THESIS
CAUSES OF DAMAGE TO FORESTS

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on

"CAUSES OF DAMAGE TO FORESTS."

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Perhaps no problem of the present is of greater importance than that of forest preservation. The growing demand for timber and the constantly decreasing supply has at last awakened interest in this matter, and forest degeneration and regeneration are promising subjects for the scientist of the future.

Sharing in this general interest, the writer has undertaken a little local investigation into some of the causes of injury to trees and the general causes of forest destruction. This investigation has been decidedly local in character, and necessarily limited in extent. Experimental work was impossible, and what was done was by personal observation, supplemented with a limited amount of reading. The observations, however, were quite extensive, and were confined to the forests adjoining the College and one visit to Genesee County. They cover a period of three months time, when the means of observation were the best.

Although the work was not as complete as could have been desired, it was instructive and revealed some interesting points about local forest areas, as well as about forest areas in general. Both normal and abnormal causes, whether confined to a single tree or to whole tracts of trees, were observed

and will be included in this article. Nor was the observation confined to forest tracts alone, but the observation of forest trees, whether in landscape, roadside or pasture, was included, for they are there subject to the same laws as in the primeval forest.

The various causes may be divided into:

Wounds,	Floods,
Twining Vines,	Drainage,
Freezing,	Drought,
Electric Currents,	Cutting of Timber,
Storms,	Pasturing Forests.

Wounds.

This term applies to any contusion of the cortex of a tree, that extends through the same to the woody tissue beneath. Wounds are a prolific cause of damage and disease in trees. Their natural tendency is to heal with but little resulting injury, but so much depends on conditions that this seldom occurs. The main healing function of the tree lies in the inner layers of cortical parenchyma and cambium. If it be wounded in the growing season these cells and the exposed woody cells commence to repair the injury at once. The woody cells exudes a fluid that supplements, for the time being, the destroyed cortex. The cambium cells exposed about the wound multiply and readily form a callus about it that will grow over the exposed part, and may in time entirely cover it. If a tree is girdled this action cannot take place, and the tree will eventually die unless the wound be protected from air and kept moist by some covering. The process of healing can also be hastened by shielding the wound from the

air, as the healing is not then dependent upon the surrounding cambium alone, but may proceed from cambium cells still remaining on the woody portion. This action is normal, and will occur only when the cells are in a growing and moist condition. If the wound occurs when the tree is dormant, no exudation will take place from the woody cells, and the cortical and cambium cells will not form a callus until the growing season arrives. Meanwhile the exposed cells of both cortex and wood will become dry, and the woody portion may check. Again, when the cortex begins to remedy the evil the process is much slower than it would have been had the injury occurred in the season of growth. This healing action depends much on the age and vigor of a tree. Old or weak trees recover much slower than young and vigorous ones. Then the characteristics of species alters the action much. For instance, the beech grows slowly and has thin bark; hence heals slowly when wounded and has a tendency to result badly. On the other hand the poplar is a rapid growing tree, and will readily recover from a wound that would permanently injure a beech.

Primarily, wounds are injuries from which no tree can fully recover. They damage the wounded portion for economic purposes, and cannot fail to impair the vigor of a tree even though they be not severe. If on a branch or in the top of a tree they weaken the same, and the wounded portion dies to the first sound branch or sub-branch. If on the trunk or root of a tree they so weaken the portion that it cannot resist the wind. Aside from these direct injuries, wounds leave a tree subject to subsequent deteriorating agencies, if they have not normally healed. If they are exposed to the elements

they eventually yield to decay, which in turn invites saprophytes and various insects. These hasten the destruction by weakening the wounded portion and are soon followed by birds in quest of food and animals that nest in hollows of trees. Incidental to these agencies comes the action of the natural elements. The wounded portion, perforated by insects, tunnelled by birds and animals and decaying from saprophytes, is at the same time subjected to moisture and oxidation, which favor the attacks of fungi and bacteria. Then it may become watersoaked and freeze so that the adjoining parts of the tree are split. Under the combined action of a part or all these agencies the wound becomes a serious injury to the tree and a center from which disease may spread.

