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WOODLOT FORESTRY.

BY DR. JUDSON F. CLARK, BUREAU OF FORESTRY, WASHINGTON, D. C.

The discovery of the silvicultural characteristics of our American forest trees, together with the dissemination of this knowledge among the owners of woodlands for practical purposes, has long been the most important feature of the work of the National Bureau of Forestry. During the last five years a special effort has been made to reach and solve the problems of the farmer. This effort has been induced because of a general lack of information on the part of the farmers in the management of woodlands and the increasing importance of the product of the woodlot.

Few appreciate the importance of the farmer's woodlot in the national economy. To emphasize this point, I shall quote a few statistics from the twelfth census (1900). The average farm in the United States contains 147 acres, of which 72 are recorded as "improved" and 74 "unimproved." This "unimproved" area of American farms foots up the enormous total of 426,000,000 acres. The unimproved areas consist of woodlands, treeless swamp and barren lands. A very conservative estimate of the amount of unimproved lands in the United States capable of producing timber is 300,000,000 acres. A vast empire of actual and potential woodlots! The value of the total product of the lumber camps of the United States (including logs, bark for tanning, charcoal, rived shingles, ships' knees, posts, ties and all other products of the lumber camps) was, in 1889, \$174,000,000. The value of the product of the woodlots of the United States (including "only the wood, lumber, ties, etc, which the farmers cut in connection with their ordinary farming operations,") and not including maple syrup or sugar, was \$110,000,000. In other words, in 1889, the farmers' woodlots of the country produced an amount very nearly equal to two-thirds of the value of the product of the regular lumber industry as it was delivered at the mills.

Not only is the present product of the woodlot of very great economic importance, but it will certainly be increasingly so as the natural supplies of virgin timber disappear. The following statistics from the twelfth census illustrate the increasing importance of the woodlot as development progresses in the different States:

SD 381
128
106

TOTAL VALUE OF PRODUCT.

	Of Lumber Camps.	Of Woodlots.
Washington	\$11,332,000	\$1,002,000
Wisconsin	18,112,000	6,116,000
Michigan	20,462,000	7,530,000
Indiana	4,058,000	5,235,000
Ohio	4,384,000	5,625,000
New York	4,364,000	7,671,000
Connecticut	493,000	1,276,000

Washington represents the newest type. Its lumber camp product exceeds that of the woodlots in the ratio of 11 to 1. Michigan has an intermediate position, having a proportion of about 2.8 to 1. New York has the balance turned the other way, and in the proportion of 1 to 1.8, and Connecticut, where lumbering as a business has become very much reduced, has the proportion of 1 to 2.6 in favor of the woodlots.

It is only fair to add, however, that the product of the woodlot is used largely, though by no means wholly, in an unmanufactured or slightly manufactured form (cordwood, railway ties, posts, etc.), while the product of the lumber camps is in a much larger degree the raw material for a vast series of manufactures. It is also worthy of note in this connection that the farmer is usually his own logger. This work is done at a time of year when there is little else to do, and in many cases the entire amount received for the product may be regarded as clear gain to be credited to the woodlot. The lumberman, on the other hand, must build his camps, purchase his horses, camp supplies, tools, etc., and especially employ labor, the cost of all which must be deducted from the sale value of his product in determining his profit. The census returns show the value of the stumpage of the cut of \$174,000,000 worth of product by the lumbermen during the census year to have been \$58,177,000. It is not improbable that the farmers' cut of \$110,000,000 represents as large a real stumpage value.

The value of the woodlot as a national asset can hardly be overestimated, and it should in future, with improved methods of management, ever contribute an increasing amount of material for general consumption. In several respects it has distinct advantages over the timber tract. Among these may be mentioned its nearness to the points of consumption, together with the practicability of an intensity of management that can hardly be hoped for on the larger areas, and which is only in part offset by the cheapness of the wild land.

