

## THE WOODLOT FOR CENTRAL INDIANA.

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### INTRODUCTION.

The purpose of this paper is to show as accurately as possible with the information at hand the conditions of central Indiana woodlots and to make suggestions for their improvement and perpetuation.

### A SHORT HISTORY OF INDIANA'S FORESTS.

Early explorers of Indiana found a wilderness of giant trees. Upon the tops of hills and higher ground were such trees as beech, hickory, oak, hard maple, walnut, ash and tulip; in the richer lowlands were the elms, buckeye, basswood and soft maples; and tall sycamores and overhanging willows lined the banks of the streams. It was not uncommon to find trees nearly two hundred feet in height and twenty to twenty-five feet in circumference. Everywhere smaller trees, shrubs and herbaceous plants struggled for their requisite amounts of sunlight. A spongy mass of forest litter made a floor that held rainfall and fed the innumerable springs, which in their turn supplied the streams and rivers with a constant and uniform volume. Such was the unbroken forest.

*Clearing.*—It was soon discovered that Indiana's soil was well adapted to agriculture. The early settlers began the work of forest destruction by clearing their homesteads for agricultural purposes. Regular log-rollings were held at which tree after tree was cut down, piled in log heaps and burned. Such work at that time was justifiable because timber was very plentiful and because the ground thus cleared was necessary to furnish a living for the ever increasing population.

*Lumbering.*—For this reason much of the land was cleared. Official records, which begin in 1870, show an acreage of 7,189,334 acres in timbered lands. In 1880 only 4,335,000 acres were left. As Indiana became more thickly settled, better houses, cities, roads, railroads and factories were being built, each requiring a certain amount of timber for construction. And in additional ways the consumption steadily increased. The towns and cities afforded market places, the roads and railroads a means of transportation for lumber. Thus began the other chief influence in

forest destruction. By 1890 over 2,500,000 acres more were cleared, of which 75,000 acres became waste land. The timber supply of the East was falling, the demand increasing. Then Indiana ranked fifth with the states of the Union in the total output of lumber. In 1907 she ranked twenty-seventh.

At the present time there are probably less than a million acres of woodland in the State. This fact shows us the truth of the prophecy made twenty-five years ago that "At the present rate of consumption the forests of the State must soon cease to be commercially important." Very little now remains of the once seemingly inexhaustible supply of valuable timber, such as oak, walnut and yellow poplar.

*Formation and Evolution of the Woodlot.*—It is with this small remainder, especially that portion which lies in the central part of the State, that this paper deals. Formerly the farmer removed only the timber on the land he actually needed for agricultural pursuits. Gradually, as his needs increased, he extended the boundaries of his fields. The trees which he removed more than furnished him with firewood and other necessary timber. But when a market was opened up the owners began to cut the still vast forests for purely financial reasons. These became more and more exhausted until now very few acres of virgin timber, and comparatively few of any kind, remain. The farmer is at present apparently satisfied with his acreage of cultivated land, good timber is too scarce for extensive clearing or sale, and he is willing that a small portion of his farm should remain covered with a more or less depleted forest in order to provide wood for general purposes about the farm. These are the chief reasons for the presence of a woodlot today. Some timber was left because it was difficult to reach. Other tracts were left because of the pasturage they afforded in the grass which sprang up when the dense forest cover was partially removed. So, for one reason or another, or purely by accident, certainly not from choice, the woodlot of today occupies the position it does, oftentimes on the best land of the farm.

*Present Conditions.*—To get an idea of the present condition of these woodlots one need only travel a few miles in the country. In the distance he can see trees in a seemingly unbroken line. Closer examination, however, shows them to be in small, scattered patches ten to thirty acres in extent. After the best trees had been cut out and sold, the custom of cutting trees for special uses, such as handle stock and spoke material, led

to the removal of the next best. All the most valuable species, black walnut, yellow poplar, white ash and the best oaks, have been cut away, leaving only a few maples, beech, ironwood, buckeye and the like. Many of these are crooked, defective and otherwise undesirable. At no time has any care been exercised to protect the undergrowth of young seedlings. The floor also presents a very different appearance from what it once did. A dense bluegrass sod has taken the place of the undergrowth and rich forest litter destroyed by constant pasturage. A heavy growth of grass is in itself an enemy of trees, for it not only makes reproduction harder but also smothers the roots of those already growing and robs the soil of moisture so essential to good tree development.

Some may ask what it matters if the conditions are thus. Are not the farmers in better circumstances now than they were forty years ago, yes, even ten years ago? Financially they are, but with wise and proper management of their woodlots they could realize still larger profits from their farms.