Various Wounds.

Of the various wounds observed the following are most common:

Wounding by Maple Borers.

A great number of Acer saccharinum that had been wounded by borers were observed in the woods east of No. 7 College Farm. These trees had nearly all recovered fairly well - a result that was no doubt due to the cortex protecting the injured portion after the wound. But in some instances the trees were seriously injured. The borer tends to make bad wounds because of his habit of burrowing around the trunk - thus having a girding effect. The depredations of this insect are by no means general. In no other place had it done much damage, and even in the woods noted above his work was confined to the trees standing on the elevated ground.

Cutting and Hauling Timber.

Many injuries result from handling timber in a forest. They are mostly caused by cutting and hauling. The wounds may be from detached, parched or glazed trunks made in felling trees, or they may be crushed or barked roots and trunks due to hauling logs. Whatsoever their cause, they may result in serious damage and are unually large wounds. From observations made it was evident that many of the beeches with weak, decayed bottoms had received the primary injury from falling trees, felled either by nature or the woodsman.

Ax Wounds.

It is hard to find a forest in the populous parts of the state that has not been injured by ax wounds on the trees. No forest visited was free from such wounds. The oaks have suffered most, no doubt because they have at some time been sorted by the timber inspectors. Some of these wounds are healed, others are leading to the final death of the trees, yet whatever their condition these wounds have injured a section of each tree for its fullest utility.

Barking by Animals.

Barking by Rabbits, squirrels and mice is confined to young deciduous trees. Rabbits and mice prefer the cortex of tender shoots of young fruit bearing trees, but will eat of less palatable shrubs when pressed for food. Their work may be severe. The squirrel is known to damage Conifers by removing the young cones and buds. In the observations made several clumps of small Acer saccharinum that had been girdled by fox squirrels for several successive seasons were found. The squirrel may also gnaw his way into the trunks of large trees if there is something edible there to invite the attempt.

Tapping the Maple.

This wound is usually not of a serious nature because made close to the growing season and is usually small. But when the old method of ax tapping was used it was rather harsh. By that method a few years sufficed to surround the tree with scars and wounds, which greatly weakened the tree.

Defoliation by Insects.

This is a wound of a serious nature, because it removes from the tree essential organs of growth and organs that have consumed a great amount of the reserve food of the tree in their formation. Once removed, the tree puts forth a new foliage for the season thus robbing the cortex of its growth and the development of the tree for the time being is arrested. Then defoliation may be followed by a second defoliation or by drought or some other adverse condition, and the virtually impaired tree is killed. Defoliation is caused by insects or fungi, and may be caused at any time in the growing season. The result of an attack depends upon the season. When the tree is growing most rapidly the result is most disastrous.

Twining Vines.

The grape and bitter sweet may injure trees by growing into them. The injuries by the latter are superficial. It does not impair the health of a tree but alters its form and retards its growth by twining tightly about its stem, even to being overgrown by the development of the host plant. Its action is confined to young trees and shrubs. The grape does not injure the stem but tends to smother the tops of trees. It grows rapidly and has abundant foliage, and may so overshadow the host tree as to cause its branches to die from

disuse and generally impair its vigor. The grape may grow into the largest forest trees.

Freezing.

Freezing may burst the soundest tree. Probably from sudden changes of temperature the outer and inner layers of the tree acquire different temperature, and stresses are thus set up which the tree cannot resist and it splits open. Such cracks are long, and if extending to the cortex usually fail to heal, as the wounded edges are kept in motion by swaying of the trunk.

Electric Currents.

During the present year Prof. Woodworth discovered a small Acer rubrum growing near an electric wire that had "short-circuited" the wire with the earth. The tree was badly charred at the point of contact and gives warning of a new source of danger to park and roadside trees.

Storms.