The value of the woodlot as a source of fuel has recently been brought very prominently to the notice of the public generally by the realization that it is the only buffer that stands between the people and the higher prices which the coal combine may ask the moment they have the field to themselves. The people have also a fresh recollection of the fact that the woodlot is the only thing that stands between them and actual suffering by cold in the event of a coal strike. The cities and villages are more interested in this matter than the farmers themselves, for if a farmer has only a small supply of wood, he will naturally provide for the comfort of his own family before he offers any for sale. A consideration of this



should lead the urban population to heartily support a moderate and equitable tax rate for the farmers' woodlots.

This article, however, is intended to refer especially to the woodlot conditions as I have found them in Michigan. It is perhaps hardly necessary to say that these conditions are exceedingly unsatisfactory. A very few farmers, indeed, have made any real effort to improve this portion of their farms, and those who have done so have in many cases made very serious mistakes. Such mistakes were inevitable, for the farmers have not had access to information regarding correct methods of handling woodlands. The necessity itself for better methods is a comparatively recent development. The average Michigan farmer of today well remembers when the trees were regarded as the natural enemies of the tiller of the soil, and their removal was the farmers' greatest labor. The change in the times has come without bringing the knowledge necessary to meet the changed conditions. It is a most unfortunate fact that knowledge of correct methods of woodland management cannot be learned experimentally by the average farmer, as is the case to a greater or less extent with almost all other farming operations. Time element alone makes this a practical impossibility—years and even decades being often required for a demonstration, instead of days or weeks. Aside from this, few, if any, farmers have had the requisite training to enable them to carry out any really careful forestry investigation. The result has been that in the absence of instruction almost every effort for improvement has been merely guesswork, while the great majority of farmers have not interested themselves in the matter.

The average Michigan farm contains about 86 acres. Of this area 58 acres are recorded as improved and 28 acres as unimproved. It is probable that three acres per farm would on the average be a liberal reduction from the unimproved land for such waste areas as are unsuited for tree growth. This leaves an area of 25 acres which is at present occupied by trees or capable of being so occupied. This gives a woodlot area of over 5,000,000 acres on the 210,000 farms of the State. As already suggested, it is sadly true that the term "unimproved" is not inaptly applied to these 5,000,000 acres, for there is nearly or quite one-half of this area, which, in its present condition, is all but wholly unproductive, and on the remaining portion, as already indicated, there has been but little effort expended that would entitle any considerable portion to be classed as "improved."

The value of the woodlot product of Michigan has already been referred to as amounting to \$7,530,000 in 1899—a sum which compares favorably with the combined products of the orchard, grapery and small fruit garden, which in the same year totaled \$5,860,000 for the State. When we recall that about one-half of the unimproved area of the farms is at present all but wholly unproductive, it will be seen that the producing area has yielded about \$3.00 per acre to the woodlot owners in 1899. Michigan enjoys the distinction of having a larger return acre for acre from her woodlots than any other State in the Union. Were this assuredly a *bona fide* income, it would be a matter for congratulation. That it is largely a result of the stripping of the land at an unusually rapid rate is evidenced by the very unsatisfactory conditions for wood production obtaining on the average woodlot, and by the rapidity with which the woodlots are disappearing in the four southern tiers of counties.

This view of the importance of the woodlot as a producer of future tim-

ber supplies and as a very considerable source of income to a very large class of the population of the country has induced the Bureau of Forestry to offer to co-operate with farmers owning woodlands in their management.* On application, the bureau offers to send a trained forester to make a careful examination on the ground of the woodlot. It is the duty of the forester to point out the defects of the woodlot and their cause, and how they may be most quickly and economically remedied; to mark sample areas, showing which trees should be removed where removal is desirable, and where planting is desirable or desired; to advise regarding the species best suited to the soil and the locality. It is also customary for the forester to prepare a detailed report on the conditions found, with notes on their treatment. A copy of this report—which usually indicates the management for about ten years—is afterwards sent to the farmer for his future guidance. This service is free to all, but the bureau reserves the right to accept or decline applications, as may be deemed wise, with due regard to the objects for which the offer is made, and the limitations of the funds at their disposal for this work.