## THE WOODLOT.

### USES.

There are many reasons why woodlots are valuable. They furnish timber for all farm needs, protect buildings and crops, shelter live stock and materially help in preventing erosion and in ornamenting the country.

*Firewood.*—Firewood comes first in the list of timber used for farm purposes. The early methods of using wood in a fireplace were wasteful. The introduction of stoves resulted in a great saving of fuel. But fuel production was not the only purpose served by the forest. Now lack of timber and the cost of getting crooked and knotty trees cut into firewood have compelled the use of a substitute. Most farmers would be glad to have again a plentiful supply of cheap fuel.

*Posts.*—The setting of 1,000,000,000 (estimated) fence posts per year shows us another very important use for timber. According to the last census 8,715,661 of these posts were produced from the regular logging camps of the country. The use of these posts as supports for woven wire fence is very economical when compared to the former practice of building rail fences, many of which were of black walnut, the most valuable timber Indiana ever produced. Their gradual displacement by wire or picket fences is a great step towards forest preservation.

*General Farm Uses.*—Then there are other innumerable general uses about the farm for poles, boards and lumber. After all these needs are satisfied there should remain some timber (logs and railroad ties) for market.

*Climatic Influences.*—The influence of woodlots on the climate makes their presence desirable. A great deal has been written about forests as a factor in rainfall, but it has never been satisfactorily proved that they increase the total amount. It is known, however, that about twenty-eight per cent. less of the annual rainfall is evaporated within the woods than outside of them, and that the mean annual temperature of forest soil is about twenty-one degrees lower than that of cultivated fields. In summer this cool soil tempers the air above, and by starting currents from the adjoining fields lowers their temperature. Besides, woodlots, if situated in favorable positions, check strong winds, in this way protecting farm buildings and preventing fruit trees and crops from being blown down.

*Shelter.*—A woodlot is invaluable for the shelter it affords to live stock in both summer and winter. Less food is required to maintain the body warmth of animals when they are well protected from the cold winter winds. Therefore the use of grain in fattening stock is much economized. The cool shade offered by a small portion fenced off from the best part of the woodlot prevents fattening animals from losing flesh during the hot weather.

*Aesthetic.*—But these uses are not all. Every one knows that a good strip of timber greatly increases the value of a farm, for by this means not only the beauty of individual farms but also that of the entire community is increased as much, if not more, than by more expensive improvements. For no other reason than this each farmer should strive to maintain a well managed woodlot.

*Water Supply.*—Forests at the head waters of streams regulate their flow. As has been said before, the amount of evaporation within the forest is much less than that outside because the loose litter offers little capillarity to the water content of the soil and also permits of a more rapid absorption of heavy rainfall. The water is then given out to the springs and streams in an almost constant supply.

*Erosion.*—The problem of erosion is a very perplexing one, especially in a rolling country. The unlimited removal of forests has left but little resistance to the flowing away of rainfall, for everywhere the soil is more

or less hard and compact. Water speedily runs over the surface, carrying soil and debris, which it deposits in the beds of streams. Places which wash badly are exceedingly common and cause the loss of much tillable land.

#### THE MODEL WOODLOT.

After a review of the reasons for maintaining woodlots it is well to consider the organization of a model woodlot.

*Number of Trees.*—It should contain the number of trees consistent with the most rapid development of the best timber. Trees should stand close enough in youth to stimulate growth in height and to produce long, clear trunks. As the stand approaches maturity more and more space is required for each tree until at last probably only one hundred and fifty to two hundred trees of the original three or four thousand remain per acre. Thinning is brought about naturally by the struggle for supremacy.

*Distribution and Soil Cover.*—Trees should be evenly distributed over the entire area, always close enough together to prevent many direct rays of the sun from reaching the ground in summer, since the large openings give grass, a very dangerous enemy of forests, a chance to grow. The ideal soil is loose, porous, rich in vegetable mould and is covered with a thick mat of leaves and leaf humus to the exclusion of all grass and light-demanding weeds.

*Forest Cover.*—The trees which should be found in a woodlot depend upon two factors—(1) the economic value and (2) silvical characteristics. Such trees as black walnut, black cherry, ash, oak, maple and poplar have the greatest economic values. The other factor has to do principally with the soil, moisture and light requirements. For example, sugar maple requires rich upland soil and very little sunlight for its best development, while sycamore will grow on any wet soil if it has plenty of light. Thus we shall find in a model woodlot the species best suited to the soil, water supply and the uses to which the timber is to be subjected. In no case should there be any worthless species.

