

and there clay. In one place the soil may be so thin that trees cannot grow; in another place the soil may be damper than the average and a stand of different trees result, or there may have been a windfall and conditions are changed so that another kind of tree comes in. These horizontal differences result in alternation in the structure of the forest.

Mortality in Juvenile Trees.

Now, a forest regarded as an organism not only has structures, but it has functions of its own apart from the functions of individual trees. The first of these is reproduction, which consists in the production of seeds and their germination. When the seeds have germinated they they must establish themselves on the area. Whether or not the seedlings will live depends upon the natural vigor of the seedlings, the amount of food material stored in the seed, the length and vigor of growth of the roots, the ability to endure drying-out conditions. When seedlings have succeeded in establishing themselves, they at once come into competition with seedlings of their own kind or those of other trees, and as you know this competition continues throughout life. We do not know, by experimental evidence at least, why some succeed and others fail, but we do know that the slaughter is terrific. I have seen Douglas fir seedlings at the rate of 500,000 to the acre, and Western hemlock at the rate of 3,000,000 to the acre; yet, when these trees reach maturity scarcely a hundred will be left upon the acre. The ordinary coniferous tree requires about four square feet of soil when 20 years old, and 150 square feet when 100 years old. There is neither room, food nor light enough for them all. The fit survive and the weaklings die. As a rule, 95 per cent of the trees in a forest sacrifice themselves that others may live. Competition then is one of the normal functions of a forest.

Another function is succession. By this is meant that the composition of the forest is constantly changing until it finds itself in equilibrium with the factors of soil and climate which have brought it into being. The familiar illustration of this is the birch and poplar on the burned areas. They control the ground for 20 or 30 years, then, if there is reproduction of the original forest, it in turn gains its normal control. Vegetation through its influence on light and soil conditions is constantly making conditions less favorable to its own kind and more favorable to another kind. This results in succession, one of the most pronounced functions of vegetation and nowhere more pronounced than in the forest, to those who have the eyes to see.

As I have just said, succession ends in a forest in equilibrium with the factors of



Northern Ontario's Winter Crop. An operation on Pickerel River.
Photo by C. Harding, Pakesley, Ont.

its environment, that is with its climatic and soil conditions. We call such a forest a climax forest, and we regard it as stationary. This conception is perhaps satisfactory if we look ahead only 100 years, and as foresters we should look ahead that far. But freeing ourselves from this cramped vision, we can look still farther ahead and say there is nothing fixed and stable in nature and, therefore, in the strict sense of the word, there is no stationary type of forest. In the first place, there would always be minor fluctuations, due to openings from natural causes, such as windfalls, lightning, and consequent changes in the light relations. There would also be wider fluctuations due to biological causes. For example, a light-demanding species such as the pines cannot control an area for more than one generation. The white pine in central Ontario cannot be considered as a climax type, especially when in pure stand. It cannot reproduce itself beneath its own shade; therefore it must give way in the end to a shade-enduring species, such, perhaps, as the balsam in the northern portions of its range in Ontario.

The Forest as a Wood Producer.

Coming back to our conception of a forest as a community with its own particular activities, we note another fact of general application, and that is, that a forest community reacts upon its environment, qualitatively and perhaps quantitatively, as does a community of human beings. The human community reacts upon its environment by clearing the forest, tilling the fields, building houses, harnessing the power of boiling and falling water and the lightning in the skies. The forest does things just as wonderful. The forest harnesses the energy from the sun; it solidifies the carbon of the air; it adds a very dilute solution of mineral

salts and transforms them into wood. It is the function of the forester to regulate and direct the growth-energy of the forest.

Just as in a human community the individuals react upon each other so in a forest community. No tree can live surrounded by other trees and be the same tree that it would if it were living alone in the open. This leads to a change in the form of a tree, and it is the function of a forester to fashion that tree into the form which best serves his purpose. The forest community reacts upon its local climate; the temperature, the humidity and the precipitation are not quite the same as in the open. The forest community reacts upon the water regime, the storage and the drainage of waters.

Of greatest importance to the forester who is to direct and regulate wood production is the reaction of the forest community upon the soil conditions. The forest is the great restorer of the soil. You know the vegetative cycle and you know how the forest keeps that cycle unbroken. A larger percentage of its contents comes from the air than in the case of the field crops, the trees being chiefly solidified sunshine. Not only the material taken from the soil, but the additional material taken from the air, decays upon the soil and thus the soil is enriched year after year, generation after generation. The soil is the cemetery of the ages. In order to have something living there, something must be dying there. The forest quite literally lives on the bones of its ancestors. The character of the forest today depends upon the successive generations that have gone before. The accumulated vegetable matter in the soil increases its waterholding content, and thus replenishes and regulates one of the most necessary and most variable factors in plant life. You know, the decaying
(Concluded on page 505).