It is hoped that by this means it will eventually be possible to have in every county, and perhaps in every township, at least one woodlot which will be handled in a correct way, and which will thus serve as an object lesson to the farmers in its vicinity of the practicability of woodlot forestry. A report on a woodlot examined by the writer in St. Joseph county during the spring of 1904 is given herewith, that those interested may have a clearer idea of the scope of the woodlot work carried on by the government, and that all who read may get a forester's opinion of a very common type of woodlot in Southern Michigan.

*Applications should be sent to Thomas H. Sherrard, Chief of Division of Forest Management, Bureau of Forestry, Washington, D. C.

REPORT ON AN EXAMINATION OF THE WOODLOT OF MR. P. P. MAJOR,
THREE RIVERS, ST. JOSEPH COUNTY, MICHIGAN.

BY JUDSON F. CLARK.

Wish of Owner.

Mr. Major wishes to know what may be done to improve the condition of his woodlot. No immediate returns other than a small amount of firewood each year are especially required, and he is willing to go to some expense if necessary to put the less satisfactory portions in better producing condition.

General.

There is an excellent opportunity to greatly improve the present condition of the stand on this woodlot by the removal of the old, decrepit, and defective trees which are scattered almost everywhere over the area. The decay of these old trees offsets the growth of younger trees, and they are exceedingly injurious to those over which they stand. The value of the cordwood in them would leave a very satisfactory profit after paying the cost of the improvement cutting.

The vigor of the stand will be greatly improved, and reproduction aided by the exclusion of the sheep which are grazed on the neighboring pasture, and which have for many years been allowed the run of the woodlot. Reproduction is needed to fill the gaps in the stand and to provide a satisfactory ground cover.

Planting must be done to fill up some of the larger gaps in the stand and to provide a windbreak along the western border.

Details regarding these measures and other matters will be found below.

Location and Area.

This woodlot is located in Fabius township, St. Joseph county, Michigan, about five miles northwest of Three Rivers station, on the Lake Shore & Michigan Southern, and Michigan Central Railways.

The area is about 80 acres.

Topography.

The topography is quite rolling, the tract being a portion of a very irregular terminal moraine. The slopes vary from gentle to quite steep. The danger of serious erosion is such as to make the area unsuited for agricultural purposes.

Soil.

The soil varies in different parts from a sandy loam to a loam. It is everywhere deep, and on most parts contains more or less gravel. It is estimated that the normal annual production on the average acre does not exceed 60 cubic feet of hard-wood, such as oak, per acre (two-thirds of a cord of four-foot wood, or two cords of 16-inch stovewood). There are small areas in different parts, especially on the lower and more gentle slopes, where the normal annual production would probably reach 90 cubic feet per acre. The present average production is, however, not more than two-thirds of what it should be. This is due to three causes: (1) The presence of many defective trees whose decay largely offsets new growth; (2) the facts that in many parts the number of trees is insufficient to fully occupy

the ground, and (3) the fact that in many parts the soil is greatly exposed to the drying winds and is unable to retain moisture sufficient for satisfactory tree-growth.

The Stand.

Its History.

This area is a portion of a large "oak opening." The original stand, consisting of oak and hickory, was quite open, a result of very frequent fires in the early days before the country was settled. The stumps of these old trees show many fire-scars, indicating severe fires at various times. As the country became settled these fires ceased and gradually the open places became filled with young trees.

When the old timber was cut by the lumbermen it would appear that a very large proportion of these younger trees was also destroyed. A remnant survived, however, and they together with the sprout growth which followed the lumbering and the culls of the original stand which were not removed at the time, constitute the present stand.

Its present condition.

The present stand consists of three distinct age-classes, viz: (1) The scattering remnant of the original stand, consisting of old, crooked, unsound trees left as worthless by the lumbermen, (2) a sprinkling of 50 to 60-year-old trees which appeared with the cessation of the former fires and were not destroyed during the subsequent lumbering, and (3) the sprout-growth which came from the stumps of the younger trees cut or destroyed during lumbering. The ages of this last class vary from five years up according to the time of the lumbering which has been carried on at various times during the last 35 or 40 years.

The species occurring are almost exclusively oaks and mockernut hickory, with aspen on several areas. Dogwood and sassafras are very common in the undergrowth. White oak predominates, and red and black oak occur. Hickory forms about one-tenth of the stand.

