use profitably.

What would be thought of the farmer who bought the poorest land, trusted to luck that the kind of seed he wanted would be wafted onto the land and take root, and if it did, left it without cultivation or thinning. If when it was ready to cut he harvested it in the cheapest possible way, with the lowest paid labor he could get, left a proportion of it in the fields and spilled quite a lot of it out of his wagons on the way to his barns or to market. If, further, his harvesting of the crop left the land in very poor condition for a future yield or postponed the gathering of his next harvest unduly or even to a remote future? Not much, I guess, and we would not be surprised if he found himself losing money and finally in bankruptcy. To labor the point a little further, we would not think much of a farmer who found a field of wild grain and was satisfied to gather a meager harvest and to leave the chance of another one to nature's tender mercy.

Now these things are just what the majority of timberland owners are doing, not only those who own their timber in fee simple but also those who lease it and pay for its protection and the carrying charges on the investment. Most of our Governments are still without accurate knowledge of how much timber they have, without proper regulations for its cutting, or if they have proper regulations they are not properly enforced. Frankly, are there any of our forests where even the most elementary silviculture is either required or practised? The most that is being done is to see that some measure of fire protection is given and that they are not entirely devastated by those to whom

they are leased. The average time that it has taken our forests to reach merchantable size may be taken as from eighty to one hundred years. All this time they have been storing up capital and earning interest. Under present methods of accounting we are taking this capital and spending it, instead of spending part of the revenue for replacement. Under present methods of cutting it will take almost as long to get another crop and, speaking generally, it will be less in quantity and poorer in quality than the one removed. Proper care and cutting would, in certain types, shorten materially the time to the next harvest and much increase the quantity and improve the quality.

The better the quality, the better the product made from it and the less the waste in culls; the larger the amount per acre, the lower the cost of logging and transportation; the shorter the time required to grow another crop, the less the interest charges on the investment, the smaller the amount for fire protection and ground rents. Every business man knows that the oftener he can turn over his capital the more money he can make and the growing of trees is no exception to the general rule.

There is only one possible objection that any business man can make to the practice of silviculture and that is that he will have to wait from ten to thirty years for a return on his investment, but all the time he is earning interest on it and it may be that his money will be safer in the forest than in the bank. Every investor when he puts his money into a new concern, knows that he will have to wait years before it begins to pay and that the chances are not by any means great that he will ever get it back. This objection certainly does not hold for our Government-owned timber, nor should it for our large wood using industries which have built expensive permanent converting plants. If the same attitude prevailed in starting manufacturing concerns we would never have any. Another objection which is sometimes raised by unintelligent men, is that before the results of present methods of cutting become known they will have finished their business careers and their successors will have to solve the problems of shortage and inaccessibility. One of the methods chosen to assure a supply of timber has been that of buying up large areas of virgin timber or to trust that when more wood is needed there will be areas available. The first of these has brought bankruptcy to two once prosperous companies and is costing many others unreasonable carrying charges. Others in making large purchases have bought areas long distances from their plants and the opening up of these areas is a very expensive proposition. These forests are always further north where the timber is poorer and operations more difficult.

In practically all European countries silviculture is practised as a matter of course. Nearly all of them suffered from wood famines, more or less

severe, a few centuries ago and having learned their lesson have developed methods suitable to their climate and species of trees. Owing to relatively small areas of woodlands, the need for fire wood and raw material for local industries and the difficulties of transport they were forced to keep up local supplies. Some of these industries, saw mills and paper mills have been operating for a few centuries and still give a good living to their owners and employment to the villagers.

In the United States, where the cut-out and get-out policy has been the general rule, whole towns and villages have been abandoned leaving idle lands and desolation. The Chief Forester of the United States said a few weeks ago that after a trip over the whole country, he was shocked at the devastation and that the good of the country demanded that it cease. Large owners of timber lands have had to over-cut in order to pay carrying charges on idle lands, thus flooding the market and ruining forest owners and local industries in other parts of the country. The same thing is taking place in Canada. Communities once dependent on saw mills and paper companies for their livelihood have dwindled and those who could afford to move have left. Expensive depots and buildings with other improvements have been abandoned.

