the tree cannot make use of the water as it could if it were pure. The method by which the water passes from the outside of the rootlets to the inside is a physical one dependent on chemical composition. If the water outside is a stronger solution than that inside the root, the water will not pass in and consequently the tree cannot get the use of it.

As you reach the northern latitudes or the alpine elevations of the mountains, the tree growth becomes more stunted until finally it lies almost like a mat on the surface of the earth, as illustrated by the view of the white barked pine at an altitude of 6,000 feet on the Porcupine Hills in Alberta. This flattening out of the growth is partly due to the fact that the water supply is not sufficient, and that it is difficult to get the water pumped up if the tree grows to a greater height than the ordinary level, and partly to the fact that the drying wind increases so largely the transpiration that the supply of water cannot be obtained quickly enough in a soil which is so cold for such a great part of the year.

To counterbalance the great extent of the tree above ground, it is necessary also that the root should extend deep and wide in the earth in order that the tree may not be overthrown by the wind. The growth of the tree in this manner is not, however, the most satisfactory for producing lumber, as the lumber produced will be knotty and will have a very small proportion of clear stuff. In order to produce the best quality of lumber the tree should be grown in a close stand. Where the trees have been sown close together and are reaching upward toward the light, each one tries to get its crown where it can get the most light. As a result the trees grow rapidly upward and the inside branches dry off and gradually drop from the tree, leaving a long, clear trunk. Many of the trees in such a stand will finally become suppressed by the more vigorous ones and will gradually die out completely. In the forests of Europe such trees would be taken out by a thinning process, but in this country the market conditions do not make such thinnings possible, although in a district like the Cypress Hills, of Alberta, where there is no other timber within one hundred miles, there seems to be reason why thinning might be done profitably.

The soil has considerable influence on the growth of trees. We find that on the light, sandy soils the pine will grow readily, particularly the red pine and the jack pine. As a rule, however, trees will grow best in a fairly good soil, and the forest floor covered by leaves and debris from the trees finally forms a bed of humus which provides excellent nourishment for tree growth. The province of Ontario is now taking active steps to replant pine on some of the sandy areas in the western part of the province, which have been entirely denuded and left bare of trees or any other useful growth.

In order to meet the different conditions as explained above, the tree has to arrange various adaptations. Sometimes the tree is in a location where water can be obtained plentifully, and in such case it is arranged that water will pass through the tree rapidly and escape. Such trees usually have broad leaves with thin coverings and numerous openings called stomata from which the moisture may escape. Trees or plants growing in dry situations, on the other hand, have devices for retaining the water as long as possible. One of the clearest examples of this, is the cactus growing in the deserts of the western United States, and even in the dry districts in the southern part of the prairies. The cactus has thick leaves containing a great many water vessels, and these leaves are covered with a close covering through which water cannot pass very easily. As a consequence all the water which the plant draws up from the earth is retained in the plant with almost no loss.

While the tree draws up water from the earth, bearing a few mineral salts, its chief sustenance is the carbon drawn from the air through the leaves. The fact that the tree is largely composed of carbon can be seen in any burnt district. The carbon is supplied largely from carbon dioxide in the air. In order to carry on its process of obtaining the carbon from the air, which process is carried on by assimilation in the leaves, it is necessary that light should play upon the leaves as fully as possible. Consequently the leaves are spread out so as to catch as much light as they possibly can. This is illustrated by the broad, flat leaf of the maple, arranged upon the stem so that the broad, upper portion of the leaf should always be exposed as much as possible to the sun. In the case of the coniferous trees the leaves are small, but this deficiency is made up by their leaves being very numerous.

The stem is so arranged as to provide for the water supply from the root passing up readily, and it is a very interesting process to investigate. It is not yet clearly understood how the force is supplied which will drive up the water required for one of the giant trees on the Pacific Coast two or three hundred feet through vessels of microscopic size. Various theories in regard to the matter have been put forward, and it was thought at one time that the matter was settled by an explanation that the pulsations of the living cells of the trees resulted in a pumping process which gradually forced the water upward. This theory is not, however, accepted as final at the present time.

Each year of growth adds a distinct ring to the woody tissue of the tree. In the spring the cells of wood are large with thin walls, and late in the summer are small with thick walls, and this makes the distinction between the growths of different years. The growth of a year may be larger or smaller according to the season. The favorable season will make the ring of growth larger, and a dry season will make it considerably narrower. Trees which are suppressed will also make slower growth than those which are open to light and air.

The bark gives protection to the growing parts of the trees, and as the tree increases in size the outer bark dies and is split open by the pressure from the inside, resulting in the corrugated bark which is so characteristic of many trees. The rough bark is characteristic of the white pine, elm and many other species. The bark in other cases, like the spruce, strips off in flakes, and that of the white birch exfoliates in thin sheets.

There is added to the natural conditions which have to be considered in the growth of the trees, an artificial condition caused by fire. Fires have occurred in all our wooded districts, and the evidence of their destructive power is clear to any person who has travelled through the timbered districts. Fires make the condition more difficult inasmuch as they make it harder to carry out the protection of a forest, and that they have made the conditions for reproducing the forest more difficult than they would be naturally. Where a tract is well covered with forest trees the cutting can be done so as to favor natural production, but where a forest fire sweeps through, the conditions are changed without regard to what is to follow, and we have to try afterwards to bring about the conditions that would have been considered and provided