The density of the stand varies greatly. In a few comparatively small areas it is all that could be desired; on much the greater part it is open, and in many places, especially on recently cut-over areas, it is very open. This is largely a result of the sheep-grazing which has been permitted in recent years, a satisfactory reproduction of timber trees being impossible under these conditions.

It has already been stated that the rate of growth of the trees is in many parts quite unsatisfactory. This is caused almost wholly by the destruction of the undergrowth by the sheep. The absence of the normal undergrowth permits the wind to blow the leaves from the more exposed parts, which are the very parts where they are most needed. Leaves are a natural and efficient mulch for a forest soil; their absence permits the soil to dry out by direct evaporation. The absence of an undergrowth permits the sunlight to reach the soil, causing the humus to be unduly oxidized, and stimulating the growth of the grass on the forest floor. The loss of humus causes a lessened moisture-holding capacity in the soil, and the growth of grass means a further drain on the depleted moisture supply. Since moisture is by far the most important element in a forest soil—is indeed almost the one factor that raises or lowers the producing capacity of most forest soils—it will be understood how much this absence of an undergrowth means to the thrift of the stand.

Treatment.

For the purpose of prescribing treatment, the three essentially different conditions of stand will be discussed separately.

1. Oak stand of all ages.

This will serve to designate the stand which occupies fully 60 of the 80 acres and the entire southern portion of the quarter-section. Although the sprout-growth varies greatly in age and density of the stand, its silvicultural condition is otherwise the same throughout the area.

Grazing should of course be discontinued at once in this as in the other stands.

Improvement cuttings.—All the old defective trees should be removed. This cutting should be made from year to year as fuel is needed, but the sooner it is completed the better for the woodlot. In connection with the removal of the old trees, all dogwood and sassafras should be cut. Much of this is suitable for

fuel, and the ground should be cleared of such inferior material to make way for better stock.

Thinnings.—After the improvement cuttings have been completed, say in 10 years, there will be many of the younger groups or portions of the stand that would be greatly helped by a thinning. In these thinnings, all dead and dying trees should be cut, and such of the remainder as are of inferior form or species and are injuring the crowns of better trees either by shading or by contact during wind storms. The openings in the crown cover caused by the removal of such trees should as a rule not be greater than may be reasonably expected to close again by growth in five to seven years. By closing is meant the coming together of the tips of the branches of the trees.

Planting.—There are many open places in the stand, and with the removal of the over-mature trees there will be many more where the natural reproduction has been and will be less satisfactory than is desirable. As Mr. Major wishes to produce fence posts, and has an excellent market for pulpwood, it is recommended that in the higher and dryer portions these open places be planted to black locust, and that the lower and moister situations be set out to cottonwood. The black locust should be set out as one-year-old plants and spaced 5x5 or at most 6x6 feet where it is entirely open and should be placed between the scattering bunches of oak coppice where such occur. The cottonwood can best be planted by the use of cuttings. Eight or ten-inch pieces of the one and two-year wood of the branches, pointed at the lower end and inserted in the soil will be entirely satisfactory. They should be placed in a sloping position, with one or two buds above the surface, at the distances above indicated for the black locust. These cuttings should be prepared during the dormant season, and kept in moist sand until needed.

A number of poplar occur throughout the stand, and there are two small areas where they form practically pure stands. The scattering poplar, which are now of very satisfactory size for pulp, may be utilized for that purpose within the next five or at most 10 years, greatly to the advantage of the other growth over which they stand. They are now of very satisfactory size for pulp and will in a few years be past their prime. The poplar groups are about 18 years old, six inches in diameter, and average fully 55 feet high. They are very thrifty, and may be retained to advantage 10 or 15 years before cutting.

2. *The 1877 Burn.*

All young trees on a small area towards the north end were destroyed and most of the larger trees scarred badly by fire in 1877. The best of the larger trees have since been cut, and the remainder should be cut at an early day. The area could then be planted to locust or white pine. Tall-growing weeds being absent, two-year-old untransplanted pine stock will be satisfactory if about 15 inches square of the sod be removed in each place before planting the pines. This sod should be placed around the pines in an inverted position after setting, for mulch purposes. The pines should be spaced five feet apart, each way.