Why do we not manage our forests properly? The main reason is that everyone thought we had wood enough for all time, but with the tremendous growth of our pulp and paper industry we are experiencing shortages near the mills and the exploitation of the north shore and Anticosti Island has gotten well under way and then we must go to the valleys of the Labrador. The lumberman who cut only the largest trees, thought that those he left would make another crop in fifteen or twenty years. He did not know that often the ones he left were just as old as the ones he cut but were smaller due to suppression and that even if they recovered it would take them a long time to become of merchantable size and they could never be of as good quality. When pulpwood began to be taken the same idea prevailed but was soon dissipated when it was found that at each cut smaller and smaller trees were being taken and now the wood piles of our paper companies look like heaps of matches. But the main reason for not giving our forests proper treatment was and is the fear of increasing logging costs, and so cutting down profits. The forests are being treated like mines and any idea of handling them for succeeding and better crops is not thought to be sound business. This is not universally true — there are at least two companies practising good silviculture and thanks to the foresters others are beginning to think about it. Unfortunately for a time even foresters were afraid to advocate proper management through fear that they might be thought to be poor business men. In the United States they solemnly discussed "minimum silvicultural requirements" which meant what

was the least they could do along these lines without frightening the timberland owner. In all ordinary businesses all the costs of doing business are charged against the product and the selling price includes the cost of the raw material as fixed by the producer. The lumberman and the pulp and paper manufacturer are both producers and consumers of wood and should charge into their costs the amounts required to properly manage their holdings. Administration and fire protection are charged now and some companies make an allowance for depletion but do not spend this on their timber lands. The proper care of forests should be charged each year to the logging cost and added to the sales price. Of course in the present dilemma of our news print industry when the product is being sold at a loss, the owners can say that they cannot afford to do anything. Were the lands their own we might say that that was unfortunate and let it go at that, but since they are the property of the people we have no right to allow them to be deteriorated and should force the licensees to practise proper management. During the depression the Quebec Government at least have lowered the stumpage dues to help out but it should have made this contingent on proper cutting. There is no reason why we should give our wood away to the publishers of United States newspapers when it entails lower revenues and lower wages for our workers and deterioration of our forest capital. The timberland owner has almost always in the case of the larger companies, been cursed with too much land and it would be very interesting to calculate whether it would be cheaper to operate smaller areas intensively than it would be to pay ground rent, fire protection and administration costs on large areas which in many cases are going backward and losing money for their owners. Most of the areas now held are covered with over-ripe timber which is deteriorating and which is very vulnerable to fire, insects and fungus diseases. I know of one instance where a company was advised to cut such an area but did not do so for ten years and then after its roads and depots were all completed and the cutting begun, found that the timber was too far gone to use and abandoned the operation. The best kind of timber to invest in is young growth which is less liable to disease and which is earning some interest on the investment.

You may ask why the economic side of the management of forests has been discussed at such length. It is because it is a matter of national policy and the prosperity of our country, and because the argument which is always advanced against better management is that it costs too much. Unfortunately we have no costs on using silvicultural methods. We have detailed costs on the establishment of forests by planting but so far nothing on selective cutting or other silvicultural practices. We will have soon. There are costs from European sources but labor conditions and markets are different. Some of the large holders in the United States have been experimenting and their experience

should soon be at our disposal. Two of our own companies, the Howard Smith Paper Mills and the Singer Manufacturing Co. are both logging properly. In mature stands the only cost would be in leaving more of the smaller sized trees and perhaps cutting some of those which had a larger percentage of cull. The heavier the stand of the desired species the less the cost. In the case of mixed soft and hardwoods we might have to girdle a few of the latter, and here perhaps one dollar per acre or ten to sixteen cents a cord would cover the cost. In any case it is probable that the maximum cost would not be more than fifty cents a cord and this would be more than made up in the shorter time required to grow the next crop and its greater yield and better quality. The increased amount of wood per acre which would result would run to 25% or higher, and the quality of the soil would build up increasing the capital value of the land.

In order to practise the growing of trees profitably we must know the fundamental or limiting conditions which influence their growth. We must know how they grow and why they react to certain methods of treatment. The first of these is climate which may be taken to mean the average annual temperature during the growing season, the minimum winter temperature, the average rate of the late spring frosts and the annual rainfall. Some species have accustomed themselves through centuries of evolution to dry climates and some to wet, some will stand very severe cold and others are very sensitive. The latitude is another limiting factor and altitude has the same effect. Trees cannot be grown successfully out of their natural range, and this must be taken into consideration when bringing in trees or even seeds from other countries and regions. Certain species have done excellently when grown in countries far removed from their natural habitat but it is always well to experiment on a small scale. Seed should be selected from areas which are as nearly alike in climate and latitude as possible.

