hawthorn and others are largely distributed by wild animals which eat the fruit and allow the seed to pass through the alimentary canal uninjured or carry off the fruit and spit out the seeds. Many seeds or seed vessels have bur-like or sticky coats by which they adhere to animals and are thus carried considerable distances. Very often bodies of water aid in the distribution of seeds since all that are spread by the agency of the wind and most of those that have fleshy coverings will float on the surface of the water and may in this way be scattered.

SHAPES OF TREES.

Different species of trees naturally develop different shapes. Some, like spruces, tamarack and balsam have a decided tendency to form a strong stem and to take on a conical form in preference to the development of a crown or head while others like the basswood, oaks, maples and box elder develop their crown in preference to their stem. The actual shape of trees depends on the space they have to grow in, on the soil, situation, and on the age of the trees. Where trees have plenty of room to grow, and their natural development is not interfered with, their individual characteristics are most apparent.

TREE GROWTH.

ASSIMILATION.

Plants are made up of various tissues and these are formed of numerous cells. The material of which these cells are composed is largely carbon. This carbon is derived from the carbon dioxide (carbonic acid) of the air which enters into the leaves and under the action of light, air and water is there decomposed; the oxygen is given off and the carbon is retained and combined with water obtained from the roots, forms starch, sugar, gum and other plant foods.

This process of food making is called assimilation and can be carried on only in the green parts of the plant and in these only when exposed to light and air. Hence, foliage, air and light at the top are essential prerequisites for tree growth and other conditions being favorable, the greater quantity and better development of foliage and the more light this foilage has at its disposal for its work, the more vigorously will the tree grow.

In general, therefore, the growth of wood may be reduced either by the removal of foliage which reduces the working surface or by shading which somewhat checks the activity of the foliage by hindering light action.

TRANSPIRATION.

The flow of sap in trees is not well understood. In a general way it may be said that the sapwood transmits the water from the roots to the leaves where a part enters into the assimilated sap and goes to build up the plant and the remainder which is by far the greater part passes off as vapor. The amount thus transpired varies greatly with the species, age of the tree, amount of foliage at work, amount of light at its disposal, climatic conditions and the condition of tree growth. The amount of water transpired is so large in comparison to the amount retained in the tree that while an acre of forest may store in its trees 1,000 pounds of carbon, 15 or 20 pounds of mineral substances and 5,000 pounds of water in a year it may have taken from the soil and given off to the air from 500,000 to 1,500,000 pounds of water or from one quarter to one-half as much as agricultural crops. It has been estimated that the leaves of deciduous trees transpire one-sixth to one-third as much water as an equal surface of water. Large deciduous trees undoubtedly give off as much as a barrel of water a day in dry summer weather. Coniferous trees transpire much less water than most deciduous trees; frequently not over one-sixth as much.

Mineral substances are taken up in small quantities and consist mostly of lime, magnesia and potash. They are carried to the leaves where they are used (perhaps also on their passage through the tree) with a part of the water in food preparation. The main part of the mineral substances taken up remains as the water transpires in the leaves and young twigs and is returned to the soil when the leaves are shed, and when the tree is cut and the brush left to decompose and make humus.

The soil of woodlands is improved from year to year if the leaves and litter are allowed to remain on the ground and fire is kept out, since the mineral matters taken up by the tree are largely returned to the soil in a more soluble form and the amount of humus is increased. For this reason there is no need of alternating woodland crops.

Almost any soil can furnish a sufficient quantity of mineral substances for the production of a crop of trees provided it is moist and the leaf mould is not removed. Good soils will continue to furnish mineral matter in sufficient quantity even if a portion of the leaf mould is carried away. If however this removal is continued annually for a long period, any but exceedingly fertile soils are likely to become exhausted just as land on which field crops are grown cannot produce crops forever without manuring.

YEARLY ROUNDS OF TREE LIFE.

In the spring the tree starts into growth and feeds on the plant food stored up the preceding year; the leaves unfold and commence furnishing plant food. These two sources of food push the growth along very rapidly in the spring and early summer. By the first of July the food stored up the previous season is exhausted in many trees and growth is entirely dependent upon the food furnished by the leaves. The growth at this time is generally much slower than in the spring and as the capacity of the tree for building up plant food increases it commences to store up starch, sugar and other foods in its cells with which to start growth the following spring and the cell walls become thicker and firmer. This maturing of the tree is termed *the ripening of the wood* and when completed the tree is ready for winter. Our hardiest trees generally ripen their wood early in the autumn and then cease growing although probably some food is being stored up so long as the leaves remain green on the trees.

REST PERIOD OF PLANTS.

With very few exceptions all plants require an occasional rest period for their best development. Some species get it naturally by being dried and others by being frozen. And even when plants are kept under growing conditions the year round they have periods of rest and of excitement. During the rest period the plants undergo very few changes and yet there is undoubtedly some growth during mild weather in winter and as evaporation must be going on most of the time from twigs and buds, water must be supplied from the roots.

WATER LOST BY TREES IN WINTER.

After many careful experiments A. L. Knisely, M. S., concludes that a soft maple standing 30 or 35 feet high with a trunk 15 to 18 inches in diameter near the ground, exposing from 750 to 800 square feet of bark surface, may lose daily by evaporation from 6 to 7 pounds of water when dormant. An apple tree 30 years old and 15 inches in diameter at the base, exposing from 800 to 1,000 square feet of bark surface may lose daily while dormant from 10 to 13 pounds of water. These figures are from results obtained during winter weather in New York where the relative humidity of the air is higher than in Minnesota which would lessen evaporation. It is probable that during our winters here the evaporation from trees will greatly exceed that in New York and that greater evaporation is nearly always responsible for some trees being tender here and hardy in New York and other places with similar conditions.

We know that in this section after a prolonged period of severely cold weather, the twigs of soft maple, apple and some other trees have a decidedly shrivelled appearance which disappears after a few days of mild weather. Soft maple trees standing on dry land will sometime in the spring appear to have been dried out and to have become partly or entirely dead. It is probable that during our coldest weather very little, if any, moisture can be supplied from the roots which may account for this shrivelled condition.

SECOND GROWTH.

Sometimes warm, moist weather in late autumn will cause trees to start a strong second growth in October which draws on the stored plant food