*Reproduction.*—In order to maintain the desired acreage of our timber producing area some efficient method of reproduction is necessary. This is usually found in the presence of large and mature seed-bearing trees, which scatter their fruits over long distances until they find lodgment in places suitable for germination. Another method of reproduction is by

stump sprouts or coppice growth. However, the size and quality of the timber produced in this way is much inferior to that formed from seedlings. For quick reproduction, advantage of this sprouting tendency should be taken in trees like the oak, basswood, catalpa and hickory.

#### HOW TO REACH THE MODEL.

The next point to demand our attention is how to bring the existing woodlots into model conditions. The examination of this problem may be conveniently considered under three heads: (1) Protection, (2) General Improvement Cuttings, and (3) Improvement of Type Stands.

#### PROTECTION.

The necessity for protection arises from the loss occasioned by grazing, fire, insects, fungi, wind and careless work in the woods.

*Grazing.*—Grazing injures a forest in two ways—by browsing and by trampling. Domestic animals browse sprouts and young seedlings, break off shoots and buds and gnaw the bark of trees. By the destruction of herbage the sharp hoofs of sheep cause loose soil to become looser and stiff soil to become more compact. Cattle and horses are much less harmful than sheep about trampling, although their hoofs frequently tear away small rootlets. This disturbance of the soil and soil cover seriously interferes with its water supply. In general the results of grazing make it imperative to exclude all stock from the woodlot.

*Fire.*—Fire is another great enemy of forests. The leaf litter and lumus, young growth upon which the future supply depends, and mature trees are all affected. A single fire does not usually seriously injure older trees but a series of fires either burns them up completely or leaves them in such a weakened condition that they are blown down by wind or attacked by insects and fungi, and then furnish a source of infection for other trees. But in this thickly settled region fires are easily handled, for they can readily be seen and extinguished.

*Insects.*—The following conclusions regarding insect injury have been drawn from a careful investigation of the existing conditions throughout the state:\*

(1) Insects causing the death of the tree:

(a) Found in extensive numbers and causing serious injury, as follows: Bark beetles on oaks, hickories and locust.

\*Report of State Board of Forestry, 1907.

- (b) Found in limited numbers and causing secondary injury as follows: Bark beetles on walnut, cherry, hackberry, elm, mulberry and ash; bark-boring grubs on oak and chestnut.
- (2) Insects not causing the immediate death of the tree:
  - (a) Found doing serious damage to timber as follows: Carpenter worm on oak; wood borers on hickory; powder post borers on hickory.
  - (b) Injury to foliage: Nearly all species of trees found affected by one or more of the following forms, of which all except the cottony maple scale cause little damage: Leaf eaters, leaf miners, leaf rollers, saw flies, scale insects and gall flies.

The bark and wood borers can usually be detected by pits or deposits of fine sawdust around the holes. About the only remedy is to remove the infected trees at such times as will prevent the hatching of the larvae. Damage due to leaf insects is usually so slight that it may practically be disregarded.

*Fungi*.—Fungi attack trees in several ways. Some kill the roots, others grow upward from the ground into the trees and change the sound wood of the trunks to a useless, rotten mass or leave only a hollow shell. The spores of others come in contact with every part of the tree as they float about through the air. These spores find a very suitable place for germination if they fall on wounds. By removing infected trees and destroying old logs fungous diseases may be fairly well controlled.

*Wind*.—Wind-blown timber frequently exists in open or unprotected stands and in moist places where root systems are shallow. Trees weakened by fire, fungous and insect attacks are easily broken off. Of course the mature trees may be partially or wholly utilized. The greatest damage is done to those for which there is no immediate use.

Woodlots which have been unprotected from the time they were comparatively small usually have their own windbreaks made by the development of numerous side branches. A strip a few rods wide along exposed margins of woods should always be kept as dense as possible. The development of brush and undergrowth should be encouraged. Unless there are others to take their places no trees should be cut in this protective area.

Should it be necessary to plant a windbreak it is best to employ two species, one a rapid grower to provide early protection, the other of slower growth to make a permanent and more efficient shield. Carolina poplar,

black walnut and catalpa are types of the first class, and any of the evergreens types of the second class. The spacing should be about four feet in rows six feet apart. At least half of the trees should be removed when they begin to crowd badly. When a good protection has been well established trees may be removed anywhere within the grove with practically no danger of windfall.