Soil, light and moisture are basic factors. Each kind of tree has its own requirements. Some will only thrive on deep rich soils, others on moist soils and others again prefer light dry soils. If the conditions are not favorable they are more liable to disease and will not give their highest yields and take longer to grow. Certain species require more of the chemical elements than others and some have the power of utilizing larger quantities of these. Red maple, for instance, will extract relatively large amounts of phosphorous from the soil and this is deposited mostly in the leaves; it will be returned again to the soil and help to improve its quality. Nitrogen is probably the most important element in tree growth and the addition of small amounts in usable form greatly stimulates the rate and quality of the wood formed. It is possible that in the more intensive handling of our forests which is bound to come fertilizing may play an important part in our methods.

Light is very important and no tree will grow without it. While some trees will grow under considerable shade, almost all of them do better when their crowns are exposed to full sunlight. One Swedish authority states that light from the side is also an important factor in the growing of conifers. Trees will exist for a long time with very little light as when they are suppressed or grown under others, but if kept under such conditions too long they lose their power of recovering and are very often diseased. Too much light, on the other hand, is also detrimental in the growing of good timber. You have all noticed how trees grown in the open are short and branchy and consequently yield knotty timber. Spacing therefore is important for the competition of other trees kills off the lower branches and forces the trees to grow higher and give greater merchantable length and clearer lumber. To have the proper spacing requires knowledge and judgment and the time of thinning is very important.

Moisture is a most important factor, and growth varies from year to year with the rainfall. The red wood trees of California furnish, by a study of the width of their annual rings, a record of the wet and dry seasons for centuries. Competition of the roots for water sometimes makes it impossible to grow certain trees together on the same site and is a factor in the reproduction of others where the large trees use up all the moisture and there is not enough left for the seedlings.

In some cases high winds prevent or hinder tree growth, as on the coast of Scotland.

Some trees do better when grown in pure stands and others in mixture. Growing of white pine in mixture with hardwood helps to reduce the damage from the white pine weevil. Ross reports that spruce and caragana will not grow together. Mountain pine and locust will aid other species by their power to fix atmospheric nitrogen and improve the quality of the soil.

Usually when fortuitous mixtures of trees start on any area, competition gradually eliminates or relegates to a less important position in the stand the less adaptable ones and we finally arrive at a so-called climax type in which the remaining species are of equal resistance and must perforce live together.

Of course the intervention of man can greatly modify the forest and within certain limits he can grow the kinds best suited to his needs. In every case, he can, by a proper understanding of the fundamental laws governing growth and experience in their application, greatly increase the yield.

Almost all the woodlands which we have in Canada to-day grew up without any interference from man except through the setting of forest fires and there are very few cases where we have yet begun to cut the second crop. Successive cuts have been made as where the large pine was removed for lumber, then the larger spruce and fir and then a cutting for pulpwood. Once the balance of nature has been disturbed man must continue to regulate the

forest if it is to be of any use to him. Errors in forest management take a very long time to correct and in some cases render the forest valueless if it is left to itself. Where on certain types of soil the spruce has been removed balsam and the hardwoods take its place and not enough is reproduced to make cutting of that species profitable. The tendency is always toward the reproduction of the less valuable species. Burning, over-cutting or the removal of a certain species may lead to deterioration of the soil which it is impossible to remedy. The water holding power of the ground may be lowered, contributing to higher water in the spring and lower water in the summer in our streams and erosion may set in, silting up the rivers, denuding hillsides and ruining fertile valleys and naturally preventing further tree growth.

Some of our forests have been so cut that we cannot afford to do anything to improve conditions but will just have to let nature take its course. In some cases the time which will be required to grow another crop is so long and the areas are so poor that the only thing to do is to cut them and leave them. Where we have not yet begun to cut proper silvicultural methods should be used. It is only by different systems of cutting that we are able to properly manage these forests which nature has provided and to perpetuate them. The axe is the only tool which the silviculturist needs. Where we are dealing with a young forest, in this country one which has come up after fire or cutting, we must begin to thin when the trees are about twenty years of age, leaving those which are the straightest and healthiest to form the crop. With hardwoods, early thinnings are most important. Later when the trees are again beginning to crowd each other we must make another thinning and sometimes a market can be found for those removed, fire wood from hardwood stands and pulpwood from soft. The main idea is to give each tree room to develop a good crown but not to let in enough light to dry out the soil or to develop side branches. Later still, if we want nature to reproduce the stand we must make another thinning to prepare the ground for the germination of the seeds which will fall from the trees and then finally when reproduction is properly established we take off the last of the mature trees. The main difficulty with regenerating a forest in this way is that we must wait for a seed year for trees do not always produce seed every year. Sometimes it may take from ten to twenty years to get our next crop established with all the expenses which must go on and the withholding from use of the trees which must be left. If we have a sufficient area of timber land so that we can get enough wood off part of it each year to supply our needs then by cutting in rotation we will have an annual crop.