3. *Old oak stand.*

This stand at the north end of the woodlot has been much less severely cut than the remainder of the area. The stand consists of red, black, and white oaks, with some mockernut hickory. Diameters up to 30 inches, and heights up to 70 feet occur. The quality is poor, the better trees having been removed some years ago. What reproduction formerly existed was largely killed by the fire in 1877 which ran over most of the area, but was not sufficiently severe in this part to scar the older trees. Grazing has prevented any reproduction in recent years. The ground is closely grassed over.

Treatment.—This stand is mature, and should be removed during the next ten years. The first consideration is to get a reproduction of good trees to form the basis of the future stand. Grazing must be discontinued, and weed trees whose seed is not desired should be removed at once.

In view of the heavy sod and the open condition of the stand it is recommended that the sod be broken before the fall of the nuts and acorns, by rough cultivation with a disk harrow. This should be followed after the fall of the seeds by dragging over with a light harrow. This will plant at a trifling expense many thousands of acorns and nuts per acre, and will insure a fine reproduction.

In order to admit light for the development of the new crop, a heavy thinning should be made the following winter, in which all of the most inferior trees

should be taken. This thinning should remove about one-third of the stand. As soon as the young growth is thoroughly established in satisfactory density the old stand may be entirely harvested. The very few trees of good form which are in the present stand may be retained to continue their growth with the new stand, but this is not especially recommended since they are few in number and would be liable to die at the tops as a result of their standing so open as to favor the development of "water-sprouts."

Protection.

Felling.—Care should in all cases be exercised to avoid as much as possible injury to valuable young growth by the felling of the old trees. Stumps should be cut as low as practicable, and with the saw. There should be no "brushing out" of the young growth.

Disposal of debris.—As much as practicable of the branches and tops should be utilized for firewood. The remaining debris should either be piled and burned in the open places during a time when the fire will not endanger the woods by running; or be scattered and made to lie as close to the ground as practicable in order to hasten decay, and thereby lessen the danger from fire and interference with young growth.

Grazing.—The importance of the exclusion of all live stock has already been fully discussed.

Fire.—The keeping of the woodlot free from dangerous debris is the only measure, other than care in the handling of fire within or near the woodlot, that is considered necessary for the protection of the woodlot from fire. The fact that but one fire of any importance has occurred on the area since the settlement of the country indicates that danger from this source is not great.

Windbreak.—It is recommended that a row of Norway spruce be planted along the western side of this woodlot wherever the stand is sufficiently open to admit of their growth. Such a row of spruce will be of great value in the future in shutting out the wind from the stand. The trees may be planted six or eight feet apart and if good stock be used a single row will be sufficient.

No treatment of woodlots is more commonly practiced than the removal of the valuable trees and the leaving of the inferior in full possession of the soil, and this notwithstanding the fact that it must appear evident to every thoughtful person that such practice must inevitably lead ultimately to the total exclusion of the more valuable trees, and consequently to a marked lowering of the value of the yearly product of the woodlot.

In the report quoted, the subject of thinnings is also touched upon. It might be of interest here to enlarge upon this topic which is so important in the management of young stands.

All stands grown under proper conditions of density in their early years require to be thinned later by the removal of a number of the trees present, that the remaining trees may be given sufficient room in which to develop. A density of at least 1,500 trees per acre is desirable during the early years in stands of any species, and a much larger number may be present with advantage. It is, of course, impossible that any such number can remain on the ground till maturity, and, if untouched by man, a natural thinning will take place, by means of which the original number is gradually reduced through the death of the trees which are overtopped by those making a more rapid growth.

A thinning by the hand of man may have several great advantages over an unaided thinning by nature. The chief of these are:

First. Control of the species in the stand.

It often happens that trees of less valuable species overtop and shade to death trees of the more valuable species in the natural forest. The re-

removal of such inferior trees before they have seriously injured their better neighbors is, of course, always desirable.

Second. Control of the quality of the timber produced.