*Work in Woods.*—Another important thing to keep in mind is care while working in the woods. The object of management is to have new trees of the most desirable species to replace as soon as possible those which are removed. Therefore it is necessary to protect young growth. Care should be taken in felling trees not to injure others nor crush young seedlings. Brush should be piled in places where danger to timber from fire is reduced to a minimum.

#### IMPROVEMENT.

The second part of our examination, general improvement cuttings, deals with defective and infected trees, tree weeds and a general plan for harvesting.

*Defective and Infected Trees.*—Many woodlots contain stag-headed or entirely dead trees which are rapidly decreasing in value. They spoil the beauty of a grove as well as furnish a convenient place for beetles and fungi to live and propagate. They should be removed immediately.

*Tree Weeds.*—Tree weeds are another waste of our resources. A tree weed occupies space in a timber stand but has comparatively little value. Ironwood, water beech, dogwood, scrub oak, pawpaw and sassafras are examples. It is advisable to remove these as well as the dead, dying and infected trees at once unless by so doing large spaces are opened up in the forest cover which will not close before grass has a chance to start.

*Mature Cutting.*—One more general rule of improvement is in regard to cutting. Usually only such trees as have passed their maturity or the point where the amount of wood formed each year begins to decrease should be cut. And no more wood should be removed than is actually grown. Thus, if a woodlot is producing five cords of wood annually, it is better to cut five or only four cords than six. If a method like this is used and care taken to keep the ground fully stocked with thrifty young trees the woodlot may be kept up indefinitely.

*Coppice.*—In cutting the following suggestions should be kept in mind: Stumps should be cut low in order that the sprouts may become independent of the old root system as soon as possible; they should be cut smooth and slanting or have the sharp edges removed so as to prevent water from collecting on them, for in such cases they are apt to rot and infect the sprouts; care should be taken not to tear the bark from the stump since this often prevents buds from developing at the root collar; the sprout should be cut when the sap is down, early spring or late fall, for when cut in midsummer frosts are apt to kill the new sprouts which start up, before their growth is completed and their wood hardened.

#### MATURE OPEN STANDS.

*Character.*—Most woodlots are remnants of the original hardwood forest. The valuable straight grained and easy splitting trees have been cut for lumber or firewood. Those which remain have received no attention. They are mature, crooked, knotty or badly diseased and grow in clumps or are scattered over the lot. Few are of any value. Almost all these timbered tracts have been used for pasture, and as a result of constant grazing the ground is covered with a thick, heavy bluegrass sod to the exclusion of desirable young growth. If any reproduction does occur it is very irregular and is composed mostly of weed species.

*Treatment.*—The treatment of such stands depends upon the degree to which it has deteriorated, its location and the owner's need for timber. If it is on land better suited for agriculture and the farmer is more in need of fields than timber, probably the best thing to do would be to remove the timber completely and cultivate.

But if the lot is to be rejuvenated, the first step to take is to exclude all live stock. Should it be necessary to keep some of the woodland for pasture the thriftiest portions should be fenced off and most of the trees removed from the remainder. More timber and more grass can be produced separately than together. The next step is to remove tree weeds and other trees whose value is decreasing. The remainder will furnish seed. In order that the seeds may have the best possible conditions for germination the sod should be broken up by means of a bull-tongue plow or disc harrow. A rank growth of briars and weeds will probably spring up as soon as the sod is removed, but these make a very good protection under which the young seedlings are to develop. Soon the new growth kills out

the weeds and briars and rapidly establishes a good stand. Should other species than those present be desired it is necessary to plant them. As soon as reproduction is well under way the mature trees may be cut. Still it is a wise plan to leave some of them for seed and to furnish timber while the new crop is growing.

#### IRREGULAR, UNEVEN-AGED STANDS.

*Character.*—It is from the irregular, uneven-aged stands that we expect the earliest good results. These are parts of the original forest retained in almost virgin condition. Some are dense, others more or less open. In them the soil is almost ideal, but not so with the forest. Fungous and insect hosts, old logs in various stages of decay, are scattered over the ground. Many of the trees are mature but in very poor condition. Some, however, are large and have long, smooth trunks and compact crowns. Increase in height has practically ceased and diameter growth is very slow. A young growth of various species, many of which are undesirable, fills up small openings made by fallen trees. On the whole the forest capital is slowly but surely decreasing, for the amount of timber produced annually is more than offset by death and deterioration of the overmature trees.