We can proceed in a different way also, that is by taking vacant land and planting the species of trees which we need. In this case we can choose the best sites, if possible as near the point of utilization as possible to reduce

transportation charges and cost of cutting. In this way we get just the kind of wood we want, without the poorer species being mixed with it. We reduce the time required to grow to maturity by nearly half, we increase the average cut per acre by about seven times and we have much better quality wood. By planting enough each year to fill our plant requirements we arrive at an annual crop basis and if the area is close enough to the mill we only need to keep a very small block pile as the wood can be cut and moved all the year round. In this way we reduce the amount of money tied up in woodyards and in logs which are held over for a year before being driven. A large scale experiment has proved that such a forest will produce the wood required to make a ton of paper at a cost of about seven dollars per ton less than wood cut on limits under license.

For convenience of discussion and classification the methods used in cutting are divided as follows.

Clear Cutting, where the whole crop is taken off at once.

Seed Tree Method, where enough trees are left to supply seed for reproduction.

Shelterwood Method, where the crop is usually removed in three stages. A preparatory cutting which opens up the stand to prepare for the seeding, a cutting just previous to a seed year to start reproduction and a final cutting to remove the mature trees.

Selection Method, where the individual trees are removed as they come to maturity and the stand is never either cut clean or opened up over large areas.

Then we have two other methods which are used only with hardwoods and which have very little applicability in this country: The coppice method, where the area is cut clean and the new crop comes from sprouts from the stumps, and coppice with standards, where part of the stand is cut and reproduces itself from sprouts under an over story which is cut in its turn.

All of these methods merge one into another. Under no circumstances, in our eastern forests could any one be applied over a large area successfully. We have such a variety of species and our stands are so heterogeneous that almost every acre must be considered separately. We can clear cut a large area or cut it in strips, wedges or groups. We can leave strips or groups of seed trees, we can apply our shelterwood method to areas of different sizes and shapes, and we can practise selective cutting on patches of any size or shape or we can combine all of these methods over larger areas. It takes experience and judgment to fit the methods to the sites. Each area must be studied and handled according to the conditions existing. Great care must always be taken not to open up the stand too much or grass, raspberry bushes or inferior species may come in and prevent natural seeding from taking place. It goes without saying that fires must be prevented; almost invariably they

deteriorate a site and often burn off all of the soil making the country barren. Grazing will also have a deleterious effect both on the forest and on the animals so pastured.

In choosing a method of cutting, the first thing to be considered is the kind of wood that is desired as raw material and then use every effort to favor that species. Spruce is the most desirable wood for pulp so a cutting method should be chosen which will favor its growth and reproduction. In buying woodlands or in managing them we want those which carry the heaviest stands of that particular kind. The best sites should be chosen for purchase and should have the most intensive management for they will produce the largest crops. Many areas now under license are steadily losing money for their holders. These should be left to the Governments to handle and need nothing more than protection from fire for nature will cover them with some kind of tree growth. Then, too, some kinds of trees do best in mixture and some use should be found for each species so that the greatest return can be obtained from the land. We have large areas which are predominantly hardwood and some use should be found for it. Paper mills can use up to 25% hardwood in their ground wood if transportation costs are not too high. Many other species than spruce can be used with the sulphite process and practically every kind of wood that grows in the sulphate process.

Finally as to the silvicultural methods which can be applied to the different species. Swamp black spruce and jack pine can be cut clean, the former does not reproduce from seed and almost always there is enough jack pine reproduction or enough cones on the ground to start a new crop. White pine can be clear cut in strips or groups. Spruce and fir, if there is not sufficient reproduction already started, must be opened up to stimulate it and can then be cut clean. Care must be taken not to open up such stands too much or the trees will blow down. The selection method can also be used but it reduces the cut per acre. Mixtures of these two species with hardwoods can not be opened up too much or the hardwoods, especially on the better sites, will crowd them out. The amount of softwood in them can be increased by judicious girdling, if there is no market for the hardwoods. Those girdled die slowly and usually rot down without damaging the young growth. Trees grown for lumber on a long rotation probably develop best in mixed stands. For pulpwood where the most usable size is probably eight to ten inches in diameter breast high, pure stands are more profitable and more economical to log. The clear cutting method, AFTER REPRODUCTION IS ESTABLISHED, may prove successful. This is being permitted by the Quebec Government. A small amount of hardwood should be kept in the stand to keep up the fertility of the soil.