It often happens that many of the dominant trees of the stand are more or less defective in form or in soundness. The stand will, of course, be improved by their removal before they have seriously injured better trees in their immediate neighborhood, which, on their removal, may be able to utilize the space to better advantage.

Third. The maturity of the crop may be hastened.

If we assume that a pine tree of thirty inches in diameter is mature, it is safe to say that the maturity of the pine stand may be hastened by at least twenty years by judicious thinning. This is accomplished by the opening up of the canopy or crown cover from time to time to enable the trees which are to constitute the final stand to enlarge their crowns and thereby make possible a more rapid increase in diameter.

Fourth. Valuable wood may be saved.

Just how valuable this wood may be depends entirely on the location of the woodlot and the character of the stand. Where the stand thins itself without the aid of man, all trees which are killed by this process are lost by the ravages of insects and decay. On most farms this material might be utilized to advantage for fuel, posts, vine crops, rails and other purposes.

The time at which a first thinning should be carried out in a dense young stand will be very largely determined by the local market conditions. As a rule, no thinning should be undertaken until the material to be removed will have acquired sufficient size to be of value for fuel or for some other purpose. On most woodlots in Southern Michigan this time will usually come when the stand is between fifteen and twenty-five years old. It is true that in leaving the stand so long untouched many good trees may be seriously injured by being overtopped by inferior neighbors, which have chanced to have gotten the upper hand in the struggle for light, but as a rule there will still remain many more good trees unharmed than are required for the future stand. In the case of some very rapid growing trees, especially where the quality of the wood makes the product merchantable at an early day, as in the case of Catalpa and Black Locust, the first thinning may be carried out to advantage as early as the sixth or seventh year.

The amount of material to be removed in a thinning of this kind will depend on the site, the species, and the purpose for which the timber is grown. In general, it may be said that trees occupying situations very favorable for tree growth may be thinned more severely than when the location is less favorable. The more rapid growing species, and those capable of enduring greater shade, may also be more heavily thinned than such as grow more slowly or are incapable of enduring great shade. As a rule, no opening should be made in the crown cover which cannot reasonably be expected to close again in the course of five to seven years.

It should be added in this connection that the margins of woodlot should not be as heavily thinned in any case as the interior, unless they are thoroughly protected by a windbreak mantle. This is particularly true of western borders.

The overcutting of the mature timber in woodlots is not of infrequent occurrence. A number of woodlots were noted where the owners, think-

ing to improve the stand, had very carefully cut out the inferior and defective trees, but to such an extent that the remaining stand was left in a very unfavorable condition for development.

The opening of the stand too freely checks the growth of the trees by making the conditions less favorable for the retention of moisture, and has, with many trees, the additional danger of checking their height growth by permitting the development of the base of the crown, and in some trees (e. g. Oaks) by the development of water sprouts on their trunks. In many cases such thinnings as those result in the ultimate death of the top of the tree. This, of course, occurs during some exceptionally dry time, and the weather conditions are usually blamed for it. The loss of soil moisture as a result of overcutting is due to the increased air motion at the soil surface and the admission of sufficient light to stimulate the growth of grass and other moisture-robbing weeds on the forest floor. The excessive light (and heat) increases the oxidation of the organic matter in the soil, thereby lowering its moisture-holding capacity, and raises the temperature, thereby increasing the direct evaporation of moisture.

If the trees of the stand are sufficiently matured to produce seed abundantly, such an overcutting will result in a natural reproduction of forest trees. Should the stand be nearly mature, this would be a desirable condition, but in all immature stands the harm done by the overcutting is but very slowly repaired by nature.

That overcutting in a woodlot open to the run of live stock should be more serious where grazing is practiced than otherwise can be readily appreciated. In the former case the absence of an undergrowth will leave the soil wholly unprotected, and there will be no young trees to develop to fill the gaps in the stand.

A detailed discussion of the injuries due to grazing, fire, insects, and other causes of injury common to Michigan woodlands would unduly lengthen an article already too long, and must be deferred for the present. Suffice to say, it is the intention of the bureau to publish at an early day a somewhat extended account of a study of woodlot conditions in Southern Michigan, which will be available for general distribution.

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