*Improvement.*—The first requirement for the improvement of this type is the same as for mature open stands: that is, the removal of tree weeds and the species undesirable for other reasons. The next process, thinning, is brought about naturally by shading. Trees which are crowded while young try to get their crowns into sunlight, and consequently produce long, slender stems. If, after a sufficient height has been reached, space is given for increased root and foliage development, an increase in wood production occurs. This increase takes place in diameter growth, since there is no longer any incentive for height growth. The purpose of artificial thinning is, then, to accelerate diameter growth as much as possible, to substitute for nature's wasteful struggle a systematic removal of weaker and inferior trees, leaving as many of the good ones as can develop without retardation for a given period.

*Thinning.*—This process requires considerable judgment and experience, for special attention is given to the trees which are to remain rather than to those which are to be cut. Of course the most valuable and rapid growing species take precedence over others. The following list will serve as a guide, although it is by no means invariable:

Species specially favored: oak, hickory, ash, black walnut.

Species of less value: yellow poplar, butternut, basswood, maple, elm, beech.

Species usually removed: ironwood, cottonwood, sassafras, water beech, etc.

The character of the tree is more important than the species. Tall, straight trees with well developed, thrifty top are left in preference to those which are spindling, weak-topped, crooked or unsound. In a group of equally good trees it is often best to remove one or more, for by so doing the remaining trees will produce more wood than all of them had they been left undisturbed. Trees with their crowns entirely exposed to sunlight are seldom removed unless a number of thrifty ones will be assisted. Those completely overtopped by others have ceased to be a factor in the growth of the stand and may be cut whenever their wood will pay for their removal. Another class of trees are those which receive sunlight from above but which have their sides shaded. It is in this class, where the struggle for existence is most severe and where the greatest economy of energy can be brought about, that most thinning is done. It is better to make light thinnings, never more than a fifth of the stand at a time, than to remove too many at once, for this opens up large patches of ground which dry out on exposure to sun and wind and furnish an excellent opportunity for the growth of grass and undesirable brush. It is not safe to say that this species must be removed to make room for that or that three sprouts must be cut from a group of six. All the improvement thinnings must be made upon the judgment of the operator.

In the woods which contain large open spaces here and there trees should be planted as in mature open stands. In any case growth of young trees and shrubs should not be hindered but rather encouraged on a strip at least two rods wide. A windbreak should be planted if necessary.

#### YOUNG STANDS.

*Character.*—The third type of woodlots is the young stand. The ground, seeded by the trees left after all merchantable timber was cut, has become covered with second growth trees four to twelve inches in diameter and twenty to fifty feet in height. Many of them are straight and thrifty, but many more are gradually being suppressed and are dying. Trees in little groups here and there which started from seed the same year are so evenly matched in size that growth is temporarily arrested.

*Care.*—The seed trees which determined the composition of the young stand are becoming useless through decay and other defects. Often there are grape vines, old fire-scarred snags and other material with which the lot could well dispense. These should be removed. At the same time a thinning could profitably be made if the stand is too thick. The aims and results of thinning have already been discussed.

#### PLANTING.

Under this subject the main points of planting and growing woodlots are mentioned for the benefit of those who wish to have more timber than can grow on the land already forested.

*Location.*—In general not less than one-eighth of a farm's total area should be in woodland. Some have more than this amount, but many others have practically not a single acre in woods. As has been said before, the woodlots existing at present have little, if any, relation to farm buildings. A little corner cut off by a stream or railroad, or land otherwise unfit for agriculture because of steepness, rocks, etc., furnish a place to plant a woodlot. It would be well if these so-called waste portions were so situated that timber growing on them could form a windbreak. This idea of protection should always come into consideration when preparing to plant.

*Species.*—Whatever the opinions of individual nurserymen may be regarding the species to plant, there will never be found trees better suited to any region than those which are natural to its soil. For central Indiana we recognize white oak, red oak and burr oak, ash, walnut, hickory, sugar maple, black cherry and elm as types for lumber; and osage orange, black locust, coffee tree, catalpa, etc., as types best suited for the production of posts, poles and ties. Careful examination of the soil should also be made, and only such species which will develop best under the existing conditions should be planted. These two points were brought out fully under the topic "Forest Cover" in "The Model Woodlot."

*Preparation of the Ground.*—The ground should be plowed, harrowed and worked into as good condition as for any agricultural crop in order to secure the best results. However, it is not necessary to prepare it so carefully. Planting has frequently been done with good results on burned over woodland according to the third method described below under "Planting." But trees growing on well prepared ground have as much

advantage over those on unprepared as has corn under the same conditions.