There are numerous ways in which the National Research Council can be of help. First in solving some of the purely scientific fundamental problems, such as the role played by micro-organisms in the soil and also that of the chemical elements. The first step is an investigation of the field of forest research to find out what has been done in other countries and here in Canada and to make the results available to the industries and the practising forester. Also to see that such work is not duplicated and that problems are assigned to institutions which are most capable and best equipped to handle them.

Our knowledge of forest soils is very meagre. Apparently soil by itself whatever its origin makes little difference to tree growth. Certain nutrient salts and micro-organisms are of fundamental importance. We need to know more of the role played by nitrogen, calcium and phosphorus in tree growth and whether some of the rarer elements play any part as do copper and manganese in the growing of plants. The question of fertilizing trees needs study. It may come to have a very important place in the more intensive forestry which will be used for growing timber for our industries. Much more study needs to be done on the best conditions for the germination of seed on the forest floor and the exact amount of light and moisture which should be given it. There are such problems as the inability of white pine to reproduce under white pine. Toumey's classic experiments at the Yale Forest seem to show that it is lack of moisture caused by the absorption of most of it by the mature trees. With such knowledge we could shorten the period required for establishment of a new stand.

We want to know more of insect and fungus control and forest sanitation. We want to know a cheap means of controlling undesirable species; girdling and poisoning are now being used. Experiments in the utilization of these species might give us a way of using them which would permit their use at a profit. They could be removed at the same time as the main crop and so reduce logging and transportation costs. It might mean the establishment of auxiliary plants in connection with our pulp and paper mills which would mean a diversity of products, always an advantage. More profitable uses for cull hardwoods than making them into fire wood and wider uses for jack pine, hemlock, white birch and poplar might be found.

There should be some economic research also to find out how much silvicultural methods would cost and what the exact result of their application would be. The time is ripe for some paper company to lay out two areas as much alike as possible of square mile each and to log one by the methods now in vogue and the other as it should be cut. By using the same men and supervisors on both operations comparative costs could be obtained as well as definite information. This was done by the Finch Pruyn Co. of Glen

Falls, N. Y., on thirty-acre tracts, and they were satisfied with the experiment but would never disclose their costs.

We have costs of starting a forest on a large scale by planting and details and costs are available. The operation was highly successful.

There are also specific problems which arise in the industries, an improved method of sawing lumber, the control of fungi in stored wood, the cooking of mixed woods, the utilization of sulphite waste liquor — the Province of Quebec could use it to great advantage as a binder and dust preventive on its huge mileage of dusty gravelled roads; it would greatly reduce maintenance costs. Experiments need to be carried out on the hogging or chipping of wood to make it usable in furnaces. Generators to make gas from wood for driving automobiles, tractors, trucks and farm machinery, already this is done in Europe. Development of domestic cooking and heating plants along the same lines.

New uses for cellulose and cellulose derivatives might greatly increase the use of wood and make our forests much more valuable in our national economy. There is serious talk about the exhaustion of the gasoline supply and we should be ready to turn to alcohol which can be produced in unlimited quantities. We are badly in need of a cheap and durable road surface and it is within the bounds of possibility that it might be made from wood. With the strides being made by the chemists whose discoveries are scrapping long established industries and creating new ones on a gigantic scale, we may find that wood will rival coal tar as a base for undreamed of uses. We can never have too much wood.

THE FORESTRY NEWS DIGEST

Walnuts in Canada

To the Editor: Regarding "Canada planting black walnut" and further details, I began experimenting with black walnut here 25 years ago. This year I shipped black walnut seeds to British Columbia, Alberta, Ontario, Quebec, Prince Edward Island, and Nova Scotia. I have a branch plantation in Prince Edward Island of 26 acres, all to be planted with black walnut; also a plantation at Victoria, B. C. We expect to plant 80,000 black walnut seeds this year. This is only starting, as it is my intention to plant hundreds of thousands of black walnut tree seeds in every province in Canada where they will grow.

The only reason this was not done 50 years ago, is lack of education in our schools and colleges. I know of no other way. There is no other way.—
H. H. Blanchet, Meach Lake, P. Q., Quebec.