Storms are a prolific cause of damage to forests. Tornadoes may even destroy large tracts of standing timber by tearing the trees entirely from the earth. Aside from such destruction the milder winds greatly injure large trees in the exposed forests of central Michigan. The Oaks are observed to suffer most in this respect, especially those that reach far above the surrounding trees. These trees are invariably dying in the tops, and when cut show the effects in their shaky hearts. That winds cause this is shown from the facts that smaller trees growing with the large ones are entirely sound. Lightning also destroys many trees by rending

them, often to splinters. Snow and sleet tend to destroy the branches of trees, more especially evergreens, by clinging to them beyond their powers to resist. Trees with several branches thus destroyed have been seen. Hail bruises the cortex of young and tender shoots of trees, and may lead to a bad form of tree, or predispose the tree to action of fungi.

Floods.

Floods are equally injurious to shrubs or large trees. Floating ice will bark large trees, and drifting matter of any kind may so collect as to overwhelm large trees in its path and break them off or tear them from the earth. This is especially so with small growth which may be observed to be absent along the banks of streams. In the observations made it was observed that the action of drift had twisted and broken the young forest trees wherever they were in its path.

Drainage.

Drainage effects forests by producing abnormal conditions, or by altering existing conditions. As with any other living organism the change of normal conditions of growth for the tree to abnormal results in impaired vigor of the same. Drainage is removal of free water from the soil. Normally, such trees as Larix Americana require an abundance of free water and a cold, humic soil. If a tract bearing these trees be drained the free water is removed, and at the same time the soil is made warmer, and oxidation of the humus is made possible. The favorable conditions are made unfavorable and decline of such a forest results. This result is true of any tree that prefers such a soil. Whatsoever the

conditions drainage changes them, and the forest is impaired in a greater or less degree.

Drought.

Drought is often a result of draining, or is made possible by drainage. Then drainage is the primary cause. But drought primarily may kill trees by limiting the supply of water and, indirectly, the supply of plant food also. Death or injury from these causes is termed "top-drying" and extends from the top of the tree downward. Repeated droughts or severe ones will at once effectually destroy the tree.

Thinning of forests.

The management of the small forest areas of Michigan tends strongly to injurious effects. They are usually small isolated areas, subject to all the detrimental influences hereinbefore mentioned, and the death of trees is common. These trees the owner aims to utilize, and they are felled as soon as beyond recovery, thus injuring the surrounding trees and modifying their conditions of growth. Light and heat is let in upon their trunks. Natural pruning is altered and the trees grow into poor forms. Branches intertwine, and rubs and natural grafts are common. From the changes of light crooked trunks and spreading tops result, and the sun's heat may scorch or check the cortex upon limbs or trunk, forming wounds. Upon injury is added injury. Even the normal conditions are so changed as a result of abnormal causes that the natural recuperative powers of the forest are impaired and degeneration is certain.

Pasturing of Forests.

The practice of pasturing domestic animals on timber lands is the most widespread cause of damage to forests. Swine are, perhaps, least detrimental. They damage the young growth mainly by eating the tender shoots and roots, and by consuming the supply of seeds, such as acorns, beech nuts, etc., thus cutting off the reserve growth of young plants. No doubt they alter the conditions of growth by tearing up the soil and allowing rapid oxidation and evaporation. Cattle are more destructive. Naturally they do not take to forests easily, but if pressed for food they will resort to browsing and so destroy many of the younger trees. Even though grasses be abundant they will break down and tramp upon the small growth in their efforts to rid themselves of insects. Sheep are fond of browsing, and are the most destructive of domestic animals because of their persistent feeding on the brush-wood. Further than this, sheep often assemble about the roots of trees, in the leaf mold, to rid themselves of insects and enjoy the shade, and therefore bark and bruise the roots. But the greatest evil of pasturing is the advent of grasses. All that grass requires in order to appear is sunlight. On the south side of forests it makes its first appearance. If domestic animals have access to the forest, they pasture where grass is found and soon destroy the young trees, letting in more light, which, in turn, favors the growth of grass. In this way the grass will in time occupy the whole forest and modify the general conditions, with the result that the forest will decline. Let pasturing be withheld, however, and the forest trees will again regain the ground.