*Where to Procure Seedlings.*—The farmer may grow his own trees from seed, procure wild seedlings or purchase from a nursery. Wherever possible wild seedlings are much cheaper. They are weaker than nursery grown stock, and should be transplanted to a nursery for one or two years before being planted in the field.

*Care of Trees Before Field Planting.*—Trees should be planted with as little exposure of their roots as possible, for the root hairs, upon which the tree depends for taking in its food supply, will dry out and shrivel up when exposed to dry atmosphere for even a few minutes. Some of the broad-leaved species can withstand this drying out if they receive proper treatment afterwards. The best way to prevent this is by “puddling.” A “puddle” is a mixture of earth and water about as thick as cream. It may be mixed in buckets, tubs or barrels and drawn along where trees are being dug up so they can be plunged into it immediately, or, if the seedlings have been received from a nursery, as soon as they are unpacked. If planting is to take place at once the trees may be carried to the field in the “puddle.” But if some time is to elapse before planting they should be “heeled in” as they are “puddled.” For “heeling in”:

Dig a trench deep enough to bury the roots and part of the stem. The trench should run east and west, with its south bank at a slope of about thirty degrees to the surface of the ground. A layer of trees should be placed in the trench on its sloping side, the tops toward the south. The roots and stems should be covered with fresh earth dug from a second trench, in which a layer of trees is put and covered in the same way. The digging of parallel trenches is repeated and layers of trees put in until all have been “heeled in.”

*Time for Planting.*—The best time for planting is just before growth begins in the spring. At such a time the seedlings are apt to receive the least injury. In general the frost should be out of the ground. Frost is one of the chief dangers of fall transplanting, for the young trees are often heaved out of the ground as it freezes. It is also best to choose a wet or cloudy day for transplanting.

*Methods.*—After everything has been made ready for planting the ground should be marked out in rows four, six or eight feet apart, depending on the species, character of the soil and length of time cultivation is

to continue. The methods of planting are very simple. The best perhaps requires two men. One carries a bucket of "puddled" seedlings. The other carries a spade which he sets full length in the ground. He then pushes the handle forward, sticks a seedling, which the first man hands him, in behind the blade, withdraws the spade and then steps firmly with both feet on the ground around the tree. Another rapid method which often succeeds is to plow a furrow, lay the trees against the side of it, cover with a hoe and tramp firmly. The remainder of the furrow may be filled by means of a cultivator. A third way is to dig a hole with a grub hoe or mattock. This method is used only on unprepared ground. The size of the hole depends upon the size and character of the root system. Fine dirt is then thrown in next to the roots and the hole filled up, the earth being firmly tramped as before. All trees should be planted deep enough so that when the ground settles they are covered to the same depth they were before being transplanted.

*Cultivation.*—One of the great troubles with the plantings already made in central Indiana is that they have not received sufficient care. They have been plowed or hoed a few times and then left to take care of themselves. The methods and aims of cultivation in the state reservation are given in the following:

"The cultivation given the young trees growing in the regularly planted fields was of two forms, plowing in the same manner that corn is cultivated and by hoeing. In some fields the trees were plowed and hoed, while in others they were simply hoed without plowing. They were given two complete cultivations. One plan seems to be as successful as the other. The aim sought by the cultivation was to keep down weeds and other wild forms of growth that might overcome the young trees. In the fields where the soil around the young trees was kept loose and free from weeds for a short distance from the trees (eight to twelve inches) by hoeing, and the other forms of growth permitted to stand around them, the young trees seemed to do the best. The only reasonable opinion that can be given for this fact is that the other growth formed a mulch over the soil and prevented evaporation and also a forest condition of shade and protection which resulted in good to the trees, and by keeping a clear opening around them prevented them from any smothering out, as will occur where the weeds and other growths are permitted to grow up close around them. The young trees in such fields are larger and have better

boles formed than those growing in the fields where more complete cultivation was performed. Those growing in the more open fields and where the most complete cultivation as to keeping the soil cleaned of all forms of outside growth seemed to grow more bushy and to cease growing earlier in the summer than the others. The only reasonable opinion to be given for this fact is that they were more exposed to the heat of the sun, nothing formed a covering to the soil to prevent evaporation and the trees were deprived of any sort of shade protection. No forest influence was thrown around them. . . .

It must not be inferred from the discussion of the cultivation here given that no cultivation is needed. The young trees must be given cultivation necessary to protect them from weeds and other wild forms of growth immediately around them. . . . The trees at the reservation are given the cultivation that can be performed with the means supplied, and no more. If more means were provided they would be cultivated more and better results might accrue."

It can be seen that the Board of Forestry recognizes the fact that they are not caring for the young trees in the best possible manner. A crop of weeds is not the best way to prevent evaporation from the soil. The maintenance of a dust mulch by cultivation will do this and will not use food material stored in the soil. A disc harrow or a five-toothed cultivator run through between the rows after each rain during the summer will keep up the dust mulch and keep down the weeds. In other words, a forest crop should be cared for just as a corn crop, except that the period of cultivation is longer, sometimes three or four years.

*Thinning.*—The maximum number of trees per acre at maturity is about two hundred. It has already been shown why thinning is beneficial, so only this remains to be said: a few years after the plantation has become well established the process of thinning should begin. The weakest and poorest trees and those crowding better ones should be removed here and there to make room for their more vigorous neighbors. Gradually this process should continue, the material being utilized, until at maturity the woodlot has the requisite number of good trees and also has provided for a permanent supply.

## DOES A WOODLOT PAY?

The question naturally arises, Is a woodlot a paying proposition? If it is not, why are the most progressive farmers taking such an interest in forest planting and forest management? Timber is a necessity. In earlier times it was not so valuable, so the land was cleared. The remnants of the old forest may easily be improved at odd times. The cost is much reduced if the farmer does his own work. So it is with planted woodlots, especially if wild seedlings are used. Besides, the price of timber is advancing as the supply is diminishing. This alone encourages planting.

The following extract from a letter shows that with a little care a woodlot can be made to pay :

"I have logs enough cut now to make from forty to fifty thousand feet of lumber. These logs I cut from a ten-acre grove that was only a brush patch thirteen years ago. In addition to the logs the grove has supplied plenty of wood for from two to four stoves, and some for sale, besides posts and poles, all of which came from the thinnings. There are still enough trees on the land to make a good grove." The present generation may not reap the profits but the next one will.

## SUMMARY.

The following conclusions have been drawn from this study:

1. The present woodlots, only the remnants of the early forests, are in very bad condition.
2. Well-ordered woodlots are valuable financially, climatically and aesthetically.
3. Old woodlots may be improved and new ones planted successfully.
4. Woodlots must be protected and well cared for in order to secure the best results.
5. A woodlot is a paying investment.

The one thing lacking is universal interest.

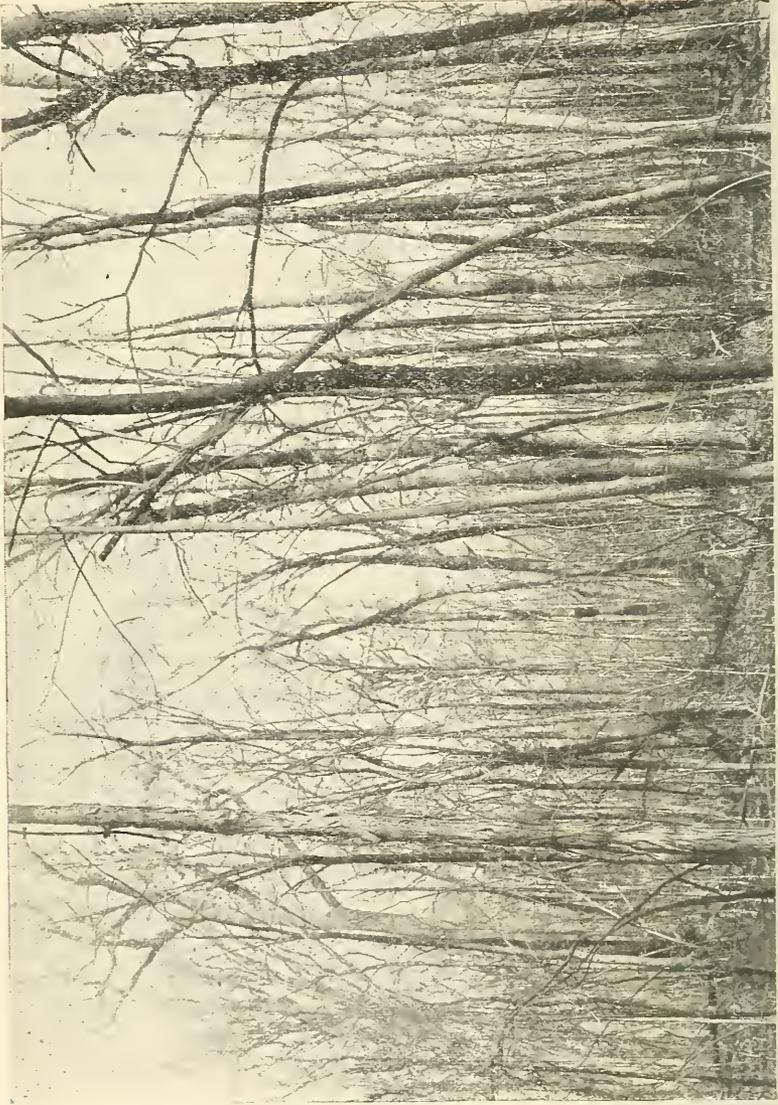
Wabash College.

Crawfordsville, Ind.

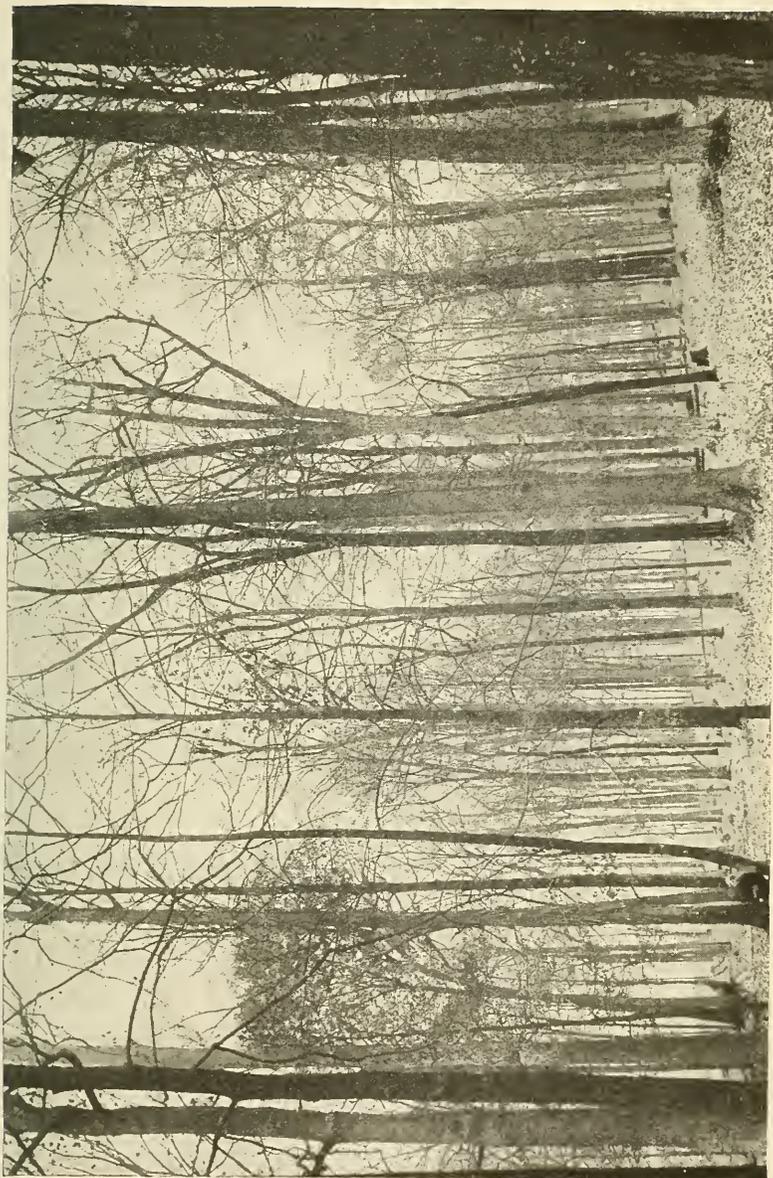
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- How to Cultivate and Care for Forest Plantations on the Semi-Arid Plains. Cir. 54.
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No. 1. An irregular stand in almost virgin condition. The owner will not allow a single tree to be cut. The fallen trees, decaying logs and accumulating underbrush indicate waste. This is not forestry, but neglect.



No. 2. A mature open stand. The ground is covered with a thick growth of grass, a great enemy of reproduction.



No. 3. A young stand of hickory about fifteen years old. All the grass has been tramped down and killed under the large black oak on the right. This would make a good grove if the cattle were excluded and the growth of seedlings encouraged.



No. 4. The usual evidence of neglect of the woodlot. Pasturing has destroyed the young growth. The mature trees not needed for seeding should be cut. The fallen timber should be taken out and saved. Unless the stand is thickened, the young growth will be low branched